Associations between Maternal Executive Function, Parenting, and Preschool Children's Executive Function in the South Korean Context

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Abstract

The study reported in this dissertation aimed at exploring relations between parental factors – parenting and maternal executive function (EF) - and preschool children's EF in the South Korean context (the Republic of Korea; Korea hereafter). Specifically, it investigated the replication in the Korean context of existing findings in Western cultures on the link between parenting and child EF. In addition, the present study explored parental aspects that have rarely been linked to child EF: 1) the relation of parental verbal input to child EF, 2) simultaneous relations of parenting and maternal EF to child EF, and 3) mediating roles played by parenting in the maternal EF-child EF link.

Ten kindergartens located in different districts (middle- to upper-middle class households) in Seoul, Korea hosted the present study, and data were collected from a total of 92 mother-child dyads who volunteered to take part. The children were aged between 3 and 5 years, with 97 per cent of them being 4 years old, and they were reported not to have experienced developmental issues. The mothers were biological parents of child participants. Both the mothers and children performed on age-appropriate EF tasks. Three types of parenting dimensions were focused on in two contexts of mother-child interactions: maternal *contingency* and *intrusiveness* in a problem-solving context and maternal *verbal input* during a mother-child reminiscing conversation. Maternal verbal input was operationalized to consist of four constructs: maternal *elaboration*, *semantic connection* (maternal utterances that are semantically connected with the child's utterances), maternal *mental-state references*, and *connected mental-state references* (maternal mental-state references that are semantically connected with the child's utterances). As such, a total of 14 maternal traits during the two mother-child interactions were examined for their relations to the development of child EF. Mother-child interactions were videotaped for later analysis. As a result, 184 five-minute video clips were obtained and analysed by adopting a quantitative approach.

Results showed that the positive relation between maternal *contingency* and child EF was successfully replicated in the Korean context. In addition, maternal *connected mental-state references*, particularly emotion references, were found as a significant factor explaining child EF, above and beyond three covariates of child EF (child age, child verbal ability and maternal educational attainment). However, maternal *intrusiveness* was found not to be significantly related to child EF in the Korean context. Next, the analysis of the simultaneous relations of maternal factors to child EF showed that maternal *contingency* accounted for unique variance in child EF more than any other parenting variables involved in the present study. In addition to maternal *contingency*, maternal EF (i.e., maternal shifting as measured by the Wisconsin Card Sorting Task) and maternal *connected mental-state references* were found to significantly account for unique variance in child EF. Finally, it was found that the maternal EF-child EF link was not explained by parenting behaviours explored in the present study. Instead, maternal *contingency* was found to mediate the link between child verbal ability and child EF and the link between maternal educational attainment and child EF.

While the above mentioned results were the main findings of the present study, the difference in the results should be addressed between when using the whole sample (N=92 dyads) and only 4-year-olds (N=89 dyads). Child's age was found to account for less unique variance in child EF when using only 4-year-olds. In addition, the significant link between maternal EF and child EF when using the data from the whole sample became insignificant when using the data from only 4-year-olds. These findings are discussed in terms of universal or culture-specific links between maternal EF, parenting behaviours and child EF, adding to the literature by presenting the first empirical evidence on this research field in a non-Western context.

Statement of Originality and Length of Thesis

This dissertation is the result of my own work and includes nothing which is the outcome of work done in collaboration except where specifically indicated in the text. This dissertation does not exceed the word limit for the Degree Committee of the Faculty of Education.

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CHAPTER 1 Introduction

Young children begin their formal schooling with different levels of cognitive, affective, and kinaesthetic skills. Some of these skills are observable in various learning situations at school while some are not. Working as a teacher for years, some observable skills that attracted my attention were children's abilities to pay attention, remain focused, and override their instinctive desires in order to follow directions for learning. It was evident that Year 1 students showed differences in these skills from the first day of school. Moreover, the initial difference at school entry seemed to contribute to the widening gap in school outcomes over the years of schooling. Observing these, I became confident in saying that young students who were able to stay focused for an extended period and override unwanted impulses at school were usually found later to be academically successful. As a result, my colleague teachers and I came to agree on the long lasting impact of these abilities and became proficient in telling whether a Year 1 child would end up being academically successful or not.

I became wondering why children as young as 6 or 7 years old began schooling with differences in their capacities to focus on teachers' instructions and resist distractions. What would cause differences in these self-regulatory abilities in first graders? These skills that I as a teacher sought in children are also relevant to school readiness. When asked to identify school readiness factors, kindergarten teachers frequently mention self-disciplinary and attentional control skills as more critical than content knowledge. In fact, as mentioned in a study by Rimm-Kaufman, Pianta, and Cox (2000), children in the transition to kindergarten show differences in their competences in following directions, working as part of a group or independently, and aspects of social skills. Therefore, given that the differences in these capacities are reported even before starting kindergarten, it may be relevant to narrow down our focus to factors that would exert influences before schooling: parents as an influence in a home environment. Later as a PhD student, I learnt that the cognitive skills that I was interested in referred to executive function (EF). I thus began to design a study exploring parental factors that would significantly relate to child EF. Indeed, parents play a critical role in promoting necessary EF skills for learning. Thus, home is children's first learning context and parents seem to be an important influence on the development of young children's EF skills. Research has reported that individual differences in EF are observed as early as toddlerhood and tend to be stable throughout childhood (Bernier, Carlson, & Whipple, 2010).

The study reported in this dissertation aimed at exploring parental factors – maternal parenting behaviours and maternal EF skills – that are favourable to the development of EF in young children in the South Korean context. From a theoretical point of view, the present study addresses research topics that have so far been denied their legitimate research attention in the

literature. Research on EF has been dominated by biological models addressing the impact of lesions to the prefrontal cortex (the core neural base for EF) or the relation between attention deficit hyper-activity/autism and deficits in EF. It is indeed only recently that environmental factors, more specifically parents as an active agent shaping children's early environment, have been integrated to research on child EF (Hughes & Ensor, 2009). This integration, however, is not without a concern that some aspects of parenting - scaffolding behaviours or autonomy support – have been predominantly focused on in this field of research. In addition, either parenting or parental EF, rather than both of them simultaneously, has been explored in relation to child EF. Only one exception to this trend, to the present, is a study by Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014), who examined relative contributions of maternal EF and parenting to child EF and mediating roles of parenting in the maternal EF-child EF link in the US setting.

Thus, against this research backdrop, it is now necessary to test in a non-Western setting the well-established links based on Western cultures between parental scaffolding behaviours and child EF. In addition, given that parental scaffolding has been predominantly addressed as an influence on child EF, it appears to be relevant to explore new aspects of parent-child interactions, which would be favourable to the development of child EF. More importantly, it would contribute to our knowledge of chid EF to examine simultaneous relations of parental EF and parenting to child EF and possible mediating roles of parenting behaviours in the link between parental EF and child EF. All of these relevant research topics constituted the research questions of the present study.

A range of parental factors may be related to child EF. Based on the socio-cultural approach to child development, the present study focused on parent-child interactions, particularly those between mothers and their preschool child. There has been an increasing awareness that fathers do have crucial impacts on the child's cognitive and affective development. Fathers have become more involved with their children's care and the roles of fathers, which may differ from those of mothers, should be incorporated into research on child EF (Mewissen & Carlson, 2015). However, mothers are still the ones who are mainly responsible for their young children's care while fathers are not at home, thus making it easier for researchers to contact and obtain data from them. Thus data were collected in the present study from only mothers.

From the onset, it may be necessary to address the extent to which the present study explored the maternal EF-child EF link. Maternal EF has been found as an influential factor explaining child EF. One way of accounting for the maternal EF-child EF link is a behavioural genetic perspective using twin study designs. Based on this perspective, some studies examined the extent to which genetic and environmental influences led to individual differences in EF. They reported that EF was almost entirely genetic at the level of latent variables (e.g., Friedman et al., 2008). Nevertheless, it has been emphasised that heritability of EF does not mean that environmental factors cannot affect EF. In keeping with this assertion, empirical evidence of

positive impacts of EF training with clinical (Klingberg et al., 2005), aging (Dowsett & Livesey, 2000) and normal populations (Erickson et al., 2007) has been presented. In addition, despite the long-held trend of research on EF being dominated by biological models, social interactions have been far from being precluded from contributing to developmental changes or individual differences in EF (Hughes & Ensor, 2009). For example, genetic factors are often shown to interact with environmental influences, such that genetic vulnerability is more likely to be expressed among individuals who have been exposed to environmental stressors, such as harsh parenting or family chaos (Asbury et al., 2003; Asbury, Wachs, & Plomin, 2005). Even with disorders that show substantial genetic influence, such as dementia, social influences may be influential on the age of onset or rapidity of cognitive decline (Gatz, 2007). As such, while it may be controversial as to the extent to which genetic or environmental factors contribute to EF development, bio-social transactions may be theorised to support the effect of parental factors on child EF skills, which were therefore adopted in the present study in accounting for the links between parenting, maternal EF, and child EF. Even though not empirically demonstrated, bio-social transactional mechanisms explaining these links serve in many studies on EF as a theoretical framework explaining how environmental factors may lead to epigenetic changes in EF-related genes.

Taken together, while there is much to learn as to the mechanism through which parents would exert an influence on child EF, bio-social transactions should not be overlooked in research on the link between maternal EF and child EF. Indeed, recent large-scale, longitudinal evidence has pointed out that age-to-age stability in EF is primarily mediated genetically whereas the environment (especially nonshared environment, in the context of twin studies) contributes to changes in EF from age to age (Kovas et al., 2007). That is, while genetic factors are of primary importance in explaining stable individual differences, environmental factors may be more important for understanding changes (Hughes & Ensor, 2009). Thus, it may be desirable in research on the maternal EF-child EF link to measure both genetic and environmental variables. The present study however was not initially designed to measure genetic variables and was focused more on the effect of parenting behaviours on child EF. Thus the research question as to the maternal EF-child EF link in the present study was explored by examining how the link may be driven by underlying maternal EF-parenting links. That is, it was the interest to the present study to explore whether and how maternal EF would relate to child EF via maternal parenting behaviours, which may reveal a possible mechanism in which parental practices would play an active role in the maternal EF-child EF link.

Next, it may also be necessary to point out the extent to which maternal mental-state references (MR) were explored in relation to child EF in the present study. While proposed as a potential correlate of child EF (Carlson, 2003), a handful of research, to date, has empirically found significant effects of MR on child EF (e.g., Baptista et al., 2017; Bernier et al., 2010). As will be

addressed later in this thesis, maternal MR was adopted in the present study as one of the variables representing maternal verbal input, which was found to significantly relate to child EF within semantically connected conversational contexts. As such, while theoretically suggested and empirically found to be relevant to child EF, parental MR has been more frequently linked to Theory of Mind (ToM), rather than to EF. One would wonder how the three variables – child EF, child ToM, and parental MR – would relate to each other. Indeed, child EF and child ToM are found to be closely linked during the preschool period and the exploration of how they relate to the effect of maternal MR may contribute to our understanding of child EF. The present study, however, did not include ToM in its discussion of the relation of maternal MR to child EF. This was because the focus of the present study was on the understanding of the development of child EF not on child ToM. The relation between ToM and EF belongs to another field in the literature and the examination of maternal MR within the link between ToM and EF was beyond the scope of the present study,

This dissertation is structured into five chapters including this introduction. Chapter 2 presents the review of the literature and discusses prior research on child EF, parenting, maternal EF and cultural and historical factors of Korean society in which the present study was considered. Specifically, this chapter presents existing findings on the relations among the three variables of interest to the present study – maternal parenting, maternal EF, and child EF. Then, this chapter provides the rationale for the selection of the maternal parenting behaviours to focus on in the present study. In addition, it is also presented why the two contexts, a problem-solving and reminiscing conversation, were chosen in observing mother-child interactions. Then, based on all these reviews and rationales presented in Chapter 2, research questions and hypotheses of the present study are presented.

Chapter 3 presents an argument for a methodology that could be best suited to test the research questions. This chapter begins by presenting a detailed description of sampling frame, strategies, sample size and participants, followed by addressing procedures of data collection and the selection of measures. Given that mother-child interactions were the crucial part of the present study, detailed descriptions of coding and scoring processes are provided. The last part of this chapter addresses the overall quality and the research process by discussing the validity, reliability and generalizability and ethical considerations.

Chapter 4 describes the processes of statistical analyses adopted in the present study, which starts by reporting the reliability of coding and patterns of mother-child interactions, followed by the presentation of descriptive statistics of all the variables involved in exploring the research questions. The flow of the main analysis was from correlation analyses through hierarchical regression to mediation analyses. At the end of each section in this chapter, a summary is provided as to the adopted statistical methods and findings relevant to the research questions.

Finally, Chapter 5 presents the final discussion by summarising the main findings relating them to the existing body of the literature and arguing for the place of the present study in the EF literature. This chapter acknowledges the study's limitations and also discusses its contributions to the EF literature as well. Then this chapter finishes with implications of the present study for educational practice and for future research.

CHAPTER 2 Review of the Literature

This chapter presents a review of the literature suggesting universal or culture-specific relations between parental factors and child EF. For this purpose, the chapter is divided in seven sections. The first section looks at child EF itself during the preschool period and includes a review of EF structure and its components. The second section presents the literature on the maternal EF-child EF link and the third section reviews existing findings on parenting behaviours that have been significantly related to the development of child EF. Then, the fourth section describes conceptual overlap or differences among the parenting behaviours described in the three previous sections, which leads to providing the rationale for the selection of the parenting behaviours to focus on and the two contexts in which to explore mother-child interactions in the present study. Then, given that parenting varies across cultures, the fifth section looks at sociocultural factors influencing parenting in the Korean context. Next, the sixth section provides the rationale for the present study, which synthesises all the argument strands presented in Chapter 2. Finally, the seventh section finishes this chapter by presenting the research questions and hypotheses.

2.1 Executive function (EF) development in preschool children

This section addresses two aspects of EF development in the preschool period: first, the structure of EF and second its EF components. The latter part of the preschool years will be particularly emphasized since the child participants in the present study were aged between late 3 to early 5 years (mostly 4-year-olds). Reviews in this section support the selection of child EF tasks to use and the way in which they were analysed[1].

2.1.1 EF structure during the preschool years

Broadly defined, EF is “an umbrella term that encompasses the higher order processes that govern goal-directed actions and adaptive responses to novel or complex situations” (Hughes, 2011, p. 251). While there have been a range of research suggestions as to the structure of EF, crucial EF components include three skills: working memory (WM), inhibition, and shifting. Working memory refers to the ability to retain and manipulate information over short periods of time (e.g., connecting information from one paragraph to the next; following multiple directions over a short period of time). Inhibition refers to the ability to resist temptations, distractions and habits so as to pause and think before acting (e.g., blocking out stimuli that are not relevant to the task at hand). Shifting (or attentional flexibility) refers to the ability to nimbly switch gears and adjust to changed

[1] Based on the reviews in this section, the followings were determined later in the Method and Results section: how to select age-appropriate child EF tasks; whether to aggregate three child EF scores to a composite; and whether to analyse the whole sample (aged between 3 and 5 years old) or only those aged 4

circumstances and priorities (e.g., learning exceptions to rules of grammar; approaching a science experiment in a range of ways).

Miyake and colleagues (2000) argued that these most common EF components are "separable but moderately correlated constructs, thus indicating both unity and diversity of executive functions" (p.87). Prior to this view, there were two broad approaches to the EF structure: EF as a unitary construct with constituent sub-processes and EF as having dissociable processes. The former approach was supported by empirical findings that a central attention system (Baddeley, 1996; Posner & Rothbart, 1998) or a general inhibitory process (Dempster, 1992) underlies important changes that are responsible for the development of EF. The latter approach was supported by research evidence showing that EF processes are separated broadly into working memory (WM) and inhibition, both of which are shown to have different developmental trajectories (Pennington, 1997; Welsh, Pennington, & Grossier, 1991). However, these two distinct perspectives have been integrated over the past couple of decades, lending support to the "university and diversity" EF model proposed by Miyake and colleagues (2000).

The above mentioned models of EF structure, however, were mostly based on research with adults, and they may not necessarily reflect the EF structure in preschool children. The pattern of unity and diversity proposed by Miyake and colleagues (2000) was replicated in a study using samples of middle childhood, adolescence, and adulthood (Huizinga, Dolan, & van der Molen, 2006). EF in preschool children and younger, however, has been shown to differ from those found in adults. Lehto, Juujarvi, Kooistra, and Pilkkinen (2003) used confirmatory factor analysis to demonstrate that EF measures taken with 8- to 13-year-olds (N=108) clustered into three factors: WM, shifting and inhibition. However, another study by Huizinga and colleagues (2006) using a sample aged 7 to 21 years (N=384) only showed partial support for Miyake's model by reporting two factors (WM and shifting) without a common inhibitory factor. This two-factor model is consistent with the finding by Van der Sluis, de Jong, and van der Leij (2007), who studied 4th- and 5th-graders (N=172). In addition, Wiebe, Espy, and Charak (2008) used a sample aged from 2.3 to 6 years and concluded that a one-factor model is ideal for children in this age range. Similarly, Hughes and Ensor (2009) suggested that a single EF latent variable reflects children's performance at the age of 4 and 6.

As such, there is now growing consensus that EF skills in preschool children are unidimensional in nature and increasingly differentiated as children become older (Fuhs & Day, 2011; Hughes et al., 2010). This account may benefit research in terms of methodological efficacy and reliability. That is, adopting a single aggregate measure not only maximizes reliability but also simplifies analyses of the relations between EF and real-life outcomes, such as academic performance or problematic behaviours (Hughes, Ensor, Wilson, & Graham, 2010). Therefore, based on this notion that elementary forms of the core EF components are present as a unitary

construct during the preschool period, child EF in the present study was measured using tasks tapping the three EF components, which were subsequently combined into a composite. In so doing, the relevant first step was to select developmentally appropriate EF tasks for children in light of developmental trajectories of EF components during the preschool period, which is addressed in the next subsection.

2.1.2 Development of EF components in preschool children

This section focuses on the extent to which the three EF components (WM, inhibition, and shifting) develop during the preschool period. Of crucial importance in selecting child EF measures would be to determine whether a given task is age-appropriate for child participants. It is essential for chosen tasks to be neither too easy nor too difficult so that individual differences could be observed (Carlson, 2003). Accordingly, this section reviews relevant literature on age-related changes in the EF components and relative difficulties of EF tasks tapping such components.

While this subsection is focused on the three most common EF components, another crucial component that is involved in the development of rudimentary forms of the EF components is attention system (Garon et al., 2008). Garon and colleagues (2008) argued that the core attention system serves as a foundation on which each EF component builds upon each other (i.e., they do not develop in parallel but rather build upon already existing networks). It is also argued that a dramatic improvements in EF components take place particularly during the latter half of the preschool period due to the development of attention (i.e., attention becomes more voluntary and less determined by external factors, which allows older pre-schoolers to form a longer and more selective attention in performing on EF tasks).

Working memory (WM) may be simple or complex in nature. Simple WM involves storage and rehearsal of information, and complex WM concerns updating or manipulation. This distinction has been supported by factor analytic studies showing that tasks imposing the demands of both simple and complex WM cluster into separate factors (Alloway, Gathercole, Willis, & Adams, 2004). In addition, this distinction is supported by neuroimaging studies suggesting different patterns of activation in the brain for the two types of WM (Smith & Jonides, 1999). The ability to simply hold information over a delay develops before six months of age (Pelphrey & Reznick, 2002). More complex WM emerges later in the second year and continues to develop throughout childhood (Huizinga et al., 2006). WM is viewed to consist of the central executive and two storage buffers: the phonological loop which stores auditory information and the visual-spatial sketchpad which stores visual-spatial information (Baddeley, 1996). The ability to update/manipulate mental representations reflects the functioning of a central attention system and changes in its coordination with the two buffering systems. For each storage buffer, the passive

storage function is associated with more posterior areas in the brain, and the rehearsal function is related to distinct frontal networks, such as Broca's area (Baddeley, 2002). Despite the lack of empirical evidence to date on whether complex WM abilities build upon simpler WM skills and what aspects of attention affect WM development, it appears to be clear that attention plays a particularly important role in WM starting very early in life (Garon et al., 2008). Based on these aspects of WM during the preschool period, it appears that both simple and more complex WM tasks would be appropriate to use in the present study since children aged between 3 and 5 years old are shown to be able to work on both types of WM.

Inhibition also develops as early as the first year of life (e.g., stopping an enjoyable activity in response to a caregiver request) and appears to build upon attentional ability and WM. According to Garon and colleagues (2008), there are two types of inhibition tasks for young children: simple (those having relatively less WM demands compare to complex tasks) and complex (those requiring children to hold a rule in mind, respond according to this rule, and then inhibit a dominant response). Simple inhibition tasks involve either overcoming automatic responses (e.g., the object retrieval task, Diamond, 1990; the antisaccade task) or delaying gratification (Mischel, Ebbesen, & Zeiss, 1973). Complex tasks involve moderate WM demands, which are shown in such tasks as Simon says (Gerardi-Cualton, 2000), flanker tasks (Rueda et al., 2004) and the Stroop task (Kochanska et al., 1996). As children reach 3 years of age, they become increasingly able to suppress a natural inclination to do what they are told. Performance on complex inhibitory tasks develops considerably during the latter part of the preschool period, and there are significant age differences in inhibiting capacities among children aged between 3 and 5 years (Garon et al., 2008). Research has shown that children are increasingly more capable of using more complex inhibitory capacities after 3 years of age and onwards. Therefore, it may be appropriate to select in the present study to select complex inhibitory tasks so that a range of individual differences in inhibition may be captured well in children during the latter half of the preschool period.

The development of shifting also builds upon pre-existing cognitive systems (attention, WM, and inhibition; Garon et al., 2008). In performing on shifting tasks, children are required to form a mental set, in which an association is made between a particular stimulus and a response, and they are subsequently required to shift to a new mental set that in some way conflicts with the pre-shift response set. Thus, shifting tasks represent a further class of inhibitory tasks in that children are required to overcome prepotent tendencies (Garon et al., 2008). In so doing, children must utilise both WM (in forming an association in the pre-switch phase) and inhibitory control. This is more complex than those required in complex inhibition tasks in that the association made in the pre-shift phase of shifting tasks is often quite arbitrary, while the initial response set in complex inhibition tasks is an already established (prepotent) response. Simple shifting tasks

involve minimal demands of WM (for learning of a simple arbitrary stimulus-response remapping) and a shift in the response. Simple shifting capacities (e.g., as shown on the A-not-B task) emerge over the 1st year of life and improve throughout the preschool years (Thelen, Schoner, Scheier, & Smith, 2001). As children approach the end of the preschool period, they become increasingly able to perform on complex shifting tasks that require shifting to a new response set that more strongly conflict with the pre-shift response set. That is, children during the latter half of the preschool period become more proficient at complex shifting tasks, and they show individual differences in their complex shifting capacities. Based on this aspect of shifting development, it may be appropriate in the present study to select complex shifting tasks so as to capture a range of individual differences shown for children aged between 3 and 5.

2.2 Maternal EF and child EF

This section presents relevant literature on the maternal EF-child EF link, which is one of the two parenting factors of interest to the present study. As addressed in the introduction to this thesis, the present study explored the maternal EF-child EF link by examining whether the link could be explained with underlying maternal EF-parenting links. As such, while the focus of the present study was on the mediating role of parenting in the maternal EF-child EF link, it may be worth addressing here bio-social transactions because the interaction between genetic and sociocultural factors may serve as a theoretical framework in which the maternal EF-child EF link may be well accounted for (Bernier et al., 2010). Bio-social transactions are one of the most frequently cited mechanisms explaining how maternal EF is linked to parenting behaviours and how parenting behaviours would lead to epigenetic changes in EF skills, even though such mechanisms are largely hypothetical and have rarely been empirically demonstrated. Therefore, the next two subsections address the followings: the first subsection focusing on explaining the maternal EF-child EF link based on bio-social interactions and the second subsection addressing briefly (due to very limited existing research on this topic) recent research on parenting behaviours playing a mediating role in the maternal EF-child EF link.

2.2.1 Bio-social interactions

As Bernier and colleagues (2010) suggested, we cannot be certain whether the parental impact on child EF is via the parental provision of the social context in which for the child to practice emerging EF skills or through changes in children's brain structures involved in EF. The former focuses on the impact of maternal EF skills on the mother's own self-regulatory behaviours, which ultimately influence the development of EF in children (Cuevas, Deater-Deckard, Kim-

Spoon, & Watson, 2014; Sanders & Mazzucchelli, 2013), whereas the latter emphasises beneficial or detrimental parenting, which would terminate or activate unfavourable genes involved in the development of EF. That is, the former suggests that parenting behaviours may provide a context, in which child EF skills are forged and practiced (Deater-Deckard, 2014). The latter addresses that mother-child relationships may engage in structural or functional changes in the brain (the prefrontal cortex and its limbic systems). From a perspective based on bio-social interactions, these two accounts are not mutually exclusive but complementary in that gene-environment transactions operate in caregiving contexts and the quality of parent-child interactions depend on how the mother and the child self-regulate their own behaviours in response to each other (Bernier et al., 2010). Thus, the first part of this subsection reviews prior literature explaining how maternal EF skills contribute to shaping mother-child interactions. Then the remaining part of this subsection reviews prior research suggesting the engagement of parenting in changes in EF-related genes.

Prior research suggests that maternal EF is significantly related to child EF. Biological mothers' EF and their children's EF have been found to be linked. Moderate correlations have been found in the EF performance between mothers and their preschool children (Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014) and between mothers and their children aged 4 to 12 years (Deater-Deackard, 2014). One account that explains how maternal EF would exert an impact on child EF concerns how maternal EF affects her verbal and behavioural responses to the child, which in turn would have an impact on child EF. Interestingly, it has been suggested that EF skills may engage in the process of exerting the effects of a dyadic partners' behaviour on one's own behaviour (Deater-Deckard, 2014). That is, it may depend on one's own EF skills that whether a response from the other person would have a negative or positive effect. For example, on the part of the parent, the child's challenging behaviour that has become a stressor may invoke the parent's self-regulatory processes, leading to either harsh or nonreactive behavioural responses to the child. In other words, maternal EF may serve as a potential modulator while interacting with the child. Research has found that maternal EF significantly relates to caregiving behaviours that are likely to contribute to shaping individual differences in child EF (Barrett & Fleming, 2011). In keeping with this account, confronted with the child's challenging behaviour (4- to 7-year-olds), mothers who exhibited greater maternal negativity were those with poor working memory (Deater-Deckard, Sewell, Petrill & Thompson, 2010). In addition, it has been reported that the link between the child's problematic behaviours (3- to 7-year-olds) and the parent's harsher caregiving is more likely to be found among mothers with poorer EF (Deater-Deckard, Wang, Chen, & Bell, 2012). Similarly, children with poorest self-regulation skills are more likely to show problems in the face of harsher caregiving (Kiff, Lengua, & Zalewski, 2011).

Deater-Deckard (2014) has argued that individual differences in self-regulation may be attributed to EF components that serve to self-regulate attentive behaviour by modulating reactive

responses to the environment. These factors are viewed to run in families and may operate with parent-child relationships that provide experiential contexts in which to practice children's emerging EF skills. As such, the bio-social perspective includes interpersonal parent-child relationships as possible mediators of child EF, in which the child's challenging behaviours invoke self-regulatory processes in the parent, which in turn would be potentially translated into behavioural or emotional problems particularly with children with poorest EF skills. As Deater-Deckard (2014) has asserted, for parents and children alike, strong EF skills can break the link between maladaptive behaviour in the dyadic partner and one's own reactive response to this behaviour. In accordance with this notion, Calkins (2011) proposed a self-regulatory framework to capture the levels of influence of the caregiver's behaviour on the child's functioning. On this account, variations in maternal parenting may be accounted for by the mother's EF capacity in that the mother must regulate her caregiving behaviour within herself and while interacting with her child as well (Barrett & Fleming, 2011; Calkins, 2011; Sanders & Mazzucchelli, 2013).

Another account based on bio-social interactions concerns epigenetic modifications of genes leading to structural and functional changes in part of the brain involved in stress reactivity and EF skills (Barrett & Fleming, 2011; Weaver et al., 2004). Concentration of cortisol, a stress-response hormone that modulates activity in the prefrontal cortex, has been found to mediate the association between parenting and child EF (Blair et al., 2011). It has been suggested that children who are exposed to maltreatment or severe neglect may be affected on their neuroendocrine and automatic stress reactivity, which in turn leads to increased demands on EF regulatory systems (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008). Although speculative and limited in empirical evidence, this notion of epigenetic modifications of genes (developmental changes in genetic influences as a function of gene-environmental interactions) is supported by some empirical studies: experience-dependent nature of the brain development in infancy (e.g., synapses are eliminated to a large degree due to lack of use; Nelson & Bloom, 1997); shifts in neurological structures and functions within brain networks, which occur with the onset of puberty (Steinburg, 2005); and shifting patterns of genetic overlap between children's EF skills and problematic behaviours spanning middle childhood, which reflect increasing demands on self-regulation as children become older (Wang, Deater-Deckard, Petrill, & Thompson, 2012). In support of this notion is the finding that mother-child interpersonal processes may exert stronger impacts on children who are born with unfavourable genes closely engaged in the development of EF. For example, children with two copies of the 7-repeat allele of the 48-base-pair gene (which are implicated with the hormones for self-regulation; dopamine and norepinephrine) have been found to show increasing problems in attentive behaviour, whereas those with only one copy or no copies show no change (Berry, Deater-Deckard, McCartney, Wang, & Petrill, 2013). Interestingly, the impact of this unfavourable gene on child EF is shown to be minimised when effective parenting is

provided. That is, the impact of the 7-repeat allele has been found to be strongly relate to poor attentive behaviour only for children whose mother was evidenced to provide less sensitive caregiving during early childhood. Genetic vulnerability may be increasingly shown when combined with severe environmental factors, such as harsh parenting and maltreatment (Asbury, Dunn, Pike, & Plomin, 2003). These accounts provide a potential mechanism through which early life experience exerts long-lasting effects on stress sensitivity, neurodevelopment, and EF skills.

In the EF literature, the perspective of EF as the outcome of bio-social transactions serves as a theoretical framework, which accounts for the link between parenting and child EF or between maternal EF and child EF (e.g., Bernier et al., 2010; Deater-Deckard, 2014). It has been argued that the prefrontal cortex, which is closely implicated in EF skills, has many aspects of development - synaptogenesis, dendritic and axonal growth, and myelination - that could potentially be affected by bio-social mechanisms (Chugani, Phelps, & Mazziotta, 1987; Tsekhmistrenko, Vasil'eva, Shumeiko & Vologirov, 2004). In addition, it is increasingly believed that early environmental experiences, particularly those related to parenting, have a direct impact on brain development (Chugani et al., 2001). Although there is much to learn about epigenetics and its relation to EF (i.e., research in this field has largely been conducted using rodents or severely maltreated children; Barrett & Fleming, 2011; Belsky & de Haan, 2001), it is a potential mechanism that should not be overlooked in research on parenting and its impact on child EF (Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014).

2.2.2 The mediating role of parenting in maternal EF-child EF link

This section reviews existing findings on parenting behaviours that explain the maternal EF-child EF link. As mentioned earlier, very little has been known in this field of research. The only prior study that is relevant to the present study is by Cuevas, Deater-Deckard, Kim-Spoon and Watson (2014), who explored relative contributions of maternal EF and parenting to child EF. They found evidence that maternal EF had an indirect impact on child EF via maternal negative caregiving, which suggested that low maternal EF, coupled with negative parenting, could potentially create a stressful environment for the child's development of EF. While their study and the present study both focused on the mediating role of parenting in the maternal EF-child EF link, these two studies are different from each other. Firstly, both positive (maternal scaffolding and verbal input during reminiscing) and negative parenting (maternal intrusiveness) were explored in the present study while only negative parenting was examined in the study of Cuevas and colleagues. Cultural settings were also different in that maternal caregiving was explored in the Korean setting in the present study while it was the US setting that Cuevas and colleagues' study was based on. In addition, 4-year-olds were mainly studied in the present study whereas children

were followed when they were 24 months old through 48 months in their study. As such, with these differences between the two studies, it may not be surprising that the two studies showed different results and suggestions, as will be addressed later in this thesis.

2.3 Social interactions and child EF

This section presents relevant literature on parenting behaviours that have been significantly linked to child EF. To this end, this section is divided into two broad subsections. The first subsection addresses the link between social interactions and child EF by reviewing the resurgence of Vygotsky's sociocultural perspective in research on EF and by addressing the key role of language based on the sociocultural perspective. Then the second subsection reviews relevant literature suggesting specific parenting behaviours that have been found to exert significant effects on the development of child EF.

2.3.1 Why is it relevant to explore the link between social interactions and child EF?

In discussing the link between social interactions and child EF, it is essential to address the resurgence of Vygotsky tradition in research on EF for the past decades. As pointed out by Lewis and Carpendale (2009), Vygotsky's theory of "extra-cortical organization of higher mental functions" (namely EF skills) and a critical role of language in the development of EF was not introduced to the West with full support. This may explain why there has been only a handful of research on the link between language and child EF (e.g., the different effect of reflecting on suppressing temptations or focusing on the reward of the task itself; Patterson & Mischel, 1976; the effect of task-relevant versus task-irrelevant remark by the experimenter on the child's performance on delay of gratification tasks; Ritchie & Toner, 1984). However, EF researchers have recently been more focused on parental impacts on young children's EF skills and it is Vygotsky's notion of parental guidance and verbal input that has been widely used in research on EF as a theoretical framework on which the link between parent-child interactions and child EF are based. In addressing the resurgence of Vygotsky tradition, this section is structured around two themes: why social interactions matter to the development of EF and how language is involved in the development of EF in young children.

2.3.1.1 The resurgence of Vygotsky tradition in EF research

Vygotsky emphasised the complex nature of higher mental functions and the role of parents in its development in young children. EF skills per se were not discussed by Vygotsky, but his concepts of higher mental functions are consistent with the terms that we now use to refer to EF skills. Vygotsky's ideas about mental functions that develop during the preschool period and his emphasis on the caregiver's role in facilitating cognitive development provide the rationale behind investigating parent-child interactions in relation to child EF.

Vygotsky maintained that higher mental functions develop when children are engaged in social learning. Social interactions and conventions contribute to the transformation of biologically given skills into higher functions that are mediated by signs (Lewis & Carpendale, 2009). Thus Vygotsky argued that a complex interplay between biological and environmental factors contributes to the development of EF skills. What occurs through this interplay is not just an acquisition of abilities or values in a specific culture, but a transformation into new forms of "a culturally-based psychological process" (Vygotsky, 1978, p.40), which comprises mental and physiological states. Thus, the development of EF may not be isolated from children's psychosocial functioning within a given culture (Lewis & Carpendale, 2009). This process goes through a sequence of stages from being social (e.g., the initiation and execution of an action is between the parent and the child) to individual (e.g., the child executes his or her self-commands). The development of this psychological system occurs when children become able to overcome their impulsive, reactive behaviour and instead undertake intentional behaviour, which constitutes the process of performing self-regulation. According to Vygotsky (1978), this cognitive transformation is one of the accomplishments that young children should fulfil during the preschool period. Impacts of biological and environmental factors interplay when children improve in their EF capacities and, as they engage more in cognitive activities in their cultural milieus, EF skills are more enhanced towards achieving established goals.

Vygotsky's notion of how parents facilitate children's cognitive development is in line with the present study highlighting the role of parenting behaviours in improving the child's EF skills. Vygotsky encouraged parents to take a more proactive role in facilitating children's higher mental processes. He emphasised the importance of a parental intention to enhance the child's cognitive growth, particularly through scaffolding, as shown in the following quotation:

> "…… The old point of view...assumed that it was necessary to adapt rearing to development (in the sense of time, rate, form of thinking and perception proper to the child, etc.). It did not pose the question dynamically. The new point of view ...takes the child in the dynamics of his development and growth …" (Vygotsky, 1997, p. 224)

Here Vygotsky indicated an approach that focused instruction not on the competences already existing in a child but on parental scaffolding bridging the gap between the child's current ability and the potential capacity – the one that exists in the child's Zone of Proximal Development (Duncan & Tarulli, 2003). Vygotsky saw that it was through interactions between children and their social environment that children could achieve higher mental functions (EF). He described how the process of parent-child interaction could impact upon two kinds of mental category: the *inter-mental* category and *intra-mental* category. Parents can facilitate children's higher mental functions by helping them to gradually transit from the inter-mental to the intra-mental category. In other words, children make progress in learning through meaningful interactions with more experienced partners. The main focus here is the process of gradual transition from other-regulated to self-regulated learners as children are assisted by parental scaffolding, which is the main research focus of the present study. As suggested by Vygotsky, parental verbal input during parent-child interactions influences the child's use of work, which serves as a tool in their self-regulation. This role of language in the development of EF is detailed in the following section.

2.3.1.2 Role of language in the link between social interactions and the development of EF

One phenomenon that can serve as an empirical window for investigating the link between language and child EF is children's private speech (Winsler, 2009). In addition, a relevant concept to the development of private speech is psychological distancing that is frequently found in the literature to relate to self-regulation. These two concepts – private speech and psychological distancing – have been theoretically suggested and empirically found as playing a role in self-regulation. While not investigated in the present study as measured variables, they are addressed here for their theoretical significance in accounting for the influence of parental factors on child EF. Thus, in discussing the role of language in EF development, the first part of this subsection presents literature suggesting that the parental verbal input that initially serves a communicative function may be adopted by the child as private speech, which may gradually become internalised and used to regulate their thoughts and actions. Then the latter part of this subsection reviews literature on psychological distancing, which is conceptually closely related to children's private speech and child EF.

2.3.1.2.1 Self-regulatory functions of young children's private speech

Private speech (self-talk) refers to audible speech that is not addressed at others, which is contrasted from inner speech (inner verbal thought), which refers to internal verbal thought in one's head (Winsler, 2009). According to Vygotsky, private speech originates from social interactions, which is an intermediate form of speech that develops over time into inner speech. This account conceptually differs from Piaget's view that private speech originates from within the child' mind, which reflects young children's limited cognitive ability and egocentrism (difficulty in taking other's perspectives) and is over time replaced with more effective social speech (Winsler, 2009). Of note in Vygotsky's notion of private speech is that speech plays not only a representational role but also a self-regulatory function. Vygotsky proposed that higher mental functions are formed through the progressive internalisation and transformation of interpersonal exchanges (spoken or written signs), which are rooted in social experiences. That is, the parental verbal input during social interactions functions to guide and regulate the child's behaviour (use of language for interpersonal communication), which may gradually become internalised by the child during the toddler/preschool period as they talk to themselves to guide and regulate their thoughts and actions (use of language for intrapersonal communication). With this emerging skill of verbal self-regulation, rudimentary EF skills that are present in paralinguistic infants may be incorporated into new functional systems. As such, the development of EF involves "the creation or use of artificial stimuli that become the immediate causes of behaviour" (Vygotsky, 1978, p.39), which takes place via the progressive internationalisation of verbal interactions with others (Fernyhough, 1996). In other words, children's private speech constitutes a distinctive stage in self-regulation through which mediated interpersonal activity is internalised to form inner speech or verbal thought, which contributes to the progression from rudimentary to more advanced forms of EF. For Vygotsky, the transformation from being externally regulated to self-regulating via verbally mediated thought is the process of developing uniquely humane, higher-order cognitive skills.

Taken together, the development of EF relies on language in general and on self-talk in particular, as 'a critical bridge of the divide between internal states or representations and overt behaviour' (Carlson & Beck, 2009, p.164). This view is consistent with the Vygotskian view that private speech has an adaptive function in the self-regulation of behaviour. Beyond simply comprehending verbal directives, language may facilitate reflection and awareness of one's own thoughts and response tendencies, which in turn assists children in top-down control of thoughts and behaviour (Carlson & Beck, 2009). According to Vygotsky, the child's language at the interpersonal plane may be more relevant to its physical features (phonology, semantics, grammar, or pragmatics) and to its communicating role, whereas the child's internalised language at the psychological plane is more relevant to intrapersonal self-regulatory speech. Based on this account,

a range of empirical studies have demonstrated better performance on EF tasks with private or overt speech adopted as a strategy. For example, children's performance on working memory task has been reported to improve when they think silently or say what they think out loud, via the phonological loop (Al-Namlah, Meins, & Fernyhough, 2012). Similarly, the task-switching cost (a measure of executive processing involved in switching back and forth) is increased when adults are asked to engage in a simple verbal task that is designed to disturb their involvement in private or inner speech (Winsler, 2009). In addition, the role of language in EF is emphasised in Zelazo and his colleagues' theory of Cognitive Complexity and Control, which posits language contributes to EF development by helping children to separate themselves from their immediate environment. This process of psychological distance between the self and the world helps children become more conscious of their own activity (self-reflection) and exercise executive control on their thoughts and behaviours.

2.3.1.2.2 Psychological distancing

One crucial function of language that is inevitably included in the discussion of the language-EF link is that language makes a distance between the self and the immediate environment, which refers to psychological distancing[2]. The language itself does not fully perform this distancing function on its own if not accompanied by the developmental emergence of the sense of agency and the sense of consciousness (i.e., levels of Consciousness and Cognitive Complexity and Control model; Zelazo et al., 2003). Being regulatory of one's own thoughts and behaviour implies that the individual has obtained a sense of self (or agency) that is separated from others, which makes it possible to step back and consciously reflect on his or her responses. The quality of this reflection may depend on the amount of consciousness the child can engage in while internalising the language they obtain through interpersonal interactions with caregivers.

Psychological distancing may serve as a descriptive device used in explaining the process of breaking ties between stimulus and responses, which is the crucial aspect constituting self-regulatory capacity. In classical theories of development, both Piaget (1954) and Vygotsky (1978) addressed the concept of distancing in explaining cognitive aspects of self-regulation. Piaget

[2] The term psychological distancing is also used in the field of social psychology. While social psychologists use this term to refer to the trend that individuals perceive themselves less similar to others having undesirable traits (sometimes referred to as defensive distancing: Schimel, Pyszczynski, Greenberf, O'Mhaen, & Arndt, 2000), developmental psychologists use this term to refer to a psychological space between children's selves and their actions/ immediate spatial-temporal surroundings (Giesbrecht, Muller, & Miller, 2010). The relevant definition for the present study is the latter one, which is viewed as the mental separation of the self from the ongoing present (Sigel, Stinson, & Kim, 1993).

argued that intelligence develops neither with knowledge of the self (subject) nor of the world (object) but with knowledge of their interaction (Piaget, 1954). In the course of the interaction between the self and the world, children come to understand the relation of their selves to the world, leading to the gradual distancing between themselves and the world (Giesbrecht et al., 2010). Unlike Piaget, Vygotsky emphasised the role of signs (specifically speech) in the process of psychological distancing. That is, psychological distancing is achieved through semiotic mediation, which demands the child to act against immediate impulses (Vygotsky, 1978). Vygotsky's ideas have been incorporated into theoretical accounts of the linguistic impact on the development of EF, as shown in Siegel's account of psychological distancing.

Siegel (2002) argued that individual differences in children's cognitive self-regulation are related to individual differences in distancing strategies employed by parents. Sigel has emphasised the manner in which parents construct the linguistic environment as a primary source of intellectual stimulation. Parents may create psychological distance for children by drawing their attention to aspects of the problem that they have not considered before, reminding children of rules and explaining the impact of consequences of behaviour on the child themselves as well as on others. Specifically, parents may use mental-state references to create psychological distance by asking children, for example, "How do you think your younger brother felt when you took away the toy he was playing with?" This distancing strategy places a cognitive demand on the child to separate the self mentally from the immediate environment (Sigel, 2002). Parents can not only broaden the range of considerations that children bring to their own perspectives but they also assist them in reframing the stressful situation so that it is less negative (Morris, Silk, Steinberg, Myers, & Robinson, 2007). Parents thus provide scaffolding for the exercise of shifting and updating processes, leading to self-reflection that supports the development of inhibitory control (Giesbrecht et al., 2010). That is, when parents openly discuss with children about feelings, explaining varying consequences of behaviour, children are more likely to develop empathy and can understand that others may have different mind-sets than his/her own (Ensor & Hughes, 2008). Sigel (2002) has argued that parental inductive control emphasising children's reasoning processes is effective in promoting internalisation of rules and development of self-regulatory behaviours (Giesbrecht et al., 2010). This distancing strategy is more effective when coupled with appropriate levels of parental behavioural control such as setting limits and monitoring (Kerr, Lopez, Olson, & Sameroff, 2004). When children are made aware of standards, rules, and goals in a warm and respectful relationship, they are likely to reflect on their own behaviour (Houck & LeCuyer-Maus, 2004) and, as children gain facility in this process of psychological distancing, they begin to evoke it for themselves (Grolnick & Farkas, 2002). Relational experiences that children have with their parents appear to serve as a context for children in which to step back from the immediate context and reflect on their own behaviours, thus playing a role in psychological distancing.

Taken together, parenting strategies (e.g., inductive control and behavioural control) not only structure interactions in which psychological distancing becomes more likely but also facilitate related EF abilities. This may be due to the nature of psychological distancing that necessitates at least some self-regulatory functions. That is, without a certain level of inhibitory control and working memory children may not even entertain the possibility that there might be more than one perspective on a given situation (Moses & Tahiroglu, 2010).

2.3.2 Parenting behaviours and child EF

This section presents a review of existing findings on parenting behaviours significantly linking to child EF. In addition, this section provides relevant literature suggesting the need to explore aspects of parental verbal input, which have rarely been linked to the development of child EF. In so doing, this section is divided in three subsections. The first subsection presents a review of existing findings on the positive link between effective scaffolding and child EF, followed by reviewing relevant literature suggesting a possible link between contingency, as the core component explaining effective scaffolding, and child EF. The first subsection also presents possible mechanisms through which parental contingency might affect child EF. Then the second subsection reviews prior work demonstrating varied effects of parental intrusiveness on child EF across cultures. Next, the third subsection presents literature suggesting the aspects of parental verbal input that may have potential significant relations to the development of child EF. In addition, this final subsection provides rationales behind such potential relations.

2.3.2.1 Effective scaffolding and child EF

If social interactions play a role in the development of EF in young children, parents should be an influential factor of EF in that they are typically the primary agent structuring children's early experiences. Parent-child relations are most intense and enduring particularly during early childhood and are thus a prime candidate to explain environmentally driven individual differences in young children's EF skills (Bernier, Carlson, Deschênes, & Matte-Gagné, 2012). The most frequently researched aspect of parenting that has been found to influence children's EF is scaffolded interactions, in which parents demonstrate different approaches to challenging tasks, exert different levels of responsiveness, and provide the foundation for children's development of motivational orientations (Wood et al., 1976).

Scaffolding refers to the parental support that is necessary for children to accomplish goals that would otherwise be beyond their ability (Wood, Bruner, & Ross, 1976). The positive impact of parental scaffolding on the development of EF is well-established in the literature (Bernier et al.,

2010; Hughes & Ensor, 2009). In the parenting literature, parental scaffolding is operationalized as the key aspect of autonomy support particularly in the context of joint problem-solving tasks. Bernier and colleagues (2010) found that parental autonomy support, which includes scaffolding as one of its core constructs, was a stronger predictor of child EF than the other two parenting behaviours they examined (maternal sensitivity and mind-mindedness). A similar finding was reported by Hughes and Ensor (2009) who adopted a longitudinal design that allowed for the exploration of the temporal stability of individual differences in EF. They found that maternal scaffolding was a stronger predictor of EF than maternal verbal input (during mother-child conversations), family chaos, and imitative learning.

Then, in investigating the positive impact of parental scaffolding on child EF, it may be worth addressing the core aspect of effective scaffolding (i.e., what aspect of scaffolding matters to the development of child EF). Research has suggested that the central component of effective scaffolding is *contingency*, which refers to the way in which instructional scaffolds are provided. Contingency concerns the extent to which scaffolding is appropriately provided or withheld as a function of ongoing evidence of the child's mastery of the task (Wood, 1980). Wood (1980) defined contingency as the ability to adapt a task at hand to create an optimal challenge for the child. Later, Bernier and colleagues (2010) adopted contingency as a crucial construct representing maternal autonomy support in a problem-solving context. Their study, however, may be differentiated from the present study on how maternal contingency was coded and processed during statistical analyses. They rated maternal contingency (maternal concern for the child's sense of competence to allow autonomy, as they termed it in their coding scheme) on a 5-point scale, which was then aggregated (together with other constructs) into a composite representing maternal autonomy support. Unlike this approach, maternal contingency in the present study was coded according to the *contingency rule* proposed by Wood (1980), which specified the extent to which parents increased or decreased support appropriately in response to the child's failure or success in acting on the previous parental guidance. Then maternal contingency in the present study was explored on its own without being aggregated into a score with other parenting traits.

As such, contingency was focused on in this study because it serves as a determinant of an appropriate scaffolding behaviour. In the exploration of the impact of scaffolding on EF, contingency should be taken into account in that it is not enough for parents just to transfer relevant information to children. What matters more is how they transfer information to children (Mattanah, Pratt, Cowan, & Cowan, 2005; Pratt et al., 1998). It has been suggested that the extent to which parental support results in children's improved self-regulation depends greatly on the contingency with which instructional scaffolds are provided (Mattanah et al., 2005). The parental role in successful scaffolding is to offer help when needed and recede when the child regains control of the task (Hammond et al., 2012). In this way, the parent ensures that the child plays an active role by

shaping the structure of scaffolding that matches the child's current level of ability (i.e., the child's zone of proximal development).

In addition, contingency was focused on in the present study since its coding process reflects the dyadic nature of scaffolding interactions (i.e., in response to ever-changing levels of the child's understanding of a given task). As pointed out by Pino-Pasternak, Whitebread, and Tolmie (2010), overall ratings or frequency counts of parenting behaviours should be avoided in research that is focused on the impact of parental scaffolding on the child because the ongoing contingency of parental behaviours cannot be captured. That is, coding of parental behaviours should be conducted in relation to children's responses so as to assess the extent to which parents are responding to the actual fluctuations in understanding of a task evidenced by the child. In addition, because maternal contingency is coded in response to the child's behaviours, behavioural reciprocity can be reflected in the process of coding parental contingency. In other words, contingency may serve as an indicator of bidirectionality (effects of children on parents and those of parents on children) in parent-child relationships (Maccoby, 2007). Children's behaviour can be a powerful influence on the parent-child relationship in that certain child behaviours might prompt parent behaviours, which will in turn have an impact on the child's subsequent behaviour.

For these reasons, a significant number of studies have adopted contingency as the core nature explaining the effect of effective parental support on children's cognitive task performance (e.g., Conner & Cross, 2003; Mattanah et al., 2005). Beneficial effects of contingent scaffolding include the effective use of strategies, persistence on task, and positive feelings/motivation (Meyer & Turner, 2002). As such, operationalization of parental contingency appears to vary across studies. For example, Bibok and colleagues (2009) reported that maternal scaffolding that was contingently provided in relation to the activities that the child was presently engaged in strongly predicted child EF. Focusing on the relational nature of contingency, Hammond and colleagues (2012) examined the amount of time in which parental scaffolding was contingently structured. They found that the time spent for maternal contingent scaffolding was positively related to child EF. These significant links between contingent scaffolding and child EF may be attributed to optimal levels of support provided by reducing the problem space of possible actions that the child could take (i.e., reduction in degrees of freedom; Wood et al., 1976) or by furnishing the child with auxiliary resources with which the child could engage in cognitive construction (Bibok et al., 2009). However, except for the above mentioned studies, little research on EF has focused on the concept of contingency. In addition, contingency has rarely been explored in the EF literature as defined by Wood (1980) using the contingency rule.

Then, how might the link between scaffolding and child EF be explained? The exact mechanism underlying the relation between parenting and child EF is not well understood. As addressed in Section 2.2.1, one possible mechanism explaining the link between parenting and

child EF is the perspective based on bio-social transactions. On this account, the impact of parental caregiving on child EF is mediated in part by epigenetic modifications of genes that are engaged in changes in neural structures and neurotransmitter functioning, which in turn influence stress reactivity and EF skills (Barret & Fleming, 2011). Another potential mechanism behind the link between scaffolding and child EF is that parents influence child EF by providing children with contexts in which to practice their emerging EF skills (Bernier et al., 2010). This notion is in line with Vygotsky's accounts (1978) of how interactions with a more competent social partner promote children's cognitive development, and of how language plays a mediating role when children gradually internalize EF skills that they learn through interpersonal interaction (Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012; see Section 2.2 for more details). Crucial to contingent scaffolding is the concept of the zone of proximal development (ZPD) proposed by Vygotsky (1978), which entails the caregiver's understanding of which components of the overall task the child is capable of doing, with and without the caregiver's assistance. Based on this understanding, the effective caregiver is able to create the optimal level of challenge by leaving just enough of a difficult subgoal for the child to complete for themselves. By providing support within the child's ZPD, the caregiver performs functional roles associated with EF skills on behalf of the child and thereby assists the child in gradually mastering EF skills (Bibok et al., 2009). Taken together, parents may influence child EF development by setting a context in which they provide carefully scaffolded support in an autonomy supportive fashion. As a result, children are presented with opportunities in which to exercise EF skills, which is why measures of contingent scaffolding are found to predict child EF.

2.3.2.2 Parental intrusiveness

Studies on parental control have consistently been shown to have harmful effects on children's developmental outcomes. For example, parental controlling verbalisations (Deci, Driver, Hotchkiss, Robins, & McDougal Wilson, 1993) or negative reactions in response to failure (Ginsburg & Bronstein, 1993) have been found to predict lower academic achievement in children. However, in relation to child EF, it may be more precise to say that parental intrusiveness may have varied effects across cultures. As such, this subsection focuses on nuanced impacts of parental intrusiveness on child EF by first conceptualizing maternal intrusiveness and then by presenting relevant research on varies effects of parental intrusiveness on child EF across cultures.

2.3.2.2.1 Conceptualization of maternal intrusiveness

In the parenting literature, the term 'intrusiveness' has been shown to be mostly tied to negative parental tendencies such as controlling behaviors or negative affection. Many prior studies that explored parental intrusiveness may be found in the attachment literature, in which intrusiveness is operationalized as the opposite construct (as a reversed score) of autonomy support or sensitivity (i.e., the tendency to respond to the child's cues appropriately and promptly: Ainsworth et al., 1974). In the Erickson scales (Erickson et al., 1985), which was constructed based on attachment theory, maternal intrusiveness was conceptualized as a lack of respect for the child as an individual, failures to understand and recognize the child's effort to gain autonomy and self-awareness, or interferences with the child's needs and interests. As such, intrusive mothers are described as those led by their own agenda rather than the child's needs and requests (Egeland et al, 1990). In a similar vein, maternal intrusiveness was operationalized by Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014) as mother-centered, non-contingent behaviours as evidenced by the mother verbalizing task-oriented concerns, which supersede the interests of the child, or expressing negative affects when the child is not doing what the mother wants. Overstimulation is another aspect of maternal intrusiveness observed when the mother does not allow the child a turn or an opportunity to respond at the child's own pace (e.g., the mother persists in explaining toys to the child long after they have gained the child's attention). Overall, parental intrusiveness is characterized as non-contingent responses to the child's behaviors, which overrides the child's actions and interest (Holochwost et al., 2016). This conceptualization of parental intrusiveness was adopted in the present study (see section 3.4.1.2 for a detailed operational definition of maternal intrusiveness).

2.3.2.2.2 Varied effects of parental intrusiveness across cultures

In contrast to maternal sensitivity, which has been found to have a positive relation to child EF (Bernier et al., 2010; NICHD & Human Development Early Child Care Research Network, 2005; Rhoades et al., 2011), parental intrusiveness has been reported to have mixed findings across cultures. Specifically, in predominantly European American samples, parental intrusiveness has typically been found to negatively relate to child EF (Bibok et al., 2009; Bindman et al., 2013). By contrast, parental intrusiveness has been found to be unrelated to child EF among African American families (Rhoades et al., 2011). This finding is in line with a broader literature suggesting that for African Americans increased levels of parental intrusiveness may not negatively affect child development (Ispa et al., 2004; Pungello, Iruka, Dotterer, Mills-Koonce, & Reznick, 2009). This trend has been further detailed across developmental periods of African American children. That is,

maternal intrusiveness in infancy was unrelated to child EF at school entry, while maternal intrusiveness in toddlerhood was found to have a significant negative relation to child EF at school entry (Holochwost et al., 2016; Rhoades et al., 2011).

Why might the impact of maternal intrusiveness on child EF be found as insignificant among African Americans? One possible explanation is that the same behaviour may not be experienced in the same way by children across cultures (Deater-Deckard & Dodge, 1997). This notion, however, does not explain the significant impact of intrusiveness only for a sample of African American toddlers in the study of Holochwost and colleagues (2016). Thus, an alternative account has been proposed that parenting behaviours may have different meanings across developmental periods, such that the similar behaviour may cause different outcomes in one period than it would in another period (Holochwost et al., 2016). In other words, despite similar levels of maternal intrusiveness across developmental phases, it was during toddlerhood but not in infancy that maternal intrusiveness was found to have a later negative impact on child EF at school entry. In support of this notion is the study by Clincy and Mills-Koonce (2013), who found that while parental intrusiveness in infancy did not predict poorer child outcomes, it was found to significantly relate to lower levels of inhibitory control and intellectual functioning in toddlerhood.

Another account for diverse impacts of parental intrusiveness on child EF concerns the notion of universalism without uniformity (Shweder & Sullivan, 1993), which synthesises culturally similar and dissimilar impacts of parenting on child outcomes. On this account, the need for autonomy is clearly relevant to children's development across cultures (Deci & Ryan, 2000). When autonomy is violated children suffer emotionally; when it is fulfilled, children thrive emotionally and academically (Wang, Pomerantz, & Chen, 2007). While these accounts suggest fundamental developmental processes that are similar across cultures (lending support to universalism), the presence and strength of parenting impacts may differ across cultures (thereby qualifying universalism with non-uniformity). For example, the need for autonomy appears to play a bigger role in children's emotional functioning in the US than in China (Qin, Pomerantz, & Wang, 2009; Wang et al., 2007). That is, children's decision-making autonomy during early adolescence was found not to predict children's subsequent emotional functioning in the Chinese context whereas gains in such autonomy did in the US setting. The extent to which children benefit from a certain parenting behaviour may be contingent in part on culturally normative trends (e.g., gains in autonomy or experiences in parental intrusiveness may provide information to children as to what is appropriate for their stage in life; Qin et al., 2009). Children may suffer when they do not make such gains or experience unduly severe levels of parental intrusiveness because they feel that their desires are not being appropriately met by their parents (Qin et al., 2009). Taken together, culture-specific impacts of a parenting behaviour on children may be interpreted as non-uniformity within

universalism, and a specific aspect of parenting in a given culture should be understood in relation to normative trends embedded in a cultural setting.

Despite little research on EF in the Korean context, several prior studies on Korean parenting may guide some expectations about the link between parental intrusiveness and child EF. It has been found that Korean mothers are more likely to direct their children's attention by introducing a new object or activity in the context of mother-toddler play, thereby taking initiatives in parent-child interaction (Sung & Hsu, 2009). Parental warmth and control may be conceived as not mutually exclusive in the Korean context. Highly controlling parents may be viewed as warm and loving, whereas such types of parents can be regarded as hostile and rejecting in Western cultures (Rohner & Pettengill, 1985). In addition, Korean American parents are generally shown to employ authoritarian parenting styles from a Western perspective, but they are not viewed by their children as particularly controlling and consequently, in this context, this parenting behaviour does not predict maladaptive behaviours (Vinden, 2001). These findings suggest that parenting that can be termed as intrusive may not influence children in the same way for Korean samples as found with predominantly European American samples. As such, the meaning and the impact of parenting need to be considered within a given cultural context.

2.3.2.3 Parental verbal input

Research on the parental impact on child EF has predominantly focused on parental scaffolding and further research is in need, which investigates new aspects of parent-child interactions that would be favourable to the development of child EF. Specific traits representing parental verbal input may be one such aspect of parent-child verbal interactions (a more casual conversational setting compared to structured joint problem-solving contexts). Language is viewed as a catalyst of cognitive change during early to middle childhood and is actually at the centre of all developed human life and thought (Nelson, 1996). Nevertheless, little attention has been paid to exploring aspects of parental verbal input that would be favourable to EF development, which is surprising. One exception to this trend is the study by Hughes and Ensor (2009), who examined the impact of maternal mean length of utterances (MLU), during meal preparations or/and a meal, on child EF (2 to 4 years old of age). They found a significant bivariate relation between maternal MLU and child EF, but this relation did not hold when maternal scaffolding was taken into account. Even though the impact of maternal verbal input (maternal MLU) on child EF was insignificant in their study, the relation between parental verbal input and child EF would merit further exploration by using a range of variables representing maternal verbal input in different settings.

Following Hughes and Ensor (2009), it was posited in the present study that parenting factors (i.e., traits of maternal verbal input) that contribute to individual differences in the child's verbal ability may underpin individual differences in EF. However, the present study can be differentiated from Hughes and Ensor's study. Specifically, the maternal MLU was examined in their study, while four aspects of maternal verbal input were investigated in the present study (i.e., elaboration, semantic connection, mental-state references, and connected mental-state references). In addition, the participants of Hughes and Ensor's study were mostly from disadvantaged SES backgrounds (i.e., low-income, lone-parent, or teen-parent families) in the UK, while the participants in the present study were mostly from middle or upper-middle class families in Korea.

This subsection focuses on presenting prior research suggesting possible links between maternal verbal input and child EF. In so doing, this section is structured into three main themes: maternal elaboration, semantic connection, and mental-state references, all of which were selected for their possible significant links with child EF. Each theme was discussed by first addressing its conceptualisation in prior research and the aspect of child development that it has been found to contribute to. Then, a rationale is provided on why a chosen aspect of maternal verbal was expected to have a possible significant relation to child EF.

2.3.2.3.1 Maternal elaboration and child EF

Parental elaborative speech has been addressed in various research fields of child development. One such field belongs to the scaffolding literature, in which parental effective scaffolding is characterised to include elaborative speech. In research on scaffolding, parental elaboration is defined and operationalized in a range of ways. For example, Hess and McDevitt (1984) defined elaboration as verbal support that was verbally and conceptually rich (e.g., questions and commands that ask children to generate responses of their own). Kruger and Tomasello (1986) operationalized parental elaboration as parental requests for clarification, justification, or elaboration of the child's ideas. In addition, Bibok and colleagues (2009) defined parental elaboration as parental verbal feedback provided on/shortly after the child's activities. These operational definitions are conceptually opposed to directive speech that is found to have a negative impact on child EF (i.e., imperatives telling the child what to do next; Bibok et al., 2009; Bindman et al., 2013).

Another line of research exploring parental elaborative speech may be found in the parent-child reminiscing literature. In research on reminiscing, maternal elaboration typically concerns how the mother structures mother-child conversations. It is defined as a style, in which parents provide a great deal of rich embellished information and encourage their children to participate in

the co-construction of a narrative about the past through open-ended questions, confirmations, provision of new information, and a willingness to follow in on the child's memory provisions (Cleveland & Reese, 2005). The variability in the way the mother structures past events while reminiscing has been addressed broadly in two types: high and low elaboration (Reese, Haden, & Fivush, 1993). Highly elaborative mothers provide a great deal of narrative structure by embellishing on events and confirming their children's responses often and thus having lengthy conversations with their child. Additionally, they tend to add further elaboration to their previous question when the child provides an empty conversational turn (Reese et al., 1993). They are focused on supporting the child to actively participate in collaborative reminiscing for its own sake. In other words, highly elaborative mothers would let their talk to be child-centred so as to help the child to be intrinsically motivated and keep focused on the conversation (Fivush & Reese, 2002). By contrast, less elaborative mothers tend to have shorter reminiscing conversations, in which they frequently repeat their own questions and do not expand on past events. These mothers seem to adopt a testing, encouraging their child to provide maximum independent memory performance (Reese et al., 1993). As such, less elaborative mothers may be depicted as having the goal of demonstrating the child's memory performance. The mother who is focused on the demonstration of the child's memory capacity would ask, repeat, or shift between the questions that she thinks are important to remember, which is called "topic-switching" because the mother tends to introduce a new topic when their child is not responding (McCabe & Peterson, 1991).

In the literature, highly elaborative mothers are more likely to provide new information to a conversation by using open-ended questions and elaborative statements, while less elaborative mothers ask simple close-ended, yes-no questions. In addition, highly elaborative mothers ask their child to report information, provide a great deal of confirmation, and evaluative feedback on what their children say (Fivush et al., 2006). However, the use of open-ended or close-ended questions may depend on the maternal awareness of the child's current developmental phase. That is, mothers may ask close-ended questions to her preschool child in discussing past events. Mothers then tend to shift to the use of more open-ended, wh-questions by the end of the preschool years, which reflects maternal sensitivity to the child's developing abilities to engage in reminiscing as they grow older (Farrant & Reese, 2000). The increasing use of maternal open-ended elaborative questions helps children to display their event knowledge in a verbal form, to produce a more complex linguistic response than closed-ended questions do, and to facilitate children's retrieval through language (Fivush et al., 2006).

One aspect of cognitive development that parental reminiscing may contribute to is the child's verbal competence (Fivush et al., 2006). Maternal elaborative reminiscing has been found to significantly relate to children's linguistic capacities (Srivastava, Reese, & Newcombe, 2004) and that mothers are more likely to be elaborative with young pre-schoolers with higher language skills

(Farrant & Reese, 2000; Newcombe & Reese, 2004). That is, highly elaborative mothers are more likely to have a child who is more verbally fluent. Children whose mothers provide a great deal of narrative structure and elaborate on what is being talked about may be more exposed to quality verbal input than those whose mothers are less elaborative. In addition, growing empirical studies demonstrate that language and child EF appear to be significantly correlated, such that children with higher verbal ability tend to have higher EF. Therefore, based on the relation among maternal elaboration, the child's verbal ability, and child EF, it may be relevant to expect that highly elaborative mothers are more likely to have children who are verbally fluent and have higher EF skills as well. In support of this account, Hughes and Ensor (2009) hypothesized that attributes of mother-child talk that make differences in child verbal ability may also contribute to individual differences in child EF. In other words, despite little research on the relation between maternal elaborative speech and child EF, it may be relevant to infer that parental elaborative speech during reminiscing may positively affect the child's higher verbal skills, which would also be related to children's increased EF skills.

Taken together, maternal elaborative speech during reminiscing may be relevant to adopt as a potential correlate of child EF. Given that the present study was focused on exploring a parenting trait in a new context of parent-child verbal interactions, maternal elaboration may be operationalized as those presented in the reminiscing literature: the tendency to use elaborative statements and closed-, or open/close-ended questions. Maternal willingness to confirm and follow in on children's responses was also focused on in the present study, which is addressed in the next section, because this kind of maternal trait is strongly related to the maternal tendency to provide semantically connected utterances to the child's previous utterances.

2.3.2.3.2 Maternal semantic connection and child EF

While maternal elaboration in the previous section concerned the support in terms of the conversational structure, maternal semantic connection in this section addresses how the mother confirms and follows in on the child's speech by providing conversational utterances within semantically connected contexts. That is, while maternal elaboration is about the form (structure), maternal semantic connection is about the content of a reminiscing conversation. Semantically connected mother-child speech helps elucidate how interlocutors are tuned in to one another, which has been found to contribute to the development of theory of mind skills in children (Dunn & Brophy, 2005; Ensor & Hughes, 2008). Studies on the impact of parental verbal input on child outcomes have focused heavily on the literal content of talk (Ensor & Hughes, 2008). It has been suggested that in conversational exchanges, interlocutors must seek not only clear and mutually

understood meanings but also conversational implications since the meaning of an utterance depends on shared understanding of conversational contexts (Grice, 1975). In this regard, the way in which one interlocutor aligns his/her utterances to another's is emphasised so as to delve into deeper meanings of conversations (Fogel, 1993). Semantic connection was defined by Ensor and Hughes (2008) as the speaker's utterance being "semantically related to the other interlocutors' previous turn" (p.204). Here the focus was on the way in which a conversation was carried out as well as on the content of a conversation.

From a theoretical point of view, semantic connection is in line with Self-Determination Theory (SDT; Deci & Ryan, 2000). Both maternal semantic connection and SDT are focused on the parental tendency to follow the child's interest and pace rather than impose the parent's own agenda, which is typically operationalized with parental feedback on the activities or topics in which the child is currently engaged. This parental tendency may lead to developing the child's cognitive development. For example, a child's acquisition of language may be accelerated by adult's sensitivity in providing feedback on the activities or objects that the child is engaged in (Tomasello & Farrar, 1986; Tomasello & Todd, 1983). Parents who talk about the aspects of the activity that the child is focused on are more likely to facilitate the child's language skills, as indicated in the following quotation:

> "mothers who follow their children's leads in determining the topics of conversation may help their children's language learning by increasing the likelihood that their children will be able to construct semantic representations of the sentences they hear" (Hoff-Ginsberg, 1987, p. 147).

In support of SDT embedded in semantic connection is a study by Cleveland and Reese (2005), who defined maternal autonomy support during reminiscing as the maternal tendency to sustain the topic or agenda that the child is engaged in during the conversation. In SDT, it is argued that autonomy supportive parents support their children's interests, which encourages their children to be intrinsically rather than extrinsically motivated to continue in a task (Deci & Ryan, 2000). Relatedly, autonomy supportive parents have been found to induce the child to be more intrinsically motivated in mother-child reminiscing conversations (Cleveland & Reese, 2005).

Taken together, semantic connection may be an appropriate construct to adopt in research on parent-child verbal interactions due to its focus on the way how interlocutors are tuned in to one another, thus leading to a better understanding of suggested meanings of conversational exchanges rather than only interpreting an actual meaning of the content. Semantic connection during parent-

child interactions however has rarely been related to child EF. Thus, it may be relevant in the present study to investigate whether and how semantically connected dialogues serves as a context in which the child is exposed to quality maternal verbal input, which in turn may contribute to the child's increased EF skills. As such, semantic connection may be a potential correlate of child EF.

2.3.2.3.3 Mental-state References and child EF

As mentioned earlier, maternal mental-state references are used as an indicator of mind-mindedness, which has been found as an influential factor explaining child EF (Carlson, 2003). As such it may be necessary to begin this subsection by addressing the definition of mind-mindedness and how maternal mind-mindedness has been related to child EF in previous studies. Maternal mind-mindedness was introduced by Meins, Fernyhough, Fradley, and Tuckey (2001) in an attempt to explore the concept of maternal sensitivity in a more comprehensive way. Maternal sensitivity is a crucial trait that determines the quality of mother-child relationships in attachment theory. Sensitive mothers are those who are able to notice and interpret the child's signals correctly, and respond them promptly and appropriately (Ainsworth et al., 1974). Ainsworth and colleagues (1974) have described the mother of a securely attached child as being "capable of perceiving things from [the child's] point of view" and regarding her child "as a separate person"… "she [the mother] also respects his activity-in progress and thus avoids interrupting him" (p. 43). From a bit different point of view, Meins and colleagues (2001) investigated the mother's tendency to make references to the infant's mental states (the ability to read the baby's mind) and referred to this ability as maternal *mind-mindedness*. They argued that the mother's ability to respond to the child's explicitly expressed needs (e.g., physical and emotional needs) should be clearly distinguished from mothers' capacity to engage with their infants at a mental level. Nevertheless, individual differences in maternal mind-mindedness have been found to be strongly related to maternal sensitivity (Meins et al., 2001). That is, mothers who are evidenced as sensitive are more likely to be mind-minded, and vice versa. The more securely attached mothers are more likely, than insecurely attached mothers, to respond sensitively to child signals and make more references to the child's mental states. In addition, both maternal mind-mindedness and sensitivity are based on the same notion that infants should be treated as an autonomous human being with complex desires and intentions.

Maternal mental-state references have been found to positively affect the child's EF skills. Empirical findings, however, appear to be little in that very few studies have demonstrated the link between parental mental-state references and child EF (e.g., Baptista et al., 2017; Bernier et al., 2010). Talking about internal states such as emotions, desires, and cognition has attracted a great deal of research attention due to its important role in the development of theory of mind (Slaughter,

Peterson, & Mackintosh, 2007) and self-understanding (Reese, Bird, & Tripp, 2007). This is partly because children's self-understanding may improve when explanations of causes and consequences of internal states are provided and such causal talk most likely helps children understand how and why an event has occurred and shape personal meanings of the event (Bird & Reese, 2006).

Interestingly, however, the mechanism through which maternal mental-state references affect children's EF and the mechanism through which maternal mental-state references influence children's theory of mind (ToM) skills appear to be similar (note that maternal mental-state references are frequently found to affect the child's ToM skills). In the EF literature, it has been asserted that the maternal use of mental terms (i.e. thoughts, desires, and knowledge) provides the child with verbal tools with which to reflect themselves and practice EF skills (Bernier et al., 2010). Similarly, in the ToM literature, it has been suggested that the acquisition of the vocabulary necessary for labelling mental states enables children to represent and reflect on abstract mental state concepts (Ensor & Hughes, 2008). These accounts may suggest that the nature of the development of EF and ToM is intrinsically social, even though the developmental directionality between them and their own developmental trajectories may differ (Moses & Tahiroglu, 2010).

As such, given that while maternal mental-state references have been suggested as a potential factor explaining child EF and that very few studies have empirically demonstrated the relation between mental-state references and child EF, it may merit further research to explore maternal mental-state references as a potential correlate of child EF. In addition, a potential link between maternal mental-state references and child EF may be supported by a sizable literature showing that preschool children's EF and ToM are closely related and that parental references to mental-state references are also influential on preschool children's ToM. Given that parental references to mental states have been suggested as an influential factor for the development of child EF and ToM, our understanding in this research field may benefit from examining how the three constructs may relate to each other.

2.4 The parenting behaviours in the present study

This section describes the parental behaviours that have been addressed in Chapter 2 in terms of their conceptual overlap or differences. The aim of this description is to show why the present study was focused on certain parenting behaviours in exploring their links with child EF. In addition, this section addresses why two specific contexts – problem-solving and reminiscing conversations – were chosen in the present study in exploring mother-child interactions. Then this section also discusses how the chosen parenting behaviours would be distinctive in their relations to child EF. In so doing, this section is structured in three subsections. The first two subsections are focused on presenting rationales for the selection of parenting behaviours and contexts in which to explore mother-child interactions. Then the third subsection presents literature suggesting how parenting behaviours of interest to the present study would have different or similar relations to child EF.

2.4.1 Conceptual overlap or differences among parenting behaviours linking to child EF

Interestingly, despite the early theoretical work emphasising the importance of social influences on EF (e.g., Vygotsky and Luria), very few studies have researched the link between adult-child interactions and child EF (Hughes, 2011). That said, this line of research is increasing and specific kinds of parent-child interactions that have been linked to child EF can be presented, which include caregivers' scaffolding or autonomy-support (e.g., Bibok et al., 2009; Bindman et al., 2013; Landry et al., 2002), intrusiveness and negativity (Holochwost et al., 2016), sensitivity (Bernier et al., 2010), and mental-state references (Baptista et al., 2017; Bernier et al., 2010). These six parenting traits are found in the literature as most frequently related to the development of child EF. Other traits, such as maternal mean length of utterances during a mother-child talk and maternal calm responses to the child's transgressions (Hughes & Ensor, 2009), were dropped from further discussion in this section because they are found not to be significantly related to child EF. Parenting dimensions based on the definitions of the six parenting behaviours are shown in Table 2.1.

Table 2. 1 Three parenting dimensions linking to child EF

	Parenting dimensions based on definitions		
	Parental verbal or behavioural responses		Parental verbal responses
	Those relating to (fostering or hindering) the child's independent performance (Wood et al., 1976)	Those relating to responses to the child's apparent verbal/physical cues (prompt/appropriate or untimely /inappropriate; Ainsworth et al., 1974)	Prompt and appropriate responses to the child's mental states (Mains et al., 2001)
Scaffolding	○		
Autonomy support	○	○	
Sensitivity		○	
Intrusiveness	○	○	
Negativity	○	○	
Mental-state references*			○

Note. * Mental state-references may be used as indicators of mind-mindedness

Table 2.1 shows that the six parenting behaviours are categorised into three dimensions. The first dimension includes parenting behaviours that aim at promoting the child's independent performance. Scaffolding was categorised into this dimension because parents are supposed to adjust levels of support so as to provide the child with the right amount of task that the child can independently work on. The ultimate aim of the parent exercising scaffolding may be that the child becomes independent in achieving a task beyond the child's current capacities, by providing a minimum amount of effective feedback. The second dimension is related to a range of mother-child interactions, which itself constitutes the definition of parental sensitivity based on attachment theory (Ainsworth et al., 1974). Parental appropriate and timely (or inappropriate and untimely) responses to the child are relevant to autonomy support and sensitivity (or intrusiveness and negativity), all of which were categorised into the second dimension. Then maternal references to mental-state were categorised into the third dimension, which itself is the definition of mind-mindedness (Meins et al., 2000).

Of note in Table 2.1 is that autonomy support was categorised into both the first and second dimensions due to its being a broad concept relevant to both the child's independent performance and the parent's appropriate and timely manner of responding to the child's needs. A sensitive mother "perceives things from the child's point of view" and "respects [the child's] activity-in-progress and thus avoiding interrupting him" (Ainsworth, 1971, p.43). This is relevant to the concept of parental autonomy support, which emphasizes to engage with the child's interests and pace rather than what the mother wants the child to do (Deci & Ryan, 2000). Similarly, intrusiveness and negativity are shown to belong to the first two dimensions. Parental intrusiveness

is known to hinder the child's independent performance. In addition, intrusiveness refers broadly to parenting behaviors that are untimely/ inappropriate and/or not contingent on the child's interest/behavior. Parental negativity refers to hostile and negative affect towards the child (Holochwost et al., 2017), which is observed in a range of parent-child interactions that are relevant to the first two categories.

Of these three dimensions, the present study explored the first and third categories. The parenting behaviours in the second categories were dropped for the following reasons. Parental autonomy support was excluded due to its partial conceptual overlap with scaffolding. That is, autonomy support and scaffolding may share at least some part of their operational definitions, particularly when they are examined in join problem-solving contexts. Scaffolding is the crucial factor of autonomy support (Bernier et al., 2010), the operation of which includes maternal elaborative statements, open/close questions, and praise (Hughes & Ensor, 2009), a range of strategies to help the child solve a problem (Lowe et al., 2014), and maternal ability to adapt problem-solving tasks to create an optimal challenge for the child (Bernier et al., 2010). Thus these aspects of effective scaffolding were not explored in the present study. Maternal contingency instead was adopted as the crucial trait determining effective scaffolding on the basis of the contingency rule by Wood (1980), as presented in Section 2.3.2.1.

Next, there were two reasons that parental sensitivity was dropped from the present study: partial conceptual overlaps with those behaviours in the first category and methodological practicality. As addressed earlier, maternal sensitivity is conceptually broad including home observations in a more extensive sense and shorter video recordings of interaction in a limited context. Several versions of Maternal Behaviour Q-Sort (MBQS; a widely used measure of parental sensitivity) are available to use in different contexts. For example, in previous studies on the link between maternal sensitivity and child EF (e.g., Bernier et al., 2010, 2012), the 90-item MBQS was used during multiple home visits, which produced a global measure of maternal sensitivity. In measuring maternal sensitivity in a more limited context (e.g., short video recordings), the 25-item MBQS can be used but with less detailed description of mother-child interactions. Maternal sensitivity using home observation was not possible to examine in the present study, because the present study was initially designed to collect cross-sectional data in kindergartens. Then maternal sensitivity in a limited context may conceptually overlap with those in the first category, particularly in a problem-solving context. Thus, in line with the decision made on maternal scaffolding, maternal sensitivity (as defined and measured in attachment theory) was dropped.

Finally, parental negativity was not included. As will be addressed later in Section 3.4.2, the Korean mothers recruited in the present study rarely showed negativity while interacting with their child. As a result, negativity was not coded and excluded from further discussion. Taken together, maternal contingency and intrusiveness (in a joint problem-solving context) were selected

as parenting behaviours of interest to the present study. In addition, maternal mental-state references were adopted as one of the constructs representing maternal verbal input in the context of a reminiscing conversation. These selected behaviours are the parenting dimensions proposed by Carlson (2003) as contributing to the development of child EF.

2.4.2 Two contexts in which to explore parenting in the present study

Based on Table 2.1, this subsection provides a rationale for the context in which to explore the chosen parenting behaviours: a problem-solving context for the behaviours aiming at the child's independent performance (the first category in Table 2.1) and a reminiscing conversation for the parental references to the child's mental states (the third category).

One favourable context that has been empirically linked to advanced EF skills is joint problem-solving tasks. Interestingly, research on child EF has predominantly used problem-solving tasks as a context in which to explore the effect of parental scaffolding on child EF (e.g., Bernier et al., 2010; Bibok et al., 2009; Meuwissen & Carlson, 2015). While parental scaffolding can be observed in other contexts, a cognitively challenging puzzle may be a relatively more appropriate context to observe maternal contingency (i.e., the ability to adjust among levels of support). This is because parents are more likely to be captured exercising distinctive levels of parental support based on the child's responses. In response to the ongoing evidence of the child's mastery of the task at hand, parents may be shown to increase or decrease the amount of support. The extent to which parental scaffolding is contingent on the child's behaviours can be well captured in a cognitively challenging puzzle. From an epistemological perspective of scaffolding, Bibok and colleagues (2009) argued that parental adjustment of levels of support refers to muting 'selection pressures', which supports the child in constructing a partial understanding of a given problem with whatever resources are available. If the selection pressures for a problem are too far beyond the child's level of ability, the parent reduces or mutes the amount of selection pressures for the child (i.e., reducing task complexity/the problem space or furnishing resources with external aids or emphasising critical features), which finally leads the child to possess enough cognitive resources to solve the problem independently. As such, problem-solving tasks may be particularly relevant as a context in research on EF, like the present study, in which the parental ability to adjust among levels of support is conceptualised to index the effectiveness of mother-child interactions.

The other context in which to explore mother-child interactions in the present study was a reminiscing conversation. Reminiscing refers to adult-child conversations about past events, in which the adult typically scaffolds the joint recall of experience (Reese & Fivush, 1993; Zamen & Fivush, 2013). Despite being rarely related to child EF in the literature, reminiscing conversations

may be an appropriate context in which to explore the link between parental verbal input and child EF for the following reasons.

Firstly, while reminiscing with the child, the parent provides a frequent and abundant mount of information. Indeed, the parental spontaneous co-narration of the child's past experiences is part of everyday family life. Reminiscing is distinct from other adult-child conversations in that talk during reminiscing is decontextualized from immediate experience (Fivush, Haden, & Reese, 2006), which is critical for children's advanced language and literacy skills (Snow, 1983). Reminiscing has been found as a context wherein children's verbal ability is enhanced (e.g., advanced vocabulary ability: Peterson, Jesso, & McCabe, 1999; increased independent narrative skills: Reese, Leyva, Sparks, & Grolnick, 2010). Language itself becomes an object around which the mother and the child reminisce, and their verbal interaction serves as the medium for cognitive skills such as autobiographical memory skills (Fivush, Haden, & Reese, 2006).

Additionally, reminiscing may be an effective context in which parents help children to understand mental-state terms and related concepts (Bernier et al., 2010). During the preschool years, children develop a relatively sophisticated understanding of mind (internal representations of beliefs, cognitive processes, and emotions) (Wellman, 2002). A great deal of research has suggested that mother-child conversations are critical in children's developing understanding of mind (Carpendale & Lewis, 2004). In addition, mother-child reminiscing conversations may serve as a context in which children are confronted with the differences between others' and their own states of mind (Nelson & Fivush, 2004).

Specifically, reminiscing in the Korean context may reveal culture-specific links between maternal verbal input and child EF. While reminiscing, both caregivers' and children's speech behaviours and skills reflect culturally preferred ways of communication (Smith & Hart, 2011). Little research on reminiscing has been conducted using Korean parent-child samples, but existing cross-cultural studies in the reminiscing literature may guide an expectation of a possible link between maternal verbal input and child EF in the Korean context. Research on cultural differences in mother-child reminiscing between Western and non-Western settings has focused on the difference in the extent to which the mother is elaborative and the child contributes to the joint conversations. For example, US mothers are usually described as initiating more interactive and elaborating conversations that focused on the child's roles while Chinese mothers are more likely to take a directive role in posing and repeating memory questions and emphasise discipline and proper conduct to their children (Wang & Fivush, 2005). In addition, research on differences in parental mental-state references across cultures shows that Euro-American mother-child pairs make more references to mental states during reminiscing and focus more on causal talk than do non-Caucasian (mostly Chinese samples in the literature) mother-child pairs (Mullen & Yi, 1995; Wang & Fivush, 2005). In a study comparing maternal references to the child's mental states between

Euro-American and Chinese mothers, Wang, Doan, and Song (2010) reported that Euro-American mothers tended to make more references to mental states than Chinese mothers did. Specifically, children whose mothers made more elaborative comments on cognition, desires and feelings were more likely to be expressive in talking about their traits and self-expressions. In addition, Western mothers were found to help the child to make personal meanings and self-knowledge of past events by elaborating on the causes and consequences of the child's thoughts and feelings, whereas Chinese mothers were found to focus more on relationships with significant others rather than on the child's mental states, thereby facilitating children's sense of relatedness (Wang et al., 2010).

In sum, reminiscing may be an appropriate context in which to explore maternal verbal input because it is one the most frequent verbal interactions between the mother and the child on a daily basis. In addition, reminiscing has been found to contribute to the development of the child's ability to understand their own and others' mind, making it relevant to observe the maternal use of mental-state references. Reminiscing in the Korean context may add to the literature by providing possible culture-specific links between mental-state references and child EF since research on reminiscing has rarely been conducted using Korean samples.

2.4.3 The parenting behaviours and their relations to child EF

It may not be surprising that any parental interactions with preschool aged children are heavily scaffolded by parents. Specifically, children become proficient at exercising strategies provided by parents in accomplishing a joint problem solving task. During mother-child reminiscing, children learn the forms and functions of narratives about past evens. Children in the latter half of the preschool period (3~5 years of age) progress in their reminiscing capacities from responding with a word or two to providing more coherent and detailed narratives about past events, but much of the structure and content of these conversations is still scaffolded by parents (Reese & Fivush, 1993). Parents provide the child with a general framework for reporting personal memories in an organized way, which is then internalised and used when talking to oneself about past events (Al-Namlah, Meins, & Fernhough, 2012). Thus, parental scaffolding in problem-solving or conversational contexts may have crucial impacts on child EF skills.

Maternal contingency (in a more structure setting of solving a problem) and verbal input (in a more casual conversational setting, like reminiscing) may have distinct relations to child EF. That is, while working jointly on a cognitively challenging task, the mother and the child are aware of a shared goal of solving a problem and thus the maternal support – cognitive, emotional, and kinaesthetic - are intentional. The mother would make a deliberate effort to accomplish a given goal. By contrast, the effect of maternal verbal input during reminiscing on a daily basis may be relatively incidental, in that the mother may not set a particular aim a priori in exchanging verbal information with her child. The way in which parents engage in reminiscing conversations during

an extended period may be mimicked and internalized by the child, leading to different styles of reminiscing across cultures (Reese & Fivush, 1993). As such, in terms used by Hughes and Ensor (2009), scaffolding may be deliberate and reminiscing may be relatively incidental in nature (i.e., a parental attitude/behaviour may have an incidental effect when the parent's attitude/behaviour is acquired by the child by observing and imitating). While it has been well established that parental deliberate efforts to scaffold children's goal-directed activities help children improve early EF skills (Hughes, 2011), little has been known on the effect of incidental parenting on child EF. Given that parental influences are often incidental rather than deliberate (Hughes & Ensor, 2009), further research on the link between incidental parenting and child EF is required.

In addition, it may be relevant to address that a trait that has typically been assessed negative may not have a maladaptive effect on child EF. As adopted in the present study as two opposing parenting traits, contingent or directive utterances are the two concepts that are predominantly found in the literature on parent-child interactions For example, Hess and McDevitt (1984) coded using two types of parental utterances: 'generative verbalizations' (questions, commands and utterances that ask children to generate a response of their own) versus 'direct commands' ("unmoderated imperatives that call for either a verbal or nonverbal response", p.2021). Landry and colleagues (2000) also categorised maternal scaffolding utterances into either 'maintaining behaviours' (non-or verbal behaviours that provide children with choices relevant to their current or immediately prior events) or direct commands (those giving less opportunities and emphasizing instead expected behaviours or activities). Similarly, Bibok and colleagues (2009) coded two types of maternal verbal scaffolding: elaborative (maternal utterances provided on the activity in which the child is currently engaged) versus directive (those provided before the child begins to work on a given task). Relatedly, Bindman and colleagues (2013) coded parental management language while scaffolding into either suggestions (non-directive language affording the child choices and thus encouraging to take an active role in decision-making) or directions.

As shown in the prior studies, maternal support may be assessed either contingent or intrusive (these concepts may be presented using different terminologies across studies). This dichotomous distinction between types of maternal support may imply that the parental tendency to use more of one type may result in the less usage of the other, and vice versa. In addition, it may appear that parental contingent utterances bring a positive impact while intrusive utterances a negative effect. Their effects on child EF, however, may vary across traits of children and contexts. One such trait is the child's age (Bindman et al., 2013). Parents use some directives to teach children appropriate behaviours, which will help children develop self-regulation (Kopp, 1982). Landry and colleagues (2000) reported that two-year-old children whose mothers adopted directives frequently tended to develop higher levels of cognitive skills. However, this was not the case for children aged between 3 1/2 and 4 1/2 years old. Additionally, it was addressed earlier

that cultures in which the mother and the child interact would exert nuanced effects on the development of EF (see Section 2.3.2.2.2 for more details). In addition to the two factors (child's developmental phases and cultures) addressed in this subsection, our knowledge on child EF would increase with further research that enquires into factors and conditions that quantify the negative or positive effect of parenting behaviours on child EF.

2.5 Sociocultural factors influencing parenting: The Korean context

As pointed out by Lewis and colleagues (2009), if the development of EF has a basis in social interaction, it may be necessary to investigate the effects of cultural differences on parenting. Prior research on EF mentioned in this thesis has been conducted almost exclusively in Western cultures. While some studies have been carried out in the Chinese context, little research on EF is found in the Korean context. Only one exception to this trend is the study by Oh and Lewis (2008), the focus of which was on comparing preschool children's EF and Theory of Mind skills between the Korean and UK context. Oh and Lewis found that Korean children showed higher performance than UK children on some inhibition measures but the link between EF and theory of Mind skills was not as strong as that in the UK sample. No parental factors, however, were explored in this study in relation to child EF.

Since the existing literature cannot afford a clear explanation on culture-specific links between parenting and child EF in the Korean context, this section presents relevant literature on cultural and historical values that would affect Korean parents' parenting practices, which may relate to increased or decreased EF skills in young children. This section is particularly focused on parenting practices that may be viewed as distinct from those in Western contexts. Among contrasting sets of values that have been argued to explain Korean society (e.g., Confucianism, Western capitalism, individualism, Buddhism, or Japanese feudal aristocracy; Shim et al., 2008), this section addressees the co-existence of Confucian, capitalistic, and individualistic values, which appears to be relevant to depicting parenting characteristics of Korean young mothers (of 4-year-olds) in Seoul (Capital of Korea). In so doing, the first part of this section concerns mother-child relationships that are prescribed by traditional Confucian values and cultural assumptions about the mother-child relationship that may be assessed differently from those based on Western cultures. Then, the remaining part of this section discusses how Korean parents are strongly required to play a role in their children's education.

2.5.1 Traditional Confucianism

The philosophical foundation of Korean culture is Confucianism. Ever since Confucianism was imported to Korea around the beginning of the Christian era, it continues to play a major role in constructing the foundation of the motivations of Koreans and their perspectives on what is worthwhile for daily life (Shim et al., 2008). Therefore one must understand Confucianism in order to understand contemporary Korea. Confucius (or Gong Fuzi, 551-497 B.C), who lived in the Chinese feudal state of Lu during a time of violence and warfare, believed that if individuals were aware of their own place in society and the nature of their relationships with others, all need for violence would vanish (Shim et al., 2008). Confucianism is a value system that seeks to bring harmony to the lives of people in the family, the community, and the state, which can be achieved by individuals' accomplishment of their obligations prescribed according to their status. As such, for the sake of the harmony of the group as whole, everyone else's needs come before one's own, which is reflected in collectivistic societies based on Confucianism. In Confucianism, people are not assumed to be created equal and therefore someone is always subordinate to another person, and accepts hierarchy and authority (Shim et al., 2008). Throughout a person's life, he or she is likely to be defined in relation to someone else (Clark, 2000). Thus, Five Relationships were established, which dictate how people relate to each other (i.e., relationships between parents and children, ruler and subject, husband and wife, older and younger sibling, and friend and friend) and distinguish individual roles and behavioural expectations in society. These five relationships are central to understanding Confucianism in the Korean context, all of which are based on authority and subordination except for the last relation (between friend and friend).

2.5.2 The nature of the parent-child relationship

One of the five relationships based on Confucianism concerns the parent-child relationship, which specifies that there should be intimacy between the parent and the child (부자유친; 父子有親). The word intimacy would summarise well the parent-child relationship in the Korean context. The nature of intimacy in the parent-child relationship is reciprocal in that parents should love their children (i.e., 자, 慈) and children should pay back their parents (i.e., 효; 孝). Parents should teach children at a young age that they owe an un-payable debt to their parents called *unhae* (은혜; 恩惠), referring to the gracious bestowal of life and nurture by parents (Baik, 1999). Intimacy is achieved when parents and children perform their roles prescribed according to their positions in the family (Shim et al., 2008). Parental love for children is natural and unconditional, and children's filial piety (or duty) is the most basic virtue of all sorts of behaviours required in society. Even though the concept and ways of accomplishing filial piety have altered in the past

few decades, its importance in the parent-child relationship is still acknowledged and emphasised in Korean society (Choi, 2006). From this point of view, one striking difference in describing the parent-child relationship between the Korean and Western contexts may be pointed out. Intimacy between the parent and the child in the Korean context is based on the hierarchy of family, whereas the parent-child relation in Western cultures are more individuated, and more egalitarian relationships are emphasized between the parent and the child (Choi, 2006). In support of this view, Choi (1992) described intimacy in the Korean setting as the parent and the child sharing their common emotional denominator, which was contrasted from the intimacy in the Canadian setting, as shown in the following quotation.

> "[Korean mothers] function as if they and their children are in a fused state… neither the mothers nor the children are recognised as independent individuals (p.120)", whereas the Canadian mothers are more likely to differentiate themselves from their children and "there is no intrusion of the mothers' reality into the children." (p. 114).

Similarly, the parental view of the child as an individuated and autonomous entity in Western contexts is described in the following quotation, which is based on attachment theory:

> "the fact that the baby has a will of its own, even when it opposed hers…[she] finds his anger worthy of respect… [she] views her baby as a separate, active autonomous person, whose wishes and activities have a validity of their own… she avoids situations in which she might have to impose her will on him." (Ainsworth, 1976, p. 4).

It may not be true that parents in Western cultures are less oriented toward intimacy because they are focused more on the individuated self. Rothbaum, Pott, Azuma, Miyake, and Weisz (2000) argued that the meaning and dynamics of parent-child relationships may differ across cultures rather than that individuation undermines relatedness. Parent-child relatedness is initially rooted in biological predispositions (such as proximity seeking, contact maintaining, and separation protest and safe haven) and is manifest in all cultures. Relatedness in Korea may be characterised by a continual adaptation of the self to fit the needs of others, whereas it is described in Western cultures as a co-existence, throughout the life course, of the desire for proximity and closeness with primary attachment figures on one hand and the desire for separation and exploration of new relationships, on the other hand (Rothbaum et al., 2000).

Therefore, there appear to be differences in the way in which parent-child relationships are shaped. For example, in Korea almost 90% of children younger than 7 years of age sleep with their

parents who emphasise familial bonds and interpersonal relationships (Yang & Moon, 2002). Parental speech directed towards babies in Korea is characterised by a greater use of verbs than in other languages (Choi & Gopnick, 1995). Korean parents' verbal input with a particular emphasis on action (whereas English input focuses more intently upon object classes) is geared towards stressing the importance of self-control (Kim, McGregor, & Thompson, 2000). In addition, Trommsdorff and Rothbaum (2008) compared Korean and German mothers on the way they exercised their sensitivity toward their young children – reactive versus proactive. German mothers were more likely to practice reactive sensitivity, which was based on the parent's expectation that their children would express their needs explicitly, whereas Korean mothers were more likely to exercise proactive sensitivity, which focused on parents' anticipation of children's needs by observing and interpreting children's behaviour. Similarly, Ziehm and colleagues (2013) found that German mothers were more likely to show reactive sensitivity, whereas Korean mothers showed their preferences to both reactive and proactive sensitivity. When asked whether a mother should attend to children's explicit requests or anticipate children's needs, half of the Korean mothers chose proactive sensitivity (anticipate child's needs), whereas the majority of German mothers chose reactive sensitivity (expect child's explicit requests). Korean mothers who preferred to respond proactively to children's needs reported that they assisted children because they prioritised their children's immaturity in dealing with emotional distress whereas German mothers emphasised children's development of independence as a reason for their reactive sensitivity.

In support of this difference in mother-child interactions, Choi (1992) reported that Korean mothers are more likely to adopt controlling behaviours (may be from a Western point of view), in which they are interactional leaders and their children are followers. Specifically, Korean mothers "constantly check, direct, or speak for the children", whereas Canadian mothers "perceive their child's utterance as an independent assertion of their communicative partner." (p. 120). As such, children in Western cultures are supposed to express actively and clearly their needs and opinions than children in the Korean context would be encouraged.

2.5.3 Parental strong sense of responsibility for children's' education

This section presents literature emphasizing Korean parents' strong sense of responsibility for children's education, which may help to explain a culture-specific link between parenting and the development of child EF in the Korean context. Traditionally, education has been viewed in Korea as a life-long affair and the parental role in children's learning has thus been strongly emphasized. Parents are supposed to teach desirable manners acceptable to the society and should provide opportunities for their children to be educated. This parental responsibility for education

may be aptly described by a Korean saying that ‘Mencius’ (372~289 BC) mother moved three times to provide him the right neighboring environment for education’ (맹모삼천지교;‘孟母三遷之敎’), which illustrates how parents should contribute to their children’s education. In order to explore what constitutes Korean parenting traits, Lim and Jung (2004) constructed a measure of parenting that was appropriate to use in the Korean context by conducting a confirmatory factor analysis. In so doing, they based their theoretical framework on 12 virtues for the parent-child relationship that are based on Confucianism (부자십이지덕목, 父子十二之德目; 12 virtues for desirable relationships between parent and child). Four parenting factors emerged from their confirmatory factor analysis, which were termed as following: respect, attention, (dis)trust, and teaching. While the first three traits may also be found in describing parent-child relationships in Western cultures, the final virtue, “teaching’, is rarely focused on in Western settings, as an explanatory variable prescribing desirable parent-child relationships.

Parental teaching (or their sense of being responsible for teaching their children) is a focal quality explaining Korean parenting not only in the traditional Confucian but also more contemporary Korean society (Lim & Jung, 2004). Specifically, parents must provide resources for their children’s education, which places a great deal of responsibility in the place of parents (Chao & Tseng, 2002). In non-Western cultures, including Korea, where interdependence is typically emphasised over individual autonomy, mothers are expected to actively guide and structure children’s environment and behaviour (Rothbaum et al., 2000). In support of this notion, the child is viewed in Confucianism as innocence and innate goodness, lacking in knowledge of the world. Children can only be corrupted by the adult world, not by their own nature (Chao & Tseng, 2002). This view shapes how parents should play a role in fostering a desirable child development. On this account, the role and responsibility of parents for children’s education are emphasised because children are viewed as an entity to be cultivated and educated from very early in life, and the parental guidance is essential in starting off the child in the correct direction.

The emphasis on the parental responsibility for teaching children can be found not only with Korean parents but also with Asian parents more generally. Interestingly, parental active involvement in their children’s learning appears to produce different responses from children across cultures. For example, Fu and Markus (2014) found a significant difference between Asian American high school students (AAs) and European American students (EAs) in their responses to maternal engagement in academic achievement. AAs experienced pressure from their mothers as unrelated to support by their mothers, whereas EAs experienced negative relationships between pressure and support. That is, AAs did not experience pressure by their mothers as undermining their independent self as EAs did. AAs rather construed this pressure as bolstering their interdependent self and were able to use this pressure to focus on academic tasks. EAs have also

been found to be motivated by their mothers, but only when maternal influence does not threaten the students' culturally prescribed independence (Fu & Markus, 2014).

However, during the last half century, Korea has widely embraced the American style of education, as well as the values of capitalistic democracy and individualism. While education is still one of the means of achieving the Confucian values of status, hierarchy, and ethical propriety, the influence of Western capitalistic values has been integrated with the meaning and significance of education largely embedded in Confucianism (Shim et al., 2008). The reason that this section addresses social status is due to the perception that schooling is focused on as one of the primary avenues for social mobility in Korean society (Chao & Tseng, 2002). This perception may be relevant to Korean parents' attitudes and active engagement in their children's education. The nature of social status (and its related power) may differ profoundly from culture to culture, as shown in the following.

> "its [the power's] potentialities and limitations are always constrained by time and place… so the phenomenon of power cannot be understood without reference to the cultural context within which it exits." (Pye, 1985, Preface).

Koreans traditionally see power in highly personal terms as coming principally from social status and hierarchy, and they believe that power can be achieved by education, hard work, and in-group memberships (Shim et al., 2008). This may partly explains the trend of Asian cultures which places greater stress upon academic training and less emphasis on the value of play even in young children (Harkness, & Super, 2004). Throughout Korean history, the educated were considered the elite of society, and leaders were chosen and conferred power based on scholarly and intellectual achievement (Shim et al., 2008). The Confucian notion of status was generally based on scholarly pursuits. However, status is more likely to relate to education, prestige, and monetary rewards of education rather than to scholarly pursuits per se (i.e., Confucian-Capitalism: Confucian philosophy that is blended with Western capitalism; Shim et al., 2008).

Korean parents are trying to provide unlimited educational opportunities for their children. Parents do not spare resources to send their children to top schools that they perceive to be the best place for the future of their children's social status. In this context, it is not surprising that Koreans spend an average of 40% of their income per household for their children's' education so that they may acquire personal status and wealth (Geier, 2006). Although Korean parents' fervour for education is in many cases attributed to positive aspects of society such as the economic growth, extreme cases of parental investment on child education include 'Kirogi families' (Wild geese families where mothers move overseas for their children's education while fathers continue to work

in Korea) or severe inequalities in private schooling, eventually leading to social and economic inequalities as a whole. In addition, young Korean mothers (of preschool children, as in the present study) are the generations that are highly educated and have been in frequent contact with Western ideals for child development (Shim et al., 2008). They are more likely to adopt Western individualistic values and place more emphasis on academic achievement and social assertiveness rather than on traditionally valued behaviours (Park & Cheah, 2005).

So far, the literature reviews in this section were provided as to cultural and historical sources for a better understanding of culture-specific traits of Korean parenting. However, Korean society may be viewed as a land of contrasts (the co-existence of contrasting values of traditional Confucianism, Western capitalism and individualism), where its citizens negotiate these contrasts on a daily basis, and it may be misleading to generalise the trend of a society at a country level (Shim et al., 2008). As such, Koreans may be the most individualistic of Asians, with the Korean self being profoundly collectivistic while deeply committed to individualistic self-assertion (Alford, 1999). In some parts of this section, parenting in some East Asian contexts based on Confucianism was mentioned due to limited prior research specific to the Korean context. Korean parenting may share some cultural commonalities (e.g., collectivism, harmonised relationships) but is distinct from parenting in other East Asian countries (Japan and China). Prior cross-cultural studies have mostly compared North Americans to Chinese as a representative sample of Asian culture. While Chinese and Korean cultures are rooted in the same Confucian tradition; there are many sociocultural differences between the two countries (Korean Confucianism posits the family as the fundamental unit of society and stresses a rigid hierarchical order of human relationships based on age, gender and inherited social status; Han, 1989; Park & Cheah, 2005). More future research is required for a better understanding of differentiated values of parenting and their effects on child development across Asian cultures.

2.6 Rationale for the present study

Having reviewed relevant literature in the fields of EF and parenting it is now possible to present claims derived from research evidence that support the conceptualisation of the present study. These claims are as follows:

1. Research on EF has focused on either biological or psychological factors, and a small body of research has recently begun to integrate parenting as an influential correlate of child EF into the research design.
2. Specifically, the line of research on parenting has predominantly focused on the impact of parental scaffolding on child EF, mainly in Western cultures, which makes it necessary to test the link between parental scaffolding and child EF in ethnically and culturally diverse samples. Thus, it may be necessary to replicate the positive link between effective parental scaffolding and child EF and the negative link between parental intrusiveness and child EF in a non-Western culture.
3. At the same time, the predominant focus on parental scaffolding has led to the scarcity of parenting aspects that significantly explain the development of child EF, which makes it relevant to explore specific parenting behaviours that have rarely been linked to child EF in the literature (note that parenting behaviours that have been suggested as favourable to child EF include mind-mindedness and verbal input; Carlson, 2003; Hughes & Ensor, 2009).
4. Alongside the line of research on the link between parenting and child EF, another line of research on maternal EF has informed possible mechanisms through which the intergenerational transmission of EF is explained (Cuevas, Deater-Deckard, Kim-Spoon et al., 2014; Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014; Friedman et al., 2008).
5. However, in these two lines of prior studies – those focused on maternal EF and parenting behaviours, these two parental factors have rarely been simultaneously taken into account in relation to child EF, except for one notable study by Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014), who examined the relative contributions of maternal EF and negative parenting to child EF in the US setting.
6. Taken together, it is relevant in the present study to explore the following research topics: replicating the existing findings on the links between parental scaffolding and child EF in the Korean context; exploring aspects of parenting behaviours that have rarely been explored in relation to child EF; and examining simultaneous relations of maternal EF and parenting behaviours to child EF. These research topics would contribute to a better understanding of the development of child EF by addressing culture-universal and culture-specific links between maternal EF, parenting, and child EF in a rarely explored setting.

These claims suggest that there is a clear need for more research on the relative associations that maternal EF and parenting would have with child EF particularly in a non-Western setting. All the evidence presented above indicates that research such as that reported in the present thesis is relevant and timely. As Lewis and Carpendale (2009) suggested, research with non-Western samples should be used to question prevailing Western assumptions about the development of EF skills. The goal of the present study was precisely to address this issue that deserves a legitimate research focus in the EF literature.

2.7 Research questions & Hypotheses

The overall research question of the present study was to explore the relations between maternal executive function (EF), parenting, and child EF in the Korean context:

How do parenting behaviours and maternal EF relate to child EF in the Korean context?

The present study had four aims: (a) to investigate whether the existing findings using mainly European American populations on the link between parenting and child EF would be replicated in the Korean context, (b) to explore aspects of parenting behaviours that have rarely been linked to child EF in the literature, (c) to explore the relative associations that maternal EF and parenting behaviours would have with child EF, and (d) to identify possible mediators of the associations between maternal EF and child EF. These research aims were translated into four research questions, which are addressed below.

1. Would the existing findings on the relation between child EF and maternal scaffolding (as indicated by maternal contingency or intrusiveness during a puzzle task) be replicated in the Korean context?
2. Does maternal verbal input during a reminiscing task significantly relate to child EF?
3. To what extent do the parenting behaviours and maternal EF account for unique variance in child EF, above and beyond covariates of child EF (child age, child language and maternal education)?
4. Do the maternal parenting behaviours mediate the link between maternal EF and child EF?

Underlying these four research questions were hypotheses that were made based on prior findings. The first research question concerned the relations between child EF and the four kinds of maternal behaviours observed during a problem-solving puzzle task: maternal contingency, flexibility & perspective-taking, intrusiveness, and praise (see section 3.4.2). Following prior findings based on Western cultures (e.g., Bernier et al., 2012; Hammond et al. 2012), it was expected that mothers who were more contingent, flexible, and perspective-taking and provided more praise would have children with higher EF skills. Maternal intrusiveness, however, was expected to be distinct from those found with predominantly European American samples. This was because of the implications suggested by prior studies on Korean parents (e.g., Rohner & Pettengill, 1985; Vinden, 2001; see Section 2.5). Based on prior studies suggesting the nature of Korean parents' practices, the link between maternal intrusiveness and child EF was expected to be weaker, than that between maternal contingency and child EF, or insignificant.

The second research question addressed a parenting behaviour that has rarely been linked to child EF in the literature: the relation between child EF and maternal verbal input during a reminiscing conversation. Four constructs of maternal verbal input were examined: maternal elaboration, semantic connection, mental-state references and connected mental-state references (see Section 2.3.2.3 and 3.4.3). Maternal elaboration and semantic connection have rarely been researched in relation to child EF in prior research. Nevertheless, a hypothesis was made in the present study based on prior findings suggesting the positive relation between maternal elaboration and children's verbal skills (Fivush et al., 2006) and the close relation between children's verbal skills and their EF skills (Hughes et al., 2010). As such, mothers whose verbal input was highly elaborative were expected to have children with higher EF skills. Similarly, mothers whose verbal input was semantically related to her child's verbal utterances were hypothesised to have children with higher EF skills, which were based on prior research on the link between connected maternal utterances and children's social understanding (Theory of Mind; Ensor & Hughes, 2008). Then, given that maternal mental-state references have been found to significantly relate to child EF (Bernier et al., 2010), it was expected that mothers who were more likely to make references to mental states would have children with higher EF skills.

The third research question concerned the relative associations that maternal EF and parenting behaviours would have with child EF. Only one prior study (Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014) on these links was available, which reported that an adverse effect of maternal negative caregiving on child EF tended to be greater, relative to that of maternal EF, as children grew from 24 to 48 months old. As such, it was hypothesised in the present study using a sample aged between 3 and 5 years, that maternal intrusiveness may account more unique variance in child EF than maternal EF would do. With regard to the relative relations that positive parenting and maternal EF would have to child EF, a hypothesis was made based on prior findings that

parental scaffolding had a stronger effect on child EF than the parenting behaviours that have been explored in the literature (Hughes & Ensor, 2009). That is, variables representing maternal scaffolding, such as maternal contingency, flexibility and perspective-taking, and praise (i.e., parenting traits related to effective scaffolding), were expected to account for unique variance in child EF more than maternal EF or verbal input would do.

The fourth research question explored the mechanism through which maternal EF was related to child EF. A hypothesis for this question was made based on a prior finding on the mediating role of maternal caregiving in the link between maternal EF and child EF (Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014). Specifically, it was expected that maternal negative parenting would play a part in the link between maternal EF and child EF. However, no prior findings were available for a hypothesis on the link between maternal positive parenting (effective scaffolding and verbal input during a reminiscing conversation) and child EF. Nevertheless, positive parenting in the present study was also expected to play a mediating part in the maternal EF-child EF link, as negative caregiving in the US context was found to mediate such a link.

CHAPTER 3 Method

The goal of the present chapter is to ensure the overall quality of the research process by addressing sampling, measures, procedures, and analysis with regard to the research questions that the present study aimed to explore. This chapter is structured in six sections. The first section provides information regarding the present study's participants addressing issues such as the sampling frame, strategy, and size. The next two sections describe in detail how the data collection session was structured and how measures were initially selected and confirmed during a pilot study. The fourth section addresses how the coding schemes were constructed and how observation of mother-child interactions was conducted. Then the fifth section presents how the collected data were analysed so as to answer the research questions. Finally, the last section assesses the overall quality of the research process discussing issues related to validity, reliability, and generalizability and then finishes this chapter by addressing ethical considerations.

3.1 Participants

3.1.1 Sampling frame

There were three considerations in deciding on characteristics of participants: socioeconomic status (SES), the gender of parent participants, and the age of child participants. Participants needed to be more or less homogeneous in their SES so that the impact of SES-related contrasts could be minimised while investigating the predictors of interest to the present study. Additionally, due to the close relation between SES and parenting quality (Berger, 2007), it was necessary to recruit parents within the same SES group. As such, mother-child dyads from middle class households were targeted in this study. Since there is no consensus on the definition of SES, which is a latent variable like well-being and feelings, SES cannot be directly measured (Oakes & Rossi, 2003). As such, scholars have conceptualised SES using such indices as income, education, occupation, welfare recipient, or some combination of these factors (Dotterer, Iruka, & Pungello, 2012). Of those, most frequently used indicators include income, education, and occupation. For example, participants' SES are frequently judged by the Hollingshead Four Factor Index of SES (Hollingshead, 1975), which combined retired/employed status, educational attainment, occupational prestige and marital status (e.g., Tudge, Hogan, Snezhkova, Kulakova, & Etz, 2000). Alternatively, social classes of participants are decided based on educational attainment only, which is proposed as the key factor that distinguishes different classes (e.g., Grossmann & Varnum, 2011; Lareau, 2003). In accordance with this account, it is frequently found in research on EF that parental educational attainment is mainly used as an indicator of parental SES and their intellectual

capacity. Parental educational attainment, indeed, has been found as a strong covariate of child EF in many EF studies (e.g., Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014; Hughes & Ensor, 2009). Thus the present study used maternal educational attainment as a factor representing parental SES. Along with maternal educational attainment, data of their occupation was obtained as additional auxiliary resource for understanding their SES (see Appendix 3.2 for the demographic questionnaire).

The second consideration concerned whether the parental participation was limited to mothers, fathers or both of them. Fathers have become more involved with child care, and this trend needs to be integrated into research designs to fully understand the context of child development (Meuwissen & Carlson, 2015). Nevertheless, more mothers than fathers still appear to serve as the principal caregiver who spends more time at home looking after children, which makes it relatively easier to recruit mothers than fathers. Additionally, the present study is one of the first empirical studies in a non-Western culture, some of which results may necessarily need to be discussed by addressing prior research based on Western cultures, which have measured maternal factors predominantly more than paternal factors. As a result, only mothers were recruited in the present study. Fathers who claimed to be a principal caregiver were left out based on research findings that children may be differentially influenced by both parents (Lucassen, Kok, Bakermans-Kranenburg, & Van Ijzendoorn, 2015). In addition, the information of whether the mother was the biological parent of the child was obtained as part of the demographic questionnaire, since prior research has revealed that biological mothers' EF skills are significantly associated with their child's EF skills (Deater-Deckard, 2014), which was one of the foci of the present study.

The third consideration was the age of child participants. As discussed in Chapter 2 section 2.1, preschool children are a relevant sample to focus on in research on EF in that the first five years of life play a crucial role in the development of EF. Important changes in EF skills occur between about two and five years of age (Zelazo & Müller, 2002). Indeed, there seem to be good reasons to focus on preschool children because critical foundations for EF skills are formed during the preschool period, which will set the stage for the development of higher cognitive processes well into adulthood (Garon et al., 2008). Given that the present study was aimed at looking into the links between parental factors (maternal EF and parenting behaviours) and child EF, it was necessary to recruit children in age ranges where they were relatively less influenced by the school impact. Additionally, child participants needed to be developmentally mature enough to solve challenging EF tasks tapping cognitive flexibility. As discussed in Section 2.1.2, shifting tasks are relatively more challenging than those tapping working memory or inhibition for children under 4 years old because shifting tasks require children to use both inhibition and WM (Garon et al., 2008). As such, 4-year-olds were most likely to be appropriate for the present study in that the impact of school factors on child development were viewed to be more limited than for children aged over 5

years, and the cognitive flexibility tasks used in the present study seemed to be more developmentally appropriate to 4-year-olds than to those under the age of 4. In addition, mothers were asked whether their child had experienced or was having developmental issues since significant performance gaps have been found between normally developing and atypical samples (Hughes, 2011). Only those who were reported not to have any issues were recruited.

3.1.2 Sampling strategy

Participants were recruited in 10 kindergartens (or preschools) in Seoul, which were located across 5 districts in Seoul (Youngsan-gu, Nowon-gu, Mapo-gu, Seodaemun-gu, and Dobong-gu). These districts were chosen because they were regarded as residence areas for predominantly middle-class households. In order to contact parents, cooperation from kindergartens was crucial. Emails were first sent to head teachers of 15 kindergartens in the 5 districts to introduce the present research and ask for help in recruiting mothers who had four-year-old children. Five of the 15 kindergartens declined the research request. Those who responded to host the present study were contacted to discuss how to send out letters of research invitation and consent forms to parents and where in the kindergarten the data collection sessions could take place. As such, the sampling of the present study was based on nonprobability since random selection was not included in the sampling process. More specifically, purposive sampling was used, in which sampling was targeted at a particular age range (mostly 4-year-olds) and typically developing children who were raised in middle-class families. In addition, it was volunteer sampling in that the participants were only possible to contact when they voluntarily expressed their willingness to take part in the present study that was advertised in their kindergartens.

3.1.3 Sample size

Given that regression analyses were used in exploring the research questions, the sample size was determined by considering (1) the number of predictors to enter to regression models, (2) the effect size (i.e., how well predictors predict the outcome), and (3) the statistical power to be detected (Field, Miles, & Field, 2012). A series of regression analyses were conducted in the present study, and it was determined to be appropriate to have 4~5 predictors in regression models so as to the inferences drawn from such models would be reliable (Field et al., 2012). As for the effect size, the medium size of effect (.15) was adopted to the calculation of the sample size, following Cohen's (1988) designation of effects .02, .15, and .35 as small, medium, and large, respectively. The small effect size is not typically adopted due to unduly large sample sizes it

requires (e.g., a sample of about 390 participants is suggested for a regression analysis, in which one predictor, the small effect size, and the statistical power of .8 are adopted). Finally, the statistical power of .8 was adopted, which is the high level of power according to the criteria by Cohen (1988). These three considerations produced the sample size of 92 (for 5 predictors) or 98 (for 6 predictors) as the minimum sample size to be used in the present study. Based on this estimation, it was aimed to recruit at least 100 mother-child dyads to ensure significant power of statistical results from regression models to be used in the present study.

3.1.4 The participants

Ten to 11 mother-child pairs per kindergarten volunteered to partake in this research, resulting in a sample of 103 mother-child pairs in total. Of them, 4 mother-child dyads were left out due to recording failures. In addition, data from 4 dyads were removed in the process of coding the puzzle task because the children would not engage in the puzzle task and their mothers also gave up keeping their children to get focused on the task. Finally, data from 3 more dyads were left out either because the children would not talk to their mothers or because they talked about topics other than their shared past events during a reminiscing task. As a result, data from 92 dyads were used for further analysis.

Table 3. 1 Demographic details of the participants

Characteristics	M	SD	Range
Children			
Boys: Girls	46:46		
Age (months)	54.11	3.61	47.04 ~63.19
Mothers			
Age (years)	37.0	3.59	28-47
Education (%)			
High school diploma	6 (6.5)		
Two-year technical college	4 (4.3)		
Four-year college degree	53 (57.6)		
Master’s degree or above	29 (31.5)		

Note. N=92

Most of the recruited children were 4 years old. Specifically, 89 of them (about 97%) were 4 years old, with one child aged 3.9 years and two children aged 5.24 and 5.27 years, respectively. Noticeable in Table 3.1 is the high educational attainment of the recruited mothers. Ninety-three

per cent of them had some form of college degree, which was presumed to be higher than the average level of educational attainment for the whole female population in Seoul. According to the Korean Statistical Information Service, about 61 % of the whole female population aged between 25 and 49 who lived in Seoul in 2010 had some form of college degree, and 35% of the whole female population had a high school diploma as their final education. However, given that university level of education for parents is part of the average profile for a middle class household in Korea (i.e., a typical middle class 3-person family may have dual-income and university-educated parents in their late forties; Cho, 2015), the high educational attainment of the mothers in the present study appeared to be an appropriate indicator of recruiting mainly middle class households. Additionally, given that Korea is one of the countries having the highest rate of tertiary education (OECD, 2014), the high educational attainment would not indicate that the educational attainment of the sample in the present study is quite different from that of average middle-class mothers of pre-schoolers in Seoul.

3.2 Procedure

3.2.1 Overall procedure of data collection

Participants were recruited during two visits to Korea (March/April and October/November 2015). Research information sheets distributed to parents via kindergartens included information on the nature of the testing and the time taken for a data collection session (about 40 minutes). Those who volunteered to partake submitted their consent forms, where they were asked to indicate possible time slots they could attend a research session. Parents' indicated time slots were coordinated to cause least inconvenience to the kindergartens. The research information sheet and consent form are presented in Appendix 3.1.

Through a discussion with head teachers, a quiet room in each kindergarten was provided for data collection. These rooms were familiar to children and supposed to affect the behaviour of the children less than when the session was conducted in an unfamiliar place such as a laboratory. Each mother-child dyad visited the provided room in the morning before school or after school. Each session began by reconfirming the mother's and the child's intention (verbal consent) to take part in the research. Then they were told that they could withdraw from the session at any time for any reason, and the information they provided was confidential. After a brief introduction (5~10 minutes) about the contents of the session, the mother was asked to work on three kinds of EF tasks (see section 3.3.4 for the descriptions of maternal EF tasks) on the computer while the researcher administered to the child three kinds of EF tasks (see section 3.3.3 for the descriptions of child EF tasks). This simultaneous administration of maternal EF and child EF tasks was attempted to

shorten the time taken for the data collection session, and most mothers were not disturbed by this way of data collection. Some mothers, however, wanted to watch how their child performed on the EF tasks and finished the maternal EF tasks at the end of the session instead. Each EF task took about 5 minutes.

Then, the mother-child dyad was asked to work on two interaction tasks; one puzzle task and one reminiscing task (see section 3.3.5 for the descriptions of the interaction tasks). Specifically, in the puzzle task, wooden blocks and a picture of a target shape (flower) were presented to the dyad by giving the following instruction.

"*Now look at the picture I provided. What does it look like? (A flower) Yes, it is. I had fun making this shape using these blocks and took a picture of it to show it to you. Would you also like to try making this shape as I did?"*

Then, one more instruction was given to the mother, "*Please work with your child as you normally do at home."* Then the researcher left the room with a camera focused toward the dyad. After 5 minutes passed, the researcher went back into the room and presented the other mother-child dyad task: the reminiscing task. The instruction for this task was written on a piece of paper, which was handed over to the mother.

"*Please think about one past event that you and your child experienced together. The event should not be a daily routine (e.g., getting ready for school/bed or having meals) but a distinct, special experience/s in the past. With this event in mind, begin talking about it with your child."*

When the mother signalled that she was ready to talk to her child, the researcher left the room again, with the camera focused on the dyad. When 5 minutes passed, the researcher went back into the room, asking the mother to work on the final measure, the demographic questionnaire, which took about 5 minutes. At the end of the session, the child received a small prize (chocolate) for taking part. The mother received some useful written information about how parents could help young children improve EF skills.

3.2.2 Observation of mother-child interaction

The method used in gathering data from the mother-child interactions was observation. Behavioural observation was the principal mode of data collection in the present study, which provided direct measures in a way not possible with mediated or inferential methods. People may differ in the accuracy of their memory, which highlights the strength of observation as a method providing live data rather than second-hand accounts. The method of observation is particularly valued as being objective about the frequencies or attributes of particular behaviours under investigation or as a means to examine the relations between behaviours, either within individuals or among dyads (Heyman, Lorber, Eddy, & West, 2014). Behavioural observation is employed frequently in studies measuring interpersonal or intergroup relations. Generalizability of findings that use self-reports (e.g., interview, questionnaire) from caretakers to measure their interaction with children may be much more limited than those using direct observation of behaviours (Brewer & Crano, 2014).

Specifically, the present study used the method of structured observation, as opposed to qualitative observation, and the focus of observation was determined (as reflected in hypotheses) prior to commencing observational sessions and the data of observed mother-child interaction was used to confirm or refute the research hypotheses. Key features of maternal verbal and behavioural interactions to be observed were initially informed by prior research and were later confirmed during a pilot study. That is, key constructs in prior research that were judged relevant to the present study were identified in the observation data and were operationalized following prior studies.

A critical issue that should be addressed with relation to the validity of inferences from observational data is the degree of the researcher's participation. According to the distinctions made by LeCompte and Preissle (1993), the status of the researcher in the present study was neither a complete participant (taking on an insider rule in the group being studied) nor a complete observer (participants do not realise that they are being observed, e.g., using a one-way mirror). The researcher in the present study was more like an *observer-as-participant* in that the researcher was introduced to the observed as an observer but had a very detached relationship with them since they met just once for the data collection session. As such, inferences made based on the observation tended to be as objective as possible in that the researcher did not adopt the values or norms of the observed and kept a distance from them.

However, the effect of the researcher might have been influential, which led to changes in the behaviour of the observed (i.e. reactive effects). When aware of being observed, participants may behave differently than when not observed. This is the common issue in all kinds of observation, and researchers have often questioned the extent to which participants show as natural behaviour as possible in the presence of an observer or a camera (i.e., overt observation; the ethical

requirement that participants be aware of being recorded not to violate the principle of informed consent). In this regard, naturalistic observation may be the most desirable in that the setting is the real world, and behaviour observed is entirely genuine. Thus the major advantage of naturalistic observation is the likelihood that data could be generalised to the real world. However, observing mother-child dyads throughout the course of their day is likely to reveal little about their interpersonal relationships in relation to children's EF skills, with much irrelevant data occupying vast quantities of time. In this regard, a minimal manipulation of the setting was imposed in the present study by asking the mother-child dyad to engage in a task, which transformed the otherwise typical environment into something close, but not identical, to the natural setting. This may increase the quality of the data by increasing the amount of interaction of interest, and is more natural relative to an experimental design, in which a very narrow or artificial selection of behaviour may be studied, but may reduce generalizability slightly, which is the kind of trade-off that all researchers must weigh in designing observation studies (Brewer & Crano, 2014).

In the present study, it was confirmed during a pilot study that the performance of children was considerably affected by the presence of the researcher (e.g., children were not fully focused on the puzzle task or became reticent during the reminiscing task). Reactive effects on the child's performance are likely to be reduced as the researcher's presence becomes a predictable or familiar part of the environment by paying frequent visits to a kindergarten or spending a substantial amount of time interacting with children (Haslam & McGarty, 2014). Given that over 100 mother-child pairs were recruited in the present study, however, it was impossible for the researcher to spend a considerable amount of time with children and their mothers. Instead, in an attempt to reduce the effect of reactivity, the researcher spent the first 5-10 minutes together with the child so that the child become more or less familiarised with the researcher. Then, the mother and the child were left alone in the room so that they worked together on the two interaction tasks. This helped elicit more natural behaviours from the dyad by helping them to feel comfortable without a researcher directly watching their interaction.

3.3 Measures

This section presents the procedures through which measures were tested for their appropriateness for the use with 4-year-olds and their mothers, and finally confirmed to be used for data collection. This section is structured in seven subsections. The first five subsections describe how tasks (for children, mothers, and mother-child pairs) were initially selected, tested and selected while performing a pilot study. Then the last two subsections describe the test used for children's verbal ability and the demographic questionnaire that the mother filled out at the end of the data collection session.

3.3.1 Initial selection of child EF tasks

The selection of EF tasks for children was guided by the nature of EF development during the preschool years. Given that the child participants in the present study were predominantly 4 years old (97% of them), the selection of child EF tasks was guided by age-related changes in EF components prominent during the latter part of the preschool years. As discussed in Chapter 2 section 2.1, the present study adopted EF tasks tapping more complex EF skills for the three EF components because the development of EF skills between 3 and 5 years of age is characterised as fine-tuning of the basic EF skills that emerge before 3 years of age. As such, complex EF tasks for the three components were determined to be developmentally appropriate for 4-year-olds in that they are increasingly able to utilise complex WM (updating as well as retaining information), complex inhibition (suppressing dominant responses with a significant amount of WM demands), and complex shifting capacity (a further class of complex inhibitory control requiring children to hold arbitrary rules in mind and then shift to a new response strongly conflicting with the pre-shift response). Multiple tasks for each EF component were selected so that their developmental adequacy was compared during a pilot study and the most appropriate task among them could be finally chosen.

The initially chosen child WM tasks were as follows: Eight boxes (Diamond et al., 1997), the backward digit span task (Carlson, Moses, & Breton, 2002), and the Corsi block span task (Milner, 1971). The first two tasks test complex working memory skills requiring updating or manipulating information, while the Corsi block span task is a simple WM task tapping visuo-spatial WM capacity. These tasks are appropriate to administer to children aged 3 years and upward (Garon et al., 2008). The ability to hold mental representations over a delay emerges before the first 6 months (Pelphrey & Reznick, 2002) and the ability to update or manipulate information emerges in the second year and continues to develop throughout the preschool period (Gathercole, 1998) and beyond (Luciana, 2003).

Then, three response inhibition tasks were selected: Hand game (Hughes, 1998), Day/night game (Gerstadt, Hong, & Diamond, 1994), and Head-Toes-Knees-Shoulders (HTKS; Ponitz, McClelland, Matthews, & Morrison, 2009). These tasks are more enhanced types of inhibition tasks, which involve moderate WM as well as response inhibition demands (Garon et al., 2008), compared to other inhibition tasks involving overcoming responses that are automatic (e.g., the object retrieval task; Diamond, 1990) or responses associated with a reinforcer (e.g., the delay of gratitude tasks; Mischel & Moore, 1973). As such, the three chosen inhibition tasks required children to hold an arbitrary rule in mind (WM), responding according to this rule and inhibiting a dominant response.

Finally, two shifting tasks were chosen: Flexible Item Selection Task (FIST; Jacques & Zelazo, 2001) and Dimensional Change Card Sort (DCCS; Zelazo, Muller, & Marcovitch, 2003). These tasks are complex shifting tasks in that a conflict occurs at the perception stage and then again at the response stage. Due to the nature that shifting capacity operates on other EF processes (WN, inhibition, and attention), the two chosen tasks may place modest demands on attention skills and coping with conflicting mental representations held in mind.

3.3.2 Testing the initial child EF tasks: Pilot study

The chosen EF tasks mentioned in the previous section were tested during a pilot study for their use with 4-year-old children. The pilot study was carried out in a kindergarten in Sang-Gye, a district in the north part of Seoul, between 23rd May and 17th June 2014. The kindergarten was located where a majority of middle class families lived. Participants were six mothers and their children who were aged between 4 and 4 ½ years old (three boys and three girls). The mothers' or their husbands' occupations fell in the category of professional occupations or middle managers. The mothers' educational attainment was at least some college education, and they were aged between 34 and 42.

The pilot study was aimed at testing the appropriateness of the chosen EF tasks and two mother-child interaction tasks. The focus was on ensuring that the tasks were neither too difficult nor too easy and yielded appropriate variation in the performance of the recruited children. Table 3.2 shows the three child EF tasks that were finally selected during the pilot study.

Table 3. 2 Selection of EF tasks for children

EF component	Initial EF task	Task dropped while piloting	Final task
Working memory (WM)	• Eight boxes (Petrides, 1995) • Backward digit span (Davis & Pratt, 1996) • Corsi block span task (Milner, 1971)	• Backward digit span • Hand game	• Corsi block span task
Inhibition	• Hand game (Hughes, 1998) • Day/night (Gerstadt, Hong, & Diamond, 1994) • Head-Toes-Knees-Shoulders (HTKS; Ponitz, McClelland, Matthews, & Morrison 2009)	• Day/night • Eight boxes	• HTKS
Shifting	• Dimensional Change Card Sort (DCCS; the standard version; Zelazo, Muller, Frye, & Marcovitch, 2003) • Flexible Item Selection Task (FIST; Jacques & Zelazo, 2001)	• DCCS	• FIST

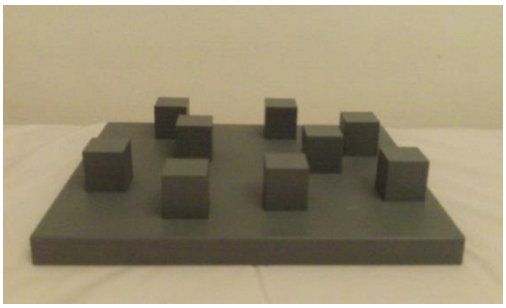
Among the initial three working memory (WM) tasks, the eight boxes task was dropped because the task appeared not to discriminate among the six children. All of them showed a similar pattern in their performance by making mistakes two to three times at the end of the task. The backward digit span task was also dropped because it was too difficult. Most of the children appeared not to understand the directions of the task and did not pass rehearsing the 2 digit span. The Corsi block span task, however, showed a range of performance (between 2 and 5 blocks) among the six children, which was similar to a prior finding that the performance on the Corsi task of children aged 4 years old were between 1 and 5 blocks, with an average span of 2.92 (Luciana & Nelson, 2002).

Next, among the initial three inhibition tasks, the hand game and the day/night game were dropped because 5 of the 6 children passed them successfully. However, the HTKS showed a sizable range in the children's performance, with their responses ranged between 20 and 44 raw scores out of the maximum score of 60.

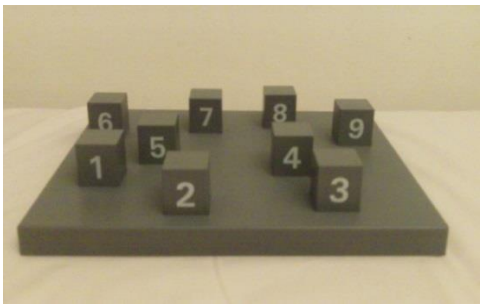
Finally, the Dimensional Change Card Sort was dropped because a distinct difference in performance was shown between children aged about 4 ½ years old and those younger than that. While the three children aged about 4 ½ years old passed the task, the other three younger children failed the task. As such, it was expected that if the majority of the sample to be recruited were aged more than 4 ½ years old, most of them would probably pass the task, which would not show a necessary variation across them. The Flexible Item Selection Task (FIST), however, showed a range of performance difference among the 6 children (between 6 and 14 raw correct responses out of 15 test trials). As a result, the FIST was confirmed to be used as the child shifting task.

3.3.3 The final EF tasks for children

Children's visuospatial working memory was measured using the Corsi block span task, a subtask from the Working Memory Test Battery for Children (WMTB-C, Pickering & Gathercole, 2001). The present study followed the administration and scoring policies suggested by the WMTB. A board with a set of nine identical blocks was placed between the researcher and the child, with the numbers (1-9) on the blocks facing the researcher so as not to be visible to the child.



Sight from the child



Sight from the researcher

Figure 3. 1 Corsi block span task

In practice trials, children were provided up to three times of explanation on how to tap the same blocks that the researcher had tapped in exactly the same order. Blocks were touched by the researcher at the rate of 1 per second. Each span level consisted of 6 trials. Six points were given if the child tapped correctly 4 out of 6 trials at each span level. The test trials discontinued when the child missed 3 trials at a span level. In the final span level, a score of 1 was given for trials that were correctly tapped.

Next, the child's inhibition was measured with the Head-Toes-Knees-Shoulders task (HTKS). This task was used to measure behavioural regulation, which involves attentional focusing, working memory, and inhibitory control (Ponitz et al., 2009). The present study followed the administration and scoring policies suggested by the test developers of the HTKS (Ponitz et al., 2009). There were a total of 30 test items with 10 items for each section. In practice trials, children were habituated to directions and provided with up to three times of additional explanations in case they failed to follow directions. In the first task section, children were asked to respond in an unnatural way by touching their head/toes when told to touch their toes/head (1 set of opposites). In the second section, one more pair of behavioural commands using shoulders/knees were added (2 sets of opposites). Children were asked to touch their knees/shoulders when told to touch their shoulders/knees. In the final section, children were introduced to new commands asking them to touch your head/shoulders when told to touch their knees/toes and vice versa (3 sets, adding a final

rule switch). Only children who responded correctly to 5 or more out of 10 trials in each section were presented with trials of the next section. Correct responses earned 2 points; incorrect responses earned 0 points; 1 point was given if children self-corrected and ended up correctly. See Appendix 3.3 for more detailed directions and test sources.

Finally, the child's shifting was tested with the Flexible Item Selection Task (FIST). This task was used to measure cognitive flexibility and abstraction (Jacques & Zelazo, 2001). The present study adopted and followed the administration and scoring policies suggested by the test developers of the FIST (Jacques & Zelazo, 2001). In practice trials, children were introduced and familiarized with picture items (i.e., a shoe, a boat, and a teapot) and directions (i.e., "Can you show me two pictures that go together one way/in another way?"). In test trials, children were presented with three pictures that varied along some combinations of two of three dimensions: size, shape, and colour. Children were instructed to make two selections consecutively by pointing to two pictures that went together in one way and then subsequently two pictures that went together but in another way. Fifteen test trials were presented for all children. One point was given only when children responded correctly to the two directions.

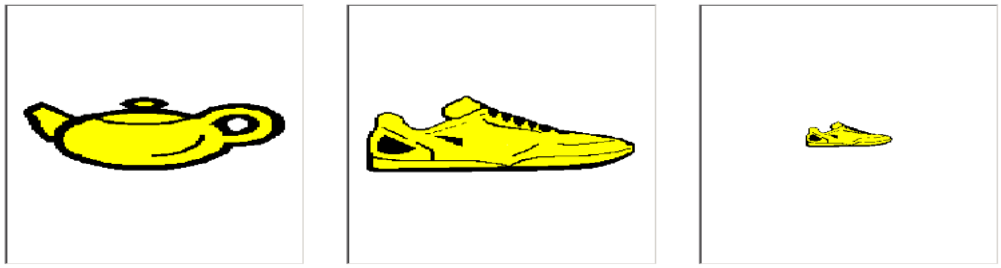


Figure 3. 2 An example of FIST cards used in a test trial

3.3.4 Selection of maternal EF tasks

It may be an ideal to use the same tasks for mothers and for children. Given that one of the purposes of the present study was to look into how maternal EF was related to child EF, it was necessary to match child EF and maternal EF tasks. This match, however, was not possible in the present study except for the Corsi block span task that was available for children and adults as well. Prior research shows its usage with 4 year old children and upward, (Luciana & Nelson, 2002) and for adults (Monaco, Costa, Caltagirone, & Carlesimo, 2013). One of the difficulties of matching child EF and maternal EF tasks was limited number of EF tasks that could be used across age ranges from pre-schoolers to adults.

As suggested by the developers of the FIST (Jacques & Zelazo, 2001), an adult EF task that is close to the FIST, in terms of their measured EF skills, is the Wisconsin Card Sort Task (WCST; Berg, 1948). Indeed, Jacques and Zelazo have ascribed part of the necessity of developing the FIST to the less than perfect characteristics of the Wisconsin Card Sort Task (WCST) as a measure of shifting for young children. As a developmentally appropriate measure of shifting for young children, the FIST may not have limitations of the WCST such as the difficulty of interpreting the performance due to the large number of cognitive processes involved. As such, the WCST was selected in the present study as a maternal shifting task that parallels with the FIST. As for a maternal EF task tapping inhibitory control, there were no adult tasks that were comparable to the HTKS. As a result, the colour-word Stroop task was selected since it is one of the most frequently used inhibition tasks.

Taken together, the Corsi block span, the WCST, and the colour-word Stroop were initially chosen and tested during the pilot study. Computer versions of these tasks were administered to mothers, which were downloaded from the Psychology Experiment Building Language system (Mueller & Piper, 2013: http://pebl.sourceforge.net). These tasks are appropriately used for adults aged between 25 and 50 (the age range of the recruited mothers). The focus of piloting study was on examining whether the recruited six mothers had difficulty in understanding task directions, whether the three tasks could be completed without the researcher providing extra directions, and how long each of the tasks took the mothers to finish. During the pilot study, the six mothers did not ask additional questions while performing on the three tasks and the time taken for each task was about 4 minutes, which was not long enough to cause physical tiredness while working on them.

3.3.4.1 Working memory: Corsi block span task

The Corsi block span task was used to measure maternal visuospatial working memory (Milner, 1971). Of note is that, even though the Corsi block span task was used for both children and mothers, different procedures of administration and scoring were adopted for them. This was because the Block Recall Task for children was from the WMTB-C, while the Corsi task for mothers was from the PEBL. For mothers, each span level of the Corsi block span task consisted of two trials, and the task discontinued when the mother missed two trials in a span level. If at least one of the two trials of each span level was tapped correctly, the next span level was administered with one increment in block sequence. The score was the product of the block span (i.e., the length of the last correctly repeated sequence) and the total number of correctly responded trials.

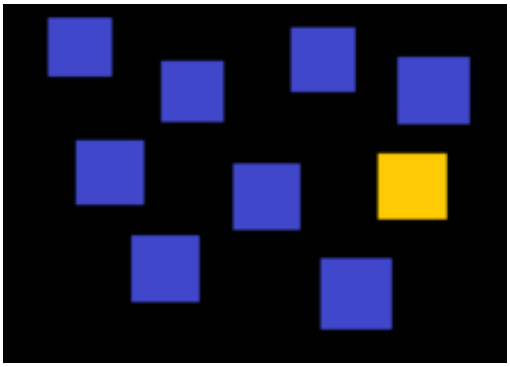


Figure 3. 3 Corsi block span task

(from PEBL Tutorials at https://www.youtube.com/watch?v=2oKqoZonBkE)

3.3.4.2 Inhibition: Colour-word Stroop task

The colour-word Stroop task was used to measure inhibition (Stroop, 1935). Mothers were instructed to press keys that matched colour words. After practicing on 24 cards, the test trials began. They received congruent (i.e., colour words in the same colour ink), incongruent (i.e., colour words in different colour link), and neutral (i.e., non-colour words) trials. It may be necessary to point out that different studies adopt different aspects of the Stroop score. For example, accuracy based aspects of the Stroop score, such as the percentage accuracy or percentile scores, are used in the study of Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014), while scores based on reaction times were used in the study of Miyake and colleagues (2000). Accordingly, the two kinds of scores were calculated in the present study in selecting the aspects of the Stroop score to use: accuracy- and reaction times (RTs)-based. The RTs-based score was not significantly related to child EF. Thus an accuracy-based score was adopted: the total number of correct responses for a set of 96 words during a block of mixed congruent and incongruent trials.

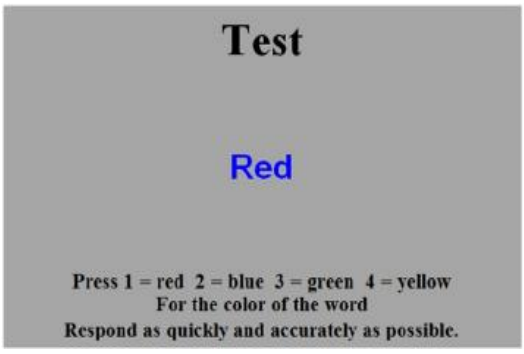


Figure 3. 4 Colour-word Stroop

(from PEBL Tutorials at https://www.youtube.com/watch?v=EgGlOok3UGg)

3.3.4.3 Shifting: Wisconsin Card Sorting Test (WCST)

The WCST was used to measure set shifting (Berg, 1948; Miyake et al, 2000). After directions on how to sort cards (a total of 128) were provided, the test trials began and continued until either nine sorting categories were achieved or all the 128 cards were sorted. Mothers responded by matching a card to one of four key cards, according to a rule (i.e., number, colour, or shape) that changed without warning. For the WCST, it appears that accuracy-based scores are typically adopted in previous studies. For example, the percentile score associated with conceptual level (i.e., consecutive correct responses occurring in runs of three or more) was used in Cuevas, Deater-Deckard, Kim-Spoon, and Watson's study (2014), and the number of classical perseverative errors (the number of times participants fail to change sorting principles when the category has changes) was adopted in Miyake and colleagues' study (2000). As such, an accuracy-based score for the WCST was used in the present study: the total number of correct responses (the reverse score of the number of errors).

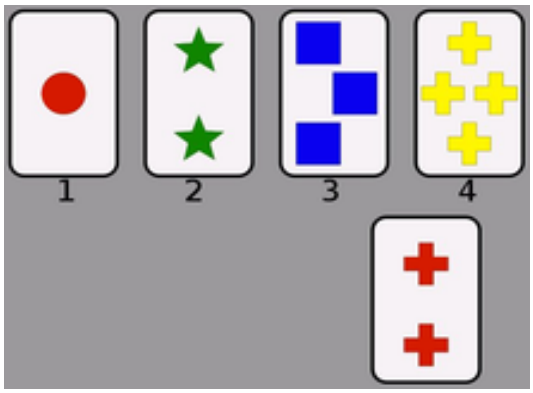


Figure 3. 5 WCST

(from https://www.youtube.com/watch?v=iJ9MAuDcFgA)

3.3.5 Selection of mother-child dyad tasks

Two types of mother-child dyad tasks were used in the present study: a problem-solving task in which to observe maternal scaffolding behaviours and a reminiscing task in which to observe maternal verbal input.

3.3.5.1 Problem-solving task

In observational studies assessing parental scaffolding, the predominantly used material for preschool-aged children is play-based problem-solving tasks. Block-building or puzzle-matching tasks have been the most frequently used context in which to explore the impact of maternal

scaffolding on children's cognitive development (e.g., Conner & Cross, 2003; Hammond et al., 2012; Wood et al., 1976). Following this trend in the scaffolding literature, two play-based problem-solving tasks were initially selected: the ring puzzle and the flower puzzle. In the pilot study testing the adequacy of these two tasks, a mother-child dyad was asked to build a target form using blocks that differed in curvature and length (Figure. 3.6), which were made of wood in the same colour. The blocks were from the curvilinear gift, one of Froebel's gifts, which were made of simple but carefully planned materials for children's cognitive development (Tovey & Green, 2013). In the ring puzzle task, children were asked to make three concentric rings that were cut into equally sized pieces (Figure. 3.7). In the flower puzzle task, children were asked to form the target shape of a flower (Figure. 3.8).

Figure 3. 6 Blocks of the puzzle task

Figure 3. 7 The target shape of the ring puzzle

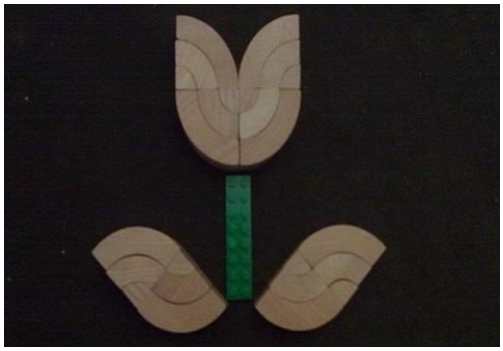


Figure 3. 8 The target shape of the puzzle task

These two problem solving tasks were tested for their adequacy when used with 4-year-olds during the pilot study. The task to be used should be difficult enough to elicit the mother's help so that mother-child interactions could be observed while working on the task. It was determined during the pilot study that the ring puzzle task was dropped because it turned out to be too easy. Five out of the 6 children were able to complete the task without their mothers' help. The flower puzzle task, however, appeared to be appropriately challenging for the 6 children in that all of them had difficulty understanding key principles required to complete the task, thus making mother-child collaboration crucial. Five of the six dyads finished the task between 4 and 7 minutes, and one child ended up failing to understand the task's key concepts. When asked about the difficulty of the flower puzzle task, the 5 children answered it was difficult at the beginning but became manageable with their mother's help. As such, the flower puzzle task (the puzzle task, hereafter) was confirmed as one of the mother-child interaction tasks.

3.3.5.2 Reminiscing task

During the pilot study, another type of mother-child interaction tasks was tested: a reminiscing task, which was selected as a context in which to observe how the mother provided verbal input while talking about past events. Types of mother-child talk tasks that have been used in the EF literature are conversations during a free play (i.e., in which to examine the impact of maternal mental-state references on child EF; Bernier et al., 2010) and family dinner conversations (i.e., in which to examine the impact of parents' mean length of utterances on child EF; Hughes & Ensor, 2009). In the current study, it was crucial to elicit as much information from the dyad as possible for a brief period of time (about 5 minutes). As discussed in section 2.4.2, one prominent research area as to child-parent talk is reminiscing (i.e., talking about past events). As such, the most frequently used measure in the reminiscing literature was adopted: asking the mother-child dyad to talk about their shared past experience. During the pilot study the mother was instructed to come up with a distinctive past event, as opposed to everyday routines (e.g., day-care arrangements,

meals, bedtime routines, etc.). The past event had to be the shared experience between the mother and the child. The most frequent topics in which the Korean mothers and children engaged included holidays, birthday parties, and visits to hospital/ museums/ cinemas. Mothers selected events that were emotionally positive in tone more than those that were negative. Most importantly, conversations from the 6 dyads in the pilot study were shown to include in their 5-minute conversation the key conversational constructs while reminiscing, which were addressed in Section 2.3.2.3 (i.e., semantic connections, elaboration, and mental-state references). As a result, the reminiscing task was confirmed to be selected as a mother-child interaction task, along with the puzzle task.

3.3.6 Child verbal ability measure

Verbal subtests from the Korean-Wechsler Preschool and Primary Scale of Intelligence (K-WPPSI: Park, Kwak, & Park, 1995) are widely used norm-referenced measures for child verbal intelligence. Thus the verbal subset tapping the child's expressive vocabulary was used in the present study. Administration and scoring procedures were applied as suggested by the K-WPPSI. A total of 22 verbal items were administered by asking the child to describe a given word as detailed as possible (e.g., "What is a boat?"). The first 3 items were presented with pictures (a cat, a tree, and a key) and the remaining items were presented with the researcher's verbal prompts. Two points were given if the child's response showed a good understanding of a given word; 1 point was given if the response was correct but showed poverty of content (i.e., a vague or less pertinent synonym; an attribute not a definitive or distinguishing feature; an example using the word itself; or not improved after the researcher's query, etc.); and 0 point was given if the response showed no clear understanding of a given word or was obviously incorrect. The perfect score was 47.

3.3.7 Demographic questionnaire

A simple demographic questionnaire was filled out by mothers at the end of the data collection session. The questionnaire included the questions about the presence of their child's developmental issues, maternal age, maternal educational attainment, and maternal occupation (see Appendix 3.2 for detailed questions).

3.4 Coding of mother-child interaction

The data were coded using the Observer 11 (Noldus, 2013), a digital coding system designed to score video materials online and enter the codes directly into a computer. Coding was performed in the original languages (i.e., Korean). Coding schemes are particularly efficient in the study of psychology as a means to indirectly index covert, internal events (typically cognitive processes), which are not amenable to measurement via direct observation or self-report (Hawes, Dadds, & Pasalich, 2013). Different coding schemes were applied to the two interaction tasks in the present study. The first step in constructing the coding schemes was to search past systems in prior research, for which psychometric work on reliability, inter-rater agreement, and validity has already been conducted (Brewer & Crano, 2014). Existing systems, nevertheless, cannot be a perfect match, and the chosen existing systems were adapted in the present study to best catch the traits of the Korean participants relevant to the research hypotheses. All coding schemes used in the present study were derived from prior systems, and some of them were supplemented with constructs observed in the video data of the present study when necessary constructs were not included.

Topographical and *micro-behavioural* coding systems were used throughout the coding process. Topographical coding systems measure the occurrence of behaviour, as opposed to dimensional systems, where the intensity of behaviours is measured using various forms of scales (Brewer & Crano, 2014). The topographical approach was taken in the present study because the focus of coding was on finding whether and how many behaviours of interest actually happened. In addition, micro-behavioural coding was used in the present study so that multiple aspects of maternal caregiving behaviours could be coded. In micro-behavioural systems, multiple fine-grained codes are given for each coding unit, describing behaviour as it unfolds over time. This approach is contrasted with global coding, which produces summary ratings several times over a recording period or once at the end of the observation (Brewer & Crano, 2014). In the EF literature, global coding systems are frequently used in coding parental behaviours (e.g., Bernier et al., 2010; Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014; Hughes & Ensor, 2009; Whipple, Bernier, & Mageau, 2011), where the intensity of behaviours coded on Likert scales are summarised as composites. By contrast, the present study adopted micro-behavioural systems which are efficient in catching culture-specific aspects of maternal traits because multiple fine-grained codes are not aggregated into a composite score. Similarly, Rochette and Bernier (2014) adopted the system of micro-behavioural coding in exploring multiple domains of maternal sensitivity drawn from the Maternal Behaviour Q-Sort, rather than using one composite for such domains. In addition, Meuwissen and Carlson (2015) coded paternal autonomy supportive and controlling behaviours separately, even though they were found to be highly correlated, because they turned out to be distinctively related to child EF. This approach to coding maternal behaviours was relevant to

catching specific maternal traits observed during mother-child interactions that affected child EF and was thus adopted in the present study.

Another aspect taken into account in constructing coding schemes in the present study was the nature of maternal traits that were related to the child's traits in a given situation. That is, the primary focus of coding was not on merely coding the occurrence of a maternal behaviour itself but on its occurrence in conjunction with the child's response to it. The strict focus on the maternal behaviour in isolation from the child's response has been pointed out by Pino-Pasternak and colleagues (2010) as a methodological limitation found in some studies on mother-child interaction (e.g., Neitzel & Stright, 2003; Stright, Neitzel, Sears, & Hoke-Sinex, 2001). The authors have argued that maternal behaviours or utterances of interest should not be captured by using overall ratings or frequency counts of parental behaviours, if the aim is to explore in detail processes or mechanisms linking parenting to children's outcomes. Therefore, in the present study, maternal behaviours and utterances were assigned to codes in relation to the behaviour of the child (e.g., coding of maternal contingency in section 3.4.3).

3.4.1 Coding of the Puzzle Task

The mother-child interaction on the puzzle task was coded as to (1) *maternal contingency*, (2) *maternal intrusiveness*, (3) *maternal flexibility & perspective-taking*, and *(4) maternal praise*.

Maternal contingency concerned whether maternal intervention was necessary and appropriate, which was operationalized as how the mother adjusted levels of intervention following the child's response. Maternal intervention was coded as contingent when it was provided upon the child's errors or when it was appropriately adjusted according to the child's responses. Maternal intrusiveness concerned the maternal tendency to show unnecessary, unsolicited intervention. This construct was considered as mother-initiated interventions. Specifically, maternal intrusiveness was coded if the mother intervened while the child was proceeding well or taking time exploring, which was judged as intrusive in a given situation. Maternal flexibility and perspective-taking concerned how the mother dealt with the child being distracted during the task. Lastly, maternal praise was about how the mother provided praise when the child showed desirable behaviours. Interestingly, no hostile or rejecting verbal or behavioural responses were observed from the recruited Korean mothers. Thus maternal negativity was dropped from the present study. As a result, the four aspects constituted the coding scheme for the puzzle task (Table 3.3), which was exclusive and exhaustive in that the scheme included all the maternal behaviours and utterances observed in the video data.

Table 3. 3 Constructs of the puzzle task

	Operationalization
Maternal contingency	Error-related/child-requested maternal feedback
Maternal intrusiveness	Non-error related/mother-initiated intervention
Maternal flexibility & perspective-taking	Maternal tendency to deal with the child being distracted
Maternal praise	Maternal tendency to deal with the child showing desirable behaviors

Maternal contingency and maternal intrusiveness were discriminated as to who the agent was in leading the interaction (i.e., whether the maternal intervention was induced by the child's errors/requests or initiated by the mother's own volition). The maternal tendency to deal with the child making errors was one of the crucial factors determining the quality of maternal scaffolding because the puzzle task was designed to be cognitively challenging for four-year-olds to solve on their own. Therefore, it was necessary to investigate how the mother kept a balance between providing and ceasing maternal support. These constructs were relevant to the distinction of whether an interaction was mother-centred or child-centred.

In what follows, the coding scheme of the puzzle task is presented by first referring to its conceptual relation to prior studies, followed by addressing specific codes used in the present study and calculating related scores using an example of mother-child interactions on the puzzle task.

3.4.1.1 Maternal contingency

3.4.1.1.1 Conceptual relation to prior studies

The codes constituting maternal contingency were related to the definitions of *maternal elaborative utterances* in the study of Bibok and colleagues (2009), which were operationalized as those provided during/shortly after the child's performance, which highlighted the necessity of maternal support in relation to the child's performance. In their study, the relevance of maternal support was determined as to its timing prior to or after the child's errors. Maternal feedback given during/shortly after the child's performance was operationalized as child-centred in that maternal intervention was induced by the errors/requests that the child had made and thus related to the event in which the child was engaged. This concept was in contrast with the case where maternal intervention was initiated based on the maternal judgment in the absence of the child's requests or errors.

Another prior system that the present study adopted was that used by Conner and Cross (2003), which originated from the seminal study by Wood (1980). Wood specified what he called a 'contingency rule', which determines contingency by looking into how the mother adjusted her instructional levels as a function of the child's success or failure. The basic unit is maternal support (M1) – child performance (C) – maternal support (M2). When C is a failure to act on M1, the mother should take over more control by increasing her levels of support in M2, whereas when C is a success after M1, the mother should relinquish some control in M2. Wood and Middleton (1975) distinguished six levels of parental support for child task participation and scored child responses as either successful (as a step toward problem solution) or as failed. This way of coding has been followed by multiple subsequent studies with some adaptation to suit their own research purposes (e.g., Conner & Cross, 2003). More recently, Pino-Pasternak and colleagues (2010) assigned maternal scaffolds to one of three levels of maternal mediation and determined maternal contingency by looking into how the levels of mediation matched different levels of the child's understanding.

Additionally, the present study adopted part of the coding system that was used by Bernier and colleagues (2010): the mother (1) adapts the task to create an optimal challenge for the child and (2) intervenes at an appropriate moment, both of which were used to code the maternal concern for the child's sense of competence during mother-child interactions. The former scale itself constituted part of the definition of maternal contingency in the present study. The second scale was also well reflected in the coding system of the present study in that the appropriate timing of maternal intervention was determined with two types of codes: contingency and intrusiveness. That is, maternal support provided during or shortly after the child's errors was first categorised into one of six levels of maternal support, whereas those provided prior to the child's errors was coded as intrusiveness. Then, only those coded as one of the six levels of support was subsequently assessed either contingent or non-contingent according to the contingency rule (see Table 3.5). As such, the basic idea of coding maternal contingency was to highlight the minimum amount of maternal intervention provided only when required or absolutely necessary in a given context.

3.4.1.1.2 Codes of maternal contingency

Table 3.4 represents the coding scheme for the six levels of maternal support during the puzzle task (see Appendix 3.5 for more details). This coding scheme was composed of six levels of maternal support (0~5). Level 0 represented no support and the highest level of support (Level 5) represented maternal demonstration. From Level 1 through Level 3, maternal support was conceptualized as relatively subtle, with verbal hints or explanation of the child's errors. For Level 4 and 5, maternal support became more directive and specific with directives and behavioural demonstrations about what to do next.

Table 3. 4 Coding scheme of maternal contingency

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 previous intervention ("This piece should go here/that there…. Now, can you do this part as I did?")

Note. Adapted from Conner & Cross (2003)

While maternal behaviours/utterances were coded as one of the six codes, the child's behaviours were coded as either success or failure. In this way, an *episode*, the coding unit, was produced, which was composed of one maternal utterance/behaviour and one child behaviour. In the case when the child was not responsive, every 30 seconds was coded as one episode. The decision on whether an episode was contingent was made based on the contingency rule in Table 3.5.

Table 3. 5 The contingency rule

UNIT OF MATERNAL CONTINGENCY:

Maternal support (**M1**) – child performance (**F/S**) – maternal support (**M2**)

An episode is coded as Contingent if the unit of maternal contingency is one of the following cases:

1. When M2 after F is of higher level of support than M1
   (e.g., L1-F-L2, L1-F-L3, L1-F-L4, L1-F-L5, L1-F-L6)
   M2 does not need to be just one level higher than M1.

2. When M2 after S is of lower levels of support than M1
   (e.g., L5-S-L4, L5-S-L3, L5-F-L2, L5-F-L1)
   M2 does not need to be just one level lower than M1.

3. When M2 is the same level as M1 and in a paraphrase that is intended to help the child's understanding Lf the mother repeats her previous utterance verbatim; this episode is not coded as contingent.

4. When the child performance was S and M2 is 0
   (e.g., any level of M1–S–L0)

5. When maternal *Taking-over* was provided in response to F, after trying at least one subtler type of support
   (e.g., L2-F- *Taking-over*, L3-F- *Taking-over*, L4-F- *Taking-over*)

Episodes in which the unit of maternal contingency is assessed other than the above cases are coded **Not Contingent**.

Note. **F**: child's failure, **S**: child's success, **L0~L5**: levels of maternal support; Adapted from Wood (1980)

As shown in Table 3.5, the contingency of an episode was considered in relation to its preceding episode (M1 – F/S – M2). There were five cases of maternal contingency. The first case was when the mother increased her level of support following the child's failure. The second was the opposite case (the mother decreased her level of support following the child's success). The third case was when the mother provided the same level of support as that in its preceding episode, and the second support was paraphrased with an addition of new information to facilitate the child's understanding. This rule was necessary since maternal verbal hints (Level 2) and explanations of errors (Level 3) were found to show a variety of content in a given context. As such, if a subsequent support was an extension of its precedent with new information attached to it, the subsequent support was coded contingent. The fourth contingent case was when Level 0 support was provided after the child's success. This case was assessed as contingent because maternal support was not necessary when the child's performance was successful. The last contingent case was when maternal *Taking-over* was provided after the child failed at least one subtler type of maternal support. As will be presented in the next section, maternal Taking-over was one of the codes for maternal intrusiveness, which referred to the mother doing herself part of the puzzle. Despite its intrusive nature, Taking-over was assessed as contingent when the mother was

evidenced to use it for the child who continued to be unsuccessful working on the mother's previous subtler types of intervention.

3.4.1.2 Maternal intrusiveness

3.4.1.2.1 Conceptual relation to prior studies

The codes of maternal intrusiveness were contrasted with those of maternal contingency in that maternal intervention provided in the absence of the child's requests or errors were coded as intrusiveness. This concept was related to the definition of maternal *directive utterances*, which was operationalized by Bibok and colleagues (2009) as the parental commands provided prior to the child's performance, directing the future course of action that the child should take next. Maternal directive utterances conveyed the agenda that the mother herself judged important and therefore commanded the child what to do, which was operationalized in the present study as *Directives*. Along with Directives, another code, *Taking-over*, constituted the coding scheme of maternal intrusiveness. Maternal taking-over was defined as the mother doing the puzzle herself, which was added due to its high frequency observed in the video data.

3.4.1.2.2 Coding scheme of maternal intrusiveness

Table 3.6 shows the operational definitions of maternal Directives and Taking-over, which constituted the coding scheme of maternal intrusiveness.

Table 3. 6 Coding scheme of maternal intrusiveness

Codes	Operational definition & Example
Directives	• Specific directives telling the child what to do next, in the absence of the child's errors or requests ("Put these here.", "Why don't we sort them into big and little pieces?", "Let's start on the outside ring first.") • Handing over a right piece to child OR pointing at a right place
Taking-over	Mother herself doing the puzzle

Note. Adapted from Bibok et al.(2009)

In coding *Taking-over*, two cases were discriminated: *Taking-over* in the presence of the child's errors and *Taking-over* in the absence of the child's errors. Specifically, maternal support provided as a final intervention after trying other subtler types of support should be less controlling than when it is provided as the first intervention or in the absence of the child's errors. This discrimination was aptly pointed out by Grolnick, Gurland, DeCourcey and Jacob (2002), who highlighted the necessity to differentiate the nature of a behavioural trait according to situations. They illustrated that the mother who gave the child an idea for the puzzle would be rated less controlling if the child asked for this information or when the child appeared unable to come up

with a right solution, compared to the child who was progressing on his or her own and received this suggestion. In this regard, only *Taking-over* in the absence of the child's errors was coded as intrusive.

Similarly, this coding principle was reflected in distinguishing the nature of maternal *Directives*: a directive that was provided as feedback on the child's error, which was deemed necessary in the process, versus a directive given in the absence of the child's errors, showing a clear sign of the mother leading the interaction. In addition, *Level 0* was differentiated between two cases: Laisser-faire zero when the mother was silent with the child struggling with errors and Contingent zero when the mother was silent because the child was proceeding well (this was discussed in the contingency rule in Table 3.5). In this case, it might be argued that the laisser-faire zero might be contingent in some cases where the mother was intentionally silent while the child was struggling because she knew from her prior experience that her silence would ultimately promote the child's independent performance. Regrettably, these somewhat personal cases could not be reflected in the coding scheme of the present study because the basic principle was that maternal behaviours were coded as observed in the video data.

3.4.1.3 Maternal Flexibility & Perspective-taking

Following Bernier and colleagues (2010), maternal *Flexibility & Perspective-taking* (F&P) was operationalized in the present study as the mother demonstrating flexibility in her attempts to keep her child on task or taking the child's perspective and acknowledging her child's feelings while bringing the child's focus back on the task. This code was not applicable when the child did not deviate from the task, and in this case it was coded as missing.

3.4.1.4 Maternal praise

Maternal praise (e.g., "Well done", "Great!") was observed in the video data and was thus included in the coding scheme. It was operationalized as maternal praise provided when the child exhibited desirable performance while working on the puzzle task.

3.4.2 Scoring of the key constructs of the puzzle task

This section demonstrates how the four key constructs of the puzzle task were coded and then translated into scores. Table 3.7 shows an example of actual coding of mother-child interactions during the puzzle task, which shows how the codes presented in Table 3.4 were assigned, how the contingency rule in Table 3.5 was applied, and how the contingent score were calculated at the end.

Table 3. 7 An example of coding for the puzzle task

Episode	Transcript	Codes	Cont
	The mother and the child are sitting at the table next to each other. The blocks of the puzzle task and its target picture are placed on the table.		
	C: (pointing at the window) She is the teacher of Rainbow (class).		
1	M: Yes, she is. Look! We have these blocks. Would you like to work with them?	F&P	
	C: I said hi when she was with my teacher this morning.		
2	M: Did you? Good to say hi to teachers. Look at this puzzle. You do not want to do this puzzle? It looks interesting!	F&P	
	C: (puts together incorrect pieces)		
3	M: (pointing at the target picture) Why don't you make your puzzle look like this?	2	
	C: (no response)	F	
4	M: (pointing at a part of the picture) Look at this. The smaller piece goes inside the bigger piece.	3	Cont
	C: (no response)	F	
5	M: (handing over a piece) This looks a correct one.	Taking	Cont
	C: (arranges the piece right)		
6	M: (handing over another piece) We need a piece a bit smaller than that, which is this one.	Dir	
	C: (arranges the piece right)		
7	M: Well done!	Praise	
	C: (finds a right piece and arranges it right)		
8	M: Find another piece that is smaller than that one.	Dir	
	C: (finds another right one and places it right)		
9	M: Now, we need the smallest sized piece.	Dir	
	C: (finds the smallest one)		
10	M: (pointing at the picture) Place it like this.	Dir	
	C: (fails to place it right)		
11	M: (pointing at the picture) You should place it under this piece.	4	
	C: (grabs another wrong piece and tries to place it at the point the mother indicated)	F	
12	M: Take it [the incorrect piece] out and make the rest look like this (pointing at the target picture).	4	Cont
	C: (fails to make the part as the mother indicated)	F	
13	M: Turn them the other way around to hold them all tight together.	4	Cont
	C: (manages to make the shape as the mother suggested)	S	
14	M: Now find another piece to go in the middle. Something like this one.	Dir	
	C: (finds an incorrect one)		
15	M: Not that one. Find something smaller.	4	
	C: (finds a correct one and places it correctly)	S	
16	M: Then, what would be the next piece to find?	1	
	C: (finds a right piece but places it incorrectly)	S	
17	M: Not that way. Raise it up. Do not lay it down.	4	
	C: (places it correctly)	S	
18	M: (places another piece next to the one the child has arranged) C: (places another piece correctly).	Taking	
19	M: (places another piece next to the one the child has arranged) C: (looks at the mother)	Taking	
19	Sum		4

Note. C: child, M: mother, 0~6: : levels of maternal support, F: child's failure, S: child's success, F&P: Flexibility & Perspective-taking, Dir: maternal directive, Praise: maternal praise, Taking: taking-over, Cont: contingent

Scoring of maternal contingency

In Table 3.7, episode 4 was judged contingent because the maternal intervention in this episode was one level higher than that in episode 3. Of note is that episode 5 was also assessed as contingent since it was provided after trying other subtler types of support, which was in contrast with the Taking-over in episode 18 and 19, where no child errors were presented. As discussed in section 3.4.1.2.2, the mother who does part of the puzzle as the last resort to move on would be less controlling, if it is given after the child's failure at following her former subtler types of support, compared to maternal taking-over given as the first intervention on an error or in the absence of the child's error. Episode 12 and 13 were also considered contingent, despite their same levels of support as those in Episode 11 and 12, respectively, because the maternal utterances were paraphrased with new information to facilitate the child's level of understanding. The overall score of the maternal contingency was calculated by dividing the total number of contingent responses (4) by the total number of episodes (19), which produced a score of 0.21 (i.e., 21% of the total episodes were contingent).

Scoring of maternal intrusiveness

In the example of coding in Table 3.7, the total frequency of both *Directives* and *Taking-over* was 7 (notice that *Taking-over* in episode 5 was not included in this score). The intrusiveness score was calculated by dividing the total number, 7, by the total number of episodes, 19, which produced a score of 0.37 (37% of the total episodes were intrusive).

Scoring of maternal F&P

In Table 3.7, there were 2 times when the mother was evidenced to try to focus the child on the task when the child was distracted by the sight of a kindergarten teacher seen through the window. The mother appeared to be gentle enough in her attempts to respond to the child's utterances that were irrelevant to the puzzle before asking the child to start working on the puzzle. In the present study, mothers who showed F&P were friendly and gentle when they encouraged their child to focus on the task and none of them were rigid in their attempts (e.g., the mother physically restrains her child or takes the hand of her child and goes on with the task). The score of F&P in Table 3.7 was calculated by dividing 2 (2 times of F&P) by 19 (the total number of episodes), which produced a score of 0.11 (11% of the episodes were F&P).

Scoring of maternal praise

In Table 3.7, maternal praise was coded once. Its score was calculated by dividing 1 by 19 (the total number of episode), which produced a score of 0.05 (5% of the total episodes were maternal praise).

3.4.3 Coding of the reminiscing task

The coding scheme for the reminiscing task was constructed based on the theoretical accounts discussed in Section 2.3.2.3: *maternal elaboration, semantic connection, maternal mental-state references*, and *connected mental-state references* (note that connected mental-state references were mental-state references within semantically connected contexts, the concept of which was not presented in Section 2.3.2.3). These four constructs are shown in Table 3.8.

Table 3. 8 Key constructs of the reminiscing task

	Verbal form of maternal input	Content of maternal input		
Construct	Maternal elaboration	Semantic connection	Maternal mental-state references	Connected maternal mental-state references

As shown in Table 3.8, maternal elaboration referred to the verbal form of maternal utterances (e.g., wh/yes-no questions, informed/confirmative sentences), while sematic connection, maternal mental-state references, and connected mental-state references concerned the content of the conversation. Maternal elaboration was about whether the maternal verbal input during the reminiscing task was informative (i.e., providing new information so as to engage the child into the conversation) or repetitive (i.e., asking the same question until the child responds). Semantic connection referred to whether maternal utterances were semantically associated with the child's previous utterances. Maternal mental-state references were about maternal references made to mental states. Maternal connected mental-state references were a special case of maternal mental-state references, which were semantically related to the child's previous utterances.

Of note is that these constructs were exhaustive to include all the observed maternal verbal input in the video data but were not exclusive. Specifically, the coding scheme was exhaustive in terms of maternal semantic connection (all maternal propositions were assigned to one of the sub-codes of semantic connection: connection, initiation and failure), while maternal elaboration and (connected) mental-state references were relevant to only some maternal propositions. In addition, the coding scheme was not exclusive in that a maternal utterance could be coded as a wh-question

(maternal elaboration), semantically connected (semantic connection) and emotion-related references (mental-state references).

In what follows, the coding scheme for the reminiscing task is presented by first referring to its conceptual relation to prior studies, followed by addressing specific codes constituting the four key constructs of the reminiscing task. Then this section finishes by demonstrating the calculation of the scores of the key constructs by using an example of coding mother-child interactions on the reminiscing task.

3.4.3.1 Maternal elaboration

In the reminiscing literature, maternal elaboration is one of the most frequently researched constructs explaining the child's autobiographical memory (e.g., Farrant & Reese, 2000; Reese & Fivush, 1993) and self-representations (e.g., Wang & Brockmeier, 2002; Wang et al., 2010). Existing coding systems are designed to include the characteristics of highly elaborative parents, such as the frequent usage of open-ended questions/statements that embellish features of past events. These are opposed to characteristics of relatively less elaborative parents, such as the usage of repeated questions and little provision of new information.

Based on the reviews in section 2.3.2.3.1, following Reese, Haden, and Magnusson, (1993), three aspects of highly elaborative mothers' utterances were adopted to code maternal elaboration in the present study: wh-questions, Yes-No questions, and elaborative statements. (See Appendix 3.6 for more details). Operational definitions of these codes constituting maternal elaboration are presented in table 3.9.

Table 3. 9 Codes of maternal elaboration

Operational definitions and examples of codes
1. Wh- questions: maternal questions asking child to provide information e.g., "What did you do on the beach?"
2. Yes/no questions: maternal questions requiring the child to confirm or deny e.g., "Did you have fun?"/ "You played soccer with Daddy, didn't you?"
3. Elaborative statements: maternal provision of new information that does not require a response from the child e.g., "I (the mother) was so pleased that you helped your friend carrying his big bag."

Note. Adapted from Reese et al. (1993)

In assigning the codes shown in Table 3.9, the coding unit was a *proposition*, which is found most frequently in the reminiscing literature (e.g., Fivush, Haden, & Adam, 1995; Reese &

Brown, 2000; Wang et al., 2010). A proposition was defined in the present study as a subject-verb construction, with each unique or implied verb in an independent clause forming a new propositional unit. For example, “I play baseball” was one proposition, and “I swim and ski” was two.

3.4.3.2 Semantic connection

One prominent prior coding system that has been used in examining the impact of maternal verbal input on the child’s social understanding is that used by Ensor and Hughes (2008). Taking the topographical approach, they coded how the maternal and the child’s utterances were semantically connected and found that mothers’ connected references to mental states were positively related to the child’s social understanding. Another existing system investigating how the maternal and the child’s utterances were semantically related is the one used by Cleveland and Reese (2005), who examined maternal verbal input in the context of mother-child reminiscing. Taking the dimensional approach, they coded maternal tendency to follow or change conversational topics in which the child was engaged. It was found in Cleveland and Reese’s study that the maternal tendency to follow the topics that the child was interested in was significantly related to the child’s attitude toward reminiscing. Even though the systems in these two prior studies differ in their approaches to coding, the two systems appear to be similar on their focus of coding on how the mother continued and expanded on the topic in which the child was engaged.

However, the system by Ensor and Hughes (2008) was topographical and micro-behavioural, this system was adopted in the present study to code maternal *semantic connection*. The coding unit was a conversational *turn*, which was defined as the utterances of one speaker bounded by another speaker’s utterances or a significant silence (usually 5 seconds or more). This turn-based coding was efficient in the determination of the semantic connection of a turn because the semantic function of one or multiple maternal propositions had to be considered in relation to its immediately preceding turn produced by the child. Operational definitions of the codes constituting maternal semantic connection are presented in Table 3.10.

Table 3. 10 Codes of semantic connection

Operational definitions
1. Connection: a maternal utterance is semantically related to the child’s previous turn
2. Initiation: the mother initiates a new topic that is unrelated to the child’s previous turn and successful in eliciting a semantically related response from the child
3. Failure: a maternal turn is directed to the child but fails to elicit a semantically related response from the child

Note. Adapted from Ensor & Hughes (2008)

As shown in Table 3.10, a maternal utterance was coded *connection* if it functioned to validate the child's contributions to their conversation or if it acted to follow the child's conversational lead. A maternal utterance was coded as *initiation* if it functioned to begin a new topic that is both unrelated to the child's previous turn and also successful in electing a semantically related response. Following Ensor and Hughes (2008), if a maternal utterance was assessed as both connection and initiation, it was coded as *connection*. Finally, a maternal utterance was coded *failure* if it was directed, explicitly or implicitly, to the child but failed to elicit a semantically related response. As such, no maternal turn was considered in isolation from its preceding turn produced by the child.

3.4.3.3 Maternal mental-state references

One notable study that explored the relation between maternal mental-state references and child EF is that by Bernier and colleagues (2010). Their coding scheme was designed to code the maternal tendency to refer to mental states in the context of mother-child free play. This coding scheme, however, was not relevant to the present study in that the children in Bernier and colleagues were toddlers aged between 12 and 26 months, whereas the children in the present study were preschool children, who were more verbally proficient than those in Bernier and colleagues' study. Instead, the system used by Wang and colleagues (2010) was adopted in the present study because this system was one of the few systems that coded maternal mental-state references in the context of mother-child reminiscing. Their coding system was initially derived from that used by Han, Leichtman, and Wang (1998), who coded Korean, Chinese, and US children's references to internal states. In addition, the scheme used in the study of Jenkins, Turrell, Kogushi, Lollis, and Ross (2003) was adopted due to its specified descriptions of mental-state references. The coding unit was a proposition, which was the coding unit for maternal elaboration. Operational definitions and examples of the codes for maternal mental-state references are shown in Table 3.11 (see Appendix 3.7 for more details).

Table 3. 11 Codes of maternal mental-state references

Operational definitions and examples of codes
1. Emotion: words indicating affective content ("I really liked the girl.")
2. Cognition: thought-state related ("You forgot to bring your book.")
3. Desire: personal wishes and want ("I really wanted the red bag.")

Note. Adapted from Wang et al. (2010) and from Jenkins et al. (2003)

3.4.3.4 Maternal connected mental-state references

The final construct of maternal verbal input was mental-state references within semantically connected conversational context, which were termed as connected mental-state references (CMR). Maternal CMR was coded by determining whether a mental-state reference was made in relation to the utterances that child had just previous made. As such, once both maternal mental-state references and semantic connection were all coded, maternal CMR was coded based on this information. The only one study in which maternal CMR was measured was by Ensor and Hughes (2008), who found that maternal connected mental state references were positively related to young children's social understanding (theory of mind). However, very little has been known on the relation between parental CMR and child EF.

3.4.4 Scoring of the key constructs of the reminiscing task

This section specifies how the scores of the four key constructs examined during the reminiscing task were derived: the elaboration score, the semantic connection score, the mental-state references (MR) score and the connected mental-state references (CMR) score. Table 3.12 illustrates how the four maternal verbal constructs were coded. Based on the coding in Table 3.12, this subsection specifies how the scores of the constructs were calculated.

Table 3. 12 An example of coding the reminiscing task

	Transcript	Pro-position	Maternal elaboration	Turn	Semantic connection	MR	CMR
M	What did we do on the beach with David?	1	Wh-Q	1st	Failure		
C	…						
M	What did you do?	1	Rep	2nd	Initiation		
C	The hole in the sand.						
M	You dug a hole in the sand. What else did we do?	2	Rep Wh-Q	3rd	Initiation		
C	Filled the bucket with the water.						
M	We did fill the bucket! Uncle Tom also gave you a boat ride, didn't he?	2	Rep YN-Q	4th	Initiation		
C	A lot!						
M	He gave you a lot of rides. Did we have some bread?	2	Rep YN-Q	5th	Initiation		
C	We ate some bread.						
M	Did we have some meat, too? What kind of meat did we have?	2	YN-Q Wh-Q	6th	Failure		
C	…						
M	Didn't we come back home early because we were concerned about Jane (a dog)? What else did we do?	2	YN-Q Wh-Q	7th	Failure	Emotion	
C	…						
M	Do you miss uncle Tom?	1	Wh-Q	8th	Initiation	Emotion	
C	I do.						
M	I miss him too.	1	Elab-statement	9th	Connection	Emotion	CMR
C	I would like to go the beach with him again.						
M	What did you like most about him?	1	Wh-Q	10th	Connection	Emotion	CMR
C	He is funny.						
	Total	15	11	10	Failure (3) Initiation (5) Connection (2)	4	2

Note. **M**: mother, **C**:child, **Wh-Q**: Wh-question, **Rep**: repetition, **YN-Q**: Yes-No question, **Elab-statement:** elaborative statement, **MR**: mental-state references, **CMR**: connected mental-state references

Maternal elaboration score

In the given example of Table 3.12, the first two scores of *proposition* and *maternal elaboration* were used to calculate the elaboration score. As discussed in section 3.4.3.1, maternal elaboration consisted of 3 codes: wh-questions, yes-no questions, and elaborative statements. In Table 3.12, the total number of these three codes was 11. Notice that the wh-question in the second

turn was not included in the total number of elaboration because it was a repetitive question after the child's silence in the first turn. The repetition of the same question or statement has been pointed out as a characteristic of less elaborative parents (Reese et al., 1993). Thus, the elaboration score was calculated by dividing its total frequency (11) by the total number of propositions (15), which produced a score of 0.73 (i.e., 73% of the maternal propositions were maternal elaboration).

Semantic connection score

The third and fourth scores of *turn* and *semantic connection* were used for the calculation of the semantic connection score. The first, sixth, and seventh conversational turns were all coded as *failure* because they were not semantically connected with the child's utterances. The second, third, fourth, fifth and eight turns were coded as *initiation* because they did not semantically relate to the child's utterances in their preceding turns but were responded by the child. The ninth and tenth turns were coded as *connection* because they were semantically connected to the meanings in their preceding turns and were also subsequently responded by the child. Since the focus of examining maternal semantic connection was on whether the mother continued or changed the topic of interest to the child, its score was calculated by using its major code, *connection*. There were two times of *connection* occurring out of the total conversational turns of 10, which produced a score of 0.2 (i.e., 20% of the conversational turns were semantically connected).

Maternal mental-state references score

Maternal mental-state references included the mental states of not only the child but also the mother. The score of maternal mental-state references was calculated by dividing the total frequency of mental-state references by the total number of maternal propositions. In Table 3.12, there were four instances of maternal references to mental states. Therefore, the score of maternal mental-state references was calculated by dividing 4 by 15 (the total number of propositions), which produced a score of 0.26 (26% of the maternal propositions concerned mental states).

Maternal connected mental-state references score

Finally, the score of connected maternal mental-state references was calculated by dividing 2 (the total number of propositions that were coded as CMR in Table 3.12) by 15 (the total number of propositions), which produced a score of 0.13 (13% of the maternal propositions were connected maternal references to mental states).

3.5 Analytic Plan

This section discusses how the data addressed so far in Chapter 3 were analysed. There were four steps of analyses taken in the present study: preliminary, correlation, regression, and mediation analysis. Based on the results and suggestions of preliminary and correlation analyses, the four research questions were explored by conducting mainly regression and mediation analyses. Table 3.13 shows the aims of these four analysed steps.

Table 3. 13 Aims of analyses

Analysis	Aims
Preliminary analysis	Reliability checking of the coded maternal behavioural and verbal traits Descriptive statistics of all the variables involved in the four research questions
Correlation analysis	Data reduction: forming composite scores for child EF, maternal EF, and parent-child interactions Bivariate and partial correlations between child EF and predictors of interest Selection of covariates of child EF to enter to subsequent regression models
Regression analysis	With regard to the 1st, 2nd, and 3rd research questions Prediction of child EF from maternal scaffolding during the puzzle task Prediction of child EF from maternal verbal input during the reminiscing task Prediction of child EF from maternal EF Unique variation in child EF accounted for by maternal EF and parenting behaviours
Mediation analysis	With regard to the 4th research question The mediating role of maternal parenting behaviours in the link between maternal EF and child EF The mediating role of maternal parenting behaviours in the link between child verbal ability and child EF

3.5.1 Preliminary analysis

Having coded mother-child interactions during the puzzle and the reminiscing task, the next step was to investigate the distributions of the coded maternal behavioural and verbal traits. It may be ideal that all participants display behaviours of interest at least once, with numbers of occurrences over participants well distributed. In practice, however, it is not uncommon for many participants never to show some behaviour at all. Therefore, following Grolnick and colleagues

(2002), variables of which raw mean frequencies were less than 1 were dropped (see Section 4.1.2). The descriptive statistics of all the variables used in the present study provided information as to whether there were ceiling or floor effects and whether the variables were normally distributed, which informed as to what statistical methods to use in further analyses.

3.5.2 Correlation analysis

Bivariate correlations were calculated in order to investigate whether variables of interest were significantly correlated with child EF and with each other. Those that were found to be unrelated to child EF were dropped from further analysis and those highly correlated with each other were entered separately into subsequent regression models due to the multicollinearity issue. Bivariate correlations also guided the decision on whether to form a composite score for child EF, maternal EF, and parenting behaviours during the two interaction tasks. Then partial correlations were calculated so as to examine a variable of interest was significantly related to child EF, controlling for influential covariates of child EF, such as child verbal ability, child age, and maternal educational attainment.

3.5.3 Regression analysis

In exploring the first three research questions, a series of regression analyses were conducted, which showed the extent to which variables of interest accounted for unique variance in child EF. Regression analysis is a way of predicting an outcome variable from one or more predictor variables. In fitting a regression model to the data, an important consideration that should be taken into account is which predictors to include and how (in what order) chosen predictors should be entered into the model. Predictors in regression models are generally selected based on the substantive theoretical importance, which would be informed from prior studies. As for the order of entering predictors to regression models, the present study adopted the way that is frequently used in performing hierarchical regression analyses. That is, predictors that have been found as influential factors of child EF in prior research were first entered into the model, followed by predictors of interest to the present study, which had rarely been explored (Field et al., 2012). Hierarchical regression was chosen in the present study due to the necessity to pre-specify orders of predictors based on theoretical considerations in order to examine the predictability of variables of interest when controlling for the impact of covariates on child EF. In this regard, the forced entry was not appropriate in that all predictors should be forced into the model simultaneously and thus the researcher makes no decision about the order in which variables are entered. In addition, the

stepwise methods (of which specific ways include forward, backward, and all-subsets method) were also not relevant to the present study in that predictors should be selected on a purely mathematical basis, which is in sharp contrast to theoretical considerations on which the hierarchical methods rely. The stepwise methods also run the risk of over-fitting (having too many variables that may contribute little to the predictive power of the model) or under-fitting (leaving out important predictors), which leads to making a Type 2 error (Field et al., 2012). Table 3.14 presents the predictors and their entering orders to regression models adopted in the present study in exploring the first three research questions (The fourth question was explored by conducting mediation analyses, which will be addressed in Section 3.5.4).

Table 3. 14 Predictors and their entering orders to regression models

Research question	Order of entering variables
1. Would the existing findings on the relation between child EF and maternal scaffolding (as indicated by maternal contingency or intrusiveness during a puzzle task) be replicated in the Korean context?	**Step 1**: covariates (those found to have significant correlations with child EF) **Step 2:** maternal contingency and intrusiveness
2. Does maternal verbal input during a reminiscing task significantly relate to child EF?	**Step 1**: covariates (those found to have significant correlations with child EF) **Step 2:** variables of maternal verbal input: maternal elaboration, semantic connection, mental-state references, and connected mental-state references
3. To what extent do the parenting behaviours (maternal contingency and verbal input) and maternal EF account for unique variance in child EF, above and beyond covariates of child EF (child age, child language and maternal education)?	**Step 1**: covariates (those found to have significant correlations with child EF) **Step 2:** maternal EF, contingency, intrusiveness, elaboration, semantic connection, mental-state references, and connected mental-state references

As shown in Table 3.14, prior research has suggested at least five possible influential covariates of child EF: child age, child verbal ability, child gender, maternal age, and maternal educational attainment. Based on a preliminary correlation analysis, only the covariates having significant correlations with child EF were used as predictors. These predictors were firstly entered in Step 1 so as to control for their impacts on child EF. Then, the variables in Step 2 varied

according to the research questions. For the first research question, maternal contingency and intrusiveness were entered together. For the second question, the variables for maternal verbal input were entered in a block in Step 2. Then, for the third research question, the variables for maternal EF were entered in addition to maternal contingency, intrusiveness and variables for maternal verbal input. These maternal variables were entered simultaneously because little had been known on their substantive theoretical importance and the orders of entering them could not be determined. Before carrying out regression analyses, some of these predictors and covariates were dropped due to their low frequencies or collapsed due to their high correlations. With reduced number of predictors, subsequent regression models became more parsimonious.

3.5.4 Mediation analysis

The fourth research question was explored by conducting mediation analyses. Mediation analysis is a statistical method that answers the question about how an independent variable affects a dependent variable through one or more potential intervening variables (Hayes, 2013). The purposes of conducting mediation analyses in the present study were to look into whether and how the maternal effect on child EF was portioned into two a range of effects – direct, indirect, and total. Specifically, the focus was on the magnitude of the indirect impact of the maternal factors on child EF, which would contribute to a better understanding of the mechanism through which the association between maternal factors and child EF can be explained.

In exploring indirect effects of parenting behaviours in the maternal EF-child EF link; two methods were used: an ordinary least squares (OSL) regression-based analysis and a Structural Equation Modelling (SEM) based on a path analysis. Of these two methods, a SEM based on maximum likelihood is recommended in many cases as a way to explore possible indirect effects. Compared with an OLS regression analysis, a SEM program provides considerable control over the estimation method and useful measures of fit for models when a model is not saturated, thereby allowing for model comparisons (Hayes, 2013). Path analysis makes it possible to study the relationships of observed variables within a system. Specifically, direct and indirect causal links between variables can be inferred while examining whether both variables are the effect of another cause or causes.

The use of ordinary least squares (OLS) regression, however, is also commonplace when estimating a simple mediation model, in which the number of mediating variable is one, with or without covariates (Hayes, 2013). A big difference between a regression-based method and a path analysis in investigating mediating effects is that a path analysis is more comprehensive, in which related equations are solved simultaneously to determine parameter estimates (i.e., variables in a path analysis could be independent and dependent whereas variables in a regression analysis are

either independent or dependent). Nevertheless, using both methods in the present study may make little difference because the results by a SEM or OLS regression are similar when testing models without latent variables to explore (Hayes, 2013). Based on this view, the two methods (OLS regression and SEM path analysis) were adopted in the present study in exploring the mediating role of maternal parenting behaviours. That is, the mediating role was examined by first using an OLS regression, followed by a path analysis. A subsequent use of a path analysis aimed at confirming that both methods indicated the same results (note that the sample size of the present study was not technically sufficient for a path analysis).

Once an indirect effect is estimated in a mediation model, it is important to make an inference about this value because the initial estimate is a sample-specific instantiation of its true value and indicates nothing about generalizability. Among numerous ways of testing inferences made from indirect effects, bootstrapping was adopted in the present study because it assures generalizability by not assuming the normality assumption about the sampling distribution of the indirect effect. Bootstrapping is typically used in a mediation analysis so as to generate an empirically derived representation of the sampling distribution of the indirect effect, and this empirical representation is used for the construction of a confidence interval for the indirect effect (Hayes, 2013). Specifically, the bias-corrected bootstrapping confidence interval was adopted in the present study due to its efficiency in making a balance between validity and power considerations (i.e., between Type 1 error and statistical power). Compared to the Sobel test, which has lower Type 1 error and lower statistical power, it is less likely to miss an indirect effect that is real when using the bias-corrected bootstrap confidence interval. For this reason the bias-corrected bootstrapping is preferred, even though the Sobel test may be a good choice when focused on reducing the Type 1 error (Hayes, 2013). Despite some cases where the likelihood of a Type 1 error may slightly inflate, the bias corrected bootstrapping has been the most widely recommended inference analysis for causal mediation effects.

3.6 Assessing the Quality of the Research Process

The aim of this final section is to assess the overall quality of the research process involved in the present study. Three crucial factors explaining the quality of research are addressed: validity, reliability, and generalizability of research findings. This section focuses on the steps taken to enhance the quality of research from the very beginning of recruiting participants through the data collection and to data analysis phases. Then this section finishes with a discussion of the main ethical issues raised during the course of conducting the present study and how they were properly addressed.

3.6.1 Internal validity

Validity refers to the extent to which the findings claimed by the researcher are satisfactorily grounded in the data. A specific type of validity that should be particularly addressed in relational/ causal study is internal validly. Internal validity is the approximate truth about inferences regarding cause-effect relationships, which is concerned with ruling out plausible alternative explanations and thus shows that indeed a causal relationship likely exists between the variables of interest and the intended outcome (Trochim, Donnelly, & Arora, 2016). Steps that were taken to promote the validity of the research findings of the present study are addressed below.

- *Reducing participant reactivity during observation*: As discussed earlier, participants' reactivity was minimised in the present study by leaving the mother-child dyad alone without the researcher watching over them while they were working on the two interactions tasks, which helped to elicit more nature behaviours from the participants.

- *Research design that partitions out the impact of influential variables on child EF*: Impacts of influential correlates of EF (e.g., child age, child verbal ability, child gender, maternal age, and maternal educational attainment) were controlled for while carrying out a series of hierarchical regression analyses. In this way, the inferences drawn from the regression models were more valid.

- *Conclusion validity was enhanced:* Conclusion validity is the degree to which conclusions about relationships between two or more variables are reasonable (Trochim et al., 2016). One crucial way of enhancing conclusion validity is to increase statistical power and sample size. As discussed in Section 3.1.3, the appropriate sample size was calculated by taking into account the number of variables to enter statistical models, effect size, and statistical power. In addition, conclusion validity was boosted by increasing the reliability of measures. That is, the data collection site was kept from noisy or disturbance caused by other children or teachers in the kindergartens. In addition, pre-determined procedures of administration and scoring were kept across participants throughout the data collection period.

3.6.2 External validity (generalizability)

External validity concerns whether the apparent effects demonstrated in an investigation can be generalised beyond the exact research context. In order to assert that the recruited families shared similar characteristics of middle-class households in Seoul, Korea, and thus to promote the

external validity of inferences drawn from the sample, the following two steps were taken in the present study.

- *Sampling sites were the areas for predominantly middle-class households in Seoul*: The 10 kindergartens in which the participants were recruited were located across the five districts in Seoul that were marked as residence for middle-class families (see Section 3.2.1).

- *Maternal educational attainment*: Most recruited mothers' educational attainment was at least some college degree, which satisfied part of the average profile for middle class households in the Korean context (Cho, 2015; see Section 3.1.4).

3.6.3 Reliability

In observational studies, observer bias is one of the threats to reliability. Observer bias refers to observers being affected by their expectations, which occurs when the observers know the goals or the hypotheses of a study and allow this knowledge to influence their observations (Trochim et al., 2016). Additionally, observer drift is another threat to reliability, which refers to the tendency for observers to become inconsistent over time in the criteria and code definitions that they use to make and record their observations (Vogt & Johnson, 2016). To overcome these problems, inter-rater reliability was checked. Inter-rater reliability refers to the extent to which two or more raters agree with each other when using the same instruments at the same time (Trochim et al., 2016). Twenty per cent of the video data were randomly selected and re-coded by another trained coder with a psychology background. In checking inter-rater reliability, both the percentage agreement and Cohen's Kappa coefficients were calculated. The percentage agreement was calculated for the constructs which were not exhaustive in nature, and thus raters had to determine whether or not they agreed on a behaviour belonging to the same construct. Then the Cohen's Kappa Coefficient was subsequently calculated for constructs having further categories to consider. The Cohen's Kappa Coefficient has been assessed as a better estimate than the percentage agreement method that fails to take into account the extent of agreement by chance alone.

3.6.4 Ethical considerations

This section presents how ethical considerations were addressed while conducting the present study. Ethical approval for this research was granted by the University of Cambridge, Faculty of Education. Throughout the whole process of conducting the present study, the standards of conduct laid down by the British Educational Research Association (BERA, 2011) were

observed. Among a range of conducts in the BERA, guidelines that were relevant to the present study are discussed under the following five headings.

- *Voluntary informed consent and right to withdraw*: Mothers voluntarily submitted their informed consent sheets prior to the present study getting underway. Before the data collection session began, participants were informed of the process in which they were to be engaged and how the data they were to provide would be used. They were also informed that their interactions were to be video recorded and that they were allowed to withdraw from the present study for any reason at any time.

- *Openness and Disclosure:* Mothers were aware that the present study concerned the relation between parental factors and the child's cognitive development (i.e., the recruitment advertisement was 'Parenting and the child's cognitive development'). The aims of the tasks that the mother-child dyad was to undertake were explained before collecting data (i.e., "This study is designed to look into how a mother-child interaction is related to the child's executive function (EF). EF is a set of higher cognitive processes, which is closely related to goal-directed behaviours. You will understand what EF is by playing these three computer games, each of which takes about 4 minutes."). Some mothers requested their performance be reported, which was rejected by the researcher saying, "As a PhD student not a professional examiner, I am not reporting any scores to anyone. I'm using the scores only for the purpose of my research." The mothers, however, were allowed to observe their child working on EF tasks.

- *Ethics related to children:* Children who are capable of forming their own views should be granted the right to express their views and should therefore be facilitated to give informed consent. As such, along with the informed consent obtained beforehand, the child was verbally asked again whether they were still willing to participate. In addition, given that the present study involved young children, a full Criminal (Investigation) Records Check was obtained from the Korean National Police Agency, which allowed the researcher to have access to children in kindergartens. The whole procedure of obtaining data from children was always undertaken in the presence of their mothers so that any necessary actions could be taken promptly by the mothers as well as the researcher in case of emergency. It was important that no physical discomfort or psychological harm should be imposed during the data collection. Therefore, it was ensured that the time taken for each task (child EF tasks, maternal EF tasks, and mother-child interaction tasks) lasted between 3 to 5 minutes, which led the whole session lasting between 35 and 40 minutes.

Most of these tasks were simple in their directions and were not difficult enough to cause mental tiredness (e.g., “Tap the same blocks in the same order as I did”, “Sort cards according to the rules based on shape, colour, or number”). Only the puzzle task was designed to be challenging for the child to complete alone so as to elicit mother-child collaboration. As such, at the end of the puzzle task, children were told that the puzzle was challenging for most 4-year-old children and that they actually did a great job.

- *Incentives.* The only incentive that was advertised in advance was the information given to the mothers as to how parents could help young children improve EF. The children received a small prize (chocolate) for their participation at the end of the session, even though this was not informed in advance. It was unlikely that these incentives had undesirable effects on the recruitment of participants or their behaviours during data collection.

- *Privacy.* It was ensured that the data the participants provided would be treated confidentially and anonymously. It was also made clear to the participants that the data would be used solely for the present study and that they would not be identifiable as theirs if the research was published.

CHAPTER 4 Results

The aim of this chapter is to address the following research question:

How do parenting behaviours and parental EF relate to child EF in the Korean context?

This overarching research question was addressed by exploring the following specific questions:

1. Would the existing findings on the relation between child EF and maternal scaffolding (as indicated by maternal contingency or intrusiveness during a puzzle task) be replicated in the Korean context?
2. Does maternal verbal input during a reminiscing task significantly relate to child EF?
3. To what extent do the parenting behaviours (maternal contingency and verbal input) and maternal EF account for unique variance in child EF, above and beyond covariates of child EF (child age, child language and maternal educational levels)?
4. Do the maternal parenting behaviours mediate the link between maternal EF and child EF?

The first research question concerned whether existing findings would be replicated in the Korean context (i.e., whether maternal contingency and intrusiveness would link to child EF positively and negatively, respectively). The second question concerned an issue that has rarely been explored in the literature. As addressed in Section 2.4.2, given that parent-child interactions are based mostly on verbal exchanges, this question aimed at exploring aspects of parental verbal input during reminiscing (one of the most frequent verbal interactions in our daily lives), which was expected to positively link to child EF. Then, in the third research question, the effects of two parental factors (parenting and maternal EF) on child EF were simultaneously examined by looking at their relative relations to child EF. Finally, the fourth question focused on finding the mediating role of parenting behaviours in the maternal EF-child EF link. As such, in what follows, upon presenting preliminary analysis in terms of reliability of coding and descriptive statistics of all the variables involved in the research questions, the statistical results of the research questions are presented under the following four themes: *replication of existing findings* (the first question), *exploration of parental verbal aspects linking to child EF* (the second question), *relative relations of parenting and maternal EF to child EF* (the third question), and *mediating role of parenting* (the fourth question). Then a summary of findings follows at the end of each theme.

The analytic strategies were as follows. For the first, second, and third research questions, correlational, zero-order and partial, and hierarchical regression analyses were conducted since the focus of the questions were mainly on finding relations between parenting, maternal EF and child EF or examining the contribution of a variable to explaining child EF. With regard to the fourth question, two methods examining mediation were conducted: an ordinary least squares regression-based analysis and a path analysis

Then, all of these analysis procedures were carried out twice, once using the whole sample (N=92 dyads) and then using only 4-year-olds and their mothers (N=89 dyads). This was due to the expectation that the link between parenting and child EF might vary across the child's age range. That is, given that a dramatic improvement in EF skills takes place during the preschool period (Garon et al., 2008), a range of performance of children aged between 3 and 5 years old may have different links with parenting and maternal EF, which made it necessary to examine using narrower age bands.

4.1 Preliminary results

4.1.1 Reliability of coding

The reliability of the coding schemes for the puzzle and reminiscing task was checked by external observers[3], who randomly selected and coded 20% of the video data. Before engaging in independent coding, the main observer (researcher) and the external observer jointly coded and discussed two trial sessions. The assessment of inter-coder agreement involved two stages. While the first stage assessed the percentage of agreement in unitising, the second stage assessed the level of absolute agreement calculating Cohen's Kappa Coefficients. The results of these two stages of reliability checking are presented in Table 4.1.

Table 4. 1 Reliability of coding

Coding scheme		% of agreement in unitising	Cohen's Kappa Coefficients
The puzzle task	Level 0 ~ 5	82%	.87
	Intrusiveness	89%	NA
	Flexibility & Perspective taking	78%	NA
	Praise	95%	NA
The reminiscing task	Elaboration	89%	.86
	Semantic connection	NA	.82
	Mental-state references	87%	.86
	Connected mental-state references	82%	.85

[3] The external observers were a native Korean speaker from Korea with previous training in psychology.

In Table 4.1, some constructs are shown to be assessed twice while some are assessed once. For example, in coding the six levels of maternal support (0-5), the raters had to determine whether a maternal intervention was provided in the absence or presence of the child's errors (unitising). Then, if provided in response to the child's errors, they had to assign the maternal intervention to one of the five levels. As such, both the percentage of agreement and Cohen's Kappa coefficients were calculated. However, only the percentage of agreement in uniting was calculated for Intrusiveness, Flexibility & Perspective taking, and Praise because these constructs had no further categories to consider. Semantic connection was the only construct for which only the Cohen's Kappa Coefficient was calculated because the extent to which observers assigned a behaviour to the same construct (Unitising) was not relevant to this construct (in other words, coding for Semantic connection was exhaustive) and thus only an episode needed to be determined as to its relevance to the three categories of Semantic connection (connection, initiation and failure). All the calculated Cohen's Kappa Coefficients shown in Table 4.1 were at least .82 or above, which indicated strong levels of agreement between raters.

4.1.2 Descriptive statistics

Next step was to examine the descriptive statistics of all the variables involved in the four research questions. It was mentioned in Section 3.1.4 that 11 mother-child dyads were left out from the initially recruited 103 dyads due to recording failures (4 dyads) or children failing to complete required tasks (4 dyads), or engaging in activities other than those asked by the researcher (3dyads). As a result, data were collected from 92 dyads. The descriptive statistics of these data are shown in Table 4.2.

Table 4. 2 Descriptive statistics of variables involved in exploring the overarching research question

Construct	Variable		Mean	*SD*	Observed range	Possible range	Skewness*	Kurtosis*
Child EF	Child WM		19.8	4.0	13-31 Span = 2-5	0-54 Span=1-9	1.1	0.3
	Child inhibition		31.3	12.0	5-59	0-60	0.0	-0.6
	Child shifting		9.3	3.8	1-15	0-15	-0.5	-0.9
	Child EF composite		0.00	1.0	-1.8-2.44		0.4	-0.7
Maternal EF	Maternal WM		51.5	17.7	24-112 Span = 4-7	0-162 Span=1-9	2.1	0.9
	Maternal inhibition		86.4	6.5	56-95	0-96	-4.0	5.6
	Maternal shifting		95.6	9.79	55-110	0-128	-4.07	5.31
Maternal scaffold-ing (puzzle)	Episode		13.36	3.69	8-24	*na*	1.70	0.13
	Levels of maternal support	Level 0	1.92	0.94	0-5		0.45	0.67
		Level 1	0.75	0.57	0-3		0.76	1.43
		Level 2	0.64	0.85	0-3		1.90	-0.34

		Level 3	0.86	0.70	0-3		1.51	1.04
		Level 4	1.99 (.15)	1.39	0-6		0.90	-0.41
		Level 5	0.39	0.64	0-2		2.73	0.62
	Flexibility & Perspective-taking		0.25	0.46	0-2		2.92	0.96
	Praise		0.23	0.68	0-4		6.78	12.37
	Intrusiveness (Intrusiveness score)		6.32(.47)	4.74	0-21	0-1	0.37	-0.9
	Contingency** (Contingency score)		5.33(.40)	0.23	0-1	0-1	1.29	-.08
Maternal verbal input (remi-niscing)	Conversational turn Maternal proposition		30.16 37.07	10.88 13.02	8-59 12-66		0.95 0.36	0.20 -0.38
	Maternal elaboration (total)		27.54(.74)	9.86	7-52		0.56	-0.32
	Open-ended question		11.61(.31)	4.97	2-27		1.05	0.23
	Close-ended question		10.13(.27)	4.85	1-22		0.27	-0.68
	Elaborative sentence		5.80(.16)	4.95	0-27		3.00	2.94
	Semantic connection Maternal connectedness		22.26(.74)	11.27	5-56	*na*	1.55	0.59
	Maternal initiation		5.29(.18)	2.85	1-18		3.29	4.57
	Maternal failure		2.49(.8)	2.57	0-16		4.60	8.08
	Maternal MR (total)		10.80(.29)	6.09	1-28		1.32	0.02
	Maternal CR		2.77(.07)	2.53	0-11		2.08	0.58
	Maternal ER		5.80(.16)	4.11	0-21		2.53	2.33
	Maternal DR		2.23(.06)	2.70	0-13		3.36	2.80
	Maternal CMR (total)		5.66(.15)	4.00	0-17		1.73	0.36
	Maternal CCR		1.47(.04)	1.66	0-7		2.86	1.68
	Maternal CER		3.14(.08)	2.74	0-11		2.39	0.94
	Maternal DER		1.05(.03)	1.67	0-9		4.65	6.34
Co-variates of child EF	Child verbal ability		19.72	5.4	8-38	0-47	0.41	0.14
	Child age (mths)		54.11	3.6	47.04-63.19	*na*	0.03	-0.08
	Mother age (yrs)		37.0	3.59	28-47	*na*	0.95	0.05
	Mother educational levels		3.1	0.8	1-4	1-4	-2.14	1.41

Note. N= 92
Values in parentheses are percentages.
WM= working memory, **MR:** mental-state references, **CMR**=connected mental state references,
***** = skew or kurtosis values divided by 2 standard errors (i.e., if a skewness* or kurtosis* value is more than 1, ignoring the plus and minus sign, the variable is judged as non-normally distributed)
**** =** episodes judged as contingent according to the contingency rule

With regard to the performance on child EF tasks in Table 4.2, the mean score of child working memory (WM) was 19.8, with 85 % of them being distributed between the score of 14 and 25. A score of 14 was obtained when the average span was 2, and a score of 25 was achieved when the average span was 4. The mean score of child inhibition was 31.3, which indicated that the children tended to end the HTKS somewhere during the second set of the task (note that there were three sets of trials, with each set consisting of 10 trials, with the first set being easiest and the third being hardest). The mean shifting score in Table 4.2 indicated that the children answered correctly to 9 out of the total trials of 15 during the FIST. The scores for child inhibition and shifting were normally distributed, while the distribution of WM scores was not normal (note that its value of skewness was 1.1, being slightly positively skewed).

The level of performance of these child EF scores may be compared to those reported in prior studies using a Korean sample. Wanless and colleagues (2011) used data from Korean kindergarten children who performed on the first 20 sets of the HTKS (N=227, M=5.05 years old on average). The mean score of child inhibition in their study was 23.99 and *SD* =12.96. Since the present study used three sets of the HTKS, a further calculation was carried out for the mean score for the first 20 sets, which was 27.7 and *SD* = 8.3 (note that the value in Table 4.2 is the score based on three sets). Then an analysis comparing these two mean score indicated that the mean score in the present study was lower, which was not surprising considering that the children in the present study were younger than those in Wanless and colleagues'. This comparison, however, may not be precise in that, despite the mean age of the children in the two studies being similar, the age range of the children in their study was larger (3.58 ~ 6.50 years) than that of the present study (3.92~5.26 years) and the number of 4-year-olds, which constituted 97% of the sample in the present study, was not known in their study.

With regard to maternal WM in Table 4.2, the WM mean score was 51.5 and the mean span was 5. Specifically, 24 mothers received a score of 40, and 29 mothers received a score of 54 (i.e., 58% of them receiving a score of 40 or 54). The Corsi score of 40 was obtained when the span level was 5, and the score of 54 was given when the span level was 6. Maternal WM was shown to be positively skewed. Maternal inhibition and shifting showed similar distributions, with both means (86.4 and 95.6, respectively) being close to their maximum possible scores and both being negatively skewed. No ceiling effects were shown in both scores. Whether these scores were of average for Korean mothers aged between 28 and 47 years could not be determined due to the lack of prior studies.

Next, the parenting behaviour that was most frequently shown during the puzzle task was Intrusiveness. That is, the Korean mothers mainly provided the child with unsolicited directives (those operationalized as provided when there were no errors or requests the child had made) or did part of the puzzle herself (Taking-over). The second most frequent maternal behaviour was

Contingency (40 % of the total episodes, which were calculated by applying the Contingency rule to each episode). The distributions of the two parenting behaviours were different, with maternal intrusiveness being normally distributed and maternal contingency being positively skewed. Then the most frequent behaviour of the six levels of maternal support was Level 4 (specific directives telling the child what to do). This indicated that about 15% of the case in which the mother gave directives were assessed contingent and 47% of the apparently same behaviour of giving directives were intrusive (see the values in parentheses).

By contrast, the least frequently practiced maternal behaviour shown in Table 4.2 is Praise, followed by Flexibility and Perspective-taking. Following Grolnick and colleagues (2002), these two codes were dropped from further analysis throughout this thesis because their raw mean frequencies were less than 1 across participants[4]. As a result, only two of the maternal behavioural constructs during the puzzle task remained as predictors of interest to the present study: maternal intrusiveness and contingency.

With regard to maternal elaboration in Table 4.2, its first aspect, Open- and Close-ended questions, were shown to be used by the mothers with similar frequencies and they were more frequent than Elaborative sentences. The distributions of Open-ended questions and Elaborative sentences were positively skewed while the scores for Close-ended questions were normally distributed. Next, of the three variables representing Semantic connection, the mean score for maternal Connectedness was highest (74 %; 22.26 episodes out of a total of 30.16 conversational turns), followed by maternal Initiation (18%) and Failure (8%). This high percentage of Connection may be partly due to the trumping system (Ensor & Hughes, 2008), in which conversational turns that could be categorised as both Connection and Initiation was coded as Connection. Of the three variables for MR (maternal mental-state references), ER (emotion references) was shown to have the highest mean score, accounting for 16% of the total maternal propositions (5.8 propositions out of a total of 37.07 propositions), followed by maternal CR (cognition references) and DR (desire references) accounting for 7% and 6 %, respectively. When considered as the percentage out of the total MR (mental-state references), ER accounted for more than half the total MR (53.7 per cent). Next, among the three variables representing maternal CMR (connected mental-state references), maternal CER (connected emotion references) accounted for 8% of the total maternal propositions (3.14 propositions out of a total of 37.07 propositions) and 55.5 % of the total maternal CMR (3.14 propositions out of a total of 5.66 CMR related propositions).

The final constructs to mention in Table 4.2 are covariates of child EF, shown at the end of the table. The mean score of child verbal ability was 19.72 out of the maximum score of 47, which

[4] Note that the scores for the six levels of maternal support were not used as individual scores and were assessed according to the contingency rule, which led to a contingency score. Therefore, Level 1, 2, and 5, which had mean frequencies less than 1, were not dropped.

was judged to be a bit higher level of performance for Korean children aged around 4.5 years old, given that a score of 20 was shown in the Korean-Wechsler Preschool and Primary Scale of Intelligence to be the mean score for children aged 5 years old (Park et al., 1995). This trend may be due to the fact that the children in the present study were from mainly middle-class households, leading their mean scores higher than those for 4.5-year-olds from a range of socioeconomic backgrounds. The mean age of the children was 54.11 months (4.51 years old). Ninety-seven per cent of the recruited children were 4-year-olds, with one child being 3.92 years old and two children being 5.24 and 5.27 years old, respectively (see Section 3.1.4). As for the mother age, 62 mothers were aged between 33 and 38 years (11 mothers being 33; 7 mothers 34; 8 mothers 35; 16 mothers 36; 10 mothers 37; and 10 mothers 38 years old). The last variable measured was mother educational levels. The recruited Korean mothers were highly educated, about 93% of them having a certain form of college diploma or higher, leading the distribution of maternal educational attainment being negatively skewed. For those variables whose skewness and kurtosis were more than 1, ignoring plus or minus sign, nonparametric methods were used in the following further analyses (e.g., Spearman correlations or bootstrapping for testing the significance of mediation analysis).

4.2 Findings Ⅰ. Replication of existing findings (RQ1)

Would the existing findings on the relation between child EF and maternal scaffolding (as indicated by maternal contingency or intrusiveness during a puzzle task) be replicated in the Korean context?

In exploring this question, zero-order correlations were first examined, followed by partial correlations accounting for child's age, in order to select parenting variables to use as predictors in a subsequent regression analysis. Then a series of hierarchical regression analyses were conducted to see the amount of unique variance in child EF that maternal contingency and intrusiveness accounted for, controlling for the three covariates of child EF.

4.2.1 When using the whole sample (N=92 dyads)

4.2.1.1 Correlations

The relation between child gender and child EF was first analysed using analysis of variance with child gender as an independent variable. There was no significant gender difference so child gender was no longer included in further analysis ($F = 0.14$, $p = 0.7$). Table 4.3 shows the zero-order and partial correlations controlling for child age among the variables involved in exploring the first research question.

Table 4. 3 Zero-order (below diagonal) and partial correlations (above diagonal) of the variables involved in the first research question (N=92)

		1	2	3	4	5	6	7	8	9	10
1.	Child WM		.26*	.32**	.26*	.74***	n/a	-.20	.33**	.24*	.15
2.	Child inhibition	0.38***		.19	.34**	.68***	n/a	-.24*	.41***	.24*	-/09
3.	Child shifting	0.42***	0.32**		.30**	.71***	n/a	-.11	.36***	.06	.01
4.	Child verbal ability	0.37***	0.44***	0.40***		.42***	n/a	-.15	.31**	.17	-.00
5.	Child EF	0.79***	0.74***	0.76***	0.53***		n/a	-.26*	.52***	.25*	.03
6.	Child age	0.39***	0.42***	0.37***	0.38***	0.51***		n/a	n/a	n/a	n/a
7.	Maternal intrusiveness	-0.22*	-0.29**	-0.17	-0.21*	-0.31**	-0.19		-.61***	-.32**	.12
8.	Maternal contingency	0.38***	0.45***	0.41***	0.36***	0.54***	0.22*	-0.63***		.32**	-.3
9.	Mother education	0.28**	0.29**	0.12	0.22*	0.30**	0.17	-0.33**	0.35***		-.10
10.	Mother age	0.15	-0.06	0.03	0.01	0.05	0.05	0.11	-0.02	-0.09	

Note. WM=working memory
Two-tailed *$p < .05$, ** $p < .01$, *** $p < .001$

In Table 4.3, the three child EF scores were moderately, positively correlated with one another. As addressed in Section 2.1.1, following prior studies demonstrating that EF skills during the preschool period are unidimensional in nature (Fuhs & Day, 2011; Hughes et al., 2010), a composite of child EF was calculated by standardizing individual EF scores and averaging them.

The child EF composite was then examined for its correlation with the covariates of child EF and maternal parenting behaviours. In Table 4.3, the child EF composite is shown to have significant moderate, positive zero-order correlations with child verbal ability, child age, and maternal contingency. In addition, the child EF composite has a weak positive correlation with mother education but a weak negative correlation with maternal intrusiveness. Child age, child verbal ability and maternal education are known to have significant impacts on child EF (Hughes, 2011). They are shown in Table 4.3 as correlating with one another. Moderate positive correlations are shown between child verbal ability and child age and also between child verbal ability and mother education.

As for the correlation between maternal contingency and intrusiveness, they are shown in Table 4.3 as strongly negatively correlated with each other. Nevertheless, they were not aggregated into a composite score in the present study, following prior studies, in which highly correlated yet conceptually opposing parenting behaviours were individually explored because they demonstrated

distinctive relations to child EF (e.g., Holochwost et al., 2016; Rochette & Bernier, 2014; Silk, Morris, Kanaya, & Steinberg, 2003). This was to test the hypothesis of the present study that maternal intrusiveness may not inversely relate to child EF, or have a weaker (than the correlation between maternal contingency and child EF) or insignificant relation with child EF. Distinct relations maternal intrusiveness may have with child EF would not be found if maternal intrusiveness is aggregated into a composite.

Finally, the above mentioned zero-order correlations were further examined by controlling for child's age, which are shown above the diagonal of Table 4.3. After controlling for child's age, the four values of zero-order correlations that were significant became no longer significant: the correlation between maternal intrusiveness and child WM; between child shifting and child inhibition; between maternal intrusiveness and child verbal ability; and between mother education and child verbal ability. These changes, however, did not affect the selection of predictors to use in a subsequent regression analysis. The variables that have significant zero-order correlations with the child EF composite are also shown in Table 4.3 to have significant partial correlations with the child EF composite. As such, the two maternal parenting behaviours (intrusiveness, contingency) and the three variables (child verbal ability, child age, mother education) were retained as predictors of child EF in subsequent regression analysis.

4.2.1.2 Regression analysis

A hierarchical regression analysis was carried out in exploring whether and how the two selected maternal parenting behaviours would relate to child EF. The three covariates of child EF were entered in Step 1 because they had been known to affect children's EF performance. Then, the two parenting behaviours that were interest to the present study were entered in Step 2. Maternal intrusiveness and contingency, however, were highly correlated with each other and were separately entered in Step 2A and 2B, respectively. The results of regression analyses are shown in Table 4.4. Due to multiple testing involved in these analyses, *p*-value was adjusted to .01.

Table 4. 4 Summary of regression analyses exploring the first research question (N=92)

	R^2	ΔR^2	F	ΔF	β	t	pr	$sr(sr^2)$
Step 1								
Covariates	.42		21.26**					
Child age					.35	3.94**	.39**	.32*(.10)
Child verbal ability					.36	4.09**	.40**	.33*(.11)
Mother education					.16	1.87	.20	.15(.02)
Step 2A	.43	.01	16.74**	2.26				
Child age					.33	3.81**	.39**	.31(.09)
Child verbal ability					.35	3.95**	.40**	.31(.10)
Mother education					.11	1.25	.20	.10(.01)
Maternal intrusiveness					-.13	-1.50	-.16	-.12(.01)
Step 2B	.52	.10	23.55**	18.1**				
Child age					.33	4.02**	.40**	.30*(.09)
Child verbal ability					.27	3.14*	.32*	.23(.05)
Mother education					.06	0.74	.08	.05(.00)
Maternal contingency					.36	4.25**	.41**	.32*(.10)

Note. *p < .01, **p < .001
pr: partial correlation
sr: semipartial correlation (part correlations)
sr^2: semipartial correlation squared (the unique variance in child EF explained by a predictor)

The focus of the regression analyses in Table 4.4 was on investigating unique variance in child EF that maternal contingency and intrusiveness accounted for, controlling for the three covariates in Step 1. In Step 2A, maternal intrusiveness was not a significant predictor of child EF. In step 2B, however, maternal contingency was a significant predictor, accounting for 10% of unique variance in child EF. Of note in Step 2B was that the unique variance in child EF that was accounted for by child's verbal ability was 5%, which was 11% in Step 1 when maternal contingency was not included as a predictor. This result suggested that part of the impact that child's verbal ability had on child EF might have been mediated by maternal contingency. This possibility was examined by conducting mediation analyses below in this subsection. Finally, in Table 4.4, the significant partial correlations for child age, child verbal ability, and maternal contingency indicated that their significant correlations with child EF were independent of other variables included in Step 2A and 2B.

Having conducted the regression analysis, the next step was to check whether the models met underlying regression assumptions. Given that Step 2A and 2B were the models focused on in this section, in what follows are the regression assumptions checking for these models. Based on the guidelines suggested by Field and colleagues (2012), the following four steps were checked.

Checking outliers and influential cases: The following four values were calculated: standardised residuals, Cook's distances, hat values (leverage), and the covariance ratio. The results showed that both Step 2A and 2B models appeared to be reliable in that the models were not unduly influenced by any subset of cases. Specifically, standard residuals of 95% cases of the two models were within about ± 1.96. Ninety-five per cent of the cases (except for 5 cases for Step 2A and 5 cases for Step 2B) were found to have standard residuals within about |1.96| and all cases had standard residuals between |2.58|. There were no cases whose standard residuals were not between |3.29|. None of the 10 cases (the 5 cases for Step 2A and 5 cases for Step 2B) had a Cook's distance greater than 1, which indicated that they did not have an undue influence on the models. The leverage values of these cases were also less than 0.054 (i.e., three times the average leverage value, which is calculated as (k +1)/n, where k is the number of predictors and n is the number of participants). Additionally, the covariance ratios of these cases were examined to see whether they were significantly lower than 0.84 or higher than 1.16. These two values constitute the boundaries for the covariance ratios, which were calculated as 1-3(k+1)/n and 1+ 3(k+1)/n, where k is the number of predictors and n is the number of participants. Two cases (for Step 2A) and five cases (for Step 2B) were a bit lower than the CVR bottom limit, 0.84 (i.e., 0.76, 0.83, .80, .073, 0.83, 0.79, and 0.73). However, the Cook's distances for these cases were much lower than 1 and there was little cause for alarm (Field et al., 2012).

Assessing the assumption of independence: The assumption of independent errors was checked using the Durbin-Watson test. The statistic for the Step 2A model was 1.99 (p =.9) and for Step 2B was 2.1 (p =.6). These values were neither less than 1 nor greater than 3, which indicated that the assumption of independence was met in these models.

Assessing the assumption of no multicollinearity: The variance inflation factor (VIF) statistics were checked to assure that the predictors were not correlated with one another too highly. The VIF indicates whether a predictor has a strong linear relationship with the other predictor(s). The VIF statistics for Step 2A and 2B models did not cause concern. Specifically, all VIF values were all well below 10, and the tolerance statistics (i.e., the reciprocals of the VIF statistics) for the two models were all above 0.2. Based on these measures, it was concluded that there was no multicollinearity within the data.

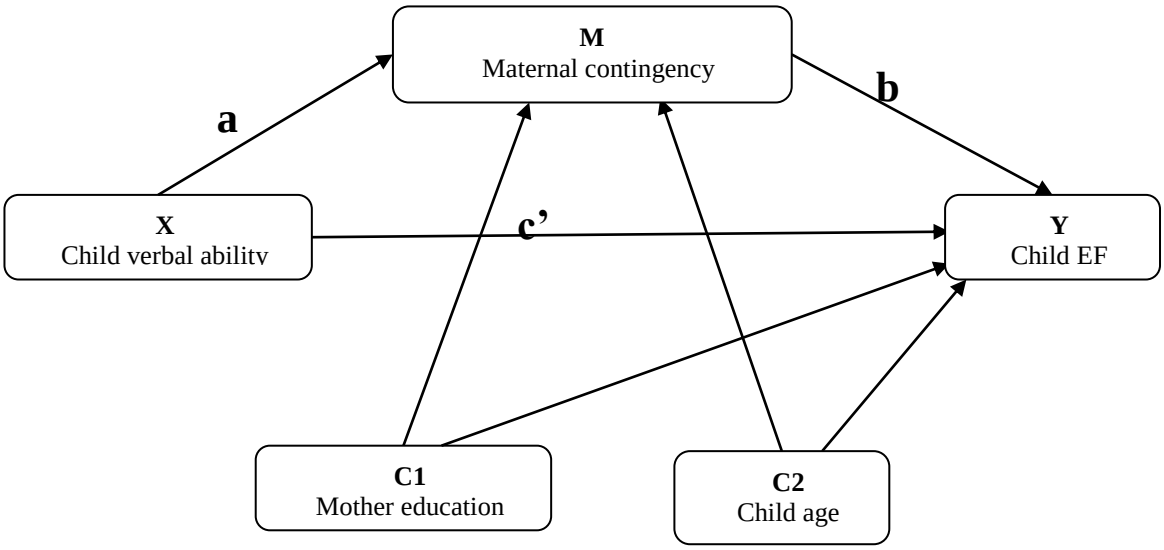
Checking assumptions about the residuals: Two assumptions that relate to residuals (i.e., a linear relation between the outcome variable and predictors and homoscedasticity of errors) were checked visually by inspecting scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals (see Appendix 4.1). These three kinds of graphs for the two

models showed fairly random patterns, which were indicative of situations where the assumptions of linearity and homoscedasticity of errors had been met.

4.2.1.3 Mediation analysis

A mediation analysis was conducted to examine the issue based on the regression analysis results (see Section 4.2.1.2). That is, in the Step 2B model in Table 4.4, it was expected that child's verbal ability might have an indirect effect on child EF via maternal contingency (note that this question was not set a priori). Since the effect of child verbal ability on child EF decreased when maternal contingency was entered in this model, it was expected that the effect of child verbal ability on child EF might be partially mediated by maternal contingency (since that child verbal ability was shown to have a significant direct effect on child EF). As such, the variables involved in Step 2B model are addressed in the current subsection as followings: the child's verbal ability as an independent variable, child EF as the dependent variable, maternal contingency as the mediating variable, and child age and mother education as covariates. The relations among these variables are shown in a conceptual diagram, Figure 4. 1 below.

Figure 4. 1 Conceptual diagram for the indirect effect of child verbal ability on child EF with two covariates



Note. X: predictor, C1; covariate 1, C2: covariate 2, M: mediator, Y: outcome

Figure 4.1 includes two outcomes (maternal contingency and child EF) and three predictors (one precedent and two covariates). This is a simple mediation model, in which at least one antecedent X variable is hypothesized to influence an outcome Y through a single mediating variable M. Since confounding associations due to other variables can be ruled out by including them as predictors in the model of mediation and outcome (Hayes, 2013), two variables that are expected to have confounding links with parenting behaviours or child EF are added as covariates: mother education and child age. As such, with two outcome variables in Figure 4.1, two linear models are required. Coefficients of the models are estimates of the putative causal influences of each variable in each system on others, and the goal of running two regression models is to estimate these coefficients and interpret effects (indirect and direct), which is of primary interest in conducting a mediation analysis. Relevant to these effects are two pathways, through which X influences Y, with one leading from X to Y without passing through M (i.e., direct effect) and the other from X to Y, which first passes from antecedent X to consequent M and then from antecedent M to consequent Y (i.e., indirect effect). Specifically, two coefficients *a* and *b* are relevant to an indirect effect of X on Y. Coefficient *a* quantifies how much two cases that differ by one unit on X are estimated to differ on M. Coefficient *b* quantifies how much two cases that differ by one unit on M but that equal on X are estimated to differ on Y (Hayes, 2013). The indirect effect of X on Y via M is the product of *a* and *b*, which indicates two cases that differ by one unit on X are estimated to differ by *ab* units on Y as a result of the effect of X on M , which, in turn, affects Y. In addition, the direct effect of X on Y is estimated as c', which indicates that two cases that differ on X by one unit but are equal on M are estimated to differ by c' unit on Y (Hayes, 2013).

Specifically, Figure 4.1 includes two outcomes and thus two linear regression models, with one having maternal contingency as its outcome and the other having child EF as its outcome. In order to rule out confounding associations, mother education and child age are added as predictors (covariates) in the two regression models. The coefficients *a*, *b*, and *c'* are obtained by running these two regression models. In Figure 4.1, *a* refers to the difference in maternal contingency score for children who differ in their verbal ability by one score point, and *b* refers to the difference in child EF scores for children who have the same score for verbal ability but whose mothers have contingency scores that differ by on score point. The indirect effect, *a*b*, refers to the difference in child EF score for children who differ in their verbal ability by one score point. In addition, *c'* refers to the difference in child EF score for children who have the same score for verbal ability but whose mothers have contingency scores that differ by one score point.

These relations conceptualised in Figure 4.1 are tested by conducting two methods examining mediating effects: first an OLS regression analysis and then a SEM path analysis so as to confirm that the same results were obtained from these two mediation analyses. In both analytic methods, the significance of effects (indirect, direct, and total) was examined using bias-corrected

bootstrap, with 5,000 times of resampling with a 95% confidence interval. As for the question as to how many bootstrap samples are required, it is usually recommended to have 5,000 to 10,000 bootstrap samples because in most cases the gain in precision is marginal beyond that (Hayes, 2013). Path analyses were performed using the AMOS software (version 22.0).

4.2.1.3.1 OLS regression analysis

The results obtained from OLS regression analyses are presented in Table 4.5.

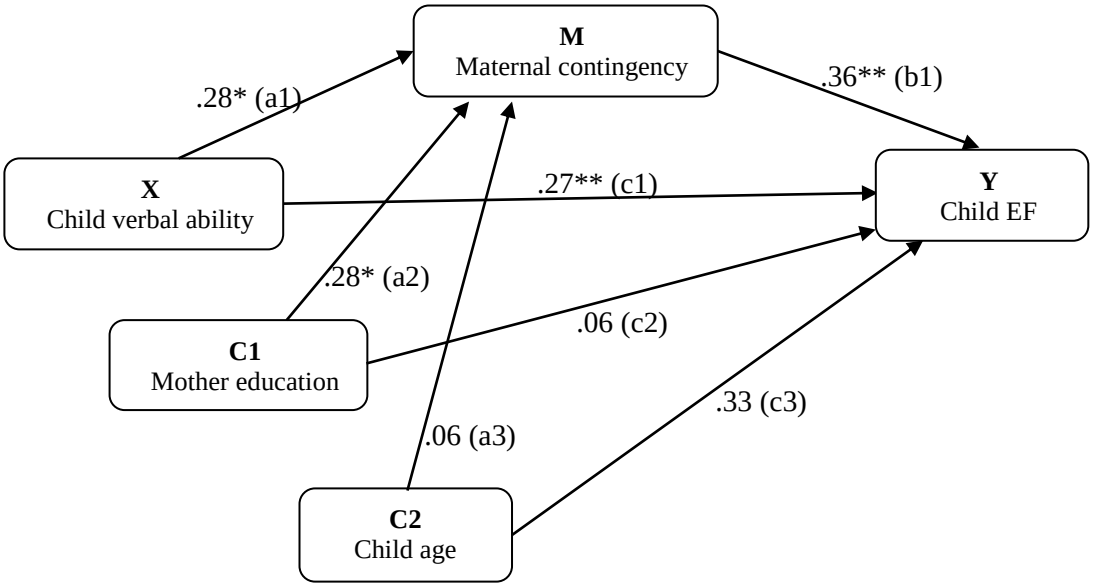
Table 4. 5 Model coefficients for child verbal ability simple mediation with two covariates (maternal contingency) (N=92)

	Consequent					
	M(Maternal contingency)			**Y**(Child EF)		
Antecedent	Standardized coeff	S.E.	*p*	Standardized coeff.	S.E.	*p*
X(child verbal ability)	**(a1)** .28	.004	.003*	**(c1)** .27	.015	.001*
C1(mother education)	**(a2)** .28	.028	.005*	**(c2)** .06	.101	.443
C2(child age)	**(a3)** .06	.0001	.528	**(c3)** .33	.001	.0001**
M(maternal contingency)	_	_	_	**(b1)** .36	.364	.0001**
	R^2 = .21			R^2 = .52		
	$F(3,88) = 7.81$, $p < .001$**			$F(4,87) = 23.55$, $p < .001$**		

Note. a1, a2, a3, b1, c1, c2, and c3 correspond to those shown in Figure 4.2, below.

Table 4.5 shows standardized coefficients obtained from running two regression models, in which maternal contingency serves as a mediating variable by being the outcome variable in a regression model and also a predictor in the other regression model. These relations are visualised in Figure 4.2 below, in which the values for a1, a2, a3, b1, c1, c2, and c3 correspond to those in Table 4.5.

Figure 4. 2 Statistical diagram for the indirect effect of child verbal ability on child EF with two covariates (N=92)



Note. X: predictor, C1; covariate 1, C2: covariate 2, M: mediator, Y: outcome

In Figure 4.2, maternal contingency (and the two covariates) are hypothesised to have a direct impact on child EF, in turn being directly affected by child verbal ability, and thus mediating the effect of child verbal ability on child EF. It was hypothesised, in addition, that child verbal ability had a direct effect on child EF. The indirect effect of child verbal ability on child EF via maternal contingency was significant, with an estimate of .10 (.28 *.36). A bootstrap confidence interval for this indirect effect based on 5,000 bootstrap samples was entirely above zero (.0267 to .18). In addition, the direct effect of child's verbal ability on child EF was significant (c1 =.27, *p* <.001). In other words, children who differed in their verbal ability by one score point had mothers who differed in their contingency scores by .28 point (a1). Children who had the same score for verbal ability but whose mothers had different contingency scores by one score point had child EF scores that differed by .36 point, controlling for the two covariates (b1). Under the influence of these effects, children who differed in their verbal ability by one score point had child EF scores that differed by .10 (a1*b1). In addition, children who differed in their verbal ability by one point but whose mothers had the same contingency score had child EF scores that differed by .27 point, controlling for the two covariates (c1).

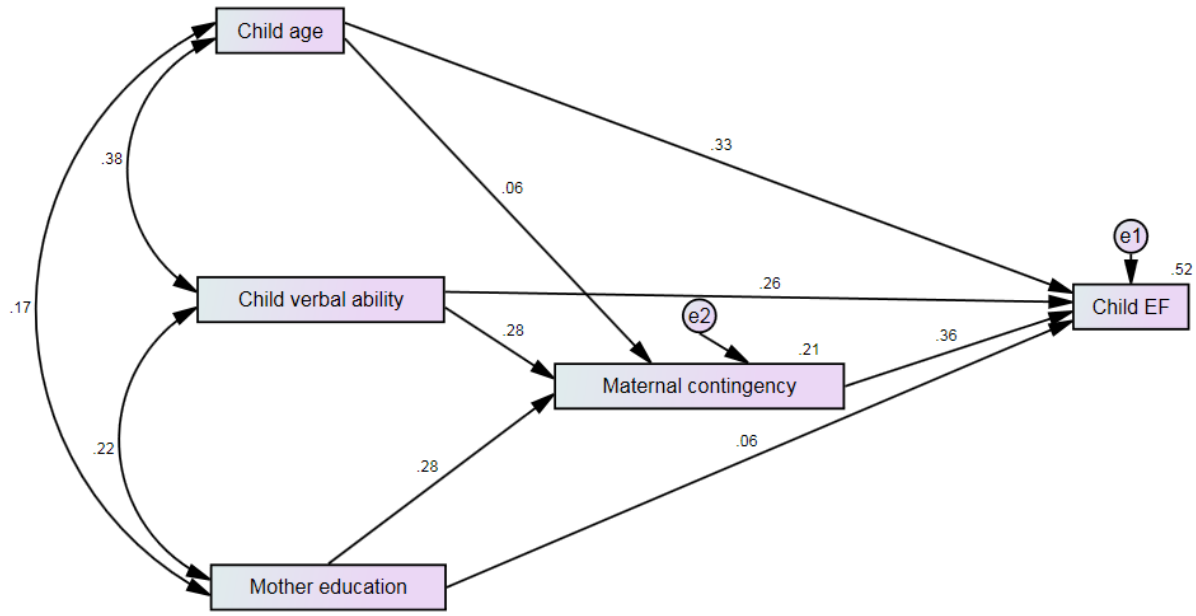
In addition, although not expected in priori, mother education in Figure 4.2 is shown to have a significant indirect effect on child EF via maternal contingency. Its indirect impact was calculated as a2*b1 (.10). Its confidence interval, based on 5,000 bootstrap resampling, was above zero (from .0230 to .21). The direct effect of mother education on child EF, however, was not

significant (c2 = .06, *p* = .4). That is, mothers who differed in their educational attainment by one point had contingency scores that differed by .28 point (a2). In addition, mothers who had the same degree of educational attainment but differed in their contingency scores by one point had children whose EF scores differed by .36 point, controlling for the two covariates (b1). Under the influences of these effects, mothers who differed in their educational attainment by one point had children who differed in child EF scores by .10 point (a1*b1).

4.2.1.3.2 Path analysis

Next, an indirect effect of child's verbal ability on child EF via maternal contingency was also tested by conducting a path analysis, the result of which is shown in Figure 4.3.

Figure 4. 3 Final model involving child verbal ability, child age, mother education and maternal contingency (N=92 dyads)



Note. Standardized coefficients are shown.

The model in Figure 4.3 was a saturated model (chi square =0, *df* = 0, Goodness of fit index=1). This path analysis further produced the values of three kinds of effects (direct, indirect, and total) that the three exogenous variables (child age, child verbal ability, and mother education) had on the two indigenous variables (maternal contingency and child EF), as shown in Table 4.6.

Table 4. 6 Effects of child age, child verbal ability, and mother education on child EF via maternal contingency (N=92)

Effect	Direct	Indirect	Total
On Child EF			
Of child age	.326**	.023	.349**
Of child verbal ability	.265**	.099**	.363**
Of mother education	.060	.098**	.158*
On maternal contingency			
Of child age	.064	.0001	.064
Of child verbal ability	.277*	.0001	.277*
Of mother education	.275*	.0001	.275*

Note. Standardized coefficients are shown.

In Table 4.6, child verbal ability and mother education are shown to have significant indirect effects on child EF. The indirect effect of child verbal ability via maternal contingency was 27% of its total effect on child EF. The indirect effect of mother education was 62% of its total effect on child EF. While child verbal ability continued to have a significant direct effect on child EF, the direct effect of maternal education on child EF, however, was not significant. These results are the same as those obtained by the OLS regression analysis in Section 4.2.1.3.1.

4.2.2 Results when using only 4-year-olds (N=89 dyads)

This section shows the results of correlations and mediation analyses when leaving out the three child participants who were younger or older than 4-year-olds. The aim of this section is to examine whether the relations of maternal parenting behaviours to child EF, shown in Section 4.2.1, would differ when using only 4-year-olds.

4.2.2.1 Correlations

Zero-order and partial correlations controlling for child age were first examined, which is shown in Table 4.7.

Table 4. 7 Zero-order (below diagonal) and partial correlations (above diagonal) of the variables involved in the first research question (N=89)

		1	2	3	4	5	6	7	8	9	10
1.	Child WM		.27*	.32**	.27*	.74***	n/a	-.21*	.34**	.25*	.16
2.	Child inhibition	0.39***		.21	.32**	.68***	n/a	-.24*	.40***	.23*	-.10
3.	Child shifting	0.4***	0.33**		.31**	.72***	n/a	-.11	.37***	.06	.02
4.	Child verbal ability	0.4***	0.47***	0.44***		.43***	n/a	-.17	.31**	.17	-.03
5.	Child EF	0.75***	0.75***	0.76***	0.60***		n/a	-.26*	.52***	.25*	.03
6.	Child age	0.4***	0.4***	0.36***	0.45***	0.51***		n/a	n/a	n/a	n/a
7.	Maternal intrusiveness	-0.25*	-0.27**	-0.17	-0.22*	-0.32**	-0.18		-.62***	-.36***	.12
8.	Maternal contingency	0.42***	0.45***	0.44***	0.34**	0.56***	0.21	-0.62***		.32**	-.04
9.	Mother education	0.29**	0.28**	0.11	0.20	0.28**	0.09	-0.30**	0.37***		-.12
10.	Mother age	0.18	-0.04	0.05	0.02	0.07	0.08	0.02	0.03	-0.01	

Note. **WM** = working memory, **EF**=executive function
Two-tailed *$p < .05$, ** $p < .01$, *** $p < .001$

The results shown in Table 4.7 are very similar to those shown in Table 4.3, when the data from the whole sample were used. That is, the three child EF scores in Table 4.3 are shown to have weak or moderate bivariate and partial correlations controlling for child age. In addition, child verbal ability, child age, and mother education are significantly correlated with child EF. Maternal intrusiveness and contingency are also significantly correlated with child EF and the two parenting behaviours are highly correlated with each other. For the same reason addressed in Section 4.2.1.1, these two variables were not aggregated into one composite score.

In Table 4.7, there are zero-order correlations that are shown to be insignificant when controlling for child age: the correlation between child shifting and child inhibition and that between maternal intrusiveness and child verbal ability. Theses insignificant partial correlations, however, did not affect the course of selecting predictors to enter to a subsequent regression analysis. That is, the five variables (child verbal ability, child age, maternal intrusiveness, contingency, and mother education) that were shown to have significant zero-order correlations with the child EF were also shown to be significant even after controlling for child age.

4.2.2.2 Regression analysis

Next, hierarchical regression analyses were carried out with the three covariates, maternal intrusiveness and contingency as predictors. The results are shown in Table 4.8.

Table 4. 8 Summary of regression analyses exploring the first research question (N=89)

	R^2	ΔR^2	F	ΔF	β	t	pr	$sr(sr^2)$
Step 1								
Covariates	.41		19.54**					
Child age					.31	3.32*	.34*	.28(.08)
Child verbal ability					.38	4.06**	.40**	.34(.11)
Mother education					.16	1.91	.20	.16(.03)
Step 2A	.42	.01	15.37**	2.11				
Child age					.30	3.27*	.34*	.27(.07)
Child verbal ability					.36	3.90**	.39**	.32(.10)
Mother education					.12	1.31	.14	.11(.01)
Maternal intrusiveness					-.13	-1.45	-.16	-.12(.01)
Step 2B	.51	.10	22.04**	17.90**				
Child age					.29	3.43**	.35*	.26(.07)
Child verbal ability					.28	3.13*	.32*	.24(.06)
Mother education					.07	0.81	.09	.06(.00)
Maternal contingency					.36	4.23**	.42**	.32(.10)

Note. *p < .01, **p < .001
pr: partial correlation
sr: semipartial correlation (part correlations)
sr^2: semipartial correlation squared (the unique variance in child EF explained by a predictor)

The notable difference between Table 4.8 and Table 4.4 is that the unique variance in child EF accounted for by child's age in Table 4.8 is smaller than those in Table 4.4. Specifically, in Table 4.8, the semi-partial correlations of child age are 8% (in Step 1) and 7% (both in Step 2A and 2B), which is 1% or 2% less than those shown in Table 4.4. These decreases occurred because the data from three non 4-year-olds were excluded, and it may be worth noting here that the data from the three non-4-year-olds did not have undue influences on the regression models, as confirmed by checking regression assumptions in Section 4.2.2.2.

Except for the decrease addressed above, the results shown in Table 4.8 are similar to those shown in Table 4.4. Specifically, Step 2B explained 10% more variance in child EF than Step 1 did. Maternal contingency in Step 2B accounted for 10% unique variance in child EF. In Step 2A, maternal intrusiveness was not a significant predictor of child EF. In addition, child verbal ability in Step 2B accounted for a smaller amount of unique variance in child EF, than it did in Step 1, which suggested a potential mediating role of maternal contingency in the link between child verbal ability and child EF, which necessitated a further analysis for this mediating role.

Finally, regression assumptions were checked based on the guideline by Field and colleagues (2012), the results of which indicated that the inferences drawn from the regression models were valid. Details of the assumptions checking are provided in Appendix 4.2.

4.2.2.3 Mediation analysis

4.2.2.3.1 OLS regression analysis

As done with the whole sample (N=92), the mediating part by maternal contingency was first explored by conducting an OLS regression analysis. Based on the conceptual model shown in Figure 4.1, a series of OLS regression analyses were carried out. The results are shown in Table 4.9.

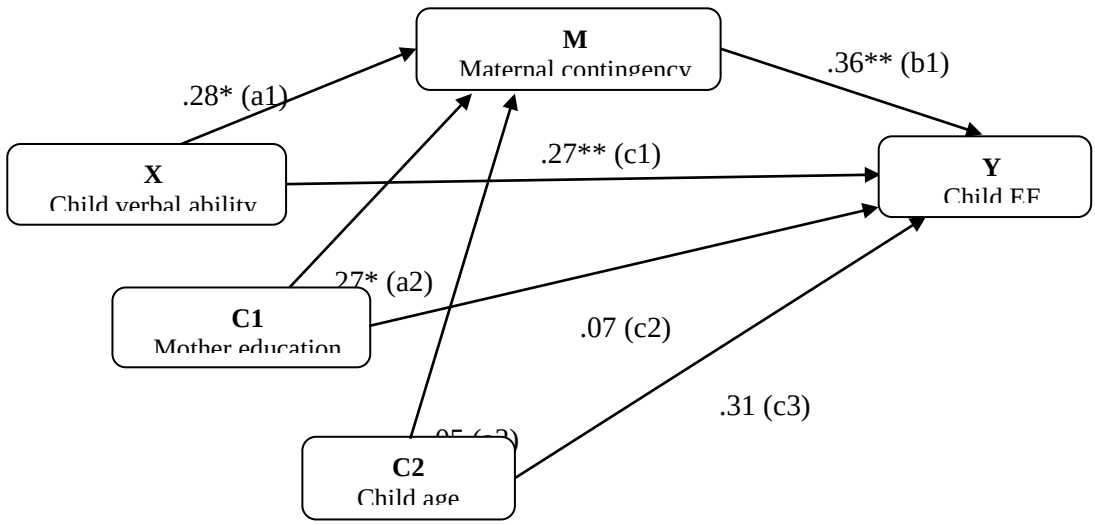
Table 4. 9 Model coefficients for child verbal ability simple mediation with two covariates (maternal contingency) (N=89)

	Consequent					
	M(Maternal contingency)			Y(Child EF)		
Antecedent	Standardized coefficient	S.E.	*p*	Standardized coefficient.	S.E.	*p*
X1(child verbal ability)	**(a1)** .28	.011	.011*	**(c1)** .27	.09	.002*
C1(mother education)	**(a2)** .27	.010	.008**	**(c2)** .07	.08	.417
C2(child age)	**(a3)** .05	.012	.663	**(c3)** .31	.09	.0001**
M(maternal contingency)	_	_	_	**(b1)** .36	.08	.0001***
	R^2 = .20			R^2 = .51		
	$F(3,85) = 7.20$, $p < .001$**			$F(4,84) = 22.04$, $p < .001$**		

Note. a1, a2, a3, b1, c1, c2, and c3 correspond to those shown in Figure 4.4. *$p < .01$, **$p < .001$

The parameters shown in Table 4.9 were obtained from running two regression models. Maternal contingency was the outcome in one model and was also a predictor in the other model. These relations are visualised in Figure 4.4, in which coefficients of a1, a2, a3, b1, c1, c2, and c3 correspond to those shown in Table 4.9.

Figure 4. 4 A statistical diagram of a simple mediation model for child verbal ability with two covariates (N=89)



Note. X: predictor, C1; covariate 1, C2: covariate 2, M: mediator, Y: outcome

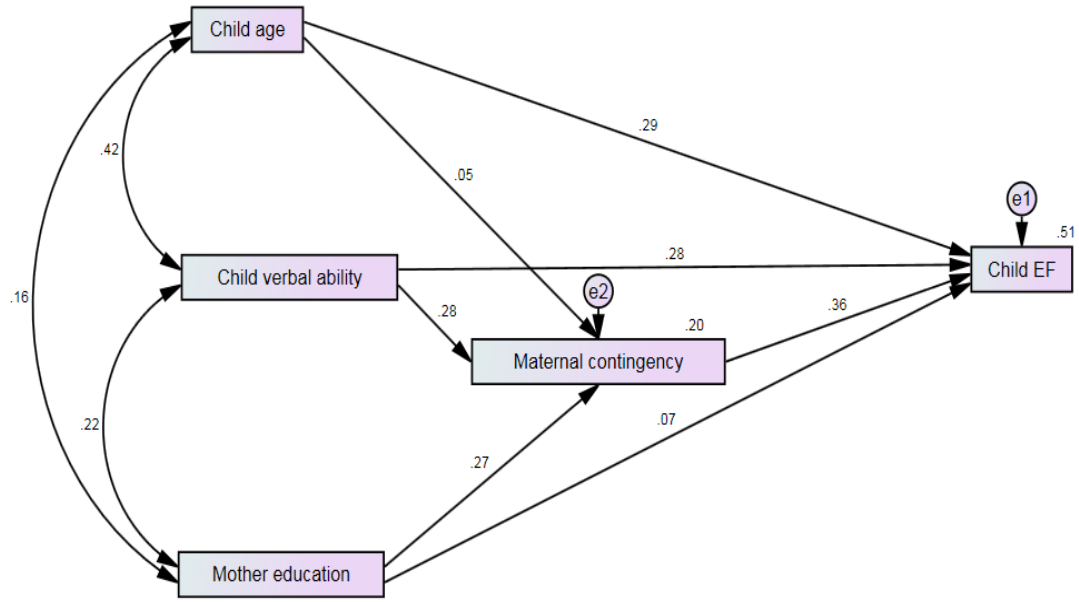
In Figure 4.4 , the indirect effect of child verbal ability on child EF through maternal contingency was shown to be significant, with a point estimate of .10 (.28 *.36), SE=.04 and a 95% bias-corrected bootstrap confidence interval from .022 to .19, which did not include zero. In other words, children who differed in their verbal ability by one score point had mothers who had contingency scores that differed by .28 point (a1). Children who had the same score for verbal ability but whose mothers had different contingency scores by one score point had child EF scores that differed by .36 point, controlling for the two covariates (b1). Under the influence of these effects, children who differed in their verbal ability by one score point had EF scores that differed by .10 point (a1*b1). In addition, children who differed in their verbal ability and whose mothers had the same contingency score had EF scores that differed by .27 point, controlling for the two covariates (c1).

In addition, the indirect effect of mother education was significant, with a point estimate of .10 (.27 * .36), SE= .04, and a 95% bias-corrected bootstrap confidence interval from .022 to.22, which did not include zero. That is, mothers who differed in their educational attainment by one score point had children who had different child EF scores by .10 point (a2*b1). However, the indirect effect of child age on child EF via maternal contingency was not significant, with a point estimate of .02 (.05 * .36), SE= .04, and a 95% bias-corrected bootstrap confidence interval from -.0526 to .11.

4.2.2.3.2 Path analysis

A path analysis was carried out to explore a potential mediating part played by maternal contingency in the link between chid verbal ability and child EF. The results are shown in Figure 4.5.

Figure 4. 5 Final model involving child verbal ability, child age, mother education and maternal contingency (N=89)



Note. Standardized coefficients are shown.

The model in Figure 4.5 was a saturated model and goodness of fit testing was not available (chi square = 0, *df* = 0). This path analysis further produced the values for the effects of the three exogenous variables (child age, child verbal ability and mother education) on the two indigenous variables (maternal contingency and child EF), as shown in Table 4.10.

Table 4. 10 Effects of child age, child verbal ability, and mother education on child EF via maternal contingency (N=89)

Effect	Direct	Indirect	Total
On Child EF			
Of child age	.29**	.02	.31**
Of child verbal ability	.28**	.10**	.38**
Of mother education	.07	.10**	.17*
On maternal contingency			
Of child age	.05	.0001	.05
Of child verbal ability	.28*	.0001	.28*
Of mother education	.27*	.0001	.27*

Note. Standardised coefficients are shown.

In Table 4.10, the indirect effect of child verbal ability on child EF via maternal contingency was significant, with a point estimate of .10, accounting for 26% of its total effect on child EF. In addition, the indirect effect of mother education on child EF via maternal contingency was significant, with a point estimate of .10, accounting for 59% of its total effect. The direct effect of child verbal ability continued to be significant, while the direct effect of mother education was not. As such, these results were the same as those obtained by running OLS regression analyses.

4.2.3 Summary

The hypotheses addressed in Section 2.7 for the first research question were partly supported by the findings in this section. That is, the positive relation between maternal effective scaffolding and child EF was replicated in the Korean context, while the negative relation between maternal intrusiveness and child EF was not replicated in the present study. Specifically, in both cases - when using the whole sample and only 4-year-olds, maternal contingency was found to have a significant moderate, positive relation to child EF above and beyond child age, child verbal ability, and mother education. Additionally, maternal contingency was the most influential variable accounting for unique variance in child EF more than any other variables involved in the regression models. When using both the whole sample and 4-year-olds, the significant bivariate correlation between maternal intrusiveness and child EF became insignificant controlling for the three covariates. A difference between using the whole sample and only 4-year-olds, however, was on the deceased unique variance accounted for by child's age when using only 4-year-olds. In addition, both an OLS regression and a path analysis showed the same result that maternal contingency played a mediating part in the link between child's verbal ability and child EF and between mother education and child EF.

It may be inferred from these results that parental provision of contingent scaffolding may be particularly favourable to the development of child EF (when they are about 4 years old) in that maternal contingency accounted for unique variance in child EF more than child age, child verbal ability or mother education did. In addition, the cultural context being investigated should be taken into account when examining the impact of parental intrusiveness on child EF in that the negative impact of intrusiveness that is typically linked to child EF in Western cultures was not found significant with the Korean sample in the present study. Finally, unique variance in child EF that is accounted for by child age may decrease due to the sample being more homogenous in terms of child's age. This finding implies that child's age is an influential factor that should be taken into account in research on EF development during the preschool period.

In addition, it is indicated from the mediation analyses that children with higher verbal ability may have a mother who is more likely to provide contingent scaffolding during mother-

child interactions, which may contribute to enhanced child EF skills. That is, children who are more verbally proficient are more likely to induce their mother to provide more quality support, which ultimately contributes to the development of EF skills. In addition, mothers with higher educational attainment tend to provide more contingent scaffolding to the child's verbal and behavioural responses, which may in turn lead to the child's increased EF skills. While both child verbal ability and mother education are shown to contribute to the development of child EF, their contribution may differ in nature. That is, the child's part is emphasised in the link between child's verbal ability and child EF. The maternal contingent or non-contingent responses may hinge on the child's verbal ability and thus the quality of mother-child interaction partly depends on the role that the child plays.

4.3 FindingsⅡ. Exploration for maternal verbal aspects linking to child EF (RQ2)

Does maternal verbal input during a reminiscing task significantly relate to child EF?

The second research question concerned the relation of maternal verbal input during mother-child reminiscing to child EF. This question was explored by carrying out correlation and regression analyses. As addressed in section 3.4.3, four aspects of maternal verbal input were examined, with each aspect operationalized with three variables, as shown in Table 4.11.

Table 4. 11 Variables operationalized to represent maternal verbal input during the reminiscing task

Aspects of maternal verbal input	Variables
Maternal elaboration (the total score of OQ, CQ, and ES)	OQ(open questions) CQ(closed questions) ES(elaborative statements)
Semantic connection	Connectedness Initiation Failure
Maternal MR (the total score of CR, ER, and DR)	CR(cognition references) ER(emotion references) DR(desire references)
Maternal CMR (the total score of CCR, CER, and CDR)	CCR(connected cognition references) CER(connected emotion references) CDR(connected desire references)

4.3.1 When using the whole sample (N=92 dyads)

The variables in Table 4.11 as well as the three covariates (child verbal ability, child age, mother age, and mother education) were examined for their zero-order correlations with child EF. The results are shown in Table 4.12, below.

Table 4. 12 Zero-order correlations among the variables involved in the 2nd research question (N=92)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.	Child EF																			
2.	Maternal Elaboration	0.11																		
3.	OQ	0	0.04																	
4.	CQ	0.07	0.57***	-0.25*																
5.	ES	0.05	0.29**	-0.45***	-0.22*															
6.	Connected-ness	0.11	-0.04	-0.2	0.12	0.01														
7.	Initiation	0	0.06	0.16	-0.17	0.04	-0.82***													
8.	Failure	-0.22*	0.09	0.18	-0.05	0.04	-0.8***	0.41***												
9.	Maternal MR	0.22*	0.04	-0.07	-0.12	0.25*	-0.08	0.1	0											
10.	CR	0.08	0.15	-0.15	0.08	0.2	0.06	-0.08	-0.11	0.4***										
11.	ER	0.22*	-0.17	0.06	-0.22*	0.09	-0.11	0.07	0.05	0.77***	0.01									
12.	DR	-0.04	0.05	-0.05	-0.09	0.24*	0.04	-0.02	-0.04	0.41***	-0.05	0.1								
13.	Maternal CMR	0.35***	0.19	-0.11	0.14	0.21*	0.35***	-0.27**	-0.35***	0.61***	0.32**	0.45***	0.28**							
14.	CCR	0.07	0.09	-0.14	0.11	0.11	0.28**	-0.2	-0.33**	0.24*	0.76***	-0.08	-0.03	0.40***						
15.	CER	0.33**	0.14	-0.04	0.14	0.11	0.17	-0.13	-0.16	0.55***	0.01	0.66***	0.11	0.80***	-0.01					
16.	CDR	0.07	0.05	-0.18	0.02	0.23*	0.19	-0.08	-0.27*	0.21*	-0.08	-0.02	0.71***	0.37***	-0.02	0.12				
17.	Child verbal ability	0.58***	0.2	-0.05	0.03	0.25*	0.12	-0.06	-0.12	0.11	0.02	0.11	0.15	0.21*	-0.08	0.18	0.15			
18.	Child age	0.54***	-0.07	0	-0.01	0	0.11	0.05	-0.25*	0.12	0.08	0.12	0.01	0.27**	0.07	0.24*	0.19	0.44***		
19.	Mother age	0.05	-0.2	-0.11	-0.04	-0.07	0.02	-0.06	0	-0.19	-0.11	-0.11	-0.08	-0.07	0.04	-0.15	0.03	0.03	0.05	
20.	Mother education	0.28**	0.14	-0.31**	0.17	0.2	-0.06	0.08	-0.02	-0.06	0.07	-0.15	-0.06	-0.07	0.05	-0.11	-0.06	0.19	0.11	0

Note. **EF**=executive function, **OQ**=open-ended questions, **CQ**=closed-ended question, **ES**=elaborative sentences, **MR** = mental-state references, **CR**=cognition references, **ER**=emotion references, **DR**=desire references, **CMR**: connected mental-state references, **CC**R=connected cognition references, **CER**=connected emotion references, **C**DR=connected desire references
*$p < .05$, ** $p < .01$, *** $p < .001$

As shown in Table 4.12, the three variables representing maternal elaboration (OQ, CQ, and ES) were not correlated with child EF. That is, elaborating on the child's utterances by using open/close ended questions or informative statements were not associated with the child's EF skills. Of the three variables representing semantic connection (connectedness, initiation, and failure), only Failure (the mother's failing to provide semantically connected utterances) was found to have a weak, negative correlation with child EF. Mothers' initiating a new topic or providing an utterance within a semantically connected context was not related to the child's EF skills. The reason Connectedness was not correlated with child EF may be due to the nature of the reminiscing task in the present study. That is, the context of the conversation was more structured (the mothers were specifically asked to talk about shared past experiences), relative to those in a natural setting (e.g., free conversations during meal preparation or a meal at home; Ensor & Hughes, 2008). Mothers who talk to their children while preparing or having a meal may focus less-than-perfect attention to the child's utterances than when they are explicitly required to talk about a topic in a given time. The Korean mothers in the present study rarely failed or ignored the child's utterances. As shown in Table 4.2, the raw mean frequency of maternal Connectedness was significantly greater than those of maternal Initiation or Failure, and the high scores of semantic connection across all mothers may not have been discriminatory enough, leading to an insignificant relation of Connectedness to child EF.

In addition, both MR (maternal mental-state references; sum of CR, ER, and DR) and ER (emotion references) are shown in Table 4.12 to have a weak, positive correlation with child EF. Similarly, both maternal CMR (connected mental-state references; sum of CCR, CER, and CDR) and CER (connected emotion references) were modestly, positively correlated with child EF. However, maternal MR and ER are shown to be highly correlated with each other, and maternal CMR and CER are also shown to be highly correlated since they are conceptually closely related with each other. These correlations indicated that, while maternal MR was related to child EF, maternal ER was particularly relevant to child EF, given that MR was operationalized as the sum of CR, ER, and DR (note that ER accounted for 54% of maternal MR; see Table 4.2). Similarly, while maternal CMR was related to child EF, maternal CER was shown to be particularly relevant to child EF (note that maternal CER accounted for 55% of maternal CMR; see Table 4.2).

Finally, in Table 4.12, the three covariates of child EF (child verbal ability, child age, and mother education) are shown to have weak to modest correlations with child EF. In addition, weak, positive correlations are shown in Table 4.12 between child verbal ability and maternal CMR, between child age and maternal CMR, and between child age and maternal CER. That is, children who were verbally more proficient were found to have a mother who provided more

CMR. In addition, mothers were more likely to provide CMR or CER when their child was relatively older.

Then, the five variables that were found to significantly link to child EF (maternal failure, MR, ER, CMR, and CER) were further examined for their partial correlations with child EF, controlling for the child's age, as shown in Table 4.13

Table 4. 13 Partial correlations controlling for child age

	Partial correlations	*p*-value
Maternal failure	-.06	.57
Maternal MR	.16	.13
Maternal ER	.20	.06
Maternal CMR	.35	.0001**
Maternal CER	.32	.002*

MR=mental-state references, ER=emotion references, CMR=connected mental-state references, CER=connected emotion references, *$p < .01$, **$p < .001$

As shown in Table 4.13, only CMR and CER were significantly correlated with child EF, when controlling for child age. As a result, maternal CMR and CER, along with the three covariates (child verbal ability, child age, and mother education), were selected as predictors for a further regression analysis. However, maternal CMR and CER were highly correlated with each other and could not be entered together in further regression analysis due to the multicollinearity issue. Thus they were entered separately in Step 2A and 2B, following the three covariates in Step1. The results are shown Table 4.14.

Table 4. 14 Summary of regression analysis for the second research question (N=92)

	R^2	ΔR^2	F	ΔF	β	t	pr	sr^2
Step 1								
Covariates	.42		21.26**					
Child age					.35	3.94**	.39**	.32(.10)
Child verbal ability					.36	4.09**	.40**	.33(.11)
Maternal education					.16	1.87	.20	.15(.02)
Step 2A	.49	.07	20.79**	11.64**				
Child age					.29	3.44**	.35*	.26(.07)
Child verbal ability					.31	3.63**	.36*	.28(.08)
Mother education					.19	2.37	.25	.18(.03)
Maternal CMR					.28	3.41**	.34*	.26(.07)
Step 2B	.49	.07	20.71**	11.46*				
Child age					.29	3.44**	.35*	.24(.07)
Child verbal ability					.33	3.89**	.38**	.30(.09)
Mother education					.19	2.34	.24	.18(.03)
Maternal CER					.27	3.39*	.34*	.26(.07)

Note. CMR = connected mental-state references; CER: connected emotion references
pr = partial correlation, *sr*: semipartial correlation (part correlations)
sr^2: semipartial correlation squared (the unique variance in child EF explained by a predictor)
*$p < .01$, **$p < .001$

In Table 4.14, maternal CMR in Step 2A was a significant predictor of child EF, accounting for 7% of unique variance in child EF. Maternal CER in Step 2B also was a significant predictor of child EF, accounting for 7% of unique variance in child EF. Maternal CMR and CER explained the same amount of unique variance in child EF in Step 2A and 2B models. In both models, the variable that accounted for the most unique variance in child EF was child verbal ability. Child age also was a significant variable explaining child EF, accounting for a similar amount of unique variance in child EF as maternal CMR or CER did.

These significant relations of CMR and CER to child EF were above and beyond the effect of child age, child verbal ability, and mother education. Similarly, the partial correlations (*pr*) shown in Table 4.14 indicated that the significant relations of child age or child verbal ability to child EF were independent of other variables involved in the regression models.

Next, regression assumptions were checked according to the suggestions by Field and colleagues (2012). See Appendix 4.3 for detailed calculations for this analysis.

4.3.2 When using only 4-year-olds (N=89 dyads)

The second research question was explored using only 4-years-old to see if its results would be the same as those using the whole participants. Firstly, zero-order correlations were examined, as shown in Table 4. 15.

Table 4. 15 Zero-order correlations among the variables involved in the 2nd research question (N=89)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.	Child EF																			
2.	Maternal Elaboration	0.14																		
3.	OQ	0.05	0.09																	
4.	CQ	0.05	0.60***	-0.31**																
5.	ES	0.08	0.4***	-0.39***	-0.18															
6.	Connected-ness	0.15	-0.19	-0.21	-0.03	-0.02														
7.	Initiation	-0.03	0.13	0.2	-0.06	0.05	-0.81***													
8.	Failure	-0.20	0.19	0.15	0.1	-0.02	-0.84***	0.37***												
9.	Maternal MR	0.15	-0.03	-0.03	-0.15	0.16	-0.03	0.02	0.04											
10.	CR	0.05	0.16	-0.17	0.13	0.17	0.02	-0.06	0.03	0.58***										
11.	ER	0.21*	-0.15	0.1	-0.23*	0.01	-0.06	0.05	0.05	0.77***	0.1									
12.	DR	-0.01	-0.02	-0.05	-0.16	0.2	0	0.03	-0.02	0.63***	0.2	0.21*								
13.	Maternal CMR	0.44***	0.2	-0.07	0.15	0.13	0.34**	-0.22*	-0.33*	0.56***	0.27*	0.51***	0.28**							
14.	CCR	0.14	0.16	-0.09	0.19	0.05	0.29**	-0.2	-0.28*	0.31**	0.71***	-0.02	0.04	0.45***						
15.	CER	0.40**	0.11	0.02	0.06	0.05	0.14	-0.1	-0.13	0.42***	-0.04	0.68***	0.02	0.79***	-0.02					
16.	CDR	0.22*	0.13	-0.12	0.06	0.18	0.27*	-0.15	-0.28*	0.29**	-0.06	0.1	0.61***	0.58***	0.05	0.21*				
17.	Child verbal ability	0.54***	0.24*	-0.05	0.08	0.23*	0.08	-0.07	-0.04	0.13	0.03	0.06	0.18	0.25*	0.04	0.18	0.24*			
18.	Child age	0.50***	-0.02	-0.04	-0.02	0.04	0.18	0.01	-0.29*	0.03	-0.05	0.09	-0.02	0.31**	0.06	0.27**	0.21*	0.43***		
19.	Mother age	0.07	-0.17	-0.12	-0.01	-0.09	0.07	-0.08	-0.03	-0.14	-0.1	-0.09	-0.09	-0.11	-0.01	-0.12	-0.05	0	0.07	
20.	Mother education	0.30*	0.2	-0.24*	0.22	0.19	-0.09	0.08	0.08	0.02	0.17	-0.08	0	-0.04	0.11	-0.04	-0.14	0.22*	0.18	-0.11

Note. **EF**=executive function, **OQ**=open-ended questions, **CQ**=closed-ended question, **ES**=elaborative sentences, **MR** = mental-state references, **CR**=cognition references, **ER**=emotion references, **DR**=desire references, **CMR**: connected mental-state references, **CC**R=connected cognition references, **CER**=connected emotion references, **C**DR=connected desire references

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

In Table 4.15, none of the variables representing maternal elaboration were correlated with child EF. Also, none of the three variables for semantic connection were correlated with child EF. Of the three variables representing maternal MR (CR, ER, and DR), only ER was found to have a weak, positive correlation with child EF. That is, elaborating on the child's utterances by using open or close ended questions and informative statements were not related to the child's increased EF skills. Providing utterances within a context that is semantically connected with the child's former utterances were also not associated with the child's EF skills. In addition, maternal cognition- and desire-related utterances were not linked to child EF. Only emotion-related utterance, however, were found to be significantly related to child EF.

In addition, of the three variables for maternal CMR (CCR, CER, and CDR), CER had a modest, positive correlation with child EF, and DER had a weak, positive correlation with child EF. In addition, maternal CMR (the sum of CCR, CER, and CDR) had a modest, positive correlation with child EF. Due to the conceptual overlap between maternal CMR and CER, these two variables were shown to have a strong correlation. As addressed in Section 4.3.1, while maternal CMR was found to significantly relate to child EF, maternal CER may be particularly more relevant than CMR to child EF, given that CMR was operationalized as the sum of CCR, CER, and CDR.

Along with these variables, the three covariates - child verbal ability, child age, and mother education - were shown to have modest, positive correlations with child EF. These three variables were also shown to have significant correlations with variables representing maternal verbal input. That is, weak to modest positive zero-order correlations were shown between child verbal ability and CMR/CDR and between child age and CMR/CER/CDR. Finally, child verbal ability was shown to have a weak correlation with mother education and a modest correlation with child age. In other words, mothers were more likely to provide mental-state references when their child was relatively older, which was the same result when using the whole sample in Section 4.3.1.

Next, the four variables that were found to have significant zero-order correlations were further examined for their partial correlations with child EF by controlling for child age, as shown in Table 4.16.

Table 4. 16 Partial correlations between variables representing maternal verbal input and child EF, controlling for child age (N=89)

	Partial correlation	*p*-value
Maternal ER	.19	.069
Maternal CMR	.34	.0001**
Maternal CER	.31	.003*
Maternal CDR	.14	.201

Note. ER=emotion references, CMR=connected mental-state references, CER=connected emotion references, CDR=connected desire references *p < .01, **p < .001

In Table 4.16, maternal CMR and CER were found to have modest positive correlations with child EF, controlling for child age. Since they were highly correlated with each other (see Table 4.15), they could not be simultaneously entered into regression models due to the multicollinearity issue. Thus, in conducting a further regression analysis, they were separately entered in Step 2A and 2B, following the three covariates (child verbal ability, child age, and mother education) in Step 1. The results are shown in Table 4.17.

Table 4. 17 Summary of regression exploring the second research question (N=89)

	R^2	ΔR^2	F	ΔF	β	t	pr	sr^2
Step 1								
Covariates	.41		19.54**					
Child age					.31	3.32*	.34*	.28(.08)
Child verbal ability					.38	4.06**	.40**	.34(.11)
Maternal education					.16	1.91	.20	.16(.03)
Step 2A	.48	.07	19.59**	12.09**				
Child age					.23	2.61	.27	.20(.04)
Child verbal ability					.33	3.74**	.38**	.29(.09)
Mother education					.20	2.42	.26*	.19(.04)
Maternal CMR					.29	3.48**	.35*	.27(.07)
Step 2B	.48	.07	19.16**	11.04*				
Child age					.24	2.67*	.28	.21(.04)
Child verbal ability					.35	3.96**	.40**	.31(.10)
Mother education					.19	2.36	.25	.19(.03)
Maternal CER					.27	3.33*	.34*	.26(.07)

Note. CMR = connected mental references: CER=connected emotion references
pr = partial correlation, *sr*: semipartial correlation (part correlations)
sr^2: semipartial correlation squared (the unique variance in child EF explained by a predictor)
*p < .01, **p < .001

In Table 4.17, child age is shown to account for a smaller amount of unique variance in child EF, compared to those shown in Table 4.14 based on the data from the whole sample. Specifically, child age in Table 4.17 accounted for 8% (Step 1), and 4% (both in Step 2A and 2B), which are 2 % or 3% less than those in Table 4.14. The unique variance in child EF that was accounted for by maternal CMR or CER, however, was same as that in Table 4.14 using the

whole sample. In Table 4.17, both maternal CMR and CER in Step 2A and 2B were significant predictors of child EF, accounting for 7% of unique variance in child EF.

4.3.3 Summary

Section 4.3 has focused on exploring aspects of maternal verbal input that would potentially significantly relate to child EF, given that only parental scaffolding, mainly in joint problem-solving contexts, has predominantly been focused on in the literature. The results in Section 4.3 indicated that mental-state references, particularly emotion-related, within semantically connected contexts, were positively related to child EF. Specifically, when analysing using the whole sample, among a total of 12 variables representing the four aspects of maternal verbal input, five variables were found to bivariately correlate with child EF: maternal failure, MR, ER, CMR, and CER. When controlling for the three covariates, however, only maternal CMR and CER were found to significantly account for unique variance in child EF (7%). When analysing data from only 4-year-olds, four variables were found to bivariately correlate with child EF: maternal EF, CMR, CER, and CDR. When controlling for the three covariates of child EF, however, only CMR and CER, were shown to account for 7% of unique variance in child EF, which was the same result when using the whole sample. However, a difference was found between the two cases. Child's age explained less unique variance in child EF when using only 4-year-olds than when using the whole sample.

It may be inferred from these results that maternal references to mental states themselves (either emotions or desires, as found in this section) may not be sufficient to have positive effects on child EF. Instead, crucial to the development of child EF may be the context in which maternal references to mental states occur, in that it was CMR or CER, not MR or ER, that significantly related to child EF. In addition, while both CMR and CER were significant factors explaining child EF, emotion-related rather than broad mental-states references may be focused on for their significance, given that CMR was defined as the sum of CCR, CER, and CDR and that CER accounted for more than half CMR (see Table 4.2). Finally, the contribution of child age to child EF may decrease when using a sample that is more homogenous in terms of child's age, which was the similar tendency addressed in Section 4.2.3.

4.4 FindingsⅢ. Relative relations of parenting and maternal EF to child EF (RQ3)

To what extent do the parenting behaviours (maternal contingency and verbal input) and maternal EF account for unique variance in child EF, above and beyond covariates of child EF (child age, child language and maternal educational levels)?

The third research question concerned the extent to which maternal parenting (contingency and verbal input during reminiscing) and maternal EF accounted for child EF. As the first step in exploring this question, correlations (zero-order and partial) were first calculated. Then a regression analysis was conducted to examine unique variance in child EF that parenting behaviours and maternal EF explained.

4.4.1 When using the whole sample (N=92 dyads)

The variables to be involved in exploring the third research question were determined based on the results from the first and second research questions. In Section 4.2.1, maternal contingency not intrusiveness was found to significantly relate to child EF. In Section 4.3.1, among the 12 variables for maternal verbal input, only CMR and CER were shown to significantly associate with child EF. As such, these three variables (maternal contingency, CMR, and CER) were included as variables of interest to the current subsection. Table 4.18 shows the zero-order correlations among all the variables involved in exploring the third research question.

Table 4. 18 Zero-order correlations among the variables involved in the 3rd research question (N=92)

		1	2	3	4	5	6	7	8	9	10
1.	Child EF (composite)										
2.	Maternal WM	-0.01									
3.	Maternal inhibition	0.17	0								
4.	Maternal shifting	0.47***	0.06	0.30**							
5.	Maternal contingency	0.54***	0.08	0.06	0.23*						
6.	Maternal CMR	0.42***	-0.07	0.12	0.25*	0.08					
7.	Maternal CER	0.23*	-0.03	0	0.14	0.14	0.51***				
8.	Child verbal ability	0.53***	-0.06	-0.09	0.14	0.36***	0.25*	0.07			
9.	Child age	0.51***	-0.07	0.04	0.31**	0.22*	0.26*	0.11	0.38***		
10.	Mother age	0.05	-0.01	-0.04	-0.20	-0.02	-0.10	-0.1	0.01	0.05	1
11.	Mother education	0.30**	0.02	-0.01	0.27**	0.35***	-0.04	-0.07	0.22	0.17	-0.09

Note. EF=executive function, WM=working memory, CMR=connected mental-state references, CER=connected emotion references

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

As shown in Table 4.18, the correlations among the three maternal EF scores were not correlated high enough to form a composite score. As such, a composite for maternal EF was not created, and the three maternal EF scores were explored individually. The account on the nature of EF structure by Miyake and colleagues (2000) was based on the data of young college students' performance and has not been replicated with populations in different age ranges across cultures. The EF structure in Korean women aged between 28 and 47 has never been examined and further research is required to see whether the maternal EF data in the present study would be similar to those obtained from other Korean samples.

As shown in Table 4.18, among the three maternal EF scores, only maternal shifting was shown to significantly correlate with child EF (a moderate, positive zero-order correlation). Maternal shifting also had weak to moderate correlations with maternal inhibition, contingency and CMR, which indicated that mothers with higher shifting scores tended to have higher inhibition scores, and they provided more contingent scaffolding and more mental-state references in semantically connected contexts. In addition, maternal shifting was correlated with child age and mother education, which implied that mothers with higher shifting scores were more likely to have older children and tended to have higher educational attainment.

Another interesting point shown in Table 4.18 is regarding the relations among contingency (observed during the puzzle task) and CMR/CER (observed during the reminiscing task). There were no significant relations in these parenting behaviours observed in the two kinds of parent-child interactions. This tendency indicated that mothers who were more contingent during the puzzle task did not necessarily provide more mental state references overall, particularly those related to emotions during the reminiscing task.

Along with maternal shifting, five variables are shown in Table 4.18 to have weak to moderate, positive zero-order correlations with child EF: CMR, CER, child verbal ability, child age, and mother education. Since maternal CMR and CER were already examined in Table 4.13 for its partial correlations with child EF (and they were found to have significant relations with child EF, controlling for child age), only maternal shifting is further examined in the current subsection for its partial correlation with child EF. The result is shown in Table 4.19.

Table 4. 19 Partial correlations controlling for child age and mother age (N=92)

	Estimate	*p*-value
Maternal shifting	.39	.0001**

*$p < .01$, **$p < .001$

In Table 4.19, maternal shifting has a moderate, positive relation to child EF, even after controlling for child age and mother age (i.e., mother age was an influential correlate of maternal EF). Therefore, maternal shifting was retained as a predictor in subsequent regression analyses, along with maternal contingency, CMR, and CER.

In carrying out a regression analysis, the three covariates were entered in Step 1. Then, the rest of the predictors of interest were simultaneously entered in Step 2, because these variables had not been explored in prior research and it was not possible to determine the order of entering them. Step 2, however, was divided into 2A and 2B due to the high correlation between CMR and CER (see Table 4.12). In this way, the number of predictors in Step 2A and 2B was six, and *p*-value was adjusted to .0084 (.05/6=.0083). The results of the regression analyses are shown in Table 4.20.

Table 4. 20 Summary of regression exploring the third research question (N=92)

	R^2	ΔR^2	F	ΔF	β	t	pr	sr^2
Step 1								
Covariates	.42		21.26**					
Child age					.35	3.94**	.39**	.10
Child verbal ability					.36	4.09**	.40**	.11
Maternal education					.16	1.87	.20	.02
Step 2A								
Child age	.63	.21	23.81**	15.71**	.22	2.90*	.30*	.04
Child verbal ability					.24	4.05*	.31*	.04
Mother education					.04	0.56	.06	.00
Maternal CMR					.23	3.14*	.32*	.04
Maternal shifting					.22	3.01*	.31*	.04
Maternal contingency					.33	4.35**	.43**	.08
Step 2B								
Child age	.62	.20	23.53**	15.37**	.22	2.93*	.30*	.04
Child verbal ability					.25	3.28*	.34*	.05
Mother education					.04	0.54	.06	.00
Maternal CER					.22	3.02*	.31*	.04
Maternal shifting					.22	2.94*	.30*	.04
Maternal contingency					.33	4.33**	.43**	.08

Note. CMR = connected mental-state references, CER = connected emotion reference
*p < .0083, **p < .001

The focus of the regression analyses in Table 4.20 was on the relative contribution of parenting and maternal EF to child EF. In both Step 2A and 2B, maternal contingency was shown to account for more unique variance in child EF than maternal shifting did (double the amount maternal shifting did). In addition, maternal CMR in Step 2A and CER in Step 2B were shown to account for a similar amount of unique variance in child EF as maternal shifting did (4%). The significant partial correlations shown in Table 4.20 indicated that the significant relation of a variable to child EF was independent of other variables involved in each model.

Next, assumptions for these regression analyses were checked, based on the guidelines by Field and colleagues (2012). The results indicated that the inferences drawn from the regression models were valid (see Appendix 4.4 for more details). Even with all these significant results shown in Table 4.20, it should be pointed out here that the sample size (N=92) of the present study was not sufficient for a regression analysis including six predictors (Field et al., 2012).

4.4.2 When using only 4-year-olds (N=89 dyads)

The third research question was explored again using only 4-year-olds. Zero-order correlations of the variables involved in this question are shown in Table 4.21.

Table 4. 21 Zero-order correlations among the variables involved in the 3rd research question (N=89)

		1	2	3	4	5	6	7	8	9	10
1.	Child EF (composite)										
2.	Maternal WM	0									
3.	Maternal inhibition	0.16	0.01								
4.	Maternal shifting	0.44***	0.07	0.30**							
5.	Maternal contingency	0.54***	0.08	0.06	0.23*						
6.	Maternal CMR	0.44***	-0.08	0.13	0.27*	0.08					
7.	Maternal CER	0.21*	-0.03	0.01	0.11	0.13	0.51***				
8.	Child language	0.54***	-0.07	-0.09	0.15	0.36***	0.25*	0.06			
9.	Child age	0.49***	-0.06	0	0.27**	0.21*	0.30**	0.09	0.42***		
10.	Mother age	0.07	-0.01	-0.03	-0.17	-0.03	-0.11	-0.09	0.01	0.08	
11.	Mother education	0.30**	0.02	-0.01	0.28**	0.34**	-0.04	-0.08	0.22*	0.16	-0.1

Note. *$p < .05$, **$p < .01$, ***$p < .001$

In Table 4.21, among the three maternal EF scores, maternal shifting was the only variable that was correlated with child EF (a moderate, positive zero-order correlation). Maternal shifting also had weak positive correlations with maternal inhibition, contingency, CMR, child age, and mother education. The partial correlation between maternal shifting and child EF, controlling for child age and mother age, was also calculated, which was .33 (p = .0014). As such, maternal shifting was entered in the subsequent regression analysis as a predictor of interest, along with other variables that are shown in Table 4.21 to significantly

correlate with child EF (maternal contingency, CMR, and CER). The results are shown in Table 4.22. As shown in Table 4. 20, *p*-value was adjusted to .0084, and it is pointed out here again that the sample size (N=89) in the current subsection was not sufficient for a regression model including six predictors (Field et al., 2012).

Table 4. 22 Summary of regression exploring the third research question (N=89)

	R^2	ΔR^2	F	ΔF	β	t	pr	sr^2
Step 1								
Covariates	.41		19.54**					
Child age					.31	3.32*	.34*	.08
Child verbal ability					.38	4.06**	.40**	.11
Maternal education					.16	1.91	.20	.03
Step 2A	.62	.21	22.19**	15.11**				
Child age					.18	2.31	.25	.02
Child verbal ability					.25	3.09*	.32*	.04
Mother education					.05	0.67	.07	.00
Maternal CMR					.24	3.22*	.33*	.05
Maternal shifting					.20	2.68	.28	.03
Maternal contingency					.33	4.35**	.43**	.09
Step 2B	.61	.20	21.72**	14.56**				
Child age					.19	2.37	.25	.03
Child verbal ability					.27	3.30*	.34*	.05
Mother education					.05	0.61	.07	.00
Maternal CER					.22	3.03*	.32*	.04
Maternal shifting					.21	2.69	.29	.03
Maternal contingency					.33	4.32**	.43**	.09

Note. CMR = connected mental-state references, CER = connected emotion references
*p < .0084, **p < .001

The regression analyses in Table 4.22 shows the relative contributions of parenting and maternal EF to child EF. Notable in Table 4.22 is that maternal shifting in both Step 2A and 2B was not a significant predictor of child EF, which differs from the results using the whole sample (see Table 4.20). Parenting behaviours in Table 4.22 instead accounted for unique variance in child EF slightly more than when using the whole sample. The variable that had the greatest value of semi-partial correlation squared was maternal contingency in both Step 2A and 2B, followed by CMR in Step 2A and CER in Step 2B. The partial correlations (*pr*) indicated that the significant relations between child verbal ability/ CMR/ contingency with child EF were independent of the effects of other variables included in each regression model. Finally, regression assumptions were checked (see Appendix 4. 6 for more details).

4.4.3 Summary

The third research question aimed at investigating the relative contribution of parenting and maternal EF to child EF. In both cases - using the whole sample and only 4-year-olds - maternal contingency was found to have the greatest semi-partial correlation squared (8% when using the whole sample and 9% using only 4-year-olds). Differences were also found between the two cases. When using the whole sample, maternal shifting accounted for a similar amount of unique variance in child EF as maternal CMR or CER did (4%). When using only 4-year-olds, however, the relation of maternal shifting to child EF became insignificant, while maternal CMR and ER continued to account for child EF (4% or 5%). In addition, the link between child age and child EF became insignificant.

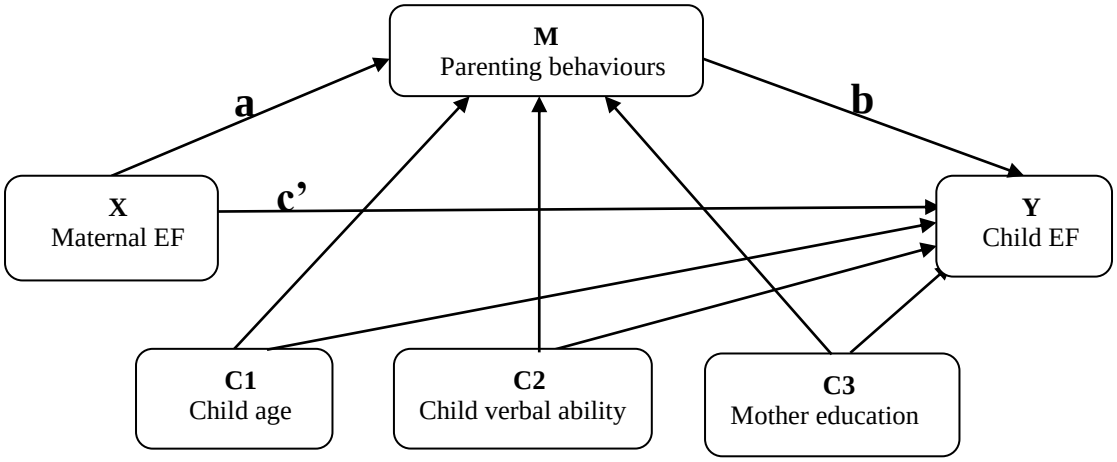
It may be inferred from these results in this section that the maternal EF-child EF link may vary across the child's developmental phases. In support of this account are the findings that the link between maternal shifting and child EF differed between using the whole sample and using only four-year-olds. In addition, maternal contingency was found to account for twice (when using the whole sample) or three times (when using only 4-yar-olds) the unique variance that maternal shifting did. The amount of unique variance in child EF, which maternal CMR or CER accounted for also changed when using only 4-year-olds. In any case, consistent across these findings was that maternal contingency accounted for more unique variance in child EF, than maternal shifting did. Taken together, child's age range may be an influential factor that should be taken into account when exploring the relative contribution of parenting and parental EF to the development of child EF.

4.5 Findings Ⅳ. Mediating role of parenting in the maternal EF and child EF link (RQ4)

Do the maternal parenting behaviours mediate the link between maternal EF and child EF?

The fourth research question concerned the indirect effect of maternal EF (shifting) on child EF via maternal parenting behaviours. A conceptual diagram for the mediating role of parenting behaviours in the maternal EF-child EF link is shown in Figure 4.6.

Figure 4. 6 Conceptual diagram for the indirect effect of child verbal ability on child EF with two covariates



Note. X: predictor, C1; covariate 1, C2: covariate 2, M: mediator, Y: outcome

The relations shown in Figure 4.6 are based on the mediation concepts addressed in Section 4.2.1.3. Figure 4.6 contains two outcome variables (M and Y) and five predictors (two antecedent variables – X and M and three covariates – C1, C2, and C3). This conceptual diagram presents a simple mediating model having parenting behaviours as only one mediating variable. Since this model includes two outcome variables, two regression models are required, one having parenting behaviours as its outcome and the other having child EF as its outcome. Note that parenting behaviours are shown to be both an outcome in one regression model and a predictor in the other model. The goal of running these two models is to estimate coefficients relevant to direct and indirect effects of maternal EF on child EF via a parenting behaviour. This is calculated as a*b, which refers to the difference in the child's EF skills for mothers who differ on their EF skills by one score point, controlling for the three covariates. Note that *a* indicates a difference in a given parenting behaviour between mothers who differ by one score point on their EF skills, and that b refers to a difference in the child's EF skills for mothers who differ on a parenting behaviour by one score point, but have the equal score on their EF skills. In addition, the direct effect of maternal EF on child EF is c', which refers to a difference in the child's EF skills for mothers who differ on their EF skills by one point score, but have the same score on a parenting behaviour, controlling for the three covariates.

As discussed in Section 3.5.4, the analytic strategy throughout section 4.5 was to use two methods; an OLS regression-based mediation followed by a Structural Equation Modelling (SEM) path analysis. In conducting these two methods, maternal contingency was used as a mediating factor, which was consistently found across Section 4.2 and 4.4 to have a significant relation to child EF.

4.5.1 When using the whole sample (N=92 dyads)

In examining a mediating role of parenting in the maternal EF-child EF link, two regression models were tested; one having maternal contingency as the outcome and the other having child EF as the outcome. The results are shown in Table 4.23.

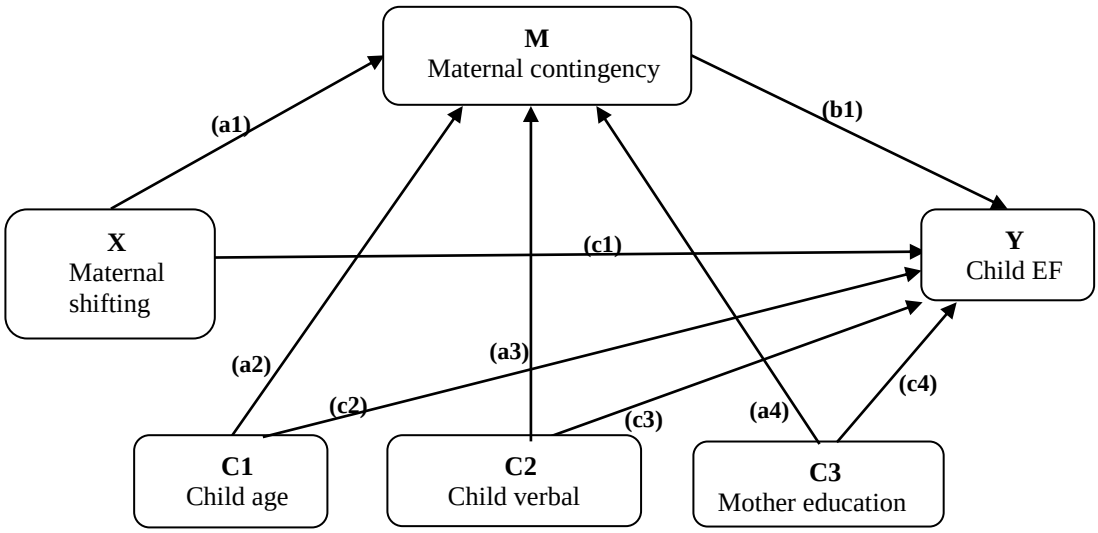
Table 4. 23 Model coefficients from an OLS regression analysis exploring the fourth research question (N=92)

	Consequent					
	M(Maternal contingency)			Y(Child EF)		
Antecedent	Standardized coefficient	S.E.	*p*	Standardized coefficient.	S.E.	*p*
X1(maternal shifting)	**(a1)** .11	.10	.277	**(c1)** .28	.08	.0001**
C1(child age)	**(a2)** .03	.11	.760	**(c2)** .25	.08	.002*
C2(child verbal ability)	**(a3)** .28	.10	.008*	**(c3)** .28	.08	.0001**
C3(mother education)	**(a4)** .25	.10	.015	**(c4)** .00	.08	.951
M(maternal contingency)	_	_	_	**(b1)** .32	.08	.0001**
	R^2 = .22			R^2 = .58		
	$F(4,87) = 6.17$, $p < .001$**			$F(4,84) = 24.13$, $p < .001$**		

Note. a1, a2, a3, b1, c1, c2, and c3 correspond to those shown in Figure 4.7, below.
*$p < .01$, **$p < .001$

Based on the standardized coefficients in Table 4.23, the effects of the independent and covariates on child EF are visualised in Figure 4.7. The coefficients - a1, a2, a3, b1, c1, c2, and c3 - that are shown in Table 4.23 correspond to those shown in Figure 4.7.

Figure 4. 7 Statistical diagram for the indirect effect of maternal EF on child EF via maternal contingency (N=92)



Note. Standardized path coefficients are shown.

In Figure 4.7, the indirect effect of maternal shifting on child EF via maternal contingency was calculated as a1*b1, which was .04. A bias-corrected bootstrap SE was .07. A bootstrap confidence interval for this indirect effect based on 5,000 bootstrap samples was between -.007 and .098, which included zero, thus indicating that maternal contingency did not mediate the maternal EF-child EF link. The direct effect of maternal shifting on child EF, however, was shown to be significant, as represented as c1, which indicated that mothers who had the same score on their EF skills but differed on their contingency by one score point had children who differed in their EF skills by .28 score points.

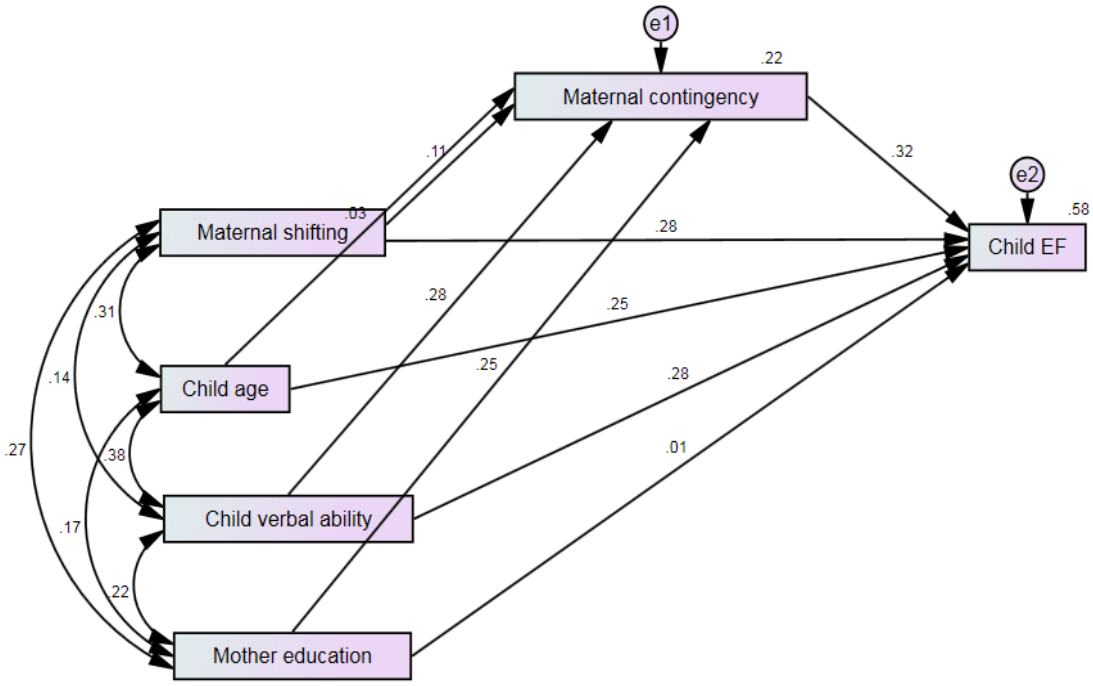
Instead, child verbal ability and mother education were found to have significant indirect effects on child EF via maternal contingency, which was not expected a priori. In Figure 4.7, the indirect effect of child verbal ability on child EF was calculated as a3*b1, which was .09. Its bootstrap SE, based on 5,000 bootstrap samples, was .04 and a bootstrap confidence interval was between .033 and .176, which was above zero. In addition, the direct effect of child verbal ability on child EF was significant, as represented as c3.

In conceptual terms, children who differ in their verbal ability by one score point would have mothers who differ in maternal contingency by .28 point score (a3). Children who differ in their verbal ability by one score point and whose mothers have the same contingency score would have child EF scores that differ by .32 point (b1). As a result of these effects, children who differ in their verbal ability by one score point would have EF scores that differ by .09 point (a3*b1). In addition, children who differ in their verbal ability by one score point and whose mothers have the same contingency score would have EF scores that differ by .28 point (c3).

Similarly, the indirect effect of mother education on child EF was computed as a4*b1, which was .08. Its bootstrap SE was .04 and a confidence interval was .014 and .178, which was above zero. In conceptual terms, mothers who differ in their educational attainment by one score point would differ in the extent to which they are contingent by .25 point score (a4). In addition, mothers who differ on their degrees of being contingent by one score point but have the same degree of educational attainment would have children who differ on their EF skills by .32 point score (b1). As a result of these effects, mothers who differ in their educational attainment by one score point would have children who differ in their EF skills by .08 point. The direct effect of mother education on child EF, however, was not significant (c4).

Next, in order to investigate whether these findings were also found when using another method of mediation analysis, a path analysis was performed. The results are presented in Figure 4.8.

Figure 4. 8 A path analysis exploring the indirect effect of maternal shifting on child EF via maternal contingency (N=92)



Note. Standardized path coefficients are shown.

The model in Figure 4.8 was a good-fitting measurement model in that it was saturated and goodness of fit tests were not available (chi square = .000, *df* = 0, GFI=1.000). This path analysis further produced the effects (direct, indirect, and total) of the four exogenous variables (maternal shifting, child age, child verbal ability, and mother education) on the two endogenous variables (maternal contingency and child EF), as shown in Table 4.24.

Table 4. 24 Direct, indirect, and total effects of maternal shifting on child EF via maternal contingency (N=92)

Effect	Direct	Indirect	Total
On Child EF			
Of maternal shifting	.288	.04	.32*
Of child age	.25*	.01	.26*
Of child verbal ability	.28*	.09*	.37*
Of mother education	.01	.08*	.09
Of maternal contingency	.32*	_	.32*
On maternal contingency			
Of maternal shifting	.11	_	.11
Of child age	.03	_	.03
Of child verbal ability	.28*	_	.28*
Of mother education	.25*	_	.25*

In table 4.24, the indirect effect of maternal shifting on child EF through maternal contingency was not significant. However, the indirect effects of child age and chid verbal ability on child EF were both significant. The indirect effect of child verbal ability was 24% of its total effect on child EF. The indirect effect of mother education was 89% of its total effect on child EF. While the direct effect of child verbal ability on child EF continued to be significant, the direct effect of mother education on child EF was not significant. These results are the same with those obtained by conducting an OLS regression analysis.

4.5.2 When using only 4-year-olds (N=89 dyads)

In this subsection, the procedures carried out in section 4. 5.1 are repeated using the data from 4-year-olds and their mothers in order to investigate whether the mediating role of parenting varies across the child's age range. As addressed in Section 4.5, two regression models were run, one with maternal contingency as the outcome and the other with child EF as its outcome. The results are shown in Table 4.25.

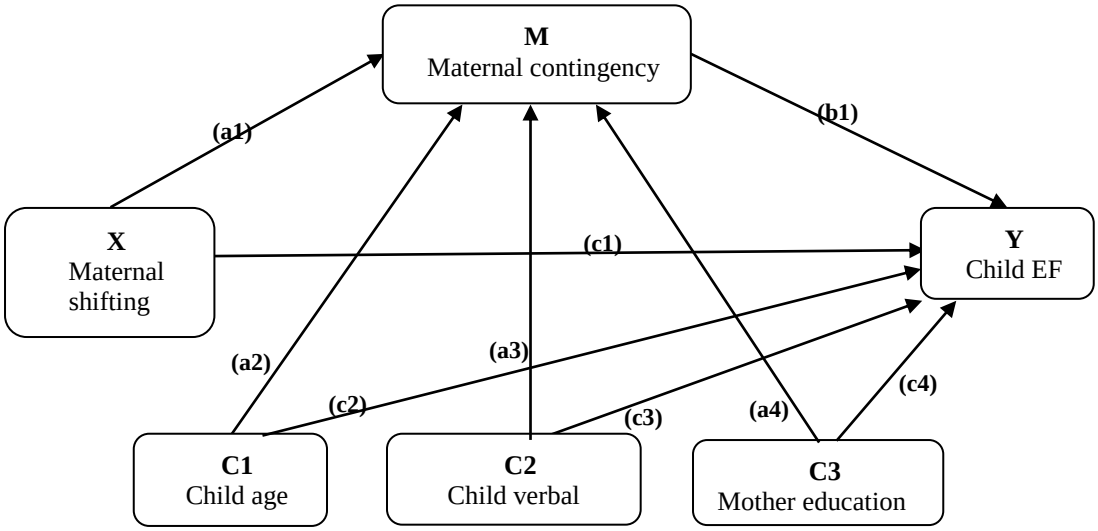
Table 4. 25 Model coefficients for the indirect effect of maternal EF on child EF via maternal contingency (N=89)

	Consequent					
	M(Maternal contingency)			Y(Child EF)		
Antecedent	Standardized coefficient	S.E.	*p*	Standardized coefficient.	S.E.	*p*
X1(maternal shifting)	**(a1)** .11	.11	.285	**(c1)** .27	.08	.001*
C1(child age)	**(a2)** .02	.12	.854	**(c2)** .25	.09	.006*
C2(child verbal ability)	**(a3)** .28	.11	.011	**(c3)** .28	.08	.0001**
C3(mother education)	**(a4)** .24	.10	.021	**(c4)** .01	.08	.891
M(maternal contingency)	_	_	_	**(b1)** .33	.08	.0001**
	R^2 = .21			R^2 = .57		
	$F(4,87) = 5.7$, $p < .001$**			$F(4,84) = 22.07$, $p < .001$**		

Note. a1, a2, a3, b1, c1, c2, and c3 correspond to those shown in Figure 4.9, below.

In Table 4.25, maternal contingency was the only mediating variable, serving as the outcome in the first regression model and as a predictor in the second regression model. These relations are visualised in Figure 4.9, in which the coefficients - a1, a2, a3, a4, b1, c1, c2, c3, and c4 - correspond to those in Table 4.25.

Figure 4. 9 Statistical diagram for the indirect effect of maternal EF on child EF via maternal contingency (N=89)



Note. Standardized path coefficients are shown.

In Figure 4.9, the indirect effect of maternal shifting on child EF via maternal contingency was calculated as a1*b1, which was .04. A bias-corrected bootstrap SE was .07. A bootstrap confidence interval for this indirect effect based on 5,000 bootstrap samples was between -.009 and .101, which included zero, thus indicating that maternal contingency did not mediate the maternal EF-child EF link. The direct effect of maternal shifting on child EF, however, was significant.

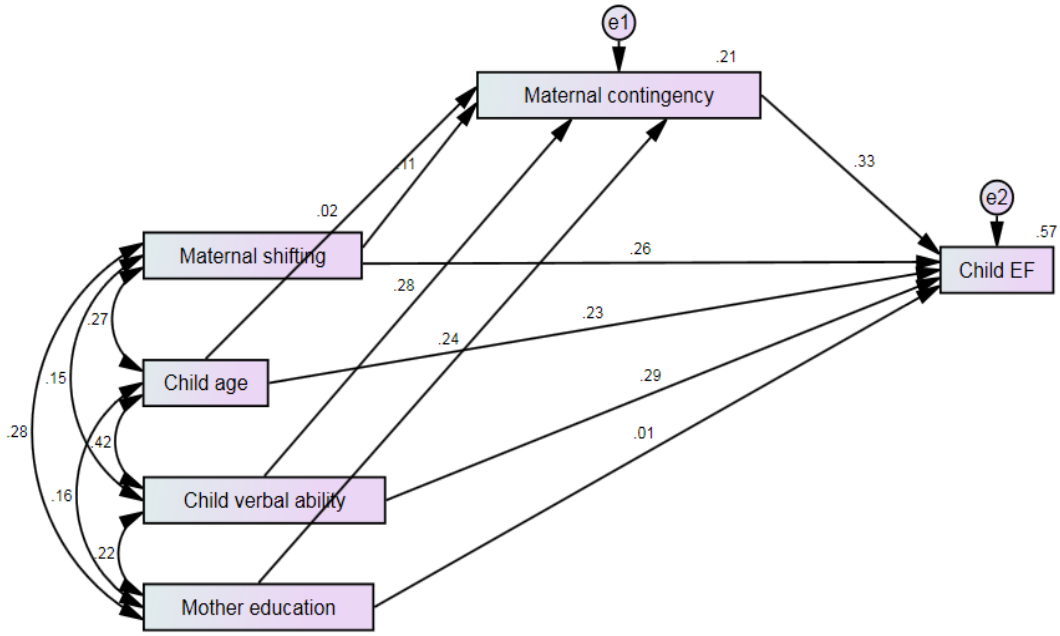
As mentioned in Section 4.2, child verbal ability and mother education were found to have indirect effects on child EF via maternal contingency, which was not expected a priori. In Figure 4.9, the indirect effect of child verbal ability on child EF was calculated as a3*b1, which was .09. Its bootstrap SE, based on 5,000 bootstrap samples, was .04 and a bootstrap confidence interval was between .032 and .183, which was above zero. Similarly, the indirect effect of mother education on child EF was computed as a4*b1, which was .08. Its bootstrap SE was .04 and a confidence interval was between .011 and .177, which was also above zero. As such, maternal contingency was found to play a mediating role between child verbal ability/mother education and child EF, but not between maternal shifting and child EF.

Taken together, in conceptual terms, mothers who differ on their shifting scores by one score point and have the same score on their contingency would have children who differ on their EF skills by .27 point (c1). Children who differ in their verbal ability by one score point would have mothers who differ in their contingency scores by .28 point (a3). In addition, children who have the same verbal score but their mothers have contingency scores that differ

by one score point would have EF skills that differ by .33 point (b1). As a results of these effects, children who differ in their verbal score by one score point would have EF scores that differ by .09 point (a3*b1). In addition, children who have verbal scores that differ by one score point and whose mothers have the same contingency score would have EF scores that differ by .28 point (c3).

Next, in order to investigate these findings were the same as those when using another mediation analysis, a path analysis was performed. The results are presented in Figure 4.10.

Figure 4. 10 A path analysis exploring the indirect effect of maternal shifting on child EF via maternal contingency (N=89)



Note. Standardized path coefficients are shown.

As shown in Figure 4. 10, the model was a good-fitting measurement model in that it was saturated and goodness of fit tests were not available (chi square = .000, *df* = 0, GFI=1.000). This path analysis further produced the effects values (direct, indirect, and total) of the four exogenous variables (maternal shifting, child age, child verbal ability, and mother education) on the two endogenous variables (maternal contingency and child EF), as shown in Table 4.26.

Table 4. 26 Direct, indirect, and total effects of maternal shifting on child EF via maternal contingency (N=89)

Effect	Direct	Indirect	Total
On Child EF			
Of child age	.23*	.01	.24*
Of child verbal ability	.29*	.09*	.38*
Of mother education	.01	.08*	.09
Of maternal contingency	.33*	_	.33*
Of maternal shifting	.26*	.04	.30*
On maternal contingency			
Of child age	.02	_	.02
Of child verbal ability	.28*	_	.28*
Of mother education	.24*	_	.24*
Of maternal shifting	.11	_	.11

In Table 4.26, to the contrary to the expectation in Section 2.7, maternal contingency did not mediate the link between maternal shifting and child EF. Only its direct effect on child EF was significant. Two variables were instead found to have indirect effects on child EF via maternal contingency: child verbal ability and mother education. Specifically, the indirect effect of child verbal ability was 24% of its total effect on child EF. The indirect effect of mother education was 89% of its total effect on child EF. These results are the same as those obtained when using the whole sample (see Table 4.24).

4.5.3 Summary

The main focus of Section 4.5 was on examining the mediating role of parenting in the maternal EF-child EF link, which was not supported by the findings in this section. That is, maternal shifting did not have a significant indirect effect on child EF via maternal contingency. Instead, child verbal ability and mother education were found to have significant indirect effects on child EF via maternal contingency. These results were the same in both cases – when using the whole sample and only 4-year-olds and also when conducting an OLS regression or path analysis. While the path analysis showed the same results as those obtained by the OLS regression analysis, it is addressed here again that the sample size was not technically sufficient for a path analysis.

It is inferred from the results in this section that mothers with higher shifting skills may not be necessarily contingent during a cognitively challenging task, and these two kinds of maternal traits (being proficient at shifting and contingent during mother-child interactions) may have distinct links with child EF, in that only their direct effects on child EF were found to be

significant. Rather, mothers may be more contingent if they are more educated and when their child is verbally more proficient. In other words, mothers with higher educational attainment are more likely to be contingent while interacting with their child, which in turn may lead to advanced EF skills in children. In addition, children who are able to verbally communicate well with their mothers may be more likely to induce their mothers to provide more contingent scaffolding, which may ultimately contribute to the development of child EF skills. Of note in this inference is the role of the child, which contributes to shaping quality mother-child interactions and thus demonstrates the importance of bi-directional nature of social interactions between parents and children.

CHAPTER 5 Final discussion

The aims of this final chapter are (a) to discuss the main findings emerging in the present study; (b) to acknowledge the present study's contributions to psychology and education and its limitations, and (c) to discuss the implications of the present study for future research and practice.

This chapter is structured in five sections. The first section summarises the study's main findings and discusses these findings in relation to the existing body of literature in the fields of executive function (EF) and parenting. The second section addresses the place of the present study in the EF and parenting literature. The third section summarises the study's limitations, some of which have been presented in the previous chapters of this thesis. The fourth section discusses the implications of the present study for educational practice and the final section finishes this chapter with suggestions for future research.

5.1 Discussion of findings

The present study aimed at examining the relations between parental factors and EF development. Previous research has indicated parenting behaviours and maternal EF have relevant links with child EF. But very little research has been devoted, to-date, to investigating these two parental factors simultaneously in relation to child EF. The present study was conducted in an attempt to look at universal and culture-specific links that these two factors might have with child EF in the Korean context. This section is divided in four sections, with each section summarising and discussing the research findings addressed in Chapter 4.

5.1.1 Replication of existing findings in the Korean context (RQ1)

It has been found in the present study that the positive link between parental effective scaffolding – contingency – and child EF was replicated with a Korean sample while the negative link between parental intrusiveness and child EF was not found. In other words, maternal contingent scaffolding may significantly contribute to the development of EF skills in young children, whereas maternal intrusive behaviours may not have particularly a negative relation to children's EF skills in the Korean context. It is worth noting that maternal contingency and intrusiveness were highly inversely correlated with each other. Despite the high correlation, they were shown to be distinctively related to child EF, with maternal contingency being significantly linked to child EF while maternal intrusiveness being insignificant. This null finding on maternal intrusiveness may be partly attributed to the trend of the recruited Korean

mothers being mostly high on their intrusiveness scores, making the link between intrusiveness and child EF significantly less likely to be significant. As discussed in Section 2.3.2.2.2, prior research has hinted at nuanced impacts of negative parenting on child outcomes across cultures. Differential impacts of parental intrusiveness on children across cultures may be found more in a broad literature. Despite limited evidence when considering EF per se, some research has begun to highlight differential links of parental intrusiveness to child EF, particularly between European American and African American samples (Holochwost et al., 2016; Rhodes et al., 2011). In what follows in this section, the discussions are focused on the two findings, with one addressing why maternal contingency might be positively linked to child EF and the other discussing why maternal intrusiveness might not be a significant factor explaining the development of child EF in the Korean context.

5.1.1.1 Why might maternal contingency positively relate to child EF?

Given that maternal contingency was operationalized in the present study as the parental ability to adjust among levels of support to create an optimal challenge for the child, this first question may be accounted for by considering how the parental provision of appropriate task difficulty would contribute to the child's increased EF skills. When the parent adapts a given task in light of the child's current cognitive and affective capacities, the child is provided with right amount of cognitive space. In other words, tasks that are modified as a function of maternal contingency should be manageable and, at the same time, cognitively challenging for the child. As presented in Section 2.3.2.1, if parental intervention is too strong (simplifying the task too much) there will be little necessity for the child to solve the task, which is the negative aspect of maternal scaffolding for the child's cognitive development. This kind of parental intervention is likely to constitute mainly directives. In determining whether a maternal directive was contingent or intrusive, one crucial aspect that was considered in the present study was whether a command or directive was provided upon the errors or requests that the child had made (Recall that maternal directives were operationalized as commands telling the child what to do next, which were basically determined based on the maternal agenda rather than what the child cognitively or emotionally needed). In addition, there should be former evidence that the mother tried lower levels of support, which were not effective, before she tried directives. Thus a parental directive may be contingent or intrusive according to the circumstance in which it is exercised. In accordance with this observation, maternal directives have been found to be beneficial during the toddler years but were not found as such after toddlerhood (Landry, Smith, Swank, & Miller-Loncar, 2000). In order to understand whether and what activities a child is cognitively and affectively engages in, the parent should carefully

observe and know how to utilize the ongoing evidence of the child's understanding of a given task.

The parent's contingent scaffolding is found to have a positive relation to young children's cognitive, affective, and kinaesthetic development, which may be closely linked to advanced EF skills. This implies that the parent knows the right amount of feedback and advice for the child to move on in a given situation, which helps make a given situation more manageable so that the child can move on without being frustrated. While interacting with the parent, the child is furnished with auxiliary resources with which to further engage in cognitive processes (Bibok et al., 2009). This does not imply that the parent should make a task just easier because the child would not continue to engage in the task unless it is cognitively challenging. That is, the significant link between maternal contingency and child EF may be attributed to cognitively manageable and challenging tasks modified as a function of maternal contingency. This account is relevant to the child's zone of proximal development (ZPD) proposed by Vygotsky (1978). The optimal level of challenge can be calibrated based on the caregiver's understanding of the child's ZPD of a given task, which may have been possible for the mothers in the present study to obtain by being aware of the child's ongoing evidence of successful or failed performance over the course of solving the puzzle task. The parental understanding of the child's ZPD includes the timely shift from directives to subtler types of support (e.g., from Level 5 to Level 1), or vice versa (from Level 1 to Level 5). Parental provision of both types of support (directives and subtler support) are required in creating the optimal level of challenge for the child because both types are necessary in making the task easier or harder when the mother needs to increase or decrease the amount of cognitive resources. This kind of parental adjustment should be determined in parallel with the child's cognitive growth (Bibok et al., 2009).

In addition, the child's motivation is enhanced when the parent provides contingent feedback on the activity that the child is currently engaged in (Deci & Ryan, 2000). This implies that it should be the child, not the parent, who leads a parent-child interaction (recall that parental support may be contingent when provided upon the child's requests or errors). If the parent lets the child to be independent in performing on a task, the child may be internally motivated to complete it. This positive relation between parental autonomy support and the child's internal motivation may depend on the quality of parental feedback when the child's is confronted with challenging tasks. That is, the child is more likely to engage in and stay focused longer in a problem-solving context if the parent is proficient at determining and providing the child with just enough amount of work left to perform alone. It would be ideal that the child can perform on a task without the parental help at all, but children do get stuck with a task that is above their current cognitive, affective, and kinaesthetic developmental level. As such, it may

be desirable for the parent to begin with subtler types of feedback so as to match their level of support to the child's current understanding of a cognitively and emotionally challenging context, which would help the child to perform independently without losing interest.

5.1.1.2 Why might maternal intrusiveness not be related to child EF in the Korean context?

As discussed in Section 2.5.1, Korea is a collectivistic country and the null finding between maternal intrusiveness and child EF in the Korean context may be attributed to the difference in perceptions of intrusiveness between individualistic and collectivistic cultures (Grusec, Rudy, & Martini, 1997). As Oh and Lewis (2008) suggested, the relations between social interactions and the development of EF are underpinned by key cultural processes in a given society. That is, parental intrusiveness may have a benign or insignificant impact on child outcomes due to differential psychological reactions across cultures to the apparently same parenting trait. It has been suggested that parental intrusiveness is non-normative in individualistic cultures, in which children may experience parental control as rejection and show the expected negative consequences (Ispa et al., 2004). By contrast, intrusive parenting (i.e., assessed as such from a Western point of view) has been assessed as normative in collectivistic cultures because parents believe that active and strict practices are best for children. In this context, parents are more likely to be intrusive (again, from a Western perspective) for the benefit of their children.

Korean parents are typically viewed as authoritarian, the impact of which, however, has been found not adverse as would be in a Western context (Vinden, 2001). Indeed, it was interesting in the present study that most Korean mothers were found to use directives more than subtler types of feedback. As such, the most frequently exercised maternal behaviours during the puzzle task were those operationalized as intrusiveness (the mother telling the child what to do or doing the puzzle herself; see Section 4.1.2). In collectivistic cultures, where intrusive or authoritarian parenting may be normative, children are more likely to be aware of values and significance of strict parental practices and they may not react to intrusive parenting in the way Western children would do. It has been reported that preschool children do appear to ascribe value to the knowledge they acquire during social interactions, which indicates that young children are aware of parental attitudes and internalise parental values (Chesnokova, 2004). Developmental processes start with social interactions between children and their caregivers, and children between one and two years old do become aware of the demands on social control that are negotiated with their parents (Lewis & Carpendale, 2009). This implies that social interactions can elicit a proper social understanding in a child who internalizes the acquired social knowledge that has personal and emotional meanings (Chesnokova, 2004). As

such, young children who are aware of values and significance of their parents being directive (which is viewed as intrusive from a Western perspective) may not react to parental directives in the way Western children would do, which may not exert a negative impact on the development of child EF.

While the above explanation is sensible in that Korea is typically viewed as collectivistic, the account based on the dichotomous distinction between individualistic versus collectivistic, however, may be an oversimplication, given that Korean society has been highly industrialised and westernised particularly in terms of educational values and practices (Shim et al. ,2008). Indeed, the mothers of 4-year-old children in the present study were relatively young in their thirties or early forties, who were highly educated and thus more likely to adopt western perspectives on desirable parenting behaviours and child development.

Then, how could the null finding be accounted for, given that the young mothers tended to be more or less individualistic and thus less likely to adopt authoritarian parenting practices? Another possible account is that, as addressed in Section 2.5.2, Korean parents are particularly sensitive about their role in children's education and they are likely to actively engage in and direct cognitive activities. Given that the mothers understood that the puzzle task was challenging for their child and that they were supposed to work with their children, it was likely that the mothers felt some responsibility to specifically and actively guide their interaction with their child. This parental attitude may be stronger for mothers with younger children. While controlling, this kind of maternal behaviour has been found to have positive effects on children's academic functioning. Children may thrive academically when parents provide them with needed guidance through behavioural control, as opposed to psychological control having detrimental effects on children (Wang et al., 2007).

The above mentioned accounts so far, however, do not indicate that Korean mothers do not care about their children's sense of autonomy. The need for autonomy is universal and its satisfaction is essential to children's optimal functioning across cultures (Deci & Ryan, 2000). This may also be the case in the Korean context (e.g., Korean high school students benefited from autonomy support at school; Jang, Reeve, Ryan & Kim, 2009). Then the finding that maternal intrusiveness was not particularly detrimental to child EF in the Korean context may be accounted for in terms of "universalism without the uniformity" (Shweder & Sullivan, 1993). In other words, universalism in parenting may not be without culture-specific aspects. Based on this account, the culture-specific finding in the present study includes the following considerations. Firstly, the Korean mothers' heightened control is based on the parental responsibility to actively engage in cognitive activities. As discussed in Section 2.5.2, a great deal of importance is placed on the parental role in their children's education, which has been more pronounced due to the societal perception that education is an avenue to social mobility

(Shim et al., 2008). Parental strong involvement in the child's education may be more successful when the parent has a strong emotional bond with the child - the parent-child intimacy and interdependence – since intrusive parenting may not be acceptable even in the Korean context without the child's awareness of the significance of their parent being directive and strict.

Another culture-specific aspect of universal parenting concerns differential parental responses to the child's developmental phases. Research has suggested that reasonable limit setting, or directing the child's behavior to the task at hand are not necessarily intrusive, particularly for young children aged 4-5 years old (Erickson et al., 1985). Setting limits is crucial to the socialization process during the preschool years and giving the child directives is part of mother-child interactions. However, parental behavioural control is supposed to change in its strength across children's age ranges. The insignificant link between maternal intrusiveness and child EF may not be the case when the child is older. That is, it should be pointed out that the null relation in the present study may be specific to the latter part of the preschool period and should not be extended to other developmental phases since parental intervention may differ in its impact on child outcomes across developmental phases (Clincy & Mills-Koonce, 2013; Holochwost et al., 2016).

As such, the notion of universalism without the uniformity necessitates meaning-based approaches to an educational phenomenon so as to avoid the notion that effects of certain parenting practices may be seen as contradictory across cultures (Shweder & Sullivan, 1993). In this regard, it is important to acknowledge indigenous meanings associated with the parenting practices being investigated so that potentially inaccurate portrayals of parents from different cultural perspectives can be avoided (Wang et al., 2007). What matters may thus be whether a parent exercises appropriate levels of control according to cultural norms and practices and whether the parent is viewed in a given culture to respect or concern for the well-being of the child in the process of exercising their influences on the child.

This culture-specific trend as to the link between maternal intrusiveness and child EF might not have been found if maternal contingency and intrusiveness had been aggregated into a composite. It is frequently found in the parenting literature that maternal negative and positive behaviours are combined into a composite. For instance, in the study by Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014), the reverse score of the maternal ability to facilitate the child's attention (so that higher scores indicate less attention-facilitating behaviours) was combined with scores of negative behaviours. While the resulting composite may be relevant to the US setting, it remains to be seen whether such a composite would explain well other samples, particularly ethnically and culturally diverse samples, in which the impact of negative parenting on child development has not been investigated.

In sum, this section has discussed possible accounts for the null link between maternal intrusiveness and child EF in the Korean context. One account was that the negative impact of maternal intrusiveness might be lessened to the extent that it is normative in a given culture (Ispa et al., 2004). Another possible account was focused on culture-specific dissimilarities within universal similarities, implying that while children both in independence- and interdependence-oriented cultures benefit from autonomy (Ryan & Deci, 2000), Korean parents may be willing to actively lead their interactions with their 4-year-old children not because they do not care about their children's sense of autonomy. They instead believe that parental strong involvement is essential for their children's developmental phase and that they regard a cognitive activity as a context in which to exercise their responsibility to teach their children. Finally, it may merit further exploration in the future research to examine the affective context in which parental intrusiveness occurs. This exploration will enhance our understanding by providing an explanation that the adverse impact of maternal intrusiveness may be lessened when it occurs in a context that minimizes its negative impact (Ispa et al., 2004). Maternal warmth, for instance, has been reported as a determinant of the impact of maternal intrusiveness with African Americans (Holochwost et al., 2016). This may be the case in the Korean context in that controlling behaviours of Korean parents are found to be associated with children's perceived parental warmth, whereas the same controlling behaviours are associated with perceived parental hostility and rejection in other cultures (Rohner & Pettengill, 1985).

5.1.2 Exploration of parental verbal aspects linking to child EF (RQ 2)

Before discussing the second research question, two specific contexts may be addressed, in which maternal mental-state references could be made: activities that the child is currently engaged in (e.g., parent-child free play) and parent-child verbal interactions on past experiences (e.g., reminiscing). In the former context, parents can make references to mental states as their interactions unfold. Maternal references to mental states in this case may be relevant to the concept of maternal sensitivity as well as with maternal mind-mindedness. In the attachment literature maternal sensitivity refers to the mother responding to the child's external, physical signs while maternal mind-mindedness referring to the mother attuning to the mental needs of their infants/toddlers (i.e., engaging with them at a mental level) (Meins et al., 2001). Given that both maternal mind-mindedness and sensitivity refer to the way the mother responses to the child, either mentally or physically, they have been shown to be strongly related to each other. Some researchers view maternal mind-mindedness as a prerequisite for maternal sensitivity because correct interpretation of the child's mental cues is fundamental to the generation of appropriate responses to such cues (Laranjo et al., 2008).

Maternal references to mental states in the present study, however, were examined in the context of mother-child conversations of past events and thus may not contain such characteristics that would belong to maternal sensitivity or mind-mindedness. That is, mothers cannot make references to the child's mental states as their interactions unfold but instead make references to mental states that the child expresses concerning past events. This aspect of maternal mental-state references are still relevant to mind-mindedness in that the mother concerns for the child's mental states but may not be used as the indicator of mind-mindedness as used in the study of Bernier and colleagues (2010). For this reason, maternal mental-state references in the present study were not named as mind-mindedness, and thus the present study is distinct from the study by Bernier and colleagues (2010). The exploration of the link between maternal mental-state references and child EF during reminiscing has rarely been addressed in the EF literature.

Given that prior studies have reported that maternal mental-state references are significantly linked to child EF (e.g., Baptista et al., 2017; Bernier et al., 2010), the present study provides a new finding that not mental-state references or emotion references themselves but those in semantically connected contexts were found to significantly explain the development of child EF. This finding demonstrates that semantic connection was an important moderator even though connectedness itself was not significantly related to child EF. Then, why might the impact of references to mental states be especially significant when embedded within connected turns? The account by Ensor and Hughes (2008) on the impact of maternal connectedness on children's theory of mind may be relevant to the present study in that their explanation is based on a broader cognitive perspective. Just as children's cognitive development is accelerated by adults' sensitivity in engaging with the activity within the child's focus of attention (e.g., children's acquisition of language is promoted by adults' labelling objects that the child's is currently interested in: Tomasello & Barton, 1994; Tomasello & Farrar, 1986), so the impact of the parent's mental-state references would be stronger when within a connected dialogue rather than in an initiated or failed dialogue. The child may be more likely to internalise the language they obtain from parent-child conversations when reinforced by the parent's semantically connected utterances. Shared conversational focus in connected conversations makes salient the similarities or differences between the child's and the parent's points of view (Ensor & Hughes, 2008), which helps the child to step back from their own thoughts and behaviours and reflect on themselves from the parent's view point. Specifically, maternal references to mental states provide the child with vocabularies describing the inner states of not only the child but also of other people, which leads to the child's understanding that their own mental states may sometimes differ from those of others. With this understanding, children undergo a transformation in the relation between him- or herself and his or her own

behaviour, which is a developmental milestone to reach during the preschool period (Vygotsky, 1978). This developmental transformation implies that the child proves able to be the master of their own behaviour, "relating to itself as to another being, regarding itself as an object" (Vygotsky & Luria, 1994, p. 11). It has been suggested that the contents of subjective experience are transformed into an object of conscious consideration through semantic descriptors such as labels (Zelazo, 2015). As such, children who are provided with semantic descriptors of mental states (i.e., vocabularies of mental states) are more likely to separate their own inner states from those of others and to better internalise norms of society by learning desirable attitudes when dealing with people who may have different mental states. Of note here is that the present study did not aim to explore the child's inner speech. The discussion in this section provides a post hoc explanatory hypothesis that appears to be the most relevant mechanism found in the existing literature. Given that the distancing role of language and children's inner speech are critical in explaining the mechanism underlying the language-EF link, our understanding may be enhanced by further research directly measuring children's self-directed speech along with EF skills to test this explanatory hypothesis.

With regard to maternal connected emotion references linking to child EF, no prior research is available against which the current fining is compared to. In Bernier and colleagues study (2010) using a Canadian sample of toddlers, a total score of maternal mind-mindedness (i.e., an aggregating score for cognition-, emotion-, and desire-related references) was used. Similarly, in Baptista and colleagues' study (2017) using a Portuguese sample of preschool children, a composite score for mental-state references was used in exploring its link with child EF. Notable in this study is that both maternal and paternal use of mental-state references was examined. The results showed that both Portuguese mothers and fathers made most references to cognition, followed by emotion-related and then desire-related references. Another study that examined maternal mental-state references, although not in relation to child EF, is Ensor and Hughes' study (2008). Using a British sample of preschool children, this study reported that the most frequently used mental-state references were desire-related, followed by cognitive- and then by emotion-related ones. This tendency changed, however, when considered within semantically connected contexts. That is, the most frequently used connected mental-state references were desire-related, followed by cognition-related and then emotion-related references. These tendencies differ from the current findings using a Korean sample in the present study, in which the mothers made more references to emotions than to cognitions or desires. Given that Asian mothers tend to make less references to mental states than to objective descriptions and didactic moral lessons during conversations with their children (Wang et al., 2010), this finding suggests the types of mental-state talk that may be particularly closely related to child EF in the Korean context. It may be inferred that the parental use of mental-state

references may vary across cultures and, given that very little research has examined the link between mental-state references and child EF in non-Western contexts (Taumoepeau, 2015), further research in this field is required to see whether the current findings in the present study would be replicated.

5.1.3 Relative relations of parenting and maternal EF to child EF (RQ 3)

The exploration of the third research question aimed at looking into the relative relations of parenting and maternal EF to child EF. Contrary to the hypothesis that maternal intrusiveness would account for greater variance in child EF than maternal EF would do (see Section 2.7), maternal intrusiveness itself was not an influential factor explaining the development of child EF. The other hypothesis concerning positive parenting was partially supported. That is, maternal contingency was found to account for greater unique variance in child EF than maternal EF did. This finding is in line with the finding by Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014), who reported that maternal parenting was found as a better predictor, than maternal EF, of child EF when their child participants were 4 years old. Maternal connected mental-state references (MR) and connected emotion references (CER), however, showed different results between using the whole sample and using only 4-year-olds. Both maternal CMR and CER accounted for greater amount than maternal EF did, when using only 4-year-olds, whereas, when using the whole sample, both CMR and CER accounted for the same amount of unique variance in child EF as maternal EF did. In other words, the significance of the link between maternal EF and child EF depended on the child's age range. Maternal contingency, however, was found in any case to account for greater unique variance in child EF than maternal EF did. These findings indicate that findings for the third research question may vary according to the child's age and types of parenting behaviours being investigated. As such, the discussion in this subsection needs to address two aspects of these findings: (a) factors that lead to varying relations across child participants and parental factors being investigated and (b) the nature of maternal contingency, which accounted for greater amount of unique variance in child EF than other parental factors considered in the present study (maternal EF, CMR, and CER).

Firstly, the present study found varied relations between maternal EF and child EF, which was in line with prior research suggesting distinct parental effects on child outcomes across developmental phases. Parental factors may differ in their relations to child EF across developmental phases. While some research demonstrated positive parental impacts on children aged between 4 and 11 (maternal sensitivity; Berry et al., 2013), aged 7, 9 and 10 (Kovas et al., 2007), and between 2 and 4 years (scaffolding; Bernier et al., 2010; Hughes & Ensor, 2009),

some studies emphasised the impact of severely negative parenting early in life, which may be persistent throughout the lifetime. For example, internationally adopted children (exposed to severely adverse early environment) showed good catch-up in many areas of development, but their EF skills were found to have persistent deficits (Jacobs, Miller, & Tirella, 2010). Relatedly, Anderson and colleagues (2010) compared EF performance among children who sustained early brain injury (as evidenced on MRI scans) at six different developmental periods (congenital/perinatal/ infancy/ preschool/ mid childhood/ late-childhood). They found that children who experienced brain injury very early in life displayed markedly more severe deficits in EF, implying irreversible impacts of severely negative environment particularly early in life. These studies suggest that negative early parenting effects may be particularly strong while EF skills are emerging. Despite different age ranges combined with parenting behaviours in the above mentioned studies, research has generally suggested decreased parental impacts on child outcomes, including EF skills, for older children. This is partly because as children get older they increasingly live their lives outside their family, implying that other socializing forces may be greater than parental influences (Ellefson, Ng, Wang & Hughes, 2017). Ellefson and colleagues (2017) studied children aged 9- to 16-year-olds in both the UK and Hong Kong and reported weaker parental influences on child EF than those reported for children aged between 2 and 4 years old in the study of Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014). In another study on the effect of maternal depression on child EF, a significant inverse relation between maternal depression and EF of preschool children was not found with older children or adolescents with depressed mothers (Klimes-Dougan, Ronsaville, Wiggs, & Martinez, 2006). This account is supported by the finding in the present study that the relation between maternal EF and child EF, which was significant when using the whole sample, became insignificant when using only 4-year-olds. The accountability of maternal contingency and CMR for child EF instead slightly increased.

Another factor that should be considered as to the third research question is the distinct relevance of maternal contingency and maternal EF to the development of child EF. The only maternal EF significantly linking to child EF in the present study was maternal shifting, which was measured with the Wisconsin Card Sorting Test (WCST). It may be suggested that the nature of maternal contingency is more relevant, than maternal WCST skills, to the skills involved in the three child EF tasks used in the present study. Thus this account may explain why maternal contingency accounted for greater unique variance in child EF than maternal EF did. This presumably special relevance of maternal contingency to child EF seems to be sensible when considering what maternal contingent scaffolding conveys to the child; problem-solving strategies, specifically such as recalling the target shape of the puzzle task (keeping the shape in mind while completing a task), making comparisons and contrasts (finding and contrasting

among a series of arrangement rules), linking concepts, and drawing inferences, which were provided by varying degrees of maternal support (i.e., Level 1 through 5). As addressed in Section 2.4.3, more deliberate type of parenting behaviours, such as scaffolding, has been found to strongly relate to child EF than those relatively implicit in its effect (e.g., maternal planning traits or children's observational learning; Hughes & Ensor, 2009).

Finally, given that maternal shifting was an influential factor for child EF when using the whole sample, it may be necessary to address the nature of the link between maternal shifting and child EF. As addressed in Section 2.2.1, from the perspective based on bio-social transactions, it is asserted that mothers' consistent exercise of their WCST-related skills during mother-child interactions over time may engage in epigenetic modifications of genes that lead to changes in neural and neurotransmitter functioning relating to stress reactivity and EF skills (Barrett & Fleming, 2011). Alternatively, it is also probable that quality mother-child interactions, in which the mother's own self-regulation is achieved by exercising relevant WCST-related skills, may serve as a context in which to practice children's emerging EF skills (Sanders & Mazzucchelli, 2013). These two accounts, however, are not mutually exclusive but complementary in that a transactional process including both accounts appears to be at play (Bernier et al., 2010).

5.1.4 Mediating role of parenting in the maternal EF and child EF link (RQ4)

The fourth research question concerned a mediating role of maternal parenting in the link between maternal EF and child EF, which was found not to be significant in the present study. This finding is not consistent with the finding by Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014), in which maternal negative parenting was found to mediate the maternal EF-child EF link. This was not the case in the present study. As discussed earlier in this thesis, the present study and the Cuevas and colleagues' differ in many aspects and the discrepant findings may be unavoidable. Maternal intrusiveness was not significantly related to child EF in the Korean context, and it may not be surprising that maternal intrusiveness was also found not to mediate the maternal EF-child EF link. This null mediating impact of maternal contingency on the maternal EF-child EF link cannot be addressed in relation to prior findings due to the lack of such findings in the literature. It may be implied, however, that the two maternal skills – being contingent during mother-child interactions and being proficient at shifting) may be distinct and have independent relations to child EF, as shown with their significant direct effects on child EF. Of note is that maternal contingency may not be synonymous with maternal WCST skills although maternal contingency does appear to involve a component of shifting. Along with this apparent shifting construct, maternal contingency includes skills such as the ability to

understand and hold the child's zone of proximal development in mind over a task and maternal concerns for the child's emotional well-being and motivation. In addition, it should be pointed out that the insignificant mediating role of maternal contingency in the maternal WCST-child EF link does not exclude the explanation that other parenting practices that were not included in the present study may mediate maternal EF-child EF link. These accounts are post-hoc theoretical speculations that possibly explain the current findings. The present study did not aim at demonstrating the impact of interplay between genes and environments on EF. Such an exploration requires longitudinal data or genetically sensitive design (such as twin methods) using larger samples (Kovas et al., 2007).

It was found instead that the child's verbal ability had an indirect effect on child EF via maternal contingency. The noteworthy aspect of this finding is the part the child actively plays in shaping the parents' attitudes and behaviours. Specifically, this finding indicates that the child who is more verbally proficient tends to make themselves more clearly understood and thus is more likely to lead the parent to be contingently responsive in parent-child interactions, which would ultimately lead to increased EF skills. This is consistent with the Vygotskian perspective, in which children with high verbal skills are better equipped to understand adults' knowledge and problem-solving strategies and to develop other mental tools such as self-directed speech to regulate their own thoughts and behaviour (Matte-Gagné & Bernier, 2011; Vallotton & Ayoub, 2011). In addition, this finding is supported by Luria's account of the role of language in children's self-regulation. Luria (1973) viewed that the source of the volitional act is the child's communication with adults and that the volitional act is not initially a mental act nor a simple habit but is mediated by speech. While this finding is supportive of the view that parent-child interactions may be bidirectional rather than unidirectional (Bernier et al., 2010), little empirical research has reported similar findings as the current finding in the present study. A handful of research, nevertheless, appears to present findings that are conceptually relevant to the present study: a line of research suggesting that children who experience more competent parenting develop better verbal abilities, which in turn provide them with verbal tools for improving EF skills (Landry et al., 2002; Matte-Gagné & Bernier, 2011) and a sizable body of research demonstrating the close link between child EF and child verbal ability (Carlson & Beck, 2009; Jacques & Zelazo, 2005).

In addition, mothers' educational attainment was found to have an indirect effect on child EF via maternal contingency. It is not new to address the close link between mother education and child EF but it is new to address in the present study that mother education may have an influence on child EF via maternal contingency. As a correlate of socioeconomic status and parents' verbal intelligence (Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014), parental educational attainment is found to influence a range of child outcomes but the

mechanism behind such influences have rarely been explained in the literature. The present finding suggests a potential mediating role of maternal contingency in the relation between mother education and child EF, above and beyond child verbal ability and child age. That is, mothers with higher educational attainment tend to provide more contingent support during mother-child interactions, which in turn may contribute to enhanced child EF skills.

Finally, it may be worth mentioning that maternal educational attainment may have a longer impact on child EF (via maternal contingency) than child verbal ability would do. Due to the inverse relations between rates of growth in EF and verbal ability, preschool children with poor verbal skills are usually found to catch up following the transition to school (Hughes, 2011). Children of mothers with less education, however, tend not to show this independent catch-up effect. As such, longitudinal research is required so as to have a more close understanding of developmental trajectories of these correlates of child EF. As such, the findings in the present study may be specific to children aged around 4 years old.

5.2 The place of the present study in the EF literature

The present study was the first empirical study in a non-Western setting of the relations between maternal EF, parenting behaviours, and child EF. As pointed out by Hughes and Ensor (2009), research on EF has been dominated by biological models, focusing on research evidence demonstrating the links between various forms of damage in the prefrontal cortex and deficits in EF skills (Satish, Streufert, & Eslinger, 2006); age-related improvements in EF based on the maturation of the prefrontal cortex (Golden, 1981); or the association between EF and disorders showing substantial genetic influence, such as deficit hyper-activity disorder and autism (Pennington & Ozonoff, 1996). Recently, with an increasing interest in the hypothesis that children's neurocognitive development is closely linked to early relational experiences, research on EF has begun to look into the impact of parenting on child EF (Nelson & Bloom, 1997). With this burgeoning yet still limited research on this field, however, our gap in understanding the mechanism through which parenting affects the development of EF skills in young children has yet to be addressed.

Hence, given its incipient stage of research on the impact of parenting on child EF, it is not surprising that a concurrent analysis of the relative contributions of parental EF and parenting to child EF is rare, even in Western cultures. As mentioned earlier, only one exception to this trend so far is the study by Cuevas, Deater-Deckard, Kim-Spoon, and Watson (2014). This study, however, was distinct from the present study, as discussed in Section 2.2.2, and the findings of the two studies were also different. For example, while Cuevas and colleagues reported the significant relation between maternal negative parenting and child EF, no such

relation was found between maternal intrusiveness and child EF in the present study. In addition, while negative parenting was also found in their study to mediate maternal EF-child EF link, no such mediating role of maternal intrusiveness was found in the maternal EF-child EF link in the present study. Instead, maternal contingency was found to have a positive relation to child EF, which was consistent with prior findings based on Western cultures. Maternal contingency was also found to mediate the link between child verbal ability and child EF. Additionally, maternal contingency was found to mediate the link between maternal educational attainment and child EF. These mediating roles of maternal effective scaffolding have rarely been addressed in prior studies, adding meaningfully to the literature. Thus, the present study provides unique information on culture-specific links between maternal EF, parenting and child EF in the Korean context, which has rarely been addressed in the EF literature.

In sum, the novel contributions of the present study may be found in demonstrating (a) that maternal EF, maternal connected mental-state references, and maternal contingency each explained unique variance in child EF, above and beyond child verbal ability, child age, and maternal educational attainment, (b) that maternal intrusiveness may not be related to child EF in the Korean context, which was inconsistent with prior studies in Western contexts, and (c) the child's verbal ability and maternal educational attainment may affect parental contingent scaffolding, which is positively related to child EF. Therefore, as the first empirical study in the Korean setting (and in non-Western contexts), the present study was exploratory in nature and may serve as a strong theoretical basis for further research endeavours on relations among maternal EF, parenting and child EF, particularly in non-Western contexts.

5.3 Limitations of the study

This section summarises limitations related to the design of the present study and the analysis of data, some of which have already been mentioned in previous chapters. Four limitations are discussed in this section. The first three limitations relate to the design of the present study and the fourth limitation concerns a sampling issue.

Firstly, the design of the present study is correlational and could not confirm causal relations between maternal factors and child EF. It is longitudinal data that allow investigators to more precisely specify the hypothesized direction among effects. The temporal precedence of one variable before another can lend support to a causal claim (Selig & Little, 2012). Thus, the direction between maternal factors (maternal EF and parenting) and child EF cannot be determined in the present study. That is, maternal factors may have influenced child EF, or child EF may have affected maternal factors, or a bi-directional relation may have been at work

between the maternal factors and child EF. Indeed, it is conceivable that children do affect parents' attitudes and behaviours and thus bidirectional effects between parenting and child EF are likely (Bernier et al., 2010). For these reasons, the research design for a second wave of data regarding child EF is needed in order to examine causal effects more completely.

Another limitation is the use of an individual score representing maternal EF. One task was administered for each EF component (working memory, inhibition, and shifting). The three maternal EF scores were not correlated high enough to form a composite, which is in line with the theoretical model by Miyake and colleagues (2000). They suggested that the three EF components are distinct constructs (i.e., even though they are moderately related to one another). Even though they are distinct, it may be preferred to form a composite score of a latent construct of correlated indicators because such composites are most reliable (Rushton, Brainerd, & Pressley, 1983). For this reason, a factor analysis is frequently used when forming composites for EF skills so as to confirm a latent factor based on at least modest inter-correlations among EF scores. Thus, it may be recommended that multiple tasks for each EF component should be administered so that a composite score can be created based on correlations among multiple tasks for each EF component.

This methodological alternative, however, could not be adopted in the present study due to the practical feasibility concerning data collection that more than 100 mother-child pairs must be recruited in a limited period. The administration of multiple EF tasks (e.g., at least two tasks for each of the three EF components) would have required mothers to fully cognitively engage in EF tasks for at least 30 minutes, making them feel physically and cognitively tired, and thus making it necessary to arrange subsequent sessions. Alternatively, it was not possible to focus on a particular EF component (either WM, inhibition or shifting) due to the lack of prior research guiding the expectation of which of the three EF components would relate to child EF and maternal parenting in the Korean context. Nevertheless, maternal shifting and child EF in the present study was found to consistently relate to the three child EF scores and this relation was robust enough to be held even when controlling for such influential correlates of EF as maternal parenting behaviours (contingency and connected mental-state references) and the three covariates of child EF (child verbal ability, child age, and maternal educational attainment). Nevertheless, the finding on the maternal shifting-child EF link in the present study should be interpreted with caution in that maternal shifting was measured by using one single EF task (the WCST). The WCST has been known to include a wide range of skills: detecting a correct dimension across a series of cards; switching flexibly between dimensions; keeping the correct dimension in mind over several trials; and inhibiting prepotent responses. These multiple types of skills required while performing on the WCST have been pointed out as an issue that makes it difficult to interpret which of the WCST skills are related to a given situation

(Pennington & Ozonoff, 1996). In addition, it should be taken into account that the maternal EF-child EF link may show different trends than those found in the present study when carried out with children in different age ranges or mothers with different educational backgrounds.

Relatedly, another limitation is that mother-child interactions were measured once for the two mother-child interactions tasks (the puzzle and reminiscing task), and that their reliability may be less than if they were measured at multiple points in time. As mentioned earlier, the present study was initially designed as cross-sectional, taking into consideration the viability and practicality of obtaining a possible, sufficient sample size in a given time. This kind of methodological consideration is important in conducting research. Nevertheless, in order to increase the reliability of data, a longitudinal research design should be preferred to a cross-sectional design

The final limitation of the present study concerns the representativeness of the recruited mother-child pairs. As pointed out in Section 3.6.2, the high educational attainment of the Korean mothers may be relevant to the external validity of the present study. Indeed, it is usually shown that mothers who are keen on participating in educational research for their children are more likely to have higher educational backgrounds. Given that educational research depends in many cases on volunteers with a particular research interest, the resulting parental high educational attainment may not be the only issue for the present study. Nevertheless, it needs to be pointed out that about 32% of the mothers had a Master's degree or higher, which was higher than the average educational level of middle-class Korean mothers. Thus, it may require caution in applying the research findings of the present study to other populations having different educational profiles.

5.4 Implications for practice

Research findings in the present study suggest at least three highly relevant implications for educational practice, as shown below.

Adjustment of a task cognitively manageable and also challenging: The finding from the present study clearly showed that parental adjustment of a task neither too difficult nor too easy within children's zone of proximal development may be positively related to the development of EF skills. Optimal levels of difficulty for children in the course of problem-solving may contribute to children's sense of competency and responsibility for the task (Bernier et al., 2010). Parental contingency is the required ability in adjusting among levels of support in addition to the parental understanding of the child's zone of proximal development

(or the ability to represent relevant aspects of the problem space at appropriate times), leading to making a task at hand cognitively manageable and also challenging for the child.

Shared focus and Connectedness: Coupled with the parental ability to be contingent upon the child's ongoing evidence of mastering cognitively and affectively challenging tasks at hand, a crucial determinant of a beneficial impact of parent-child relationship on child EF may be the temporal coincidence in shared focus between the parent and the child. In other words, both maternal scaffolding (during the puzzle task) and verbal input (during the reminiscing task) were more effective when they were directly addressed to the activity in which the child was physically and cognitively engaged. Parents are supposed to follow and thus provide feedback on the aspect of an activity that the child is presently interested in. Likewise, parental verbal input became more influential when semantically connected to the child's previous conversational turns. From a cognitive perspective, children may benefit from joint attention because they do not need to disengage from the activity on which they have focused their attention, as opposed to the case in which parents redirect their attention to a new activity that parents themselves judge as important. In addition, from a motivational point of view, children are more encouraged to actively participate when parental feedback is aligned with the child's interests and needs.

Distinct parental linguistic input in two different contexts: In the context of a cognitively challenging task, children may be cognitively stimulated with the parental provision of hints, demonstrations and specific strategies of how concepts are compared and contrasted. In the context of a reminiscing conversation, children may have a better understanding of concepts and vocabularies of mental states when parents make mental-state references in conjunction with appropriate explanations or reasons for emotional, cognitive, and desire-related states (Ensor & Hughes, 2008; Fivush & Nelson, 2006). Interestingly, the Korean mothers did not show similar attitudes for the two different contexts. That is, contingent mothers were not necessarily likely to provide more mental-state references. This may imply that parental attitudes and feedback may vary across contexts in which they are required to interact with their children.

5.5 Suggestions for future research

Since the present study was the first study, in the Korean context, on the links among maternal EF, parenting behaviours, and child EF, future research should replicate the present findings and assess the extent to which they are specific to the Korean (middle-class) culture or even generalizable to those in a similar collectivistic culture. In accordance with the limitations addressed earlier in this chapter, related suggestions for future research are listed below:

Replication using longitudinal research designs: Future longitudinal research may contribute to confirming stability and changes in child EF performance across developmental phases due to the autoregressive impact of data that are collected in multiple time points. Autoregressive effects describe the stability of individual differences from one occasion to the next. That is, a causal relationship between maternal parenting and child EF may be found more robust when held after the initial child EF performance is taken into account. A future study using this longitudinal design may make it possible to test what Bernier and colleagues (2010) suggested: maternal mental-state references account for changes between 18- and 26-month EF performances, while maternal scaffolding accounts for stability across these two age periods. Given that the research design of the present study did not permit assessing the stability or changes in the link between maternal factors and child EF, it is worth replicating the Bernier and colleagues' finding in the Korean context and in Western cultures as well since very little has been carried out on this topic.

Using multiple tasks to assess maternal EF subcomponents: Prior research using adults and adolescents has suggested that the three EF components (working memory, inhibition, and shifting) are partially dissociable (Miyake et al., 2000). In accordance with this notion, the three maternal EF scores in the present study were shown to be distinct but were not moderately correlated and, as a result, a composite maternal EF was not created. While a composite is shown to be used in a range of prior studies, one score to represent maternal EF may obscure our understanding of which EF component is related to child EF/a parenting behaviour. In this regard, it may be recommended multiple tasks for each of the three EF components should be administered so that a composite can be created for each EF component. Alternatively, based on the finding in the present study highlighting the link between maternal shifting and child EF, future research in the Korean context may focus on the impact of maternal shifting on child EF. In this case, reliability of the data for maternal shifting should be increased by deriving a composite from multiple shifting tasks.

Using the same task battery across generations in research on the parental EF-child EF link: One of the reasons for limited research on the links between parent EF and child EF is the challenges in measuring the same EF abilities in parents and their children. While the same task (Corsi block tapping task) was used for child and maternal WM in the present study, different tasks were administered for inhibition and shifting. In addition, computerised versions of EF tasks were administered to the mothers only because 4-year-olds were expected not to be proficient enough to deal with computers while performing on the tasks. In future research, it may be ideal to use computerised EF tasks for both children and parents so as to increase the reliability of EF measures.

Probing deeply into the impact of maternal intrusiveness on child EF: It is required to replicate the null relation between maternal intrusiveness and child EF in further research since this finding was new in a non-Western context. In addition, as discussed earlier in section 2.3.2.2, future research is required to investigate the affective contexts in which parental intrusiveness occurs since maternal affects (e.g., warmth) have been found as a crucial determinant of the impact of maternal intrusiveness on child EF. Moreover, a more specified definition of parental intrusiveness using related sub-constructs would benefit the interpretation of more specified impacts of parental intrusiveness on child EF across cultures (Ispa et al., 2004).

More nuanced scales for parenting behaviours, particularly for ethnically and culturally diverse samples: The scales for maternal contingency and intrusiveness were not aggregated into a composite in the present study although they were highly correlated with each other. Despite a close correlation between parenting constructs, some parenting behaviours should not be combined into one global score because parenting behaviours may relate differently to child EF across cultures. High correlations are a prerequisite condition for computing a composite, and such closely related yet opposing traits as parental autonomy granting and control have been aggregated into a composite. However, as demonstrated in the present study, it may be recommended for future research particularly using ethnically/culturally diverse samples that parenting behaviours that are viewed to have different meanings and practices across cultures should be individually explored due to their possible differential relations to child outcomes.

Direct measures of young children's self-directed speech that would function to mediate the link between maternal verbal input and child EF: As prior research suggests, it is conceivable that children might have used inner speech or even audible self-directed speech,

when confronted with a cognitively challenging task such as the puzzle task in the present study. The link between maternal (connected) mental-state references and child EF was accounted for in terms of the distancing function of language because the role of children's self-directed speech in regulating their thoughts and behaviours is indispensable in explaining the link between language and EF. Therefore, this notion should be tested in future research designed to measure children's self-directed speech along with child EF during parent-child interactions.

Varied results when using different combinations of EF tasks, parenting, and socioeconomic/demographic factors: Finally, it may be necessary to address that the current findings in this thesis may change with different maternal EF tasks and parenting behaviours being investigated. Due to the lack of prior research in this field, no data are available against which to compare the present study. However, it is possible that results depend on a range of combinations of variables measured in a given context. For example, Wang and colleagues (2012) reported that, for mother-child pairs from low socioeconomic status (SES), the impact of negative parenting on child EF disappeared when the impact of house chaos (lacking in routines, high noise level, and crowdedness) was taken into account. That is, unfavourable developmental aspects of child EF in low SES may be better explained by indices of SES rather than those for negative parenting. As such, future research needs to adopt a range of parenting and EF tasks so as to compare varied results across studies on the relative relations of parenting and parental EF to child EF.

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Appendices

Appendix 3. 1 The research information sheet and letter for the parent (consent form)

<u>Participant Information Sheet</u>
How Does the Difference in Parental Scaffolding Relate to Children's Executive functions?

Researcher: Min Kyung Lee

You are being invited to take part in this research. Before you decide whether or not to take part, it is important for you to understand why this study is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish. I and my supervisors can be contacted if there is anything that is not clear or if you would like more information (our contact details are provided at the end of this information leaflet). Please take your time to decide whether or not you wish to take part.

What is the purpose of this study?
This research has two broad aims. One is how parents are involved in the play with their preschool children at home and how the difference in parent-child interactions relates to young children's development of executive function (EF). Secondly, this research is also aimed at looking at how relations between parenting behaviours and child EF development differ between the UK and Korean settings. This will help us find culturally universal and distinctive features of parenting, which are expected to provide meaningful implications for early childhood education in both countries.

Who is conducting the research?
This information sheet is for a PhD thesis by Miss Min Kyung Lee, in the Department of Education (Psychology and Education), University of Cambridge. The research is being supervised by Dr Sara Baker and Dr David Whitebread.

Why have I been chosen?
You have been asked to take part because you are a parent of a 4-year-old in _____ preschool.

Do I have to take part?
No. It is entirely up to you to decide whether or not to take part. If you decide not to we will completely respect your decision. If you decide to take part you will need to sign a consent form and we will provide you with a copy of this to keep for your records. You are still free to withdraw at any time during the study and without giving any reason.

What will happen to me if I take part in the study?

- At preschool, your child will be administered a simple vocabulary test and two EF tasks, which are developmentally appropriate for 4-year-olds. EF tasks are usual preschool games using picture cards and toy blocks. The test and tasks will take 20~25 minutes altogether (this will be performed several sessions).
- You will be visited by the researcher. You and your child will be asked to work together on two tasks, which will take 10 minutes. For these two tasks, you and your child are just required to play together using toy blocks and puzzle pieces that pre-schoolers usually play with, just as you do at home in your daily life. Then, a short interview (15 minutes) and a questionnaire (5~10 minutes) will be carried out at the end.

Will my taking part in this project be kept confidential?
Yes. Data collected by this study will only be analysed by me and my supervisors. Results will always be presented in such a way that data from individuals cannot be identified. Every participant will be presented using pseudonyms. Audio/video tapes are anonymised and will be destroyed when no longer required.

Are there possible disadvantages or risks in taking part?
Taking part in this study should not cause you and your child any harm. If you feel even slightly uncomfortable with any activities during each phase you will be able to skip such activities if you wish. I will do whatever I can do to help you feel comfortable in performing activities during two phases of fieldwork.

What will happen to the results of the research project?
You will not be identified personally in any report or publication. The overall results will be published as part of my study.

Ethical review of the study
This study has received ethical approval from the Ethics Committee of the University of Cambridge.

Contact for further information

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Letter for the parent

8th April, 2015
Dear Parent,

I am writing to you as a PhD student in the Psychology and Education group at the Faculty of Education. My research focuses on how parents interact with their 4-year-old child during children's play. Homerton Children's Centre has kindly agreed to distribute this letter to you in order to invite you and your child to participate if you give your permission.

My research focuses on what children learn while engaging in children's play and how parent-child interactions influence cognitive development in young children. Specifically, in relation to what I'm going to do with you and your child at the Homerton children's centre, you and your child will be asked to play together with puzzle pieces and Lego blocks. This parent-child interaction will take approximately 15~20 minutes. All of my observations remain anonymous in any reports or presentations. It would be great if you can participate in my research either when you visit the Homerton children's centre to pick up your child or when you have free time to stay at the centre for around 20 minutes, if it is possible (or, if you prefer, you can take part in my research at the laboratory in the faculty of Education). **If you agree to take part, then please sign and return the permission form to your child's teacher.**

It would be a good chance for you to look at how your child would work on games that require your child to use some aspects of cognitive functioning and how you and your child would interact to achieve established goals in making objects using Lego blocks. I am always available to answer any questions you may have. Please do not hesitate to contact me and my supervisors (details above). I will be looking forward to meeting you and your child soon. Thank you.

Permission form – *Minkyung Lee's research* (ml653@cam.ac.uk)

Please return this form to your child's teacher.

_____ _____ (male female)
Child's name Child's date of birth

_____
Signature of parent or guardian

Please choose one

- I agree to take part in the research project.
- I do not agree to take part in the research project.

Appendix 3. 2 Questionnaire

1. Korean version

자녀의 이름:

자녀의 생년월일:

당신의 만 4 세 아동은 당신에게 몇 번째 자녀입니까? (　　)번째

당신의 자녀는 출생 당시 저체중으로 태어났거나 성장하는 동안 발달장애가 있었습니까? (예, 아니오)

학부모님의 모든 정보는 익명 처리되며 본 연구자 외 누구에게도 제공되지 않습니다

<u>학부모님</u>의 나이: 만(　　)세

학부모님의 가장 높은 교육단계는 무엇입니까?
_____ 고등학교 졸업　　_____ 초대졸
_____대학교 졸업　　_____ 대학원 졸업

학부모님은 현재 일을 하고 계십니까? (예, 아니오)

Q1. 현재 취업 중이거나 (또는 과거에 취업 경험이 있거나), 자영업을 하고 계십니까(또는 과거에 자영업을 하셨습니까)?

1. 현재 취업 중(또는 취업경험 있음) (　　)
2. 현재/또는 과거에 직원을 둔 자영업 (　　)
3. 현재 /또는 과거에 직원이 없는 자영업/프리랜서(**Q4** 로 가십시오) (　　)

Q2. 직장에는 얼마나 많은 직원들이 있습니까?(있었습니까?)/현재(또는 과거에) 얼마나 많은 직원을 고용하셨습니까?

1. 1-24 명 (　　)
2. 25 명 이상 (　　)

Q3. 당신은 직원들의 일을 감독합니까 (또는 과거에 감독하셨습니까)?

1. 예 (　　)
2. 아니오 (　　)

Q4. 현재(또는 과거에) 귀하의 가장 주된 직업은 무엇입니까? 아래의 직업분류표를 보시고 해당되는 직업종류 옆의 (　　)에 √표시해 주십시오. 해당되는 직업이 없는 경우에는 간단히 직업의 내용을 써 주시면 감사하겠습니다.

[직업 분류표]

1. 반(半)전문 및 전문직 · (　　)

교사 · 학원강사	연구원
간호사/물리치료사	작가/예술가
소프트웨어 디자이너	종교인
의사/약사	변호사/판사/검사/회계사
대학교수	언론인/방송인 등

2. 관리직 (　　)

중소기업체 사장 (5인 이상 고용)	사회단체 간부 (부장 이상)
대기업/은행 간부 (부장 이상)	군인(영관급 이상) 경찰(경정 이상)
고급공무원 (4급 서기관 이상)	기타 관리직

3. 생산직/판매직/서비스직 **중간단계 관리자** (　　)

중간관리직 회사원 (차장,과장)	음식점/여관 등의 주인	기타 중간단계 관리자
중간관리직 은행원 (차장,과장)	이/미용실 세탁소 주인	
도 소매 상점 주인	생산감독(주임 반장)	

4. 사무직 (　　)

일반사무직 회사원(계장 대리 이하)	군경(위관/경관 이하)
일반사무직 은행원 (대리, 행원)	전화교환수
사회단체 직원 (과장급 이하)	비서
일반공무원 (5급 사무관 이하)	기타 사무직

5. 생산직/판매직/서비스직 **직원** (　　)

음식점/여관 종업원	우편배달원	외판원
이/미용실 세탁소 종업원	공장근로자 (숙련공/반숙련공)	부동산 중개인
청소부/파출부	광원	행상 노점상
수위 경비원	도소매 상점 점원	농업관련
트럭/화물차/버스/택시 운전	백화점 대규모 유통업체 판매직원	유아원 보모
간호조무사	기타 생산직/판매직/서비스직	

6. 기술/기능 관련직 (　　)

엔지니어	인쇄업
건축사	전기관련
정비/설비/조립/도구 제작	정원사
기계/장치 검사원	열차 운전
배관공	기타 기술관련

7. 해당 직업이 없는 경우 (간단히 내용을 써 주시면 감사하겠습니다.)

2. English version

Your child's name:

Your child's birthday:

Did your child had a low birth weight?
Have your child has experienced/is now having any developmental issues?

Your age: ( ) years old.

What is the highest level of education that you have completed?

___ Junior High/Middle School ___ High School or equivalent
___ Community College/Vocational School ___ 4-year College/University Degree
___ Professional Degree/Graduate School

Q1. 'Do/Did you work as an employee or are/were you self-employed?'

1. Employee ( )
2. Self-employed with employees ( )
3. Self-employed/freelance without employees (**go to Q 4**) ( )

Q2. For employees: 'How many people work/worked for your employer at the place you work/worked?

For self-employed: 'How many people do/did you employ?'

1. One to 24 ( )
2. 25 or more ( )

Q3. 'Do/Did you supervise the work of other employees on a day-to-day basis?

1. Yes ( )
2. No ( )

Q4. Please tick one box to show which best describes the sort of work you do/did in the past.

1. Modern professional occupations ( )
such as: teacher – nurse– physiotherapist – social worker – welfare officer – artist–musician – police officer (sergeant or above) – software designer

2. Clerical and intermediate occupations ( )
such as: secretary –personal assistant – clerical worker – office clerk – call centre agent – nursing auxiliary – nursery nurse

3. Senior managers or administrators ( ) (usually responsible for planning, organising and co-ordinating work, and for finance) such as: finance manager – chief executive

4. Technical and craft occupations ( )
such as: motor mechanic – fitter – inspector – plumber – printer – tool maker –electrician – gardener – train driver

5. Semi-routine manual and service occupations ( )
such as: postal worker – machine operative – security guard – caretaker – farm worker – catering assistant – receptionist – sales assistant

6. Routine manual and service occupations ( )
such as: HGV driver – van driver – cleaner – porter – packer – sewing machinist –messenger – labourer – waiter/waitress – bar staff

7. Middle or junior managers ( )
Such as: office manager – retail manager – bank manager – restaurant manager – warehouse manager – publican

8. Traditional professional occupations ( )
Such as: accountant– solicitor – medical practitioner – scientist – civil/mechanical engineer

Many thanks

Appendix 3. 3 Flexible Item Selection Task

Task Instructions

ITEM IDENTIFICATION TASK

You and I are going to play some pick-some-pictures games together. But before we start, I'm going to put a little sticker on my magic pointing finger, just so I can remember which finger is my magic pointing finger. And you know what? When I point to pictures in my games, I can only use my magic pointing finger. Now, I'm going to put a sticker on your magic pointing finger too, just so you remember which finger is your magic pointing finger. [Place a sticker on the index finger of the child's dominant hand]. When you point to pictures in my games, you can only use your magic pointing finger. Do you think you can do that? I think you can too! Here are some pictures for you to look at. [Present the first sheet] Put your magic pointing finger on_ (red) _?

Provide feedback to participants on 1) whether or not their choice was correct (e.g., "That's right, that's _ (red) _!" or "Good try but I think that this one is _ (red) _. What do you think?"), and 2) whether or not they used their magic pointing finger ("And you used your magic pointing finger, Good for you!").

Now show me _____? What about _____? [Provide appropriate feedback]

> If a child fails to identify one or more of the cues correctly for a given dimension, ask about that cue again after asking about all cues for that dimension (e.g., "Can you show me _(red)_ again?. That's right!").
>
> When they have identified all cues of a given dimension correctly, before removing the sheet mention the dimensional term (e.g., "Good job! You really know your [colors, things, or sizes]".)

Now, let's look at some other pictures [show cues for next dimension]. Can you show me _____?

FAVORITE ITEMS TASK

Demonstration Trial Instructions

Now you and I are going to pick some of our favorite pictures together. I'm going to pick my favorite pictures first, just to show you how we pick our favorite pictures, and then it will be your turn. OK?

See, here's a picture, here's another picture, and here's another picture. I'm going to pick my **two** favorite pictures. So I'm going to put my magic pointing finger on this picture here because that's one of my favorite pictures, and I'm going to put my magic pointing finger on this picture here because that's my other favorite picture. Picture one and picture two. So these **two** pictures here are my **two** favorite pictures. I'm not going to touch that other picture over there because that's not one of my favorite pictures. I'm only going to touch these **two** pictures here because these **two** pictures are my **two** favorite pictures.

Practice Trials Instructions

Now it's your turn. Put your magic pointing finger on your **two** favorite pictures.
Provide feedback to participants 1) for using only their magic pointing finger, and 2) for not touching the third picture (e.g.**,** "So these pictures are your **two** favorite pictures? Good job! You didn't touch that picture over there because that's not one of your favorite pictures, is it? So you only touched your two favorite pictures and you only used your magic pointing finger. Good for you!) Repeat same instructions for Practice Trials 2 and 3.

FLEXIBLE ITEM SELECTION TASK

Caution for Testers

During the test, it is important to never label any of the items in terms of their shape, color, or size, even in the demonstration or practice trials. If participants label the items in any way, never tell them whether they are correct or not. Acknowledge their utterances with vague statements, such as "uh-uh". This is important because labeling has been found to improve performance on the FIST.

Demonstration Trial Instructions

Now, you and I are going to play a different pick-some-pictures game. We are going to pick some more pictures together with our magic pointing finger. But we are going to play a different pick-some- pictures game. I'm going to pick some pictures first, just to show you how we pick pictures in this game, and then it will be your turn. OK?
(Selection 1) I'm going to pick two pictures that go together in one way. So I'm going to put my magic pointing finger on this picture here and on this picture here, because these two pictures here go together in one way. That picture over there doesn't go with these two pictures here. No! So these two pictures here go together in one way.
(Selection 2) Now you know what I'm going to do? I'm going to pick two pictures that go together, but in another way. So I'm going to put my magic pointing finger on this picture here and on this picture here, because these two pictures here go together but in another way. That picture over there doesn't go with these two pictures. No! So these two pictures here go together, but in another way.
(Summarize both selections) So see, these two pictures here go together in one way, and these two pictures here go together, but in a another way.

Practice Trials Instructions

Now, it's your turn to pick some pictures! Put your magic pointing finger on two pictures that go together in one way. **(Selection 1)**

If the participant selects a matching pair, say:

You know what? Your right! That's right, these two pictures here go together in one way. That picture over there doesn't go with these two pictures here. No! Good job! So these two pictures here go together in one way.

If the participant selects an incorrect pair, no items, one item, or all three items, say:

Good try, but you know what? I think that these two pictures here go together in one way. What do you think? That's right! These two pictures here go together in one way. That picture over there doesn't go with these two pictures here. No! Good job! So these two pictures here go together in one way.

Now, can you put your magic pointing finger on two pictures that go together, but in another way? **(Selection 2)**

If the participant selects a matching pair, say:

You know what? Your right! That's right, these two pictures here go together, but in another way. That picture over there doesn't go with these two pictures here. No! Good job! So these two pictures here go together, but in another way.

If the participant selects an incorrect pair, the same pair, no items, one item, or all three items, say:

Good try, but you know what? I think that these two pictures here go together in another way. What do you think? That's right! These two pictures here go together, but in another way. That picture one over there doesn't go with these two pictures here. No! Good job! So these two pictures here go together, but in another way.

(Summarize both selections) So see, these two pictures here go together in one way, and these two pictures here go together, but in a another way. Good job!

You did a great job on this one, so let's pick some more pictures.

Repeat same instructions for Practice Trial 2.

Test Trials Instructions

I think you know how to play my game now. Right? Yes! So I think we can go a little bit faster now.

Show me two pictures that go together in one way. **(Selection 1)**

Now, show me two pictures that go together, but in another way? **(Selection 2)**

DO NOT PROVIDE FEEDBACK OF ANY KIND ON THE TEST TRIALS, EXCEPT FOR GENERAL PRAISE (e.g. "You're doing a great job.")

Appendix 3. 4 Head-Toes-Knees-Shoulders Task

Child ID: _____ Date: _____ 1

HEAD-TOES-KNEES-SHOULDERS (HTKS)

Parts I, II, and III
FORM A - Extended

Child name	_____
Birthdate	_____
ID #	_____
Gender	_____
Examiner name	_____
Today's date	_____

Directions: After establishing positive rapport with the child, say or read the directions in **bold type** aloud. Words in CAPITAL LETTERS should be emphasized. Administer the task seated or standing; the child should stand, about 3 feet from you, during the task. *Administer Part II* if child responds correctly (include self-corrects) to 5 or more items on Part I of the task, *or* if child is in kindergarten or beyond. *Administer Part III* if child responds correctly (include self-corrects) to 5 or more items on Part II of the task, *or* if child is in first grade or beyond.

The person symbol indicates that you should perform the motion to demonstrate the correct movement to the child. If the child produces the correct (opposite) response immediately, score the item "2". If they self-correct to the correct response, score the item "1". If they do not touch the correct part of their body at all or touch the named part, score the item "0".

A self-correct occurs if the child makes any discernible motion toward an incorrect response, but then changes his/her mind and makes the correct response. Pausing to think, not moving, and then responding correctly does not count as a self-correction – it would be scored as correct.

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PART I: INTRODUCTION

Now we're going to play a game. The game has two parts. First, copy what I do. Touch your head.

Touch your head; wait for the child to touch his/her head.

Good! Now touch your toes.

Touch your toes; wait for the child to touch his/her toes.
Repeat the two commands with motions again, or until the child imitates you correctly.

PART I: PRACTICE

Now we're going to be a little silly and do the OPPOSITE of what I say. When I say touch your HEAD, INSTEAD of touching your head, you touch your TOES. When I say touch your TOES, you touch your HEAD. So you're doing something DIFFERENT from what I say.

If the child responds correctly: Provide positive feedback on each practice item where the child responds correctly.

***If the child responds incorrectly* at any point during the practice portion, provide additional explanations up to 3 times before beginning the test portion:

Remember, when I say to touch your ____, you touch your ____, so you are doing something DIFFERENT from what I say. Let's try another one.

→ Number of additional explanations given: 0 1 2 3

A1. **What do you do if I say "touch your head"?**	0 (other than toes)	1	2 (toes)
A2. **What do you do if I say "touch your toes"?**	0 (other than head)	1	2 (head)

If the child responds verbally: "can you show me? "

Ok, let's practice a few more.

B1. **Touch your head**	0 (other than toes)	1	2 (toes)
B2. **Touch your toes**	0 (other than head)	1	2 (head)
B3. **Touch your head**	0 (other than toes)	1	2 (toes)
B4. **Touch your toes**	0 (other than head)	1	2 (head)

Proceed to Part I test section. Do not explain any parts of the task again. Do not provide feedback during the test portion.

Child ID: _____ Date: _____ 3

PART I: TESTING

We will keep playing this game, and you keep doing the OPPOSITE of what I say.

	Incorrect	Self-Correct	Correct
1. **Touch your head**	0 (other than toes)	1	2 (toes)
2. **Touch your toes**	0 (other than head)	1	2 (head)
3. **Touch your toes**	0 (other than head)	1	2 (head)
4. **Touch your head**	0 (other than toes)	1	2 (toes)
5. **Touch your toes**	0 (other than head)	1	2 (head)
6. **Touch your head**	0 (other than toes)	1	2 (toes)
7. **Touch your head**	0 (other than toes)	1	2 (toes)
8. **Touch your toes**	0 (other than head)	1	2 (head)
9. **Touch your head**	0 (other than toes)	1	2 (toes)
10. **Touch your toes**	0 (other than head)	1	2 (head)

TOTAL (Self-Correct + Correct) → ☐

*****If the child responds correctly (include self-corrects) to 5 or more items on Part I of the task, or if child is in kindergarten or beyond, continue to Part II.***

*If the child should **not** continue to Part II:* **Thank you for playing this game with me today!**

PART II: INTRODUCTION

Ok, now that you've got that part, we're going to add a part. Now, you're going to touch your shoulders and your knees. First, touch your shoulders.

Touch your shoulders; wait for the child to touch his/her shoulders.

Now, touch your knees.

Touch your knees; wait for the child to touch his/her knees.
Repeat the two commands with motions again, or until the child imitates you correctly.

PART II PRACTICE:

Ok, now we're going to be silly again. You keep doing the opposite of what I say like before. But this time, touch your knees and shoulders. When I say to touch your KNEES, you touch your SHOULDERS, and when I say to touch your SHOULDERS, you touch your KNEES.

If the child responds correctly: Provide positive feedback on each practice item where the child responds correctly.

***If the child responds incorrectly* at any point during the practice portion, provide additional explanations up to 2 times before beginning the test portion:

Remember, when I say to touch your ____, instead of touching your knees, you touch your ____. Do the OPPOSITE of what I say.

→ Number of additional explanations given: 0 1 2

C1. **What do you do if I say "touch your knees"?**	0 (other than shoulders)	1	2 (shoulders)

If the child responds verbally: "can you show me? "

D1. **Touch your knees**	0 (other than shoulders)	1	2 (shoulders)
D2. **Touch your shoulders**	0 (other than knees)	1	2 (knees)
D3. **Touch your knees**	0 (other than shoulders)	1	2 (shoulders)
D4. **Touch your shoulders**	0 (other than knees)	1	2 (knees)

Proceed to Part II test section. Do not explain any parts of the task again. Do not provide feedback during the test portion.

Now that you know all the parts, we're going to put them together. You're going to keep doing the opposite of what I say to do, but you won't know what I'm going to say.

There are four things I could say.
If I say touch your HEAD, you touch your TOES.
If I say touch your TOES, you touch your HEAD.
If I say touch your KNEES, you touch your SHOULDERS.
If I say touch your SHOULDERS, you touch your KNEES.

Are you ready? Let's try it.

	Incorrect	Self-Correct	Correct
11. **Touch your head**	0 (other than toes)	1	2 (toes)
12. **Touch your toes**	0 (other than head)	1	2 (head)
13. **Touch your knees**	0 (other than shoulders)	1	2 (shoulders)
14. **Touch your toes**	0 (other than head)	1	2 (head
15. **Touch your shoulders**	0 (other than knees)	1	2 (knees)
16. **Touch your head**	0 (other than toes)	1	2 (toes)
17. **Touch your knees**	0 (other than shoulders)	1	2 (shoulders)
18. **Touch your knees**	0 (other than shoulders)	1	2 (shoulders)
19. **Touch your shoulders**	0 (other than knees)	1	2 (knees)
20. **Touch your toes**	0 (other than head)	1	2 (head)

PART II TESTING:

TOTAL (Self-Correct + Correct) → ☐

*****If the child responds correctly (include self-corrects) to 5 or more items on Part II of the task, or if child is in first grade or beyond, continue to Part III.***

Thank you for playing this game with me today!

*If the child should **not** continue to Part III:*

PART III INTRODUCTION

You are doing so well we just have one more part! Now we are going to change the rules of the game.

When I say to touch your HEAD, you touch your KNEES.
When I say touch your KNEES, you touch your HEAD.
When I say touch your SHOULDERS, you touch your TOES.
And when I say touch your TOES, you touch your SHOULDERS.

Ok? Let's practice!

If the child responds correctly: Provide positive feedback on each practice item where the child responds correctly.

***If the child responds incorrectly* at any point during the practice portion, provide additional explanations up to 2 times before beginning the test portion:

Remember, we changed the rules. "Touch your head" means touch your KNEES – head goes with knees now. "Touch your shoulders" means touch your TOES – shoulders goes with toes.

→ Number of additional explanations given: 0 1 2

PART III PRACTICE:

E1. **What do you do if I say "touch your head"?**	0 (other than knees)	1	2 knees)
E2. **What do you do if I say "touch your shoulders"?**	0 (other than toes)	1	2 (toes)

If the child responds verbally: "can you show me? "

F1. **Touch your head**	0 (other than knees)	1	2 (knees)
F2. **Touch your shoulders**	0 (other than toes)	1	2 (toes)
F3. **Touch your toes**	0 (other than shoulders)	1	2 (shoulders)
F4. **Touch your knees**	0 (other than head)	1	2 (head)

You're doing great! Let's do a few more.

Proceed to Part III test section. Do not explain any parts of the task again. Do not provide feedback during the test portion.

PART III TESTING:

	Incorrect	Self-Correct	Correct
21. **Touch your shoulders**	0 (other than toes)	1	2 (toes)
22. **Touch your head**	0 (other than knees)	1	2 (knees)
23. **Touch your knees**	0 (other than head)	1	2 (head)
24. **Touch your toes**	0 (other than shoulders)	1	2 (shoulders)
25. **Touch your toes**	0 (other than shoulders)	1	2 (shoulders)
26. **Touch your knees**	0 (other than head)	1	2 (head)
27. **Touch your shoulders**	0 (other than toes)	1	2 (toes)
28. **Touch your head**	0 (other than knees)	1	2 (knees)
29. **Touch your head**	0 (other than knees)	1	2 (knees)
30. **Touch your shoulders**	0 (other than toes)	1	2 (toes)

After the child completes the task, say: **Thank you for playing this game with me today!**

Appendix 3. 5 Coding schemes of the puzzle task

MOTHER-CHILD DADIC INTERACTION DURING THE PUZZLE TASK

1. UNIT OF MOTHER-CHILD DYADIC INTERACTION: EPISODE

AN EPISODE is defined in this study as structured in one instance of maternal support followed by the child's response to it. The maternal verbal/behavioural intervention in an episode is coded as one of the following four constructs: (a) one of six levels of maternal support (maternal contingency), (b) maternal intrusiveness, (c) maternal praise, or (d) maternal flexibility and Perspective-taking (F&P). Notice that these four constructs are exhaustive (to code all maternal traits observed during the puzzle task and also exclusive). Then, the child's response to the maternal intervention (coded as one of six levels of support) is coded as successful (S) if the child succeeds acting on the maternal intervention or failed (F) if the child fails to do so.

2. MOTHER ACTIONS

(a) Six levels of maternal support (Level 0 to Level 5)

An episode is assigned to one of six levels of support when provided when the maternal support in the episode aims to help the child correct errors or fulfil requests that have been made by the child. Of note here is that maternal support provided in the absence of errors or requests made by the child, is not assigned to one of six levels of support but coded as *Intrusiveness* (for more details for Intrusiveness, see below).

<u>Maternal Levels of Support</u>

Levels	Operational definition (Example)
0	No support 1) Code an episode as Level 0 if the mother does not provide support because the child is evidenced to progress well. 2) Do not code an episode in which the mother does not provide any support despite the child apparently struggling with the task. This episode should be coded as Laissez-faire (L).
1	Level 1 support is one of the following: 1) General verbal start ("You do one.") 2) Questions/comments to trigger former knowledge or cognitive process 3) Plan actions
2	Level 2 support is the maternal intervention in which the mother does not specify s what the errors in a given situation are but indirectly hints at something has gone wrong (verbal hints at errors). ("Something seems to be wrong...why don't you check it?")
3	Level 3 support is the maternal intervention in which the mother points at specific errors and may explain why they are wrong but does not provide solutions to them. 1) Pointing at errors ("This piece is wrong.") 2) Explanation of errors ("That piece is too big/short/too curvy.")

4	Level 4 support is the maternal intervention in which the mother provides solutions to errors/ requests the child has made. 1) Specific directives of what to do (“Find something like this. “Place this shorter piece next to the big piece “) 2) Do not code an episode in which the mother provides specific directives in the absence of errors or requests that the child has made. These episode should be coded as *Intrusiveness.*
5	Level 5 support is the maternal intervention in which the mother demonstrate and then asks the child to perform in the same way she has just demonstrated. 1) Maternal demonstration followed by the child’s performance in the same way the mother has shown (“This piece should go here/that there…. Now, can you do this part as I did?”) 2) Do not code an episode in which the mother only demonstrates and then does part of the puzzle herself or does not ask the child to do the puzzle in the same way as she has done. These episodes should be coded as Taking-over (Intrusiveness) or Level 3 (Explanation of errors)

Note. Adapted from Wood (1980)

(b) Maternal intrusiveness

An episode is coded as intrusiveness if the maternal verbal or behavioural intervention is provided in the absence of errors or requests that the child has made or if the mother does part of the puzzle herself. The former is operationalized as Directives and the latter as Taking-over.

Maternal Intrusiveness

Codes	Operational definition (Example)
Directives	In the absence of the child’s errors or requests: • Specific directives telling the child what to do next (“Put these here.”, “Why don’t we sort them into big and little pieces?”, “Let’s start on the outside ring first.”) • Handing over a right piece to child OR pointing at a right place
Taking-over	Mother herself doing the puzzle

Note. Adapted from Bibok et al. (2009)

(c) Maternal praise

An episode is coded as maternal praise if the maternal verbal input aims to praise the child’s performance on the task (“Great/Well-done/You did it!”).

(d) Maternal Flexibility and Perspective-taking (F&P)

This construct is not applicable if the child does not deviate from the task. In that case, code as missing. An episode is coded as F&P if the mother demonstrates flexibility in her attempts to keep her child on task or takes her child’s perspective, acknowledging her child’s feelings while gently bringing the child’s focus back on the task. That is, she is not rigid (e.g., she physically restrains her child; takes his/her hand and goes on with

the task as if the child was a puppet or gives orders in an excessively stern tone of voice without explanation).

Do not code as episode in which the mother does not take any action when the child deviates from the task. These episodes should be coded as Laissez-faire (L).

3. Once the maternal verbal/behavioural intervention (as one of the six levels of maternal support) and the child's response to it (as either Successful or Failed) within an episode have been coded, the following rules of contingency are applied to determine whether the maternal intervention was contingent or not.

Appendix 3. 6 Coding schemes for maternal elaboration

UNIT OF MATERNAL ELABORATION: PROPOSITION
A proposition is defined in this study as independent clauses, with each unique or implied verb in an independent clause forming a new propositional unit. “We tried and tried” is one proposition, whereas “We tried and accomplished the goal” is two.

A proposition is coded as one of the following categories:

Categories	Operational definition (Example)
Wh-question elaborations	Mothers’ questions that asked children to provide a piece of new information about an event. (“What happened to us on the trip?”)
Yes-no question elaborations	1. Mothers’ questions that require the child to confirm or deny a piece of new information provided by the mother (“You know when we went to the theatre?”). 2. This category includes tag questions (“Daddy joined us there, didn’t he?”)
Statement elaborations	New pieces of information provided by the mother that does not require a response from the child (“I liked when you and your brother worked together on the task.”)

Note. Adapted from Reese, Haden, & Fivush (1993)

The above three categories (Wh- and Yes-no questions and statement elaborations) are also relevant to the following three cases:

1) Mothers’ questions that are not specifically about the event under discussion but related to the event. (“What other train have we gone on besides the one at the zoo?”)
2) Mothers’ questions concerning the event in question couched in fantasy rather than factual terms (“Did any crabs play the guitar?”)
3) Mothers’ questions on a future occurrence of the event in question (“Do you want to go to the baseball game again?”)

Do not code a proposition that is not assessed to ask the child to provide new information or provide the child with new information (LEAVE IT BLANK). These cases involve the following three cases:

Cases	Operational definition (Example)
Repetitions	1. Mothers repeat the exact content or the gist of their own previous utterances (“mother asks, “Who was there?” and in her next conversational turn repeats, “Do you remember who was there?”) 2. Maternal utterances directed at eliciting memory information but which provided no new information (“Do you remember?” “Tell me about it.”)
Evaluations	Maternal utterances that confirm or negate the child’s previous utterance (which often include repetition of the child’s previous utterance along with “Right,” “Yes,” (repeating the whole/part of the child’s previous utterance, “Black and White?” “Very good!”)
Off-topic	Maternal utterances that are not related to the topic being discussed

Appendix 3. 7 Coding schemes for maternal mental-state references

Wang, Q., Doan, S. N., & Song, Q. (2010). Talking about internal states in mother–child reminiscing influences children's self-representations: A cross-cultural study. *Cognitive Development*, *25*(4), 380–393.

Jenkins, J. M., Turrell, S. L., Kogushi, Y., Lollis, S., & Ross, H. S. (2003). A Longitudinal Investigation of the Dynamics of Mental State Talk in Families. *Child Development*, *74*(3), 905-20.

1. **Cognitive terms**

Terms used to denote the thoughts, memories, or knowledge of the speaker, listener, or a third person: think, know, wonder, remember, forget, guess, pretend, understand, and expect, which have been found to the most common cognitive state terms uttered by young children. The following cases are also coded as cognitive terms:

1) "Know what": when 'now' is used to direct an interaction by introducing information (e.g., "Know what, I have a…"

2) References to I know and I don't know if a descriptive statement is made implicitly, not only explicitly, such as "the big snake is dangerous." "I know."

3) I know and I don't know are coded as cognitive terms if they were linked with a description of knowledge or ignorance.

4) "Know" as it refers to ability (e.g., I know how to tie my shoes") or to facts ("I know my socks are in the drawer.")

<u>The following cases are not relevant to cognitive terms:</u>

1) Know having unclear meanings of a term: "Where do you think the sock is?" "I think the sock is in the drawer."
2) Know when used to paraphrase to indicate other meanings: "know Tom" if this can be paraphrased to mean "I met Tom."

2. Desire terms

Terms used to capture children's desires or goals: want, hope, wish and care

1) Want is coded when used as a reference to a goal directed behaviour (e.g., "I want to sit down.")
2) Hope when used as a reference to a wish or want (e.g., "I hope Santa comes soon.")
3) Care when used as a reference to a preference or lack of preference (e.g., "I don't care which crayon I use.")

3. Feeling terms

Terms that refer to emotional states: sad, hurt, angry, happy, excited, love, dislike, afraid, enjoy, fun, glad, mad, scared, upset, surprise, and fear

Appendix 4. 1 Regression assumptions checking for Step 2A and 2B in Table 4.4

1. Step 2A model

   1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.38549	0.045887	0.041667	0.788309
19	2.004442	0.029553	0.048392	0.878971
33	2.071671	0.02922	0.038016	0.855229
53	2.591279	0.044494	0.028124	0.729586
54	2.069697	0.051833	0.08375	0.89836

   2) Assessing the assumption of independence

Lag	Autocorrelation	D-W statistic	p-value
1	-0.01462	1.991543	0.99

   3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

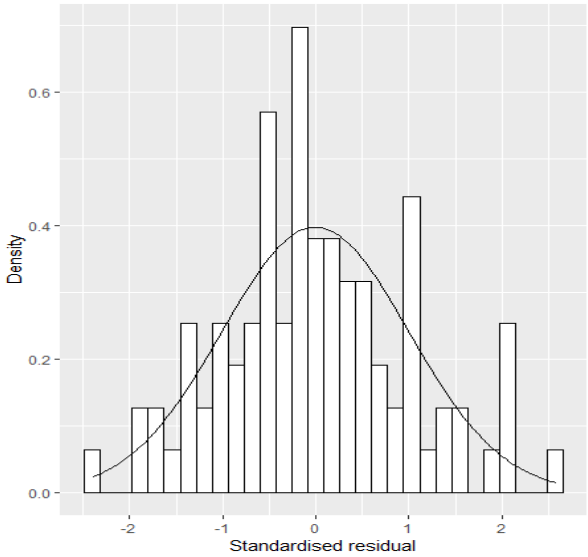
Child age	Child verbal ability	Mother education	Maternal intrusiveness
1.192962	1.219302	1.209507	1.208501

The mean of VIF: 1.207568

Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal intrusiveness
0.838249	0.820142	0.826783	0.827472

   4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals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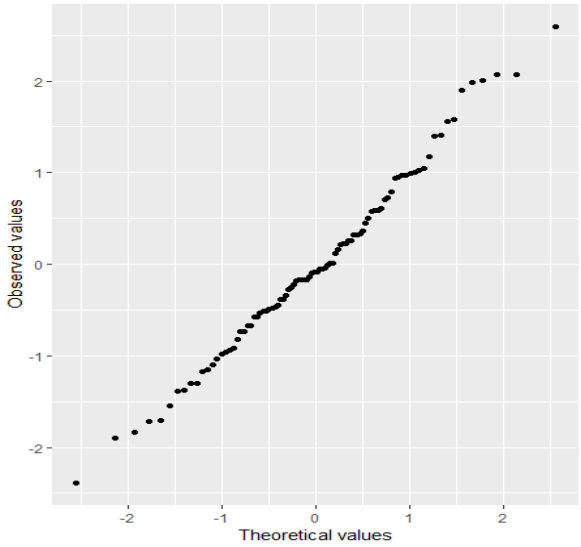
0.0
-2
-1
0
1
2
Standardised residual


Observed values
2
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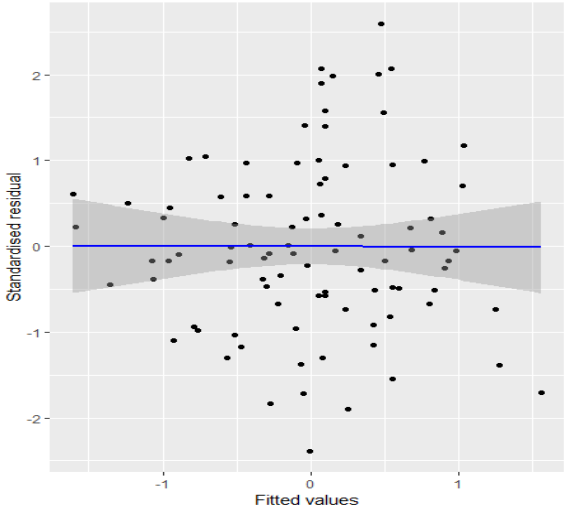
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-1
0
1
Fitted values

2. Step 2B model

1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
27	2.247504	0.01933	0.022445	0.763142
33	2.025687	0.02922	0.040975	0.834164
53	2.202224	0.044494	0.052174	0.798906
70	2.411447	0.028781	0.028839	0.725691
74	-2.23034	0.084116	0.092113	0.826396

2) Assessing the assumption of independence

Lag	Autocorrelation	D-W statistic	p-value
1	-0.05998	2.080595	0.768

3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

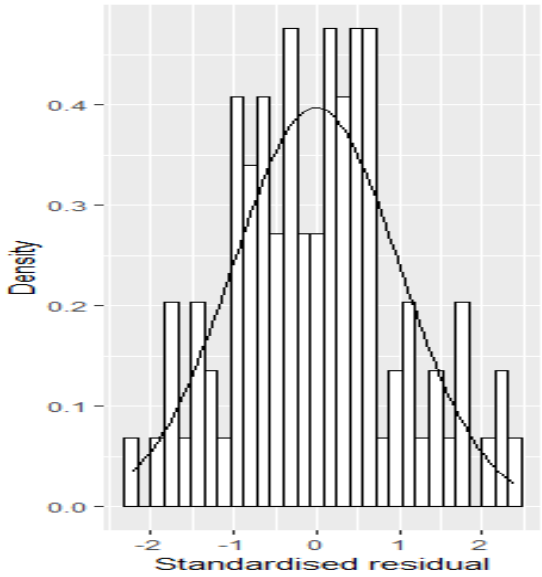
Child age	Child verbal ability	Mother education	Maternal contingency
1.187061	1.305016	1.159811	1.266262

The mean of VIF: 1.229538

Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal contingency
0.842416	0.766274	0.86221	0.789726

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals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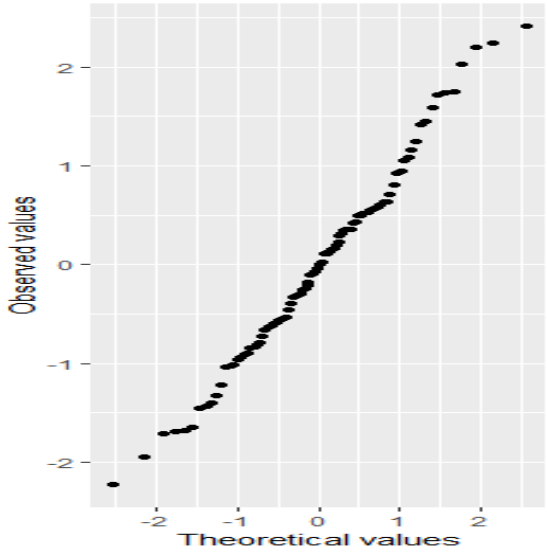
0
1
2
Standardised residual


Observed values
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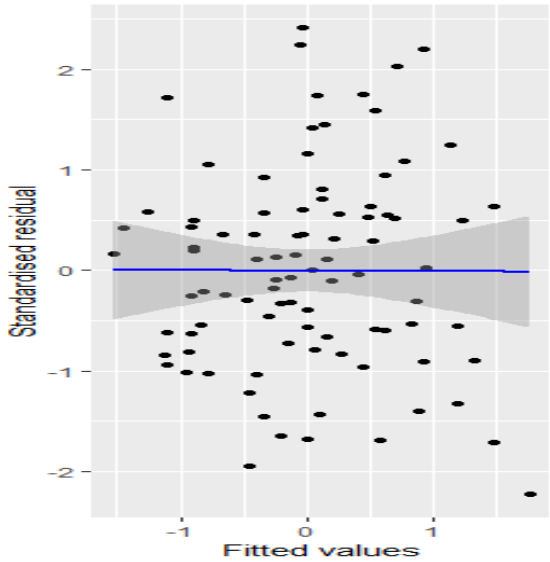
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-1
0
1
Fitted values

Appendix 4. 2 Regression assumptions checking for Model 2A and 2B in Table 4.8

1. Step 2A model

1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.36876	0.052867	0.04499	0.786822
33	2.048639	0.038648	0.044017	0.859523
53	2.550677	0.038007	0.02838	0.730222
54	2.009224	0.084549	0.094792	0.916868

2) Assessing the assumption of independence

Lag	Autocorrelation	D-W statistic	p-value
1	-0.04271667	2.045894	0.856

3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

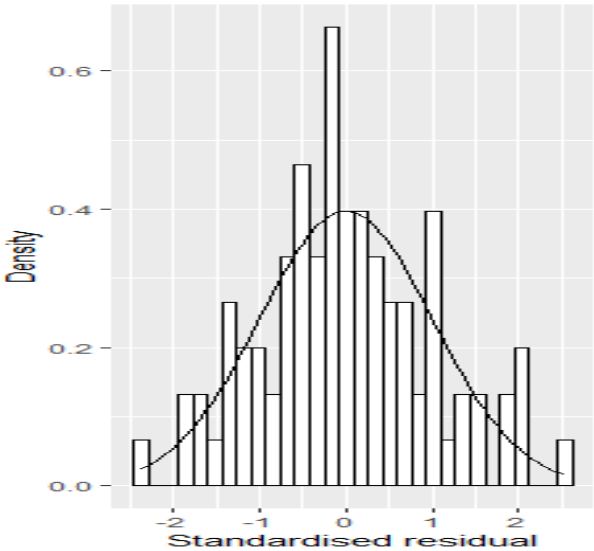
Child age	Child verbal ability	Mother education	Maternal intrusiveness
1.230747	1.274749	1.19954	1.192491

The mean of VIF: 1.224382

Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal intrusiveness
0.812514	0.784468	0.833653	0.838581

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals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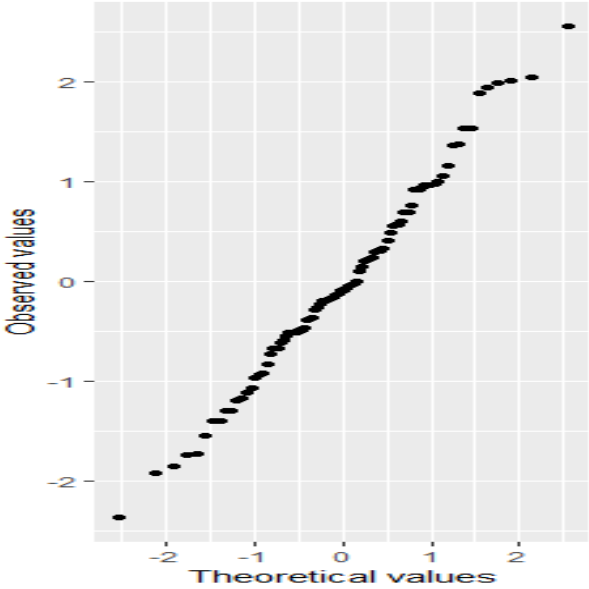
0.0
-2
-1
0
1
2
Standardised residual


Observed values
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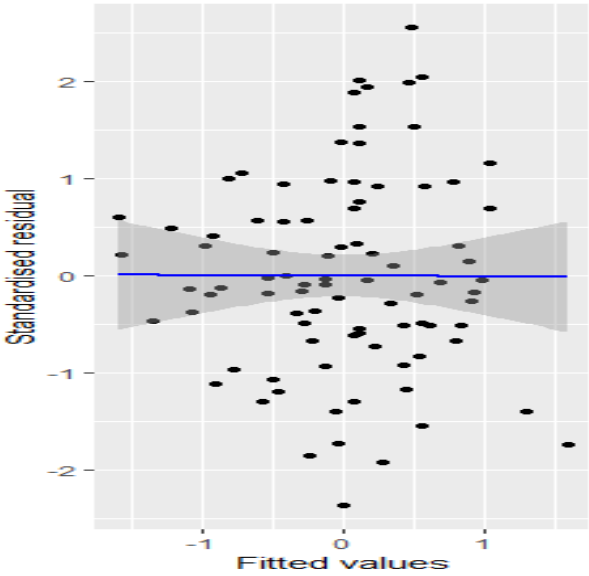
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-1
0
1
Fitted values

2. Step 2B model

1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
27	2.242009	0.021465	0.024981	0.758198
33	2.013997	0.033173	0.046775	0.835276
53	2.163028	0.043242	0.05254	0.801375
70	2.388742	0.028989	0.029581	0.722818
74	-2.25218	0.088369	0.094639	0.813667

2) Assessing the assumption of independence

Lag	Autocorrelation	D-W Statistic	p-value
1	-0.06762575	2.09387	0.604

3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

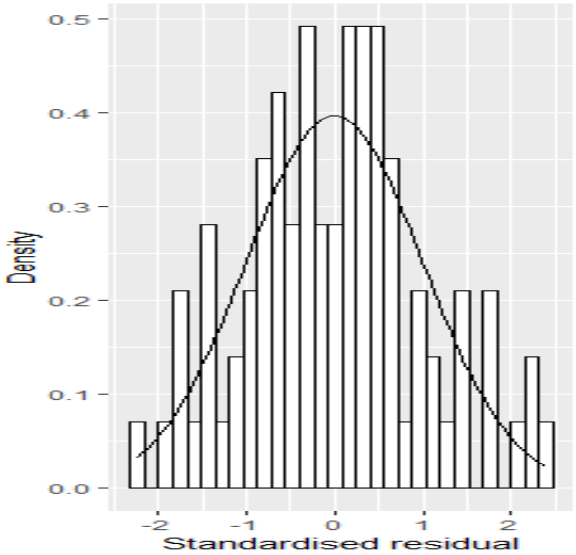
stnd_age_2	stnd_voc_1	stnd_edu	stnd_int	stnd_contin
1.231568	1.361969	1.210906	1.765544	1.856824

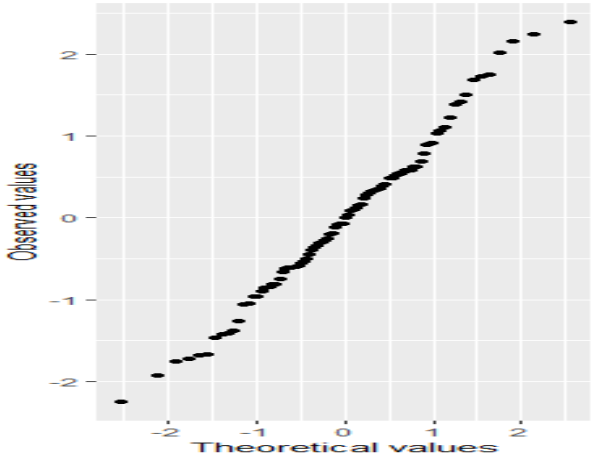
The mean of VIF: 1.485362

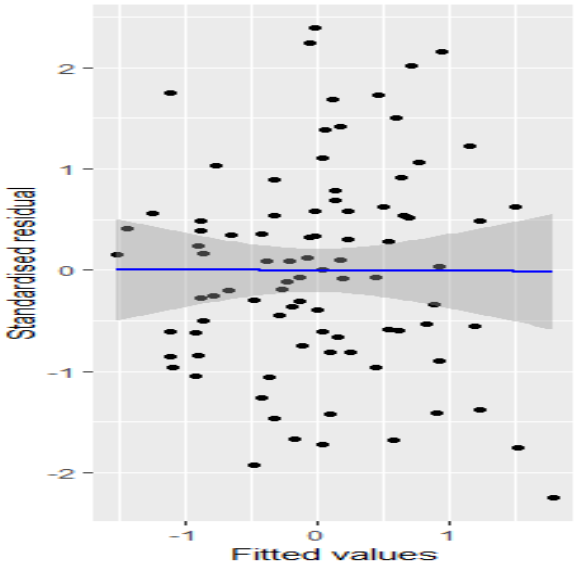
Tolerance statistics (i.e., the reciprocals of the VIF statistics)

stnd_age_2	stnd_voc_1	stnd_edu	stnd_int	stnd_contin
0.811973	0.734231	0.825828	0.566398	0.538554

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals







Appendix 4. 3 Regression assumptions checking for Step 2A and 2B in Table 4.14

1. Step 2A model

   1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.25057	0.020699	0.020024	0.801011
19	2.254921	0.038427	0.036412	0.813658
26	-2.13901	0.033292	0.035104	0.838132
30	2.33663	0.040808	0.036025	0.794877
54	2.000669	0.075078	0.085744	0.915715

   2) Assessing the assumption of independence

lag	Autocorrelation	D-W Statistic	p-value
1	-0.05787	2.077786	0.714

   3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

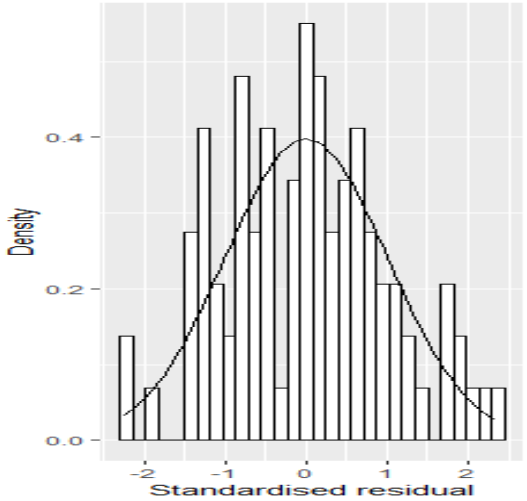
Child age	Child verbal ability	Mother education	Maternal CMR
1.227119	1.250454	1.07878	1.115474

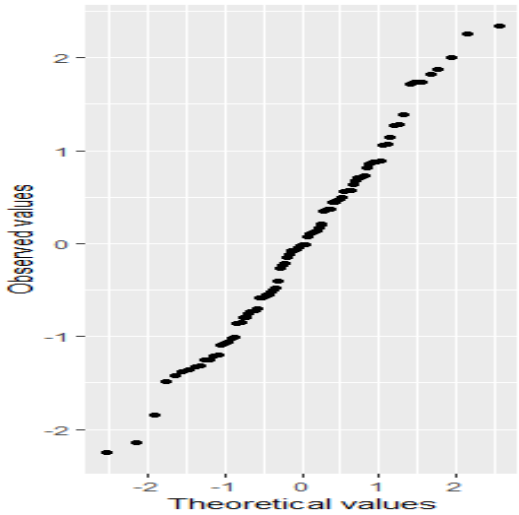
The mean of VIF: 1.167957

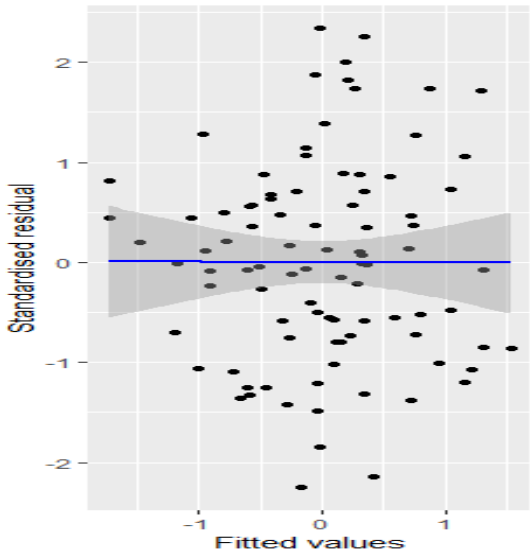
Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal CMR
0.814917	0.79971	0.926973	0.89648

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals







2. Step 2B model

1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.11934	0.019601	0.021354	0.830563
19	2.327811	0.041272	0.036686	0.797431
26	-2.24408	0.033682	0.03236	0.812668
30	2.411624	0.050981	0.041988	0.782512
53	2.449199	0.045301	0.036386	0.769251

2) Assessing the assumption of independence

lag	Autocorrelation	D-W Statistic	p-value
1	-0.01362	1.986239	0.956

3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

Child age	Child verbal ability	Mother education	Maternal CER
1.226842	1.225445	1.077116	1.081464

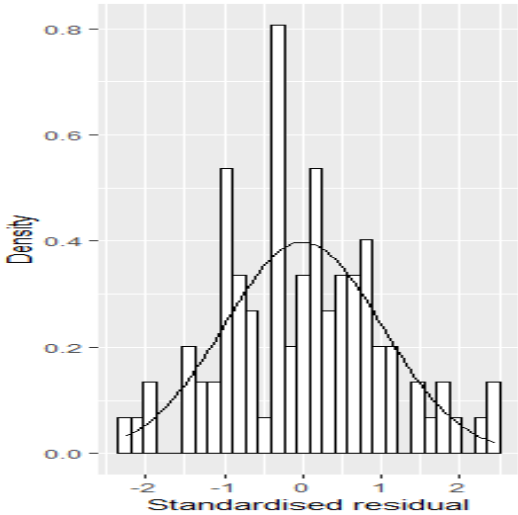
The mean of VIF: 1.152717

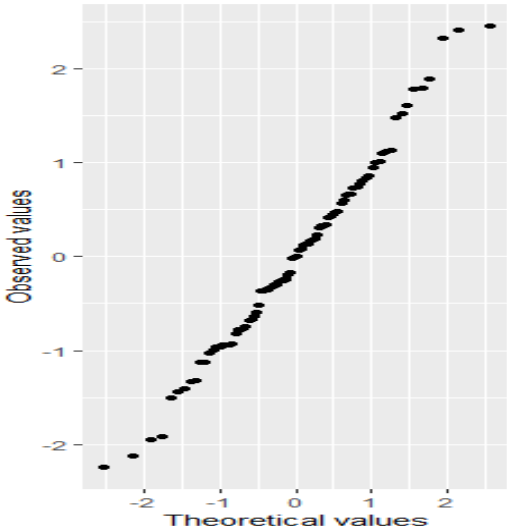
Tolerance statistics (i.e., the reciprocals of the VIF statistics)

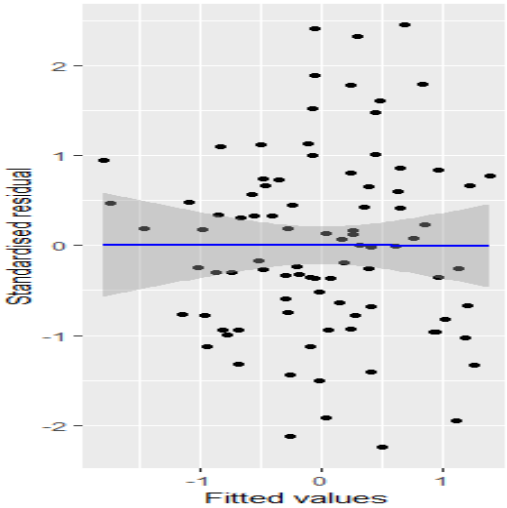
Child age	Child verbal ability	Mother education	Maternal CER
0.815101	0.81603	0.928405	0.924672

4) Checking assumptions about the residuals

scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals







Appendix 4. 4 Regression assumptions checking for Step 2A and 2B in Table 4.17

1. Step 2A model

   1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.36876	0.052867	0.04499	0.786822
33	2.048639	0.038648	0.044017	0.859523
53	2.550677	0.038007	0.02838	0.730222
54	2.009224	0.084549	0.094792	0.916868

   2) Assessing the assumption of independence

lag	Autocorrelation	D-W	Statistic	p-value
1	-0.04272		2.045894	0.834

   3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

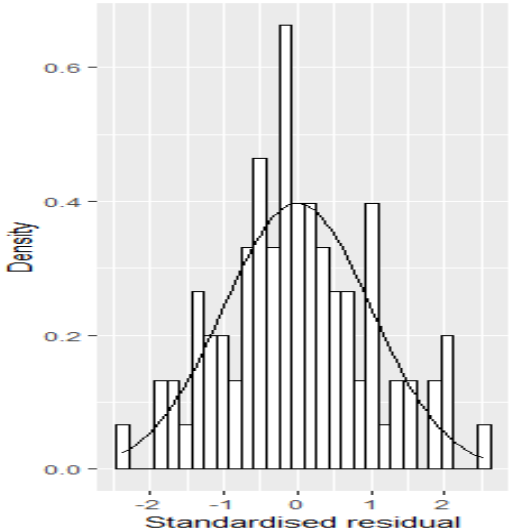
Child age	Child verbal ability	Mother education	Maternal intrusiveness
1.230747	1.274749	1.19954	1.192491

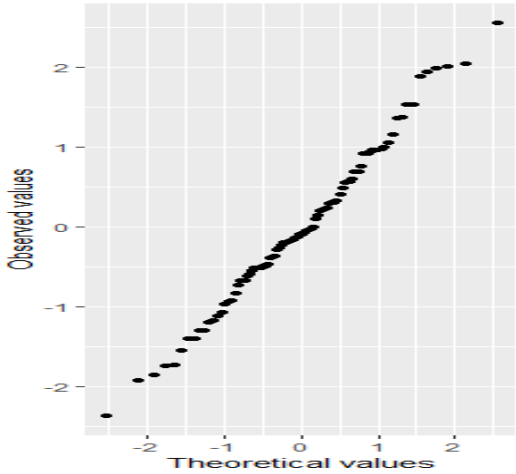
The mean of VIF 1.224382

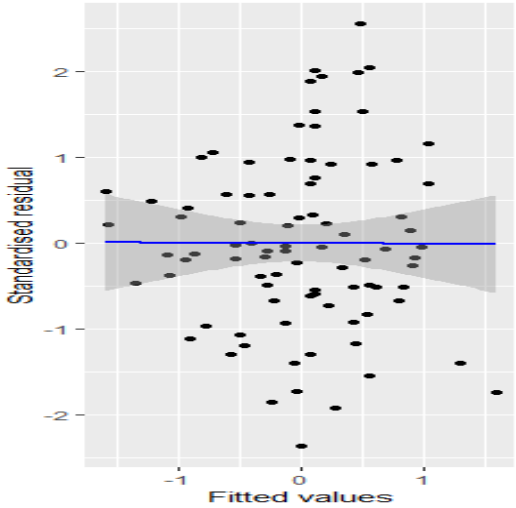
Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal intrusiveness
0.812514	0.784468	0.833653	0.838581

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals







2. Step 2B model

1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
27	2.242009	0.021465	0.024981	0.758198
33	2.013997	0.033173	0.046775	0.835276
53	2.163028	0.043242	0.05254	0.801375
70	2.388742	0.028989	0.029581	0.722818
74	-2.25218	0.088369	0.094639	0.813667

2) Assessing the assumption of independence

lag	Autocorrelation	D-W Statistic	p-value
1	-0.06763	2.09387	0.642

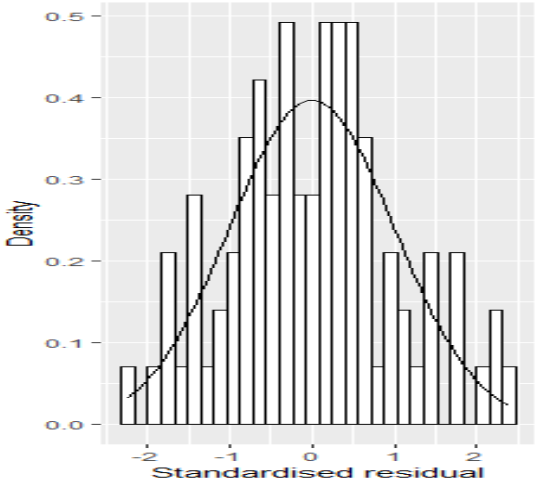
3) Assessing the assumption of no multicollinearity

Child age	Child verbal ability	Mother education	Maternal contingency
1.230922	1.357763	1.14924	1.254143

The mean of VIF 1.485362

Child age	Child verbal ability	Mother education	Maternal contingency
0.812399	0.736506	0.870141	0.797357

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals


Density
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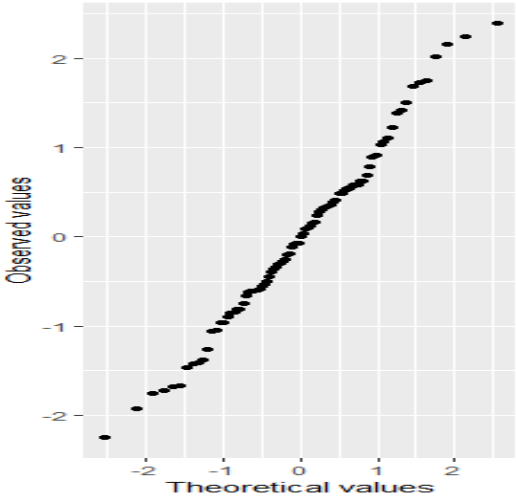
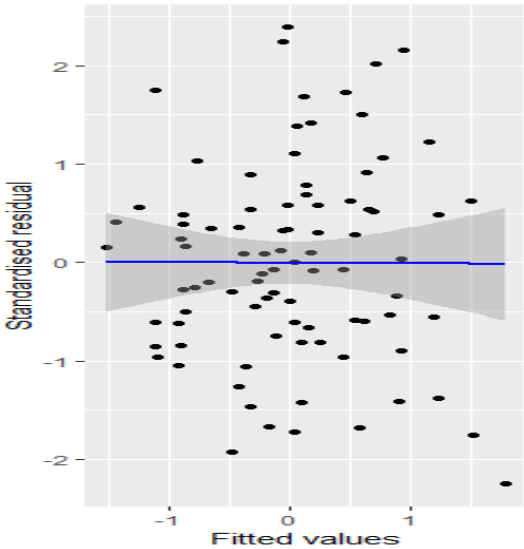
0.4
0.3
0.2
0.1
0.0
-2
-1
0
1
2
Standardised residual


Observed values
2
1
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-1
0
1
Fitted values

Appendix 4. 5 Regression assumptions checking for Step 2A and 2B in Table 4.20

1. Step 2A model

   1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.68558	0.033759	0.031725	0.603145
30	2.147526	0.031763	0.045993	0.770614

   2) Assessing the assumption of independence

lag	Autocorrelation	D-W	Statistic	p-value
1	0.002282		1.969517	0.904

   3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

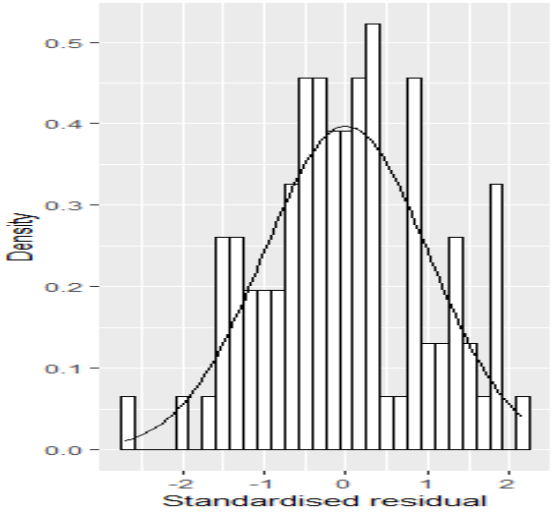
Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CMR
1.296949	1.358402	1.237239	1.284171	1.252545	1.175298

The mean of VIF 1.267434

Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CMR
0.771041	0.736159	0.808251	0.778713	0.798374	0.850848

   4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals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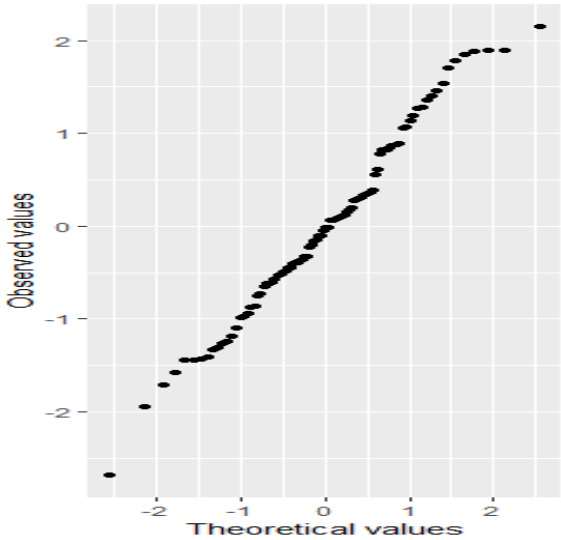
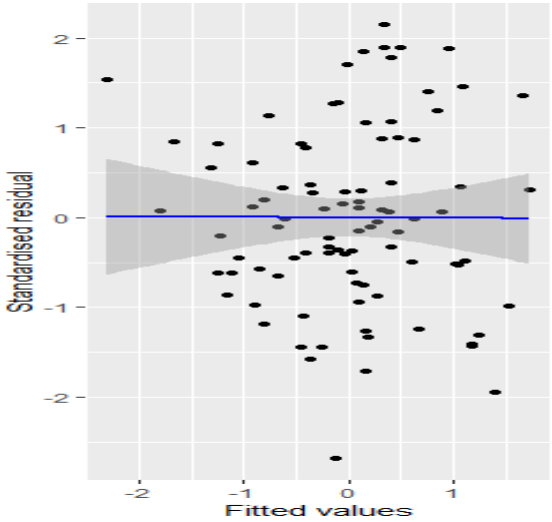
0.4
0.3
0.2
0.1
0.0
-2
-1
0
1
2
Standardised residual


Observed values
2
1
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-2
-1
0
1
Fitted values

2. Step 2B model

1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.55463	0.033914	0.0351	0.643633
30	2.204839	0.039002	0.053174	0.759749
53	2.080118	0.042607	0.064484	0.805555
74	-2.16813	0.073841	0.099064	0.80971

2) Assessing the assumption of independence

lag	Autocorrelation	D-W Statistic	p-value
1	0.022808	1.926197	0.68

3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

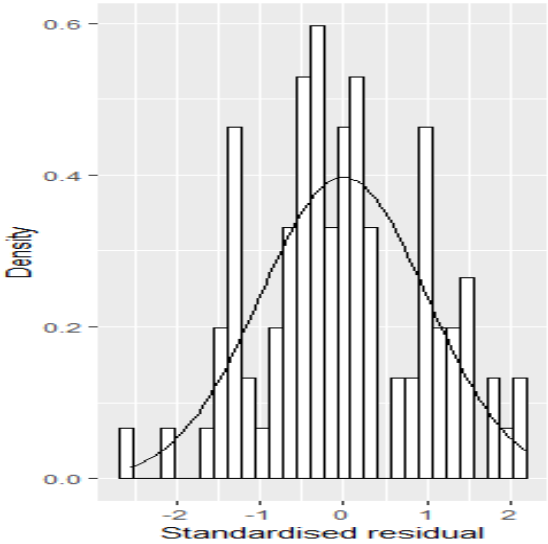
Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CER
1.295033	1.330733	1.236882	1.284213	1.266076	1.151806

The mean of VIF: 1.260791

Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CER
0.772181	0.751466	0.808485	0.778687	0.789842	0.868201

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals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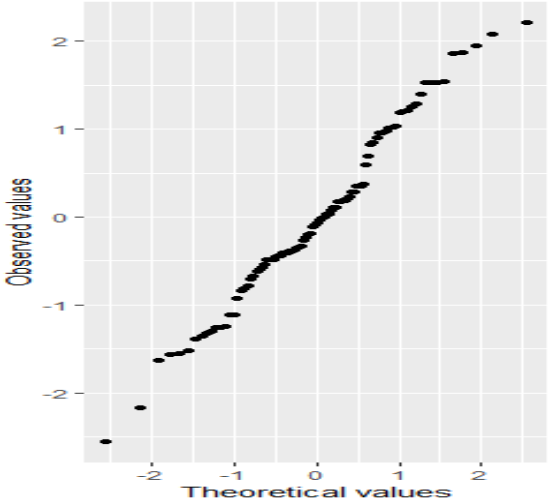
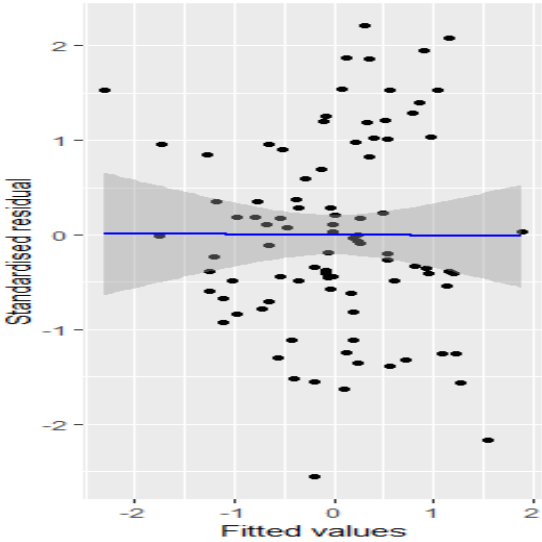
0.2
0.0
-2
-1
0
1
2
Standardised residual


Observed values
2
1
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-2
-1
0
1
2
Fitted values

Appendix 4. 6 Regression assumptions checking for Step 2A and 2B in Table 4.22

1. Step 2A model

   1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-2.61541	0.034969	0.034548	0.613434
30	2.14432	0.032178	0.046699	0.763195

   2) Assessing the assumption of independence

lag	Autocorrelation	D-W Statistic	p-value
1	-0.01472	2.002012	0.968

   3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

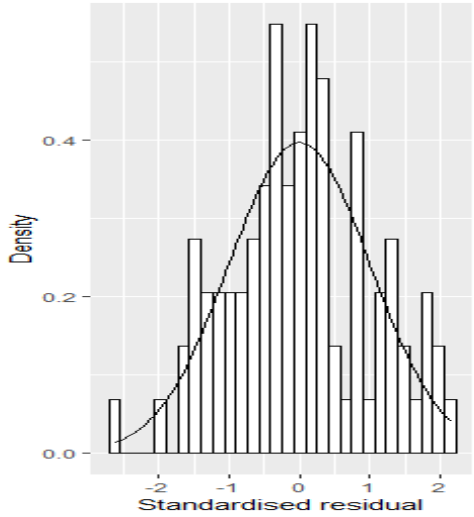
Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CMR
1.339985	1.394458	1.235363	1.272004	1.238749	1.204282

The mean of VIF: 1.280807

Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CMR
0.746277	0.717125	0.809479	0.786161	0.807266	0.83037

   4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals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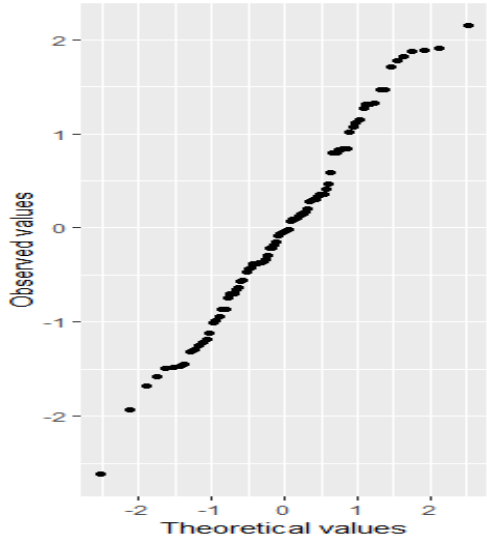
0.2
0.0
-2
-1
0
1
2
Standardised residual


Observed values
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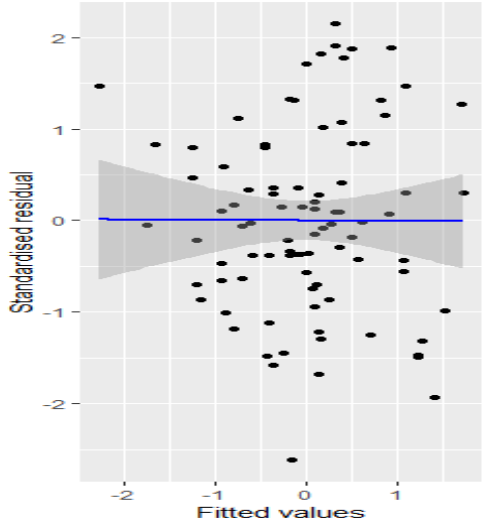
1
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-2
-1
0
1
Fitted values

2. Step 2B model

1) Checking outliers and influential cases

Case number	Standardized residuals	Cooks distance	Leverage	Covariance rations
15	-1.95069	0.045887	0.067473	0.876781
30	1.754309	0.023973	0.04465	0.902309
52	-0.18165	0.000162	0.028612	1.101753
72	1.087134	0.009323	0.045194	1.03396

2) Assessing the assumption of independence

lag	Autocorrelation	D-W	Statistic	p-value
1	-0.00336		1.977432	0.912

3) Assessing the assumption of no multicollinearity

Variance inflation factor (VIF) statistics

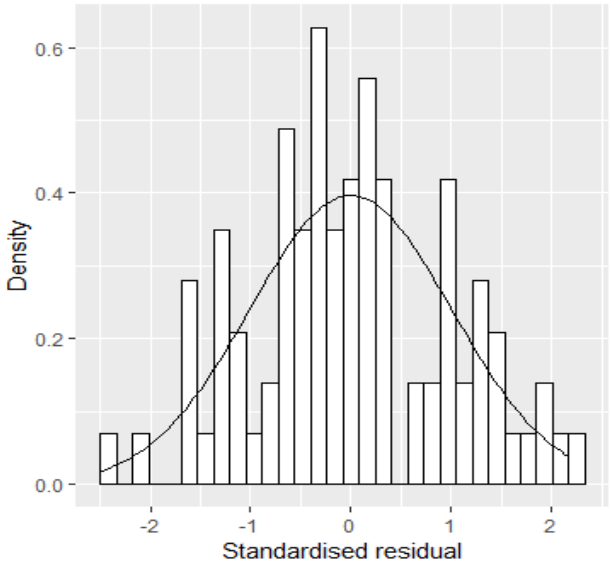
Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CER
1.333754	1.373518	1.231934	1.271968	1.241088	1.164788

The mean of VIF: 1.269508

Tolerance statistics (i.e., the reciprocals of the VIF statistics)

Child age	Child verbal ability	Mother education	Maternal contingency	Maternal shifting	Maternal CER
0.749763	0.728058	0.811732	0.786183	0.805745	0.858526

4) Checking assumptions about the residuals: scatterplots of residuals against predicted values, Q-Q plots, and histograms of standardised residuals


Density
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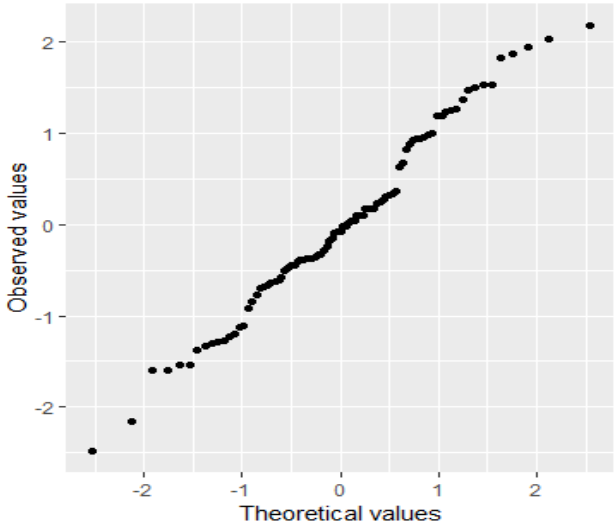
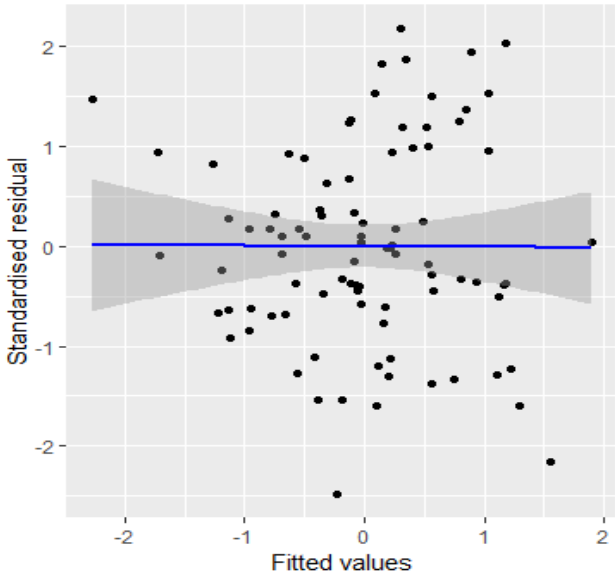
-1
0
1
2
Standardised residual


Observed values
2
1
0
-1
-2
-2
-1
0
1
2
Theoretical values


Standardised residual
2
1
0
-1
-2
-2
-1
0
1
2
Fitted values