The relevance of maternal scaffolding behaviours in infancy to child cognitive abilities and academic achievement : a bioecological study

The Relevance of Maternal Scaffolding Behaviours in Infancy to Child Cognitive Abilities and Academic Achievement: A Bioecological Study

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DECLARATION

I can confirm that, except where explicit attribution is made, the work presented in this thesis is entirely my own.

ABSTRACT

The development of cognitive and academic abilities can be understood as part of a larger ecological system. One mechanism said to promote the development of these abilities is scaffolding, a process characterised by contingent response, and cognitive and emotional support, aimed at promoting autonomy. In a diverse sub-sample of 400 mother-child dyads from the Families, Children and Child Care study, maternal scaffolding-related behaviours were recorded during semi-structured play interactions when children were 10 months.

Employing the Process-Person-Context-Time model (Bronfenbrenner & Morris, 2006), the study aims were threefold: (1) to test whether mothers' show behaviours akin to the central dimensions of scaffolding during play interactions with infants, (2) to address individual differences in maternal scaffolding behaviours, and (3) to explore the relevance of these behaviours for child cognitive abilities in the preschool years, and academic attainment at age 11 years.

Maternal behaviours reflecting the main dimensions of scaffolding were explained by an overarching construct labelled 'scaffolding-like behaviours'. Child (play maturity at 10 months), mother (age, personality, ethnicity, first language and education) and context (family size and neighbourhood adversity) characteristics, explained unique variations in these behaviours. After taking person and context characteristics into consideration, these behaviours predicted children's non-verbal ability but not verbal ability at 51 months, an association moderated by maternal levels of education. Non-verbal ability mediated the effects of maternal scaffolding-like behaviours on child English and maths academic attainment at age 11 years.

Studying a large and diverse English sample, the current study made the following contributions: it elucidated some of the mechanisms by which individual differences in scaffolding occur, and illustrated that alongside proximal and distal contextual factors, maternal behaviours in the first year continue to be relevant to child intellectual development.

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CHAPTER 1: INTRODUCTION

'In ecological research the principal main effects are likely to be interactions'

(Bronfenbrenner, 1979, p.38)

Academic attainment is a vital predictor for later positive outcomes in contemporary society (Bradley & Corwyn, 2002; Duncan & Brooks-Gunn, 1997; Heckman, 2006; Fiscella & Kitzman, 2009). Higher levels of school achievement are associated with more lifetime income, employment stability, lower welfare dependency, lower likelihood of teen pregnancy, and less criminality (Bronfenbrenner, McClelland, Wethington, Moen, & Ceci, 1996). Cognitive ability and academic achievement are the product of a cumulative process in which the early foundations of academic skills are being cultivated during the preschool and the primary years, subsequently contributing to knowledge acquisition and performance during secondary school and beyond (Entwisle & Alexander, 1990; Johnson, McGue, & Iacono 2006). However, social class differences in the critical features of future academic attainment appear before children reach formal education age, implying that intellectual functioning-based disparities can be explained in part by early experiences and particularly by household social and economic factors (Heckman, 2006; Phillips & Shonkoff, 2000).

Children's cognitive abilities and educational achievement are likely to be influenced by an interrelated network of factors, including child, family and context characteristics (Bradley & Corwyn, 2002; Duncan & Brooks-Gunn, 1997; Johnson et al., 2006); abilities likely to reflect both genetic and environmental influences (Shakeshaft et al., 2013). To mention one pertinent example: children growing up in low socioeconomic status (SES) households are more likely than those living in more advantaged homes to be born prematurely or at low birth weight and to experience early health problems, all risk factors associated with delayed development. Across the life course children from low-SES households are more likely to be exposed to multiple adverse environments such as more deprived neighbourhoods, less stimulating home environments and less positive parenting behaviours (Duckworth, 2008; McCulloch & Joshi, 2001). Additionally, the timing of exposure to SES disadvantage is relevant to development; early exposure appears to have more enduring effects on intellectual functioning than the same risks later in childhood (Duncan & Brooks-Gunn, 1997). Thus, the processes, or interactions in early life, between contexts and persons should be considered when studying the predictors of cognitive abilities and academic achievement (Duckworth, 2008).

Genetically sensitive designs and studies observing neurodevelopmental processes are often employed when cognitive and academic abilities (and developmental outcomes in general) are under investigation (Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). Environmental effects may be more readily measured and thus assessed; yet with advances in both imaging techniques and genetic designs, the role environment plays in predicting specific outcomes could be better understood.

In the context of genetically motivated studies, compelling evidence on the heritability of cognitive ability and academic achievement is often shown. Such studies seek to explain how genes interact with the environment to predict the occurrence of particular traits and/or behaviours. It is now widely accepted the individual variations in cognitive development are highly heritable (Devlin, Daniels, & Roder, 1997). Some suggest that up to 68% of the variance in children's literacy and numeracy abilities could be attributed to genetic differences, even more so than intelligence (Kovas et al., 2013). Genetically sensitive designs investigating the extent to which heritability is involved in cognitive and academic abilities include methods such as ‘twin design’, Genome-wide Association Studies (GWAS), and adoption studies amongst others.

To give a brief description of the above-mentioned methods, the twin method enables researchers to investigate the influences on the phenotype, by testing both monozygotic and dizygotic twins, the former are 100% genetically similar, whereas the latter are on average only 50% similar. This design allows for quasi-experimental comparisons to take place, under the assumption that if a trait is heritable, the resemblance within monozygotic twins should be higher than that seen in dizygotic ones (Haworth, Dale, & Plomin, 2008). Using this method, a number of longitudinal studies with large samples of twins have revealed some remarkable findings. In the UK-based Twin Early Development Study (TEDS; Howarth, Davis, & Plomin, 2013), 68% of the variance in primary school academic ability was attributed to heritability, whilst at later stages of development (age 16 years) 52-58% of the variability in English, math and science could be ascribed to heritability in the TEDS sample (Shakeshaft et al., 2013). Dutch (Bartels et al., 2012), and American (Olson, et al., 2011) investigations have shown similarly strong patterns, of over 50% of the variance in children’s intellectual abilities can be ascribed to genetic heritability.

The findings from Twin designs reveal the significant role of heritability in cognitive and academic abilities, yet it is not without limitations. For example, to detect genetic mediation effects of SES on child development would be impossible for twins growing up in the same household, as family SES is shared by both twins (Trzaskowski et al., 2014). Thus twin design can only observe differences within rather than between families. By using DNA alone, methods such as GWAS, aimed at evaluating heritability by testing common single-nucleotide polymorphisms (SNP) associations in unrelated individuals, with specific outcomes (Visscher, Brown, McCarthy, & Yang, 2012) can look at differences between families. A recent permutation of the method, Genome-wide, Polygenic Score (GPS), which aggregates SNP scores to account for the negative and positive effects these may have across the genome (Selzam et al., 2016). The study by Selzam and her associates included a very large sample, revealing that GPS accounted for 15% of the heritable variance in educational attainment between the ages of 7-16 years. GWAS methods are at the cutting edge of developmental research, and no doubt will become more prevalent in future, yet being a novel design means that the data required for performing longitudinal analyses is still lacking.

Genetic research, nevertheless, provides solid evidence that the environment has a significant role to play in the development of cognitive and academic abilities (Kovas, Haworth, Dale, & Plomin et al., 2007; Plomin & Spinath, 2004). Especially in childhood, the environment is said to play a significant role in shaping one's cognitive ability, more so than any other stage in the lifespan (Plomin & Spinath, 2004). What is more, in the context of academic attainment across middle childhood, genetics are said to explain continuity (stability) from age-to-age, whilst the environment is associated with change (differences) in performance across ages (Kovas et al., 2007). Thus, as eloquently put by Kovas and her associates (2007), 'genes are generalists and environments are specialists' (p.vii). This emphasizes that genetics are not deterministic, if anything genetic research helps to better understand the role and extent of environmental influences.

As previously mentioned environmental factors are by far the most prevalent factors under investigation when studying children's cognitive and academic abilities. Large longitudinal studies allow for testing the relative contributions of child, family and context-related characteristics to later outcomes. For example, a study examining the unique contributions of multiple contexts found that neighbourhood effects accounted for less than 5% of progress in academic attainment between Key Stage 2 (KS2; age 7 to 11) and Key Stage 3 (KS3; age 11 to 14). Primary and secondary schools quality each explained around 10% of the variance, whereas child and family characteristics accounted for 38% and 40% respectively (Rasbash, Leckie, Pillinger, & Jenkins, 2010). Other studies observed similar findings, while child and parent characteristics explain a greater proportion of the variance in attainment; effects sizes of neighbourhoods and services remain significant, albeit small (Lupton & Kintrea, 2011; George, Stokes, & Wilkinson, 2012).

Though it is evidenced that cognitive ability and attainment should be studied by addressing multiple factors and contexts, it appears from the literature that parent-related factors are the most predictive of children's developmental outcomes. In the UK-based Effective Provision of Preschool Education (EPPE) study, evaluating the effects of childcare provisions on child developmental outcomes, Melhuish and colleagues (2008a) found that children's over and under achievement at age 5 was predicted by the home learning environment at 3 years, controlling for preschool centre quality. At age 7 years, the 3-year home learning environment, again, significantly predicted under achievement, but the difference between average and high achievement became non-significant, perhaps due to the experience of schooling. In the most recent report from the Effective Pre-school Primary and Secondary Education (EPPSE) study, home learning environment measured at age 3 still predicted better academic and social functioning at age 14 (Sammons et al., 2012).

Parenting practices, such as home stimulation, are associated with contextual and environmental influences and often moderate the effects of other contextual factors on children's development (Collins et al., 2000). Findings from research in neuroscience and genetics support this notion. A review by Hackman, Farah and Meaney (2010), designed to elucidate the effects of SES on brain development, suggests that parenting practices mediate the effects of SES on the development of different brain regions (and subsequent outcomes). Hackman and associates supported this assertion with findings from animal models and behavioural genetics, maintaining that cognitive stimulation in and outside the home is highly predictive of later intellectual functioning (Hackman et al. 2010). Hackman and his colleagues suggested that high quality parent-child interactions are particularly pertinent for promoting resilience, especially for children experiencing high levels of disadvantage. As variations in children's intellectual development occur before they attend formal schooling (Heckman, 2006), the quality of parent-child interactions, as early as the first year, may have a significant role to play in the way in which these abilities develop.

1.1 Scaffolding

Parent-child interactions occur regularly throughout development representing one of the mechanisms through which the actualisation of human genetic potential occurs (Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006). Behaviour consistently found to be associated with children's intellectual development and one primarily driven by *contingent* response is scaffolding. First coined by Wood, Bruner and Ross (1976), scaffolding was defined as the process by which an ‘expert partner’ provides help to a less able partner, increasing or reducing the level of assistance according to the less able partner’s performance. The process is based on the premise that the ‘expert’ partner responds contingently to the ‘less able’ partner activities. Furthermore, it is often claimed that scaffolding is made manifest through support in three domains: *cognitive*, *emotional* and *autonomy promoting* (Hughes, 2015; Mulvaney, McCartney, Bub, & Marshall, 2006; Neitzel & Stright, 2003; 2004).

Learning-based interactions are said to promote child reasoning and problem solving skills required for functioning within a given society (Vygotsky, 1978). In Western cultures cognitive and academic abilities are considered central for future positive development. Thus, it is not surprising that a process that affords the development of language, reasoning and problem-solving skills would be likely to occur in parent-child interaction. In fact, scaffolding is often linked with children’s development of executive functions (EF; Bernier, Carlson, & Whipple, 2010; Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2011; Hughes & Ensor, 2009), cognitive and socio-emotional functioning (Landry, Smith, & Swank, 2006; Mulvaney et al., 2006; Neitzel & Stright, 2003), and educational outcomes (Dieterich, Assel, Swank, Smith, & Landry, 2006).

Early scaffolding research was concerned with understanding its process, rather than the possible individual differences in scaffolding effectiveness (Meins, 1997; Pratt, Kerig, Cowan, & Cowan, 1988). Renewed interest has lead developmental psychologists to test for possible individual variations in scaffolding. As observed in studies looking at mother-child interactions in more general terms, individual difference in scaffolding were linked mother’s levels of education (Carr &

Pike, 2012; Lowe, Erickson, MacLean, Schrader, & Fuller, 2013; Neitzel & Stright, 2004), parenting styles (Carr & Pike, 2012; Mulvaney et al., 2006; Pratt et al., 1988), attachment classifications (Meins, 1997); ethnicity (Bae, Hopkins, Gouze, & Lavigne, 2014); cognitive ability (Mulvaney et al, 2006); mental health (Hoffman, Crnic, Jason & Baker, 2006) and personality characteristics (Neitzel & Stright, 2004).

Scaffolding research has been largely carried out with relatively homogenous, middle-class families, in the North American context. In the British context scaffolding has been studied explicitly in two different but relatively small samples, each of around 100 families. The participant were mainly Caucasian, from working and middle class backgrounds (Carr & Pike, 2012; Hughes & Ensor, 2009), the latter sample was characterised by relative disadvantage. Scaffolding was recorded when the children were 2 (Hughes & Ensor, 2009) and 10 years old (Carr & Pike, 2012).

The way in which scaffolding is defined and researched has varied according to child age. When observing scaffolding in infancy, maternal response is often the focus of the investigation. This means that the extent to which mothers show behaviours that are contingent and reflect cognitive, emotional and autonomy support are more generally recorded (Bernier et al., 2010; Bigelow, MacLean, & Proctor, 2004; Lowe et al., 2013). Beyond infancy investigators have explored the central dimensions of scaffolding mainly focusing on maternal verbal input (Hughes & Ensor, 2009; Neitzel & Stright, 2003; 2004). In later stages of development, as the child becomes a more active partner in learning-based interactions, scaffolding within the child's 'region of sensitivity to instruction' is often addressed (Connor & Cross, 2003; Meins, 1997; Pratt et al., 1988; Carr & Pike, 2012; Wood & Middleton, 1975). The region of sensitivity is the difference between children's actual and potential ability (Wood & Middleton, 1975; Meins, 1997), a concept similar to Vygotsky's (1978) theory of the 'zone of proximal development'. Mothers who correctly identify children's region of sensitivity and instruct according to child current abilities, are considered more able 'scaffolders'.

Despite methodological and definitional differences, scaffolding is generally understood within a sociocultural framework. Children are said to acquire the skills necessary for functioning within a culture through interactions with their caregivers (Rogoff, 1990; Vygotsky, 1978). Whilst initially children rely on their parents for support in problem solving over time they become less dependent and more competent in carrying out tasks, eventually becoming autonomous (Vygotsky, 1978). Furthermore, argued to be an 'artifact of the family' (Neitzel & Stright, 2003, p.147), scaffolding can be understood in the context of an ecological system (Hughes & Ensor, 2009; Mulvaney et al., 2006).

1.2 Theoretical framework

Scaffolding can be thought of as an activity that operates in the wider context, promoting cultural ideals, as well as an activity influenced by more proximal factors, being a product of the family environment. To understand the mechanisms by which scaffolding behaviours relate to children's intellectual development an ecological framework should be useful. This study is guided by the bioecological theory of human development, or the Process-Person-Context-Time (PPCT) Model, referred to interchangeably (Bronfenbrenner & Morris, 2006) to try and elucidate the mechanisms by which individual differences in maternal scaffolding are associated with the development of children's intellectual abilities over time. The PPCT model is a modification of Bronfenbrenner's (1979) theory of human ecology. The bioecological model takes account of the processes occurring overtime to the biopsychological characteristic of humans as individuals or in groups, focusing on processes rather than environments in shaping development (Bronfenbrenner & Morris, 2006).

The bioecological model comprises of four interrelated dimensions: process, person, context and time. The ***process,*** dimension of the model refers to *'proximal processes'*; enduring interactions in the individual's immediate environment with people, objects and symbols. These interactions are predicted to become increasingly complex over the life course, and are said to be especially important in the early years when such processes lay the foundations to engage in similar activities in the future (Bronfenbrenner & Morris, 2006).

The second dimension, the ***person*** in the centre of the model, affects and is affected by the way in which the proximal process occurs, being both the 'producer and product of development' (Bronfenbrenner & Morris, 2006, p.798). Person characteristics are classified into three categories: demand, resource and force. *Demand* characteristics are those demographic characteristics (e.g. age, gender and ethnic background) that may lead others react to the developing person in differential ways. *Force* characteristics are those related to personality traits such as temperament, motivation, beliefs and attitudes. These characteristics can be both 'generative'- setting the proximal process in motion, or can interfere with them. Finally, *resource* characteristics are associated with aspects of human capital, skills, education and past experiences, as well as conditions such as learning disabilities and forms of physical handicap. These characteristics may be disruptive or facilitative to development.

Context, the third dimension in the bioecological model has four interlinked systems: microsystems, mesosystems, exosystems and macrosystems (Bronfenbrenner & Morris, 2006). The microsystems are those environments inhabited directly by the developing person, such as the home, the school and the neighbourhood. The mesosystems refers to interactions between the microsystems. The exosystems are the environments in which the developing person does not take part directly, but which could indirectly affect the person; such as parents' place of work or siblings' schools. Finally, the macrosystems refer to more global effects relating to the wider culture, such as beliefs or religious affiliations. This can be as wide as a whole country or can be related to a sub-culture or a smaller group.

Time is the final aspect of the model. Bronfenbrenner and Morris (2006) stipulated that time is the defining property of the bioecological model reflecting the change or stability in processes, persons and contexts. Time was referred to in the context of three sub-factors: micro-time, meso-time and macro-time. Micro-time describes the behaviours occurring during a specific interaction or activity. Meso-time relates to the extent to which some types of activities or interactions occur in the developing person's environment; and macro-time is similar to the idea of chronosystem (Tudge, Mokrova, Hatfield, & Karnik, 2009) referring to the variations in developmental processes as a function of the historical context in which they are positioned (see Figure 1.1 for a depiction of the Bioecological Model).

Bronfenbrenner and Morris (2006) argued that the PPCT model is concerned with discovery rather than verification; a bioecologically informed design is rooted in the concepts under investigation and the possible relationships between them. Yet they also stress that theoretical underpinning are critical at the early stages of the investigation implying that the PPCT model takes a bottom-up approach. The process of understanding the interrelations between concepts is theoretically based, but also generative in nature. To quote 'the proposed strategy for developmental investigations in the discovery mode involves an iterative process of successive confrontations between theory and data leading toward the ultimate goal of being able to formulate hypotheses that both merit and are susceptible to scientific assessment in the verification mode' (Bronfenbrenner & Morris, 2006, p.802).

While the PPCT model is useful when trying to understand developmental processes, there is scarcity of studies which employ the bioecological model as intended (Tudge, et al., 2009). Out of 25 studies, Tudge and her associates found that only 4 used the theory appropriately. Bronfenbrenner and Morris (2006) stipulated that, for a study to be bioecologically sound, it should include all four aspects of the model; i.e. process, person, context and time. What is more, the focus should be on processes relevant for the developmental outcomes under investigation. The effects of person characteristics on proximal processes should be included in the model, the minimum requirement being that demand characteristics are taken into consideration, though for a richer design both force and resource characteristics should also be included. The influence of at least two contexts should be considered. Tudge et al. (2009) recommended including at least two possible microsystems, namely the home and school, or alternatively two macrosystems such as poverty or cultural background. Finally, in relation to time, they suggest that the study should be longitudinal to ascertain how proximal processes relate to particular developmental outcomes over time.

The PPCT framework appears to be very general, yet all encompassing. Though it is a relatively flexible model, a number of requirements are to be met, before the investigation could be deemed to 'correctly' employ the PPCT model.

This means that many studies do not meet the criteria set by Bronfenbrenner and Morris (2006). It could also be that its ‘generality’, to some extent attenuate any effects that could be found if very few factors are in the centre of the investigation, rather than a whole host of predictors associated with multiple contexts. This may explain why so few studies end up utilising the model appropriately. Irrespective of its limitations, the model provides the opportunity to test multiple factors in a flexible manner and give a wider, and hopefully a more accurate depiction, of a proximal process and its associations with specific developmental outcomes.

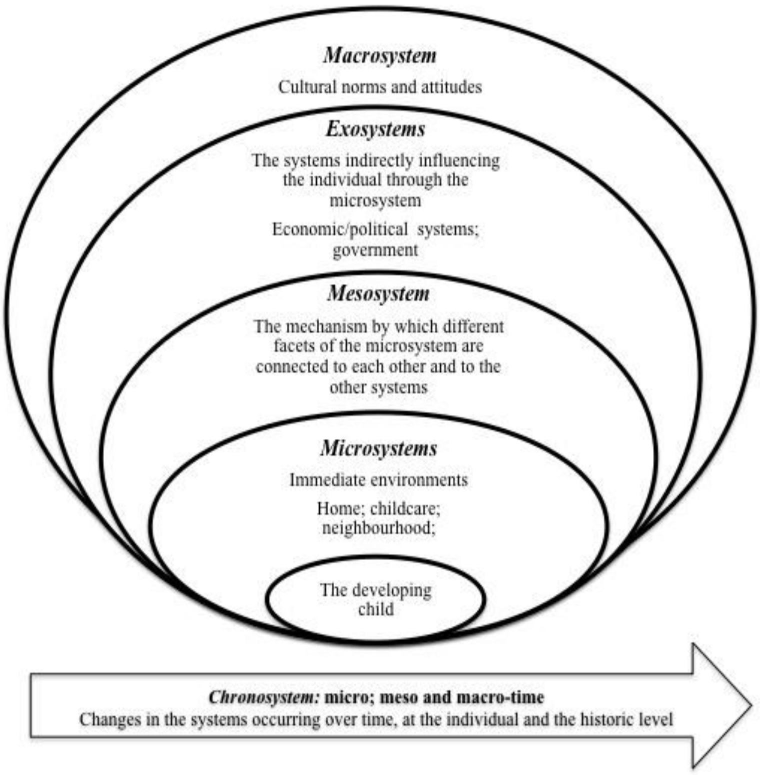

Figure 1.1: A diagram describing the Bioecological Model including the present study’s process, person, context and time variables

1.3 The present study

Although a number of studies make appropriate use of the bioecological model (Tudge et al., 2009), it appears that scaffolding behaviours are not explicitly treated in the literature as a proximal process predicting child intellectual development. Thus, this investigation aims to test whether the bioecological theory can aid in understanding the relation between maternal scaffolding behaviours and child intellectual development.

In keeping with the PPCT model the study has been carried out in a cascading manner, each stage setting the scene for the next. In the first stage, the development of a tool aimed at measuring maternal scaffolding in infancy was developed. Behaviours associated with the main dimensions of scaffolding (contingent response, cognitive, emotional, and autonomy support) were measured, and a factor structure tested. Some suggest that each dimension is a separate aspect of scaffolding (Neitzel & Strigh, 2003; 2004); thus it was empirically tested whether these dimensions form one overarching construct of scaffolding behaviours.

In the next step, individual variations in the proximal process of scaffolding were addressed. Based on previous findings the effects of infant and mother demand, resource and force person characteristics on scaffolding behaviours were tested. For children: object play maturity, gender and temperament and for mothers: age, ethnic background, educational qualifications, mental health, personality and attitudes. The influence of context was addressed by looking at the possible effects of adverse home environment, family size and neighbourhood poverty on maternal scaffolding. Maternal age and family size effects have yet to be tested as possible predictors of maternal scaffolding, yet these factors have been found to relate to mothers interaction style and subsequent child development (Keown, Woodward, & Field, 2001; Steelman, Powell, Werum, & Carter, 2002; Tang, Davis-Kean, Chen & Sexton, 2014) and are likely to be implicated in scaffolding quality.

In the final step, the relevance of scaffolding behaviours in infancy for intellectual development over time was tested. Taking person and context factors into consideration, the possible mediating and moderating role of maternal scaffolding were examined. Finally, the role of childcare experiences and the neighbourhood were tested as an additional microsystem/exosystem – influencing child development directly and indirectly (See Figure 1.2 for hypothesised model).

The decision to employ the PPCT model was driven by the availability of a dataset that includes both observation and self-report information that could elucidate the role of scaffolding in context. However, in some cases, frameworks such as the 'family stress' and 'family investment' models (Conger & Donnellan, 2007; Hackman et al., 2015) are sufficient when explaining individual variations in scaffolding behaviours and child cognitive abilities. These models are largely informed by the effects of socioeconomic factors on parental behaviours not taking the role of the child into account, nor the proximal processes said to put development in motion. The PPCT model, however, being an interactionist model, puts the person and the process at its core, making it more suitable for a study attempting to develop an ecological model that includes process, person and context factors. It is of note, however, that the 'family stress' and 'family investment' frameworks fit within the PPCT model, providing a causal explanations to the way in which the microsystems are affected by variations in SES.

The present study focuses on observed environmental factors only. It aims to test the role of a specific process occurring between parents and their young children in relation to future development, and in the context of multiple environments. It is acknowledged, however, that using a genetically sensitive design could have provided additional dimensions when trying to understand the mechanisms by which scaffolding operates. Nevertheless, the merits of the PPCT model, and the reasons for preferring it to other frameworks, are based on the premise that it offers a flexible approach when testing numerous factors that predict development over time, and in multiple contexts. Furthermore, as well as theory testing, it allows for theory development first and foremost.

In reviewing the scaffolding literature it became apparent that studies explicitly addressing the core dimensions of scaffolding are limited. Furthermore, although scaffolding is argued to be an artefact of the family (Neitzel & Stright, 2003), only two prior studies (Hughes & Ensor, 2009; Mulvaney et al., 2006) addressed scaffolding as part of a larger ecological system. Finally, although there is relatively large body of research associating scaffolding with EF and cognitive abilities, the evidence pertaining the relevance of scaffolding for educational attainment is scarce. In light of these findings the study has focussed on four main aims:

1. To document the structure of maternal scaffolding behaviour with children in infancy
2. To examine which child, maternal and contextual factors predict maternal scaffolding behaviour.
3. To determine the extent to which maternal scaffolding behaviour can predict children's subsequent cognitive development in the preschool period.
4. To determine the extent to which maternal scaffolding behaviour can predict children's academic attainment at the end of primary schooling.

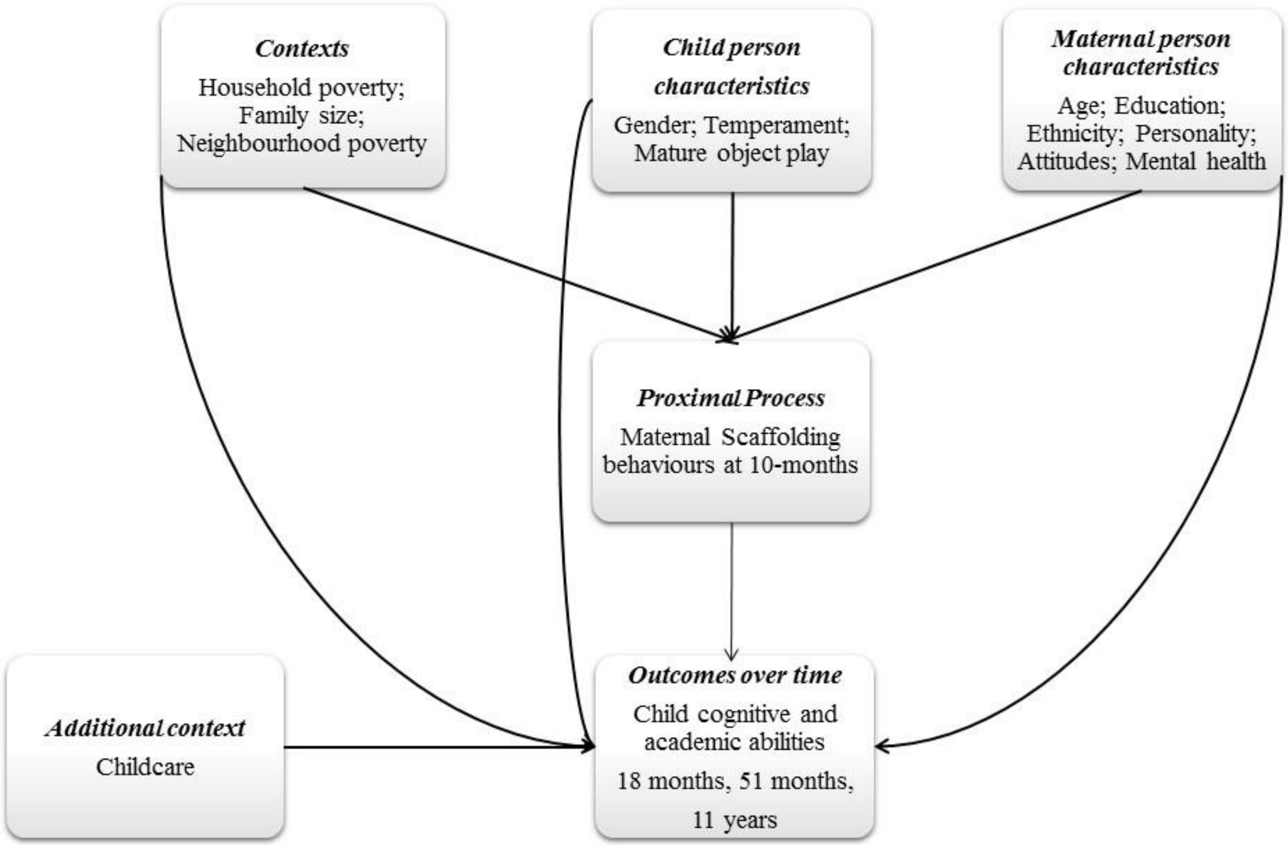

Figure 1.2: Study's hypothesised model

1.4 Structure of the thesis

The structure of the thesis is as follows.

Chapter 1 - has provided a brief overview of the background for the study and the theoretical framework employed in this investigation.

Chapter 2 - includes a narrative literature review of the environmental predictors of cognitive abilities and academic attainment. With the bioecological framework in mind, the review is structured as such that the developing child person characteristics are addressed first, followed by maternal characteristics and then contextual factors.

Chapter 3 – specifically discusses the scaffolding literature. Here an overview of the theory is provided, introducing central themes and a discussion on the origins of the theory. Methodological and theoretical developments, and the correlates of scaffolding-individual differences and child development follow this.

Chapter 4 – described the methods used, including sample characteristics (pilot and main study) and comparison with the rest of the FCCC sample. This is followed by the procedure, measures employed, analytic strategy, information about attrition and multiple imputation.

Chapter 5 – pilot study results. Here the process of developing the observation scheme used for recording maternal scaffolding behaviours is discussed, as well as tests of its reliability and validity.

Chapter 6 – the first results chapter explores the factor structure of maternal scaffolding behaviours. Here the research question ‘Can maternal scaffolding behaviours in infancy be treated as one overarching factor?’ was addressed. To test this question a second order factor analysis was performed, followed by a factor mixture analysis.

Chapter 7 – the second results chapter addresses individual differences in maternal scaffolding, includes multiple regression analyses testing the role of child, mother and contextual factors in predicting variations in maternal scaffolding behaviours. As multiple imputation data were used, analyses presented for both original (missing) and imputed data.

Chapter 8 – the third results chapter addresses prediction of child preschool cognitive development. Multiple regressions performed testing the possible role of maternal scaffolding in predicting child cognitive ability at age 18 month, and verbal and non-verbal ability at 51 months.

Chapter 9 – the fourth results chapter includes a structural equation model to test for the relevance of maternal scaffolding-like behaviours to predict child academic attainment at age 11 years. Here the possible confounding effects of childcare experience were added to the final model as a further microsystem likely to explain some variance in children's intellectual development, independently from other contextual factors.

Chapter 10 – the discussion links the results with the study hypotheses and previous findings. The study's strengths and limitations are discussed in addition to possible future research and concluding remarks.

CHAPTER 2: LITERATURE REVIEW

Both abilities and educational achievement are terms used in developmental assessments. Achievement represents what a person knows at a specific point in time, and is curriculum-based. Abilities are thought of as "raw" talent, reflecting the benefits one may gain from instruction, though, the content of ability assessments often rely on information taught in educational settings (Halpern et al., 2007). In some ways abilities and educational attainment are theoretically dissimilar, however, differentiating between the two may be quite complex given that both constructs are highly related (Calvin, Fernandes, Smith, Visscher, & Deary, 2010; Halpern, 2007).

Abilities and achievement can both be considered a product of multiple environments (Bradley & Corwyn, 2002; Brooks-Gunn & Duncan, 1997; Johnson et al., 2006). The independence and interdependence of multiple person characteristics and environmental factors, can lead to better understanding of processes such as the development of cognitive and educational abilities (Bornstein, Hahn, & Wolke, 2013). In keeping with Bronfenbrenner and Morris's (2006) bioecological theory, the following section will review existing evidence in relation to person, contexts and proximal process in predicting child cognitive abilities and academic attainment. First, person- demand, force and resource characteristics of child and mother will be reviewed. Next, the effects of contextual factors will be addressed, followed by a review of the influence of processes, with specific focus on the role of mother-infant interactions.

2.1 Person characteristics predicting child cognitive abilities and academic achievement

The abilities to learn languages and understand numerical information are said to be innate, yet experiences in the developing person's environments are likely to determine the developmental trajectories these abilities take (Halpern et al., 2007). It is possible that 'person characteristics' directly and indirectly relate to specific outcomes. Person characteristics may reflect individual differences directly relating to the outcomes in question. However, given Halpern and colleagues' (2007) aforementioned proposition that the manifestations of abilities depend on the environment inhabited by the developing organism, person characteristics may be mediated or moderated by the proximal processes driving specific developmental outcomes.

First, child cognitive ability and academic attainment will be reviewed in relation to child 'person characteristics'. Then the effects of maternal 'person characteristics' will be addressed. As the topic of child cognitive development is extremely broad, only the most recent evidence covering the association between person characteristics and child cognitive development and educational attainment will be reviewed, including review papers and meta-analyses.

2.1.1 Child characteristics

Demand characteristics

Demand characteristics are demographic characteristics, such as gender and cultural background that can yield differential reactions towards the developing person (Bronfenbrenner & Morris, 2006), and may therefore play a role in determining developmental outcomes. Gender and ethnic background will be reviewed in relation to cognitive ability and academic attainment.

Gender: The relationship between gender and intellectual functioning is a much-debated area of research and findings are generally inconclusive (Ardila, Rosselli, Matute, & Inozemtseva, 2011; Halpern et al., 2007; Hines, 2010; Kaushanskaya, Gross, & Buac, 2013; Reilly, 2012). Although males' and females' behaviours (such as play activities and levels of aggressive behaviours) and brain development differ (for review see Andreano & Cahill, 2009), in terms of their cognitive development, the differences are not as clear (Hines, 2011). There is a traditionally held view, however, that females are likely to perform better, on average, on verbal tasks than their male counterparts, whereas males are more likely to excel in spatial processing (Maccoby & Jacklin, 1974), with recent reviews reaffirming these findings (Andreano & Cahill, 2009; Halpern et al., 2007; Hyde, 2005). These differences though reliable, are relatively small (Hyde, 2005). Furthermore, some have contested this view altogether, suggesting the males and females share the same mechanisms by which talent for maths and science abilities develop (Spelke, 2005). Thus, it is not entirely clear how these differences translate in the educational settings (Reilly, 2012).

Cross-cultural studies, according to Reilly (2012), may have the capacity to explain the mechanisms by which gender differences in cognitive abilities and educational attainment occur. Reilly's analysis of the 2009 PISA results found that girls were outperforming boys in reading proficiency across all OECD and partner countries, with a moderate effect size (d= .44). In relation to mathematics Reilly found that boys were more likely to outperform girls, yet the effect size was relatively small (d= .16); Reilly suggested that the slight advantage males have in mathematical skills may be amplified by social reinforcement in countries where there is less gender equality. Finally gender differences in science were less pronounced. The largest effect size was observed in the data from the USA (d= .14) favouring males, whereas cross-culturally significant differences between boys and girls were not observed, and in some countries females were found to outperform males in science (Reilly, 2012).

Similar results can be observed in UK-based cohorts. For instance, in a study including over 175,000 11-year-olds undertaking their Key Stage 2 (KS2) exams on completion of primary school (age 11 years) Calvin and colleagues (2010) found that girls significantly outperformed boys (d= .33) in English, whereas the opposite pattern was observed in math and science, yet the effect sizes were negligible. They also found that these differences could not be accounted for by general cognitive ability. Individual aspects of cognitive functioning such as verbal abilities for girls and quantitative abilities for boys explained significant variance in attainment; perhaps reflecting a more fragmented view on the relationships between specific abilities and educational attainment as a function of gender. Finally the most recent UK KS2 results published (Middlemass, 2014) presented similar results: girls outperformed boys in English, whereas, boys outperformed girls in mathematics, whilst a significant difference in science scores was not observed. It is possible therefore, that an important factor in explaining gender differences is the macrosystem, reflecting cultural norms about roles and abilities of females and males.

Ethnic background: Another longstanding contentious issue is the role of ethnicity in cognitive development with debate spanning over 150 years (Rindermann, 2007; Rushton & Jensen, 2005). For instance, in the USA children of minority background start school with lower pre-reading and pre-mathematics skills compared to European American children, although gaps become significantly reduced once social class is taken into account (Brooks-Gunn, Klebanov, & Duncan, 1996). Furthermore, differential treatment from teachers by way of lower expectation from minority students was also suggested as another mechanism perpetuating this achievement gap (Farkas, 2003). It is likely that ethnic differences in cognitive development are influenced by both micro-level factors such as family background and teacher behaviour in educational settings (Rindermann, 2007) and macro-level factors such as cultural expectations and bias in cognitive testing, lending superiority to one (the majority) ethnic group undermining other ethnic (minority) groups or cultures (Helms, 1992).

In the UK context some ethnic differences in cognitive development and educational attainment have been observed indicating that it is not simply minority status that is relevant. For instance, in the Millennium Cohort Study (MCS) Kelly, Sacker, Schoon and Nazroo (2006), found differences in 9 month-olds developmental milestones, argued to be markers of cognitive development in infancy (Gerber, Wilks, & Erdie-Lalena, 2010). In comparison to Caucasian infants, Black Caribbean, Black African, and mixed ethnicity 9-month-olds were more likely to have achieved the normal range gross motor developmental milestones, whereas infants from Indian, Pakistani and Bangladeshi origin showed the opposite trend; once SES and home environmental adversity indicators were taken into account, only infants from Pakistani backgrounds were still likely to show delayed development. Similar trends were also observed for communicative gestures at the same age (Kelly et al., 2006). This led Kelly and colleagues to conclude that it is possible that ethnic differences in developmental outcomes in infancy may be largely influenced by SES disparities (influenced by macro cultural factors) experienced by minority populations and not by biological factors.

In a later stage of the MCS, Dearden and Sibieta (2010) observed relatively large ethnic differences in scores on the British Ability Scales (BAS; Elliott, 1986) at ages 3 and 5 years. There were significant differences in cognitive abilities at age 3 years between children of white British background and those of Indian, Pakistani, Bangladeshi, Black African, Black Caribbean, and 'other' minority backgrounds. After taking into account family characteristics such as language spoken in the home, parenting styles, home learning environment, family interaction and health and wellbeing, the gap between white British children and minority children decreased, and in some cases becoming non-significant (Black African and 'mixed' children). At age 5 years the gaps were further reduced. Once family characteristics were controlled for, the difference in cognitive abilities between white British children and all but two minority groups became insignificant; these groups are Black Caribbean and Black African.

In accordance with Kelly and colleagues (2006), Dearden and Sibieta (2010) concluded that ethnic differences observed in this large UK sample were interlinked with poverty; children in the minority groups were more likely to have mothers who had no qualifications and were in the lowest SES band (more than 60 per cent of Bangladeshi children and 45 per cent of Black African/Caribbean children, were in the lowest 20% of the lowest SES band). South Asian children were less likely to be exposed to English in the home, and Pakistani, Bangladeshi and Black African children were more likely to be born into larger families.

In relation to academic attainment and ethnic differences in the UK, the most recent KS2 results show interesting ethnic differences in those achieving level 4 or above (the government specified minimum level of good achievement) in reading, writing and mathematics combined favouring some minority groups over the white majority (Middlemas, 2014). On average 78% of pupils achieved the required level 4 or above, with white British pupils averaging on 79%. Chinese-origin pupils were the best performing with 9 percentage points ahead of the national average in a combined measure of all three KS2 measures. Pupils from Black ethnic background have shown a 3% improvement from the previous year, but were still the lowest performing group, with 76% achieving a level 4 in reading, writing and mathematics combined. Some 80% of mixed ethnicity and Asian ethnicity pupils achieved the required level 4 in all three assessments. Thus 'minority ethnic status' is not necessarily the most useful indicator to use to predict cognitive development.

Force characteristics

'Force characteristics' such as temperament, personality and attitudes, are said to have the capacity to be both 'generative'- setting the proximal process in motion, or to interfere with such processes (Bronfenbrenner & Morris, 2006). The possible relationships between child temperament and cognitive development will be reviewed here. Personality traits and attitudes that may indirectly affect child cognitive development through parental practices will be addressed in the section covering maternal force characteristics.

Temperament: Temperament has been defined as the variations in individuals' reactivity and self-regulation as seen in attention, motor and affective domains (Rothbart, Posner, & Kieras, 2006). It is argued that temperament is the early manifestation and foundation on which personality traits subsequently develop. Furthermore, individual differences in temperament are likely to be shaped by both heritability and environment (Rothbart et al., 2006). Some argue, that these variations in child temperament, or reactivity, are important in predicting child susceptibility to the effects of both positive and negative rearing environments (Belsky, 2005; Belsky, Bakermans-Kranenburg, & van IJzendoorn, 2007).

There is considerable evidence showing associations between child temperament and subsequent cognitive development and educational attainment (Al-Hendawi, 2013; Healey, Brodzinsky, Bernstein, Rabinovitz, & Halperin, 2010; Leerkes, Paradise, O'Brien, Calkins, & Lange, 2008). Young children who present high levels of negative emotionality and difficult temperament are likely to be less well adjusted to the school environment, and less academically successful (Al-Handawi, 2013; Blair, 2002).

Temperament in infancy has been found to relate to subsequent cognitive functioning, with some suggesting that child temperamental dispositions are expressed from birth (Healey et al., 2010). To illustrate, 3-months-old infants who showed more distress when separated from their mothers in the separation-reunion paradigm were more likely to show lower cognitive scores at age 4 years (Lewis, 1993). In a different investigation, infants' who were soothed more easily at age 8 months, were likely to show more advanced receptive language, working memory and inhibitory control at age 4½ (Wolfe & Bell, 2007).

Preschool temperament has also been found to be predictive. Emotional control and emotional understanding of 3 year olds were more closely linked in a study in the USA to early social and academic abilities than were earlier cognitive processes (Leerkes et al., 2008). Furthermore, in another US study 3-4 year-olds who showed more expressed negativity alongside lower neuropsychological functioning, were found to be likely to show less advanced global functioning (Healey et al., 2010).

Some argue that influences on child emotion and cognition are inextricably linked (Wolfe & bell, 2004); thus emotion and cognition cannot be observed independently from the caregiving environments (Hane, Cheah, Rubin, & Fox, 2008). The differential susceptibility theory (Belsky, 2005; Belsky et al., 2007), which assumes that children's temperamental vulnerability determine their susceptibility to positive and negative rearing environments, may partially explain this connection. Child temperament interacts with the quality of maternal caregiving to shape development (Degnan, Henderson, Fox, & Rubin, 2008; Hane et al., 2008) so both need to be taken into account.

Resource characteristics

'Resource characteristics' are associated with aspects of human capital, skills, education and past experiences, as well as conditions such as learning disabilities and forms of physical handicap. These characteristics could be considered as both disruptive and facilitative to development (Bronfenbrenner & Morris, 2006). Given that the development of cognitive abilities in preschool children is the focus of the study those aspects related to human capital, education and skills are within the remits of parental resource characteristics. These characteristics will be reviewed in the 'maternal force characteristics' subsection.

2.1.2 Maternal characteristics

Parents convey to their children, through a process of socialization, attitudes and behaviours relating to educational achievement. These values and practices relate to parents' own characteristics such as personality and ethnicity, and to more distal factors such as levels of education and income (Davis-Kean & Sexton, 2009).

The following subsection will review maternal characteristics that have been shown to be directly or indirectly implicated in child cognitive development.

Demand characteristics

As previously mentioned demand characteristics are concerned with demographics, such as gender, age and ethnic background (Bronfenbrenner & Morris, 2006). Maternal age and ethnicity is reviewed in relation to child cognitive development and educational performance.

Age: In industrialised societies, delayed childbearing has become normative. In order to pursue a career or further education, women are more likely to delay childbirth (Mathews & Hamilton, 2009; Tang et al, 2014). Younger mothers, especially those who give birth in the teenage years, are less likely to complete high-school education or be enrolled in further education programmes (Perper, Peterson, & Manlove, 2010) consequently having fewer opportunities to increase their earning potential; they may also be limited in the financial resources that can facilitate their children's development (Tang et al., 2014).

Young motherhood is associated with poor cognitive and socio-emotional child development (Moore & Brooks-Gunn, 2002; Tang et al., 2014). Tang and colleagues (2014) found that mathematics and reading attainment of children of adolescent mothers was significantly lower than that of children born to non-adolescent mothers. These children were more likely to experience multiple risks such as living in an urban environment, have a larger family size and be of minority background. Teenage mothers' parenting practices are found to differ from older mothers with less verbal stimulation and more intrusiveness, which is said to account for much of the relationship between maternal age at childbirth and child cognitive development (Keown et al., 2001; Lee & Guterman, 2010). However it is not their age per se that may be the most relevant factor. In two separate US-based studies it was found that maternal age become a less significant predictor of child test scores once family background such as poverty, experience of divorce and heritability were taken into account (Moffitt & the E-risk Study Team, 2002; Turley, 2003).

The relationship between childbearing at an older age and child development is less well understood. Although there are known medical risks to conceiving at an older age (Vohr, et al., 2009), the evidence linking maternal older age and child developmental outcomes is sparse (Sutcliffe, Barnes, Belsky, Gardiner, & Melhuish, 2012). In a study including over 20,000 children from UK-based cohort (MCS) and an intervention study (SSLP), Sutcliffe and colleagues (2012) found that maternal older age (>40) was associated with better child language abilities, more positive health outcomes and fewer socio-emotional difficulties. In a later investigation with the same sample, Barnes, Gardiner, Sutcliffe and Melhuish (2014) found variations in maternal behaviours as a function of age, though these behaviours were not associated with child outcomes. Harsh discipline was found to be highest in mothers in their mid-twenties, but was low for teenage mothers and mothers over 30. Furthermore, maternal responsivity increased with age, but plateaued around the age of 40 (Barnes, et al., 2014). Given the dearth of studies in this area it is not entirely clear how maternal older age relate to child cognitive development, yet from the evidence available teenage parenting is associated with multiple risk indicators and fewer positive child outcomes, whereas older parenting does not appear to negatively affect child cognitive development.

Ethnic background: Evidence linking parental ethnic minority status to child attainment is said to be scarce (Davis-Kean & Sexton, 2009). As ethnicity and SES are interlinked, much of the research with ethnic minority families depicts a deficit model; in the US-context, for instance, the majority of the research into ethnic differences focuses on African American, low-income families compared to middle-class, European Americans (Conger & Donnellan, 2007; Davis-Kean & Sexton, 2009). Trying to address this model of deficit, Davis-Kean and Sexton (2009) found that across four racial groups (European American, African American, Hispanic American and Asian American) it was parental level of education that was predictive of parental educationally related behaviours known to be positively associated with subsequent educational attainment (Conger & Donnellan, 2007; Magnuson, 2007). In relation to children's attainment, however, Davis-Kean and Sexton (2009) found that only in the African American families, education-related behaviours did not predict child academic achievement.

In another North American study variations in maternal behaviours according to ethnic background were associated with child cognitive development. Brady-Smith and associates (2013) found that European American, African American and Mexican American mothers similarly clustered into three groups reflecting supportive, directive and detached parenting. A harsh parenting group was also revealed, but only in the European American and African American mothers. Children of African American and European American supportive mothers, were likely to better perform on cognitive tests at ages 2 and 3 years, compared to those whose mothers were classified as directive, detached or harsh. The development of Mexican American children could not be linked with specific parenting patterns at age 2 years, but by age 3 years those experiencing more detached parenting were likely to show poorer cognitive outcomes.

The evidence relating to ethnic differences in parenting and child subsequent development according to a specific minority groups in the UK is limited. Some have found that children growing up in non-British households are likely to show less advanced verbal and nonverbal ability (Pike, Iervolino, Eley, Price, & Plomin, 2006;

Waldfogel & Washbrook, 2010). However, it is cautioned that such findings should not be misinterpreted as adverse effects of ethnicity on general intelligence, as these findings are likely to relate to immigrant background and exposure to languages other than English (Waldfogel & Washbrook, 2010). Although studies have shown that cognitive abilities vary in relation to ethnic background (Kelly et al., 2006; Dearden & Sibeta, 2010; Middlemas, 2014) is it not entirely clear how these differences come about, the likelihood being that socioeconomic, behavioural and cultural factors interact in determining ethnic differences in child developmental outcomes.

Force characteristics

‘Force characteristics’ are personality-related characteristics such as personality traits and attitudes. These characteristics can be both ‘generative’- setting the proximal process in motion, or can interfere with them (Bronfenbrenner & Morris, 2006).

Maternal personality: Five major factors have been identified to describe personality: openness to experience, neuroticism, extraversion, agreeableness and conscientiousness (Costa & McCrea, 1985). These dimensions reflect individual differences in the way people think, feel, act and interact with others, consequently shaping human relationships (Back et al., 2011). There is a wealth of evidence associating individual personality traits with specific parenting behaviours (Bornstein et al., 2011; McCabe, 2014; Prinzie, Stams, Dekovic, Reijntjes, & Belsky, 2009). Given that parenting behaviours are critical to child subsequent development (Collins et al., 2000), it can be assumed that parents’ personality, by shaping parenting behaviours and the environment they inhabit, will indirectly affect child cognitive development (Belsky, 1984).

Notwithstanding this, there is a lack of literature relating parental 'big five' personality factors with child cognitive ability although it can be linked with parenting behaviour. Prinzie's (2009) meta-analysis found that parental warmth, said to relate to subsequent cognitive abilities (Brady-Smith et al., 2013; Brooks-Gunn et al., 1996; Deater-Deckard & Petrill, 2004), was positively associated with agreeableness, conscientiousness, openness and extraversion, and negatively with neuroticism. Similarly more maternal agreeableness was found to relate to autonomy support (Prinzie et al., 2009), an aspect of parenting found to predict executive functions in preschool children (Bernier et al., 2010).

Attitudes: Parental attitudes towards child rearing have been found to be associated with child cognitive development and academic attainment (Baumrind, 1971; Burchinal, Peisner-Feinberg, Pianta & Howes, 2002). Baumrind's (1968) seminal work, classified parental childrearing styles into three broad categories: authoritarian authoritative and permissive. Authoritarian parents are defined as inflexible and punitive in their approach, propagating a belief that children must be obedient to a higher authority. Authoritative parents are those who value the child autonomy and special interests, whilst promoting conformity and setting clear boundaries essential for future conduct. Finally, permissive parents are those who take non-punitive approach to childrearing, making few demands on the child and avoiding using controlling strategies or promoting conformity in the child (Baumrind, 1968).

Baumrind (1971) found significant associations between children's cognitive ability and parental parenting styles. Male children of more authoritarian parents were likely to score lower on cognitive ability tests at age 4 years. Furthermore, children of both sexes of more authoritative parents were likely to show better cognitive abilities at the same time point. Other have shown that parents' more progressive beliefs and fewer traditional beliefs about child rearing were positively associated with better vocabulary, reading and problem solving from preschool to second grade (Burchinal et al., 2002).

Resource characteristics

As mentioned, 'resource characteristics' are person characteristics associated with human capital, skills, education and past experiences, as well as conditions such as learning disabilities and forms of physical handicap. They may be either disruptive or facilitative to development (Bronfenbrenner & Morris, 2006). Two resource characteristics said to be very influential for child cognitive development are maternal depressive symptoms in the early years (Grace, Evindar, & Stewart, 2003; Murray, Halligan, & Cooper, 2010b; Sohr-Preston & Scaramella, 2006) and maternal level of education (Burchinal et al., 2002; Davis-Kean, 2005; Davis-Kean & Sexton, 2009; McCulloch & Joshi, 2001; Tang et al., 2014).

Maternal depressive symptoms: Women, especially during pregnancy and the postpartum period, are at an increased risk for depression (Sohr-Preston & Scaramella, 2006). Depression is said to affect around 20% of pregnant women (Marcus, Flynn, Blow, & Barry, 2003) and between 10%-15% in the postnatal period (Murray, Arteche, et al., 2010a), and is likely to show strong continuity from the prenatal period across the preschool years (Jensen, Dumontheil, & Barker, 2013). It is possible that mothers' experiences of depression will indirectly influence subsequent child outcomes through compromised caregiving (Grace et al., 2003; Lovejoy, Graczyk, O'Hare, & Neuman, 2000; Murray et al., 2010b).

Sohr-Preston and Scaramella (2006) reviewed the relationships between cognitive development and maternal depressive symptoms in different developmental periods. They concluded that exposure to maternal depressive symptoms prenatally, postpartum and persistently are likely to increase the risk of subsequent child cognitive and language difficulties. In the prenatal period maternal emotional health was found to affect foetal development, through influencing maternal help-seeking behaviours, undermining physical health care. This in turn influences foetal health, compromising the development of the hypothalamic-pituitary-adrenal (HPA) axis by increasing its reactivity (Sohr-Preston & Scaramella, 2006). An over-sensitive HPA axis was associated with deficits in emergent cognitive abilities, making it likely that children would be more reactive to stressful situations and less able to sustain attention and carry out executive function tasks (Blair, Granger, & Peters Razza, 2005; O'Connor, Heron, Golding, & Glover, 2003).

Although some have found direct negative effects of postnatal depression (PND) on child outcomes (Hay et al., 2001), others have found partial or indirect relationships (Murray, Fiori-Cowley, Hooper, & Cooper, 1996; Stein, Malmberg, Sylva, Barnes, & Leach, 2008). In the postpartum period depressive symptoms are likely to influence the way in which mothers interact with their infants (Sohr-Preston & Scaramella, 2006; Stein et al., 2008). Whilst, Lovejoy and colleagues' (2000) meta-analysis showed associations between maternal depression and coercive/negative behaviours, a relationship moderated by current depression status. They also found that mothers who had a lifetime history of depression were likely to show more negative and less positive behaviours in interaction with their children, especially in infancy.

Chronicity of depression is said to most pervasively affect child developmental outcomes (Sohr-Preston & Scarmalla, 2006). Chronically depressed mothers are found to consistently respond in a less sensitive and contingent manner to their child (Hay et al., 2001). As sensitive responsivity was found to moderate the effects of maternal depression on children's language and cognitive development (Dannemiller, 1999), the extent to which a child is exposed to such risk may pose a constant risk to the development of cognitive abilities in children.

Associations between educational performance and maternal depressive symptoms have been also been observed. Hay and colleagues (2001) found that children, and especially boys, whose mothers were depressed at 3 months postpartum, were at greater risk of having behaviour difficulties and poorer numeracy performance at age 11 years than children of non-depressed mothers. Similarly in a more recent study, Murray et al. (2010a) showed an association between maternal PND and poorer GCSE results at age 16 years, an effect more significant for boys than girls. The detrimental effects of maternal PND predicted the quality of mother-child interactions throughout childhood, as well as child cognitive abilities, an effect appearing to be amplified for boys (Hay et al., 2001; Murray et al., 2010b).

Maternal education: A review by Bradley and Corwyn (2002) concluded that maternal education was the most consistent predictor of children cognitive development. It is assumed that parents' experience of schooling may affect the way in which they interact and structure activities with their children around the home (Davis-Kean, 2005; Eccles, 2005; Hoff, 2003). Parents' education relates to a number of factors, which reliably predict attainment. For example, better-educated parents have been found to use more varied and complex language with their children in turn predicting children's better reading and language abilities (Hoff, 2003). Such parents may invest more in extra-curricular educational activities and the home learning environment, both associated with better educational outcomes (Klebanov, Brooks-Gunn, & Duncan, 1994; Smith, Brooks-Gunn, & Klebanov, 1997). Perhaps it is therefore not surprising that parental education is the most often used dimension of SES when linking academic attainment with socioeconomic factors (Sirin, 2005).

Studies linking increases in maternal educational qualifications with changes in child attainment can illuminate how maternal education operates in predicting child cognitive development (Magnuson, 2007; Harding, 2015). Magnuson found that mothers who increased their years of education after having had children, tended to have better quality home environments. In addition, 6 to 10 year-old children of mothers who completed additional years of schooling during the child rearing years were more likely better perform on academic tests compared with children whose mothers did not increase their educational attainment at the same period (Magnuson, 2007). Relatedly, Harding (2015) found that at age 6 years children, whose mothers increased their levels of education after childbearing, were likely to better perform on cognitive tests at age 6 years.

Harding, Morris and Hughes (2015) argued that maternal education influences maternal human, cultural and social capital, in turn affecting specific mechanisms by which these forms of capital are transmitted to the child in way of language use, educational behaviours in the home and outside it, involvement in child schooling and having access to better educational environments. These in turn affect child proximal experiences, influencing development. Maternal education is decidedly an influential resource characteristic in determining child cognitive development and academic attainment.

Thus parental education may affect child outcomes in both proximal and distal fashions. Parents' levels of education are likely to affect demographic characteristics such as income, type of occupation as well as choice of neighbourhoods and schools, all of which are associated with children's experiences (Eccles, 2005). In comparison, parents whose resources are stretched, who reside in more dangerous neighbourhoods and who may experience elevated levels of stress caused by multiple risk factors may be less able support such development (Eccles, 2005).

2.2 Contextual factors predicting child cognitive abilities and academic achievement

The bioecological model posits that contexts comprise of four interconnected systems: microsystems, mesosystems, exosystems and macrosystems (Bronfenbrenner & Morris, 2006). The following section reviews the contexts in which child development takes place. It needs to be noted however that distinctions between the systems in Bronfenbrenner’s model are not clear-cut in that some microsystems can also be considered as exosystems. For instance the child is part of a specific neighbourhood (microsystem), but during infancy the neighbourhood may have more distal effects (exosystem) by determining parents’ abilities to provide safe and stimulating home environments (Duncan & Brooks-Gunn, 2000; Eccles, 2005; Leventhal & Brooks-Gunn, 2000). Although neighbourhood disadvantage can be considered as a macrosystem factor, it has marked implications for the way in which the microsystems inhabited by the developing child are likely to operate (Bronfenbrenner, 1979). The following section will treat the contexts reviewed as microsystems unless specified differently. Furthermore, the relationships between those systems (the mesosystems) will be mentioned in cases where multiple contexts were taken into account.

2.2.1 Neighbourhoods and the wider community

The neighbourhood and wider community's physical environment are likely to indirectly affect children's developmental outcomes in both the behavioural and the academic domains (Hart, Atkins, & Matsuba, 2008; Leventhal & Brooks-Gunn, 2000). It is assumed that within neighbourhoods the institutional composition of childcare centres and schools reflect to a great extent the characteristics of the wider community (Dupéré, Leventhal, Crosnoe, & Dion, 2010; Leventhal & Brooks-Gunn, 2000). Neighbourhood characteristics are, however, defined in part by their inhabitants. Thus, family and individual-level factors such as SES, ethnic background and family structure need to be taken into account when estimating the effects of neighbourhoods on child development (Leventhal & Brooks-Gunn, 2000).

Consistent associations between neighbourhood affluence and positive child development have been identified (Leventhal & Brooks-Gunn, 2000). For instance, results from the Infant Health and Development Program (IHDP) showed that neighbourhood affluence, assessed by the mean incomes of neighbourhood residents, was positively associated with children's cognitive abilities at age 3 (Brooks-Gunn, Duncan, Klebanov, & Sealand, 1993) and 5 years (Duncan, Brooks-Gunn, & Klebanov, 1994). Similarly, neighbourhoods' advantage has also been found to relate better educational outcomes (Ainsworth, 2002; Dupéré, et al., 2010). These findings can be understood in the context of collective socialization; adults within the neighbourhood model and reinforce specific behaviours associated with deprivation / affluence, in turn influencing the behaviour of neighbourhood's children (Jencks & Mayer, 1990).

Evidence suggests that living in more affluent neighbourhoods is associated with better educational outcomes yet, in some cases the effects of neighbourhood affluence were found to be negative. In a multi-site US-based randomised controlled trial (RCT) African American families from high-poverty neighbourhoods were relocated to housing in (predominantly white) advantaged neighbourhoods (The Moving the Opportunity study [MTO]: Leventhal & Brooks-Gunn, 2003). Here, no marked differences in children's educational outcomes were identified between children who were moved into more affluent neighbourhoods and those who were not (Sanbonmatsu, Kling, Duncan, & Brooks-Gunn, 2006). What is more, in some cases lowered school engagement and grades were observed in the intervention group compared to those who remained in their original neighbourhoods (Leventhal, Fauth, & Brooks-Gunn, 2005).

To a certain extent, findings from a UK-based longitudinal cohort study mirror Leventhal and colleagues' (2005) results. In the 1970 British Cohort Study (BCS70), Flouri and Ereky-Stevens (2008) found that boys of lower social class, who resided in relatively affluent neighbourhoods assessed at 5 years, were at greater risk of leaving school with the minimum qualifications, compared to boys of similar social class who had lived in average or deprived neighbourhoods. One explanation for these findings may be that deprived adolescents living in affluent neighbourhoods are negatively affected by the incompatibility between their lack of resources and the relative affluence of their neighbours. The findings from the MTO and the BCS70 could be considered in the context of relative deprivation (Jencks & Mayer, 1990) suggesting that people judge their level of economic position and potential for academic success in relation to their neighbours. These judgments may reinforce less favourable views on one's economic status or academic abilities in relation to their peers' economic or academic standing.

It is argued that in order to understand neighbourhood effects on academic attainment, the mediating roles of the family, childcare and schools environment should be taken into account (Barnes, Belsky, Broomfield, Melhuish, & the NESS team, 2006; Dupéré et al., 2010; Leckie, Pillinger, Jenkins, & Rasbash, 2010; Leventhal & Brooks-Gunn, 2000). Dupéré and colleagues found that the home environment, childcare quality and the school environment partially mediated the associations between neighbourhood affluence and child attainment. In the case of neighbourhood disadvantage, Barnes et al. (2006) observed that both neighbourhood deprivation and school disorder predicted academic attainment of 7 and 11 year olds in a sample of 1777 primary schools in the most deprived areas in England.

Overall, the unique contribution of neighbourhood level factors in predicting child cognitive development and academic attainment is small in magnitude compared to family factors, between 5%-10% (Leckie et al, 2010; Leventhal & Brook-Gunn, 2000; Lupton & Kintrea, 2011; Sammons et al., 2012). However, there are complex interrelationships between neighbourhoods, the institutions within them and the people who make up the neighbourhood. Neighbourhood characteristics are instrumental in affecting the proximal and contextual processes influencing children's cognitive development.

2.2.2 Childcare providers

Both childcare providers and schools are microsystems directly inhabited by the developing child. These settings may have specific physical and material characteristics in which the developing person assumes different activity patterns, functions and interpersonal relationships (Bronfenbrenner, 1979). Experiences of childcare and education have meaningful and long-lasting effects on child cognitive abilities and academic achievement (Barnes et al., 2006; Barnes & Melhuish, 2016; Belsky, Vandell et al., 2007; Crosnoe, Leventhal, Wirth, Pierce, & Pianta, 2010; Duckworth, 2008; Eamon, 2005; Leckie et al., 2010; Melhuish, 2011; Melhuish, Quinn et al., 2013; Vandell, Belsky, Burchinal, Vandergrift, & Steinberg, 2010). Furthermore, the characteristics of such setting may be interlinked with family-level and/or neighbourhood-level factors (Barnes et al., 2006; Dupéré et al., 2011; Leventhal & Brooks-Gunn, 2000).

Children in ever growing numbers experience some form of non-parental care prior to attending formal schooling across nations and social classes (Melhuish, 2011). Recent UK figures show that 94% of all 3-year-olds and 99% of all 4-year-olds attended formal preschool education in 2014, using up the free entitlement of 15 hours per week provided by the government (Department for Education [DfE], 2015). In addition, 58% of all 2-year-olds eligible for state-funded early education were enrolled in some kind of formal childcare (DfE, 2015).

A strong link has been drawn between investment in early-years education and promoting healthy and productive economies (Heckman, 2006). In his seminal paper, Heckman argued that early learning experiences provide the basis for task-mastery and motivation to learn; by school-entry age differences in children's abilities in these two areas can be observed. What is more, these differences persist overtime. Findings from childcare-based early interventions for highly disadvantaged children such as the High Scope Perry Preschool Study (Schweinhart, 2007) and the Abecedarian Project (Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001; Pungello, Campbell, & Barnett, 2006) suggest that high quality; cognitively rich interventions may have enduring effects on outcomes across the lifespan.

However it is important to note that that these studies were conducted with samples that were particularly disadvantaged, and were initiated many decades ago and in the USA, which could limit the generalizability of the findings. What is more, some argue that children of low SES who experience multiple risks are more likely to be susceptible and benefit more from interventions such as childcare (George et al., 2012; Heckman, 2006; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004).

Large longitudinal studies from the UK and USA have addressed the question of childcare effects generalizability in more heterogeneous samples. For example, the NICHD SECCYD study of a demographically varied sample of 1,364 children and their families recruited in 10 different sites across the US was followed from infancy to age 15 (Vandell et al., 2010). Higher-quality childcare predicted better pre-literacy at 4 ½ years (NICHD ECCRN, 2002) and better academic abilities at age 12 (Belsky, Vandell et al., 2007) and age 15 years (Vandell et al., 2010) after taking family SES into consideration. Similar findings have been observed in other countries. In the Dutch ‘Generation R Study’ found that more hours spent in childcare between 1 to 6 years was associated with better language development aged 6 years (Lujik et al., 2015).

A number of longitudinal studies in the UK were carried out with the aim of investigating the possible effects of childcare provision on children’s subsequent outcomes: the Effective Pre-school, Primary Education (EPPE; Sylva et al., 2004), and the Families Children and Childcare study (FCCC; Malmberg et al., 2005). In addition to these, some researchers have used data from British cohort studies to answer questions about childcare effects on cognitive abilities and academic attainment.

The EPPE study (Sylva et al., 2010) found that more hours of high quality preschool attendance was associated with better sociability and cognitive ability at school entry, at age 7 and at 11 years (Sammons, 2010). The effect of having over 2 years of exposure to preschool education was similar in magnitude to the effect of maternal education on children's language, pre-reading and number concept (Sammons, 2010).

Associations between early cognitive abilities and type and intensity of exposure to childcare were observed in the FCCC study conducted before the universal offer of a preschool place in the UK was available for all 3 and 4 year olds. Sylva, Stein, Leach, Barnes, and Malmberg (2011) found that group-care attendance was predictive of better cognitive abilities as early as 18 months. Investigating patterns of exposure to childcare provision in the FCCC, Eryigit-Madzwamuse and Barnes (2014) found that compared to children who experienced only home-based care, a combination of home and centre-based care or multiple types of care, those in continuous centre-based care were likely to have better cognitive and language abilities at 18 and 36 months respectively. An earlier start in any kind of group care, which also meant more hours in centre-based care, was found to predict in particular more advanced non-verbal cognitive skills at school entry (Barnes & Melhuish, 2016). It is noteworthy that children who experienced early centre-based care were more likely to have mothers who were better educated, and who provided more cognitively stimulating caregiving; factors that were taken into account in the abovementioned analyses.

Finally, childcare effects in the UK context have been identified in a number of British cohort studies. In the British 1958-cohort study (BCS1958), Goodman and Sianesi (2005) found persistent effects of non-compulsory, pre-school education in relation to cognitive abilities occurring at ages 7, 11 and 16 years. Childcare exposure in the more recent MCS (George et al., 2012) was also associated with better outcomes at age 7 years for children who experienced early disadvantage, though the effects largely disappeared once child, family and school characteristics were controlled for. It is possible that the lack of beneficial effects for the more recent cohorts is related to the almost universal take-up of free child-care places for 3 year olds, introduced in England in 2004 when the MCS children would be reaching the relevant age.

The evidence suggests that childcare participation, and especially high quality provision, cultivates particular behaviours and concepts that are salient for classroom participation and relative educational success. Yet, the effect sizes of childcare provision are small compared to family and child factors (Eryigit-Madzwamuse & Barnes 2014; Melhuish et al., 2008a). Other microsystems in which the developing child takes part, such as primary and secondary schools, are also said to individually predict academic attainment (Leckie et al. 2010, Sylva et al., 2012), even though preschool factors are said to have more predictive power than aspects of primary and secondary schools (Sylva et al., 2012). It is acknowledged that the school context is meaningful for understanding individual differences in academic abilities (Barnes et al., 2006; Crosnoe et al., 2010; Duckworth, 2008; Gutman & Feinstein, 2008), yet the focus of this study is on contexts experienced prior to attending formal education. Thus reviewing school effects is beyond the remit of this investigation.

2.2.3 Family factors

It is clearly demonstrated in the literature that parental input is by and large the most influential contextual factor affecting children's developmental outcomes (Barnes & Melhuish, 2016; Bradley & Corwyn, 2002; Hackman et al., 2010; Heckman, 2006; Leckie et al., 2010; Melhuish et al., 2008a). In addition the relevance of the wider environment is often transmitted via parenting practices (Hackman et al., 2010; Stein et al., 2013). What is more, some parenting practices may be associated with the propensity to use specific services, undertake employment or further one's education. In keeping with the bioecological framework the following sub-section review the family microsystem, first addressing family SES, then family structure and finally the home environment.

Family socioeconomic status (SES): A central factor in predicting children's developmental outcomes in relation to parenting behaviour is socioeconomic status (SES). Both prestige and resource-based measurements including education, occupation and income levels are taken into account when addressing SES (Bradley & Corwyn, 2002), yet each aspect is often studied separately and used as a proxy for SES. In the context of cognitive development, disparities related to socioeconomic factors can be observed prior entry to formal schooling (Ermisch, 2008; Feinstein, 2003; Heckman, 2006). In terms of academic attainment, children from low SES families tend to score from half to one standard deviation below their more advantaged counterparts in a range of academic attainment tests (Rouse, Brooks-Gunn, & McLanahan, 2005).

Social causation frameworks such as the 'family stress model' and the 'family investment model' provide explanations of the way in which SES effects operate

(Conger & Donnellan, 2007). The 'family stress model' postulates that economic stress impacts on both the overall quality of the living environment and on parent emotional well-being and can in turn cause both marital stress and less nurturing parenting practices, consequently affecting child developmental outcomes (Conger & Donnellan, 2007). The 'family investment model' proposes that socioeconomic factors such as family income, parental education and occupational status all relate to levels of parental investment, such as providing enriching and less chaotic environments, more opportunities for extracurricular activities, and generally showing more positive parenting practices (Bradley, Corwyn, Burchinal, McAdoo, & Coll, 2001; Conger & Donnellan, 2007), investments pertinent for the development of cognitive and academic abilities. Family income can also be relevant if it is invested in gaining housing near to the more successful primary or secondary schools.

The relevance of maternal education for child outcomes have already been covered in section 2.1.2 so is not repeated here but the related factor of family income is covered in addition to family size and family composition.

Associations between family income and cognitive and academic abilities are often found (Dahl & Lochner, 2012; Duncan, Magnuson, & Votruba-Drzal, 2014). Both intensity and length of exposure to income deprivation are said to have a central role in predicting lower cognitive abilities. Children living in poverty are 1.3 times more likely to experience learning difficulties than their more well off counterparts (Brooks-Gunn & Duncan, 1997). In fact findings suggest that a $10,000 increase in yearly family income predicted half a standard deviation increase in preschool-aged children's IQ, an association mediated by family investment in more enriching home environment (Yeung, Linver, & Brooks-Gunn, 2002). More recently it was shown that a more modest increase in income (~$1000 a year) was associated with around 6%

increase in maths and English test scores in disadvantaged families (Dahl & Lochner, 2012).

Compelling evidence linking children's cognitive development to household income has been found as early as the child first year. Analysing the UK MCS, household income at 9 months was significantly associated with cognitive and behavioural outcomes at age 3; children growing up in better-off households were likely to better perform on cognitive tasks, and present with fewer behavioural difficulties (Ermisch, 2008). It was also found, however, that parent educational input and parenting styles varied according to income bands; parents in the top income band were likely to provide more enriching environments. In a different study of the MCS, the detrimental effects of family material hardship, (measured using five indicators such as: low net household income, welfare reliance, access to own transportation, home ownership and overcrowding) on children's cognitive development at age 3 years were demonstrated. Material hardship predicted higher maternal emotional distress, which in turn affected caregiving and parent-child relationship, negatively influencing school-readiness (Schoon, Hope, Ross, & Duckworth, 2010).

The mechanisms by which socioeconomic differences affect developmental trajectories can be explained to some extent by frameworks such as the 'family stress' and 'family investment' models (Conger & Donnellan, 2007; Hackman, Gallop, Evans, & Farah, 2015). These models fit in with the bioecological framework to a certain extent, providing a causal explanations for the way in which the microsystems are affected by variations in SES. However, given that the bioecological is an interactionist model, the role of the child and the proximal processes in which the child takes part should be taken into consideration, including the family.

Family composition: Some evidence suggests that children's development may be related to family composition, with an implicit assumption that two biological parents provide the optimal family environment (Amato & Keith, 1991), although it is of note that most children growing up in divorced, single-parent or atypical families are well adjusted (Golombok, 2015; Lamb, 2012). However, it has been demonstrated that children growing up in single-parent households are at greater risk for socio-emotional problems due to associated risk factors, particularly poverty and loss of contact with a supportive parent (Booth & Amato, 2001; Carlson & Corcoran, 2001; Hetherington, Bridges, & Isabella, 1998; Lamb, 2012). Once the above factors are taken into account the psychological risk of growing up in 'non-traditional' families is significantly reduced (Golombok, 2015; Hetherington et al., 1998; Lamb, 2012).

Differences according to family composition have been identified in children's academic abilities. Carlson and Corcoran (2001) found that children experiencing single-parenthood at some point during early to middle childhood were likely to show lower reading and maths scores at age 7-10 years with the largest effect for those experiencing single-parenthood throughout. However, taking maternal aptitude, SES and the home environment into account, the effects of growing up in a single-parent family appear diminished.

The effects of family composition on child achievement have been examined cross-culturally. Pong, Dronkers and Hampden-Thompson (2003) compared third and fourth grade children's attainment in maths and science in 11 Western countries as a function of family composition. Single-parenthood negatively affected maths and science achievement in nine and seven of the countries respectively, with relatively small but significant effects sizes. Pong and colleagues (2003) conjectured that country-level welfare policies aimed at equalizing the economic gaps between single-parent families and 'traditional families' might have had a role to play. In countries with more generous welfare policies this difference in attainment was no longer evident (Pong et al., 2003) suggesting that factors within the microsystem, such as family composition interact with the aspects of the macrosystem such as social policies, to reduce or increase the possible effects of risk factors on child outcomes.

Family size: Sibship size is another family-structure characteristic that may be associated with cognitive development. The effects of sibship size can perhaps be considered in the context of a 'resource dilution' model, predicting that an increase in the number of siblings may dilute parental resources, posing a threat to the development of cognitive abilities (Blake, 1986). Findings largely support the 'resource dilution' theory, as negative associations are often observed between larger siblings groups and academic outcomes (Steelman et al., 2002). Resource dilution can be observed through strain on financial resources, argued to be to most significant factor linking family size with poorer academic outcomes. Moreover, parental investment in their involvement in child schooling and development of social capital has also been found to negatively relate to the size of the sibling group (Steelman et al., 2002). Some argue, however, that the effects of the size of the sibling group are not as real as they seem. By analysing a subsample of sibling pairs from the US-based NLSY study, Gou and VanWey (1999) found that, when defining sibship size as an individual trait that changes over time and controlling for its effects alongside environmental, genetic, child and family specific effects, it no longer had a negative association with child educational outcomes.

Some evidence suggests that birth order and not sibship size is responsible for differences in academic attainment seen between siblings, but the findings are also inconclusive. It has been suggested that firstborn children may benefit from more parental engagement (Powell & Steelman, 1993) but later-born children may benefit more from more economic resources given that at this stage of the life cycle parents may be more financially secure (Powell & Steelman, 1995). In a powerful study carried out on the entire Norwegian population, Black, Devereux and Salvanes (2005) found that variations in educational attainment were largely due to birth order. Although they found negative associations between the sibship size and educational achievement, once birth order effects were taken into account the observed effect of family size diminished. However, in the British context, later-born children were found to be in greater risk for poorer educational outcomes compared with earlier born children (Iacovou, 2001).

The inconclusive findings in relation to the effects of family structure on child cognitive and academic abilities may imply that individual differences in the characteristics of family members, particularly ‘force’ and ‘resource’ characteristics of parents, may account for specific trajectories. It could be assumed, nevertheless, that socioeconomic factors alongside parental investment by way of providing an enriching home environment may exacerbate or lessen the possible effects family structure may exert on the developing child.

The home environment: The home environment is perhaps the most influential microsystem inhabited by the developing child. It is a powerful mechanism by which socioeconomic and biological factors wield their effects on child development (Bradley & Corwyn, 2002; Hackman et al., 2010; Hart & Risley, 1995; Heckman, 2006; Kelly, Sacker, Del Bono, Francesconi, & Marmort, 2011; Lugo-Gil & Tamis-Lemonda, 2008; Melhuish et al., 2008a; Wichman et al., 2006). Variations in the quality of the home environment have been consistently found to be associated with SES; those experiencing higher levels of disadvantage providing less enriching home environment (Hackman et al., 2010; Hackman et al., 2015; Hart & Risley, 1995; Waldfogel & Washbrook, 2010).

The home environment can be thought of as the efforts made by parents in structuring the child's environment in a way that facilitates and promotes positive developmental outcomes (Bradley & Caldwell, 1984). Aspects of the home environment associated with parents' behaviours and the organisation of the physical and temporal environment consistently predict children's cognitive and socio-emotional development in diverse samples (Lugo-Gil & Tamis-LeMonda, 2008; Rodriguez & Tamis-LeMonda, 2011; Totsika & Sylva, 2004).

Strong association have been observed between child cognitive development and the home learning environment (HLE), defined as parental activities that afford opportunities for learning. Melhuish and colleagues (2008a) observed strong effects of HLE at age 3 years on child cognitive and academic abilities at ages 5 and 7 years.

Another investigation originating from the UK, measured the effects of the home learning environment in explaining the attainment gap between low and middle-income children in the MCS (Waldfogel & Washbrook, 2010). Their findings indicated that only 45% of the most deprived children were read to each day, in comparison to 65% of those from average income, and 78% of the higher income band. They also found that 20% of the low- to middle-income gap observed in children's vocabulary at age 5 could be explained by parenting behaviour and the home environment. Individual aspects of the HLE uniquely explained differences in specific cognitive abilities at age 5 years (Waldfogel & Washbrook, 2010).

Some argue that, alongside the home learning environment, other aspects of the home such as household chaos should be taken into consideration when studying children's cognitive development (Johnson, Martin, Brooks-Gunn, Petrill, 2008). Household chaos refers to the degree of noise, crowding, disorganisation, lack of routines and unpredictability (Wachs, 2000). In a genetically sensitive twin study Petrill, Pike, Price and Plomin (2004) found that general household chaos explained shared environmental influences on children's cognitive skills, an effect that was independent of SES and stable over time. Johnson and colleagues (2008) found that higher levels of household order (vs. chaos) were associated with children's better reading skills, over and above the effects of the home learning environment, especially amongst children of mothers with above-average reading abilities(Johnson et al., 2008).

The microsystems within which children grow up clearly have an effect on children's developmental trajectories. The preceding section discussed contexts said to explain individual variations in children's cognitive and academic abilities, each of which uniquely explains such outcomes to varying degrees, with the family environment having the largest effect. Yet, in order for these contexts to exert effects on the developing child, the proximal processes taking place within these contexts also need be addressed. So far person and context characteristics have been discussed in relation to cognitive and academic abilities. In the next chapter the proximal process of scaffolding occurring in parent-child interaction will be discussed. Scaffolding behaviours are said to have a unique influence on child cognitive outcomes across development (Bernier et al., 2010; Hammond et al., 2012; Hughes & Ensor, 2009; Landry et al., 2006; Lowe et al., 2013; Smith, Landry, & Swank, 2000) and have been found to be associated with distal and proximal person and context characteristics.

CHAPTER 3: SCAFFOLDING - A REVIEW OF THE LITERATURE

'The only good instruction received in childhood is the one that precedes and guides development.' Vygotsky, 1987, p.48)

3.1 Overview – scaffolding a proximal process

According to Bronfenbrenner and Morris (2006) human development occurs through reciprocal interactions (proximal processes) between the developing child and the persons, objects and symbols in its environment. To influence development, these proximal processes should occur regularly, over extended periods and have enduring effects. Feeding, parent-child play and learning of new skills are examples of proximal processes (Bronfenbrenner & Morris, 2006). Through interactions with their parents, children are likely to become autonomous problem-solvers and one aspect of adult behaviour that may promote children's capacity for autonomy in problem solving is 'scaffolding'. The process of scaffolding is expected to culminate in the child's autonomous solution of a task (Neitzel & Stright, 2003).

First termed by Wood, Bruner and Ross (1976) scaffolding refers to a process by which an 'expert partner' provides help to a less able partner, by increasing or reducing the level of assistance according to the less able partner's performance. Scaffolding is interlinked with Vygotsky's (1978) theory of the zone of proximal development (ZPD). The ZPD is the distance between a child's actual developmental abilities, established through independent problem solving, and higher levels of potential development, determined by assisted problem solving with a more capable partner. Vygotsky (1978) proposed that some developmental processes will not be possible without instruction and that organised instruction will eventually result in the development of children's intellectual abilities. While it is argued that scaffolding only partially explains the complex notion of the ZPD, it is a useful construct to consider when describing tutoring practices (Griffin & Cole, 1984).

Scaffolding needs to be age appropriate input in support of goal-directed activities, aimed at promoting children's independent problem solving (Bernier, et al., 2010; Hughes & Ensor, 2009). Carlson (2003) noted that, alongside sensitive parenting and maternal 'mind-mindedness', scaffolding is likely to be a central component in promoting the development of executive function. This has been supported by research showing that parents' contingent scaffolding behaviours are consistently related to child executive function and advanced cognitive development (Bernier et al., 2010; Hammond et al., 2012; Hughes & Ensor, 2009; Landry, Miller-Loncar, Smith, & Swank, 2002; Smith, Landry & Swank, 2000).

Scaffolding is said to consist of several dimensions (Hughes, 2015; Neitzel & Stright, 2003; 2004). *Cognitive support* is the information provided by the parent relating to task management and solution (Vygotsky, 1978), provided in a contingent manner to the child's cognitive needs. This may promote meta-cognitive development and subsequent competency in managing own learning (Neitzel & Stright, 2003). *Emotional support* refers to parents' encouragement, praise and positive attitudes, and the absence of negative behaviours such as rejection and dismissal of the child's efforts (Neitzel & Stright, 2003). *Autonomy support* can be seen in parents' efforts in encouraging the child to attempt the task independently, relinquishing control when appropriate. The underlying assumption is that parent (and child) behaviours will occur in a contingent manner. Though not explicitly discussed, a fourth dimension of scaffolding is *contingent response*.

Scaffolding most often occurs in a family context and has been shown to relate family, parent and child characteristics. It could be thought of as part of the more general term of the 'home learning environment', as a specific process of instruction appearing organically between children and their parents. As with the home learning environment, positive associations were found between contingent scaffolding and both higher maternal education and higher family SES (Carr & Pike, 2012; Hughes & Ensor, 2009; Lowe et al., 2013; Mulvaney et al., 2006; Neitzel & Stright, 2003; 2004). Maternal force characteristics such as personality traits have been linked with scaffolding (Neitzel & Stright, 2004) and resource characteristics, such as more maternal depressive symptoms have also been associated with less contingent scaffolding (Hoffman, Crnic, & Baker, 2006). More contingent scaffolding is likely to be seen in interactions with children who have less difficult temperament and more advanced cognitive abilities (Mulvaney et al., 2006; Neitzel & Stright, 2004) and less with infants at biological risk (Landry et al., 2006; Lowe et al., 2013), though infants experiencing biological risk generally show more gains compared to infants who did not experience biological risk, when exposed to more complex scaffolding.

This chapter reviews the 'scaffolding' literature in detail, first providing a chronological account of the theory's development, then an overview of related developments in methodology, focusing in particular on scaffolding in the preschool years. Next individual differences in scaffolding are addressed, looking at correlates with mother, child and context characteristics and finally evidence for the predictive value of scaffolding for children's development of cognitive and academic abilities is assessed.

3.2 Origins of scaffolding theory

It is argued that the competencies and higher mental abilities necessary for successfully functioning within a given society develop through interactions and collaborations between children and more skilled partners, be they caregivers, siblings or peers (Rogoff, 1990; Vygotsky, 1976). Before acquiring these vital abilities, children are ultimately reliant upon their caregivers and others for assistance, until becoming skilful in carrying out tasks independently (Vygotsky, 1978). Caregivers are said to support or 'scaffold' a child's problem-solving efforts until such time as the child internalizes the skills shown by the caregiver and is subsequently able to work independently (Bruner, 1986). Thus, scaffolding in interactions between caregivers and children are thought to be central to the development of children's intellectual competencies.

In a series of studies David Wood and his colleagues (Wood & Middleton, 1975; Wood et al., 1976) first described the process of scaffolding between 'expert tutors' (parents and researchers) and children aged 3 to 5 years. Wood and his collaborators (1975; 1976), created a problem-solving task (constructing a three-dimensional wooden structure) testing tutors' scaffolding strategies. The design was such that children were faced with a task likely to be beyond their current skills, but one that could be achieved with the help of an 'expert' partner. This influential research was the basis for a theoretical model of scaffolding (Meins, 1997; Pea, 2004; Pratt et al., 1988) by providing operational descriptions of the observed behaviours.

Wood and Middleton (1975) examined modifications in maternal levels of intervention in response to their 3-4 year old child's behaviours finding that the optimal instruction was one level above that at which the child was presenting. They suggested that children possess a ‘region of sensitivity’, reflecting a level of ‘readiness’ for different maternal input, which is the difference between children’s observed and potential ability (Wood & Middleton, 1975). In a second study using the same apparatus the role of the adult tutor’s feedback that recognises the child’s ‘range of competence’ was highlighted (Wood et al., 1976). On the basis of this research six steps ideally occurring in the process of scaffolding were described: recruitment of interest, simplification of task, direction maintenance, marking task’s critical features, frustration control and demonstration.

Wood and his colleagues (1976) were primarily concerned with describing a phenomenon rather than testing specific hypotheses. As they eloquently stated: “We are, as it were, involved in problem-finding rather than in problem-solving” (Wood et al., 1976, p.91). Furthermore, the sample sizes were relatively small, Wood and Middleton (1975) tested 12 mother-child dyads, whilst Wood and colleagues (1976) observed 30 children in interaction with one tutor. Nevertheless, this pioneering work set the scene for future scaffolding research by providing a framework describing ‘the optimal teaching method in a problem-solving situation’ (Meins, 1997 p. 130). Notwithstanding this, individual differences associated with different profiles of maternal instruction, and their possible implications in children’s developmental outcomes were not addressed (Meins, 1997; Pratt et al., 1988).

Defining scaffolding as ‘guided participation’; Barbara Rogoff (1990) addressed the topic of individual differences in scaffolding behaviours by discussing the cultural specificity of the scaffolding theory. Rogoff argued that cognitive functioning is embedded within a culture giving particular, and possibly differing, meaning to tutoring-type interactions. She used the term ‘guided participation’ for the way in which children learn to manage the skills and values essential to their society, presumed to be a collaborative process between children and caregivers that supports children's learning efforts. Guidance might occur explicitly or could manifest itself indirectly, developing organically. She proposed that guided participation in middle-class families in Western societies often evolves to become instruction-based interactions. With a specific learning aim in mind, the parent communicates in accordance to child abilities reducing the task into 'manageable subgoals' (Rogoff, 1990, p.94).

Guided participation is not primarily concerned with instruction, but with the active participation of children in culturally related activities (Rogoff, 1990). Given that in Western cultures academic abilities such as literacy, mathematics and scientific reasoning are considered fundamental for later economic and political participation (Heckman, 2006), instruction may become a central aspect of guided participation. For example, Rogoff (1990) described a study of mother-infant interactions with 1 year olds in middle-class American families. Despite asking mothers to avoid reacting to their child if a toy fell off the high chair, mothers unconsciously shared the focus of attention with their infants, by making a running commentary on the events. Similarly, Hart and Risley's (1995) seminal research showed that, in comparison to parents from welfare-reliant families, professional American parents tended to speak to their 1-2 year olds as if in preparation for participation in a culture where symbolism and problem solving are central. It is not clear whether these differences between advantaged and disadvantaged families are specific to Western cultures. Yet, Rogoff and colleagues (1993) found that in Mayan families, mothers who spent more years in education were likely to be more verbal during guided participation activities with their 1-2 year olds.

As with scaffolding, for guided participation to promote learning, the manner of interaction should be centered on the child's current abilities (Rogoff, 1990). Rogoff discussed the idea of 'intersubjectivity' between parent and infant, the 'shared understanding based on common focus of attention and some presuppositions that form the ground for communication' (p.71). As intersubjectivity develops, by the end of the first year of life, some form of scaffolding, be it instruction-based or otherwise, is expected to take place.

Although the level of contribution from the infant and adult is by no means equal, the infant still determines whether to attend, cooperate or disrupt the adult during social interaction (Rogoff, 1990). The adult's role is to maintain the infant's attention in a manner most suitable to the child's current level of understanding. The transactional nature of such interactions and the importance of understanding the infant or child's role is supported by Pratt and colleagues (1988) and Wood and colleagues (1975; 1976). In order that learning can be promoted during problem-solving activities, the manner of response should be centered on the child's abilities. Rogoff was concerned with the cultural specificity of instruction (Mulvaney et al., 2006), whereas Wood and colleagues described the mechanisms by which optimal teaching strategies operate in problem-solving situations (Meins, 1997; Pratt et al., 1998). Wood and his collaborators (1975; 1976) and Rogoff (1990) suggested that a child's active learning occurs under the guidance of caregivers, who may take a tutoring role almost unconsciously, allowing for the transmission cultural ideas. These early investigations provided a guiding framework for future scaffolding-based research, paving the way for addressing individual differences in scaffolding.

3.3 Methodological developments in scaffolding research

3.3.1 Defining scaffolding

To conduct research on the relevance of a construct, it needs to be measureable, and one must know under what circumstances it is likely to occur. This is also true in the context of scaffolding. According to Granott (2005), there has been lively debate with regard to defining and thus measuring scaffolding. Some argue that in early research scaffolding was seen primarily in controlled situations involving formal instructions (Bickhard, 1992). In contrast others have suggested that, while its original permutation evolved from experimental studies, the theory intends to describe informal, naturally occurring interactions typical to Western families (Pea, 2004). However, more recently there is less division of opinion and scaffolding research occurs under both controlled, laboratory-based situations (Conner & Cross, 2003; Hammond et al., 2012), and in less formal situations such as daily interactions (Landry et al., 2002; Deitriech et al., 2006) and play activities (Bigelow et al., 2004; Hughes & Ensor, 2009; Lowe et al., 2013).

The discrepancies in definitions and methods of measurement may relate to the fact that the process of scaffolding is yet to be fully understood or clearly defined (Renninger & Granott, 2005). Some researchers adopted the more traditional concept of scaffolding using Wood and Middleton (1975) and Wood, Wood and Middleton's (1978) methodology, focusing on the child's 'region of sensitivity for instruction' (Carr & Pike, 2012; Conner & Cross, 2003; Meins, 1997; Pratt et al., 1988). These studies employed goal-directed activities, focusing on parental instruction behaviours in relation to children's task performance. Parental interventions are classified into predetermined behaviours computed against children's task-success at each level of intervention. This computation reflects an individual child's 'region of sensitivity' and parents' ability to contingently shift their response according to child success or failure. The findings from these studies largely suggest that, when parents contingently adjusted their responses according to the child's 'region of sensitivity', more dyadic task success is likely to be observed (Conner & Cross, 2003; Meins, 1997; Pratt et al., 1988). It could be argued that the above-mentioned studies captured the relational nature of scaffolding by formulating the parent's and child sensitivity to the feedback.

The process of scaffolding is bidirectional, developing through the interaction between the parent and child, though parent and child input during the process are often unequally distributed (Granott, 2005; Rogoff, 1990; Wood et al., 1976). Parental actions are more central for the process of scaffolding to be successful. Yet, as Hammond and colleagues (2012) argue, the way in which the process is structured is reliant upon the interaction between parent and child. Although the process is a relational one, parent contingent responses are often described when scaffolding is under investigation. By addressing parental contingency the bi-directionality associated with the process of scaffolding, though not perfectly, is captured.

Refinement of the definition of scaffolding has emerged from some recent studies linking scaffolding with child EF, focusing on parental input in general terms rather than recording specific steps taken by parent and child (Bernier et al., 2010; Hammond et al., 2012; Hughes & Ensor, 2009). Using a range of methodologies, all have found significant and robust positive associations between higher levels of scaffolding and more advanced EF in the preschool years. For example, in the British context, Hughes and Ensor (2009) studied maternal verbal scaffolding (use of open-ended questions, elaboration, encouragement and praise) in 125 mother-toddler dyads during unstructured play activity with their 2 year-old. In a Canadian study of predominantly college-educated women Bernier and colleagues (2010) studied 80 mothers with infants aged 12 to 15 months in several situations including free play in a laboratory and play with puzzles in the home. They found that autonomy support predicted subsequent (26 month) EF, identifying 'autonomy support' in both verbal and non-verbal maternal behaviours and dividing them into four categories: (1) contingent response; (2) sensitive encouragement; (3) attention maintenance; and (4) autonomy promotion. Although not directly stated, Bernier and colleagues' behavioural categories reflect Wood and colleagues' (1976) steps in the process of scaffolding.

Another recent Canadian investigation linking EF and scaffolding carried out by Hammond and colleagues (2012) is more closely related to Wood et al.'s (1976) notion of scaffolding. Guided by the original framework of scaffolding, Hammond and associates observed parental behaviour when 2 and 3 year olds were given a number of puzzles to solve in a laboratory setting. They studied 82 parent-child dyads, focusing on aspects of recruitment of child's attention, frustration control/direction maintenance and demonstration, though they did not record the behaviours directly. The way in which they captured scaffolding was by scoring the proportion of time in which parents used scaffolding strategies consistent with the three behaviours of interest. It could be argued that this method is somewhat too general, yet testing for scaffolding over two time points strengthened their findings. What is more, the significant associations found between scaffolding and individual differences in child EF over time are compelling.

3.3.2 Dimensions of scaffolding

Some researchers theorize that scaffolding behaviours can be grouped into three components: cognitive support; emotional support; and transfer of responsibility (Hughes, 2015; Neitzel & Stright, 2003; 2004). Each of the three dimensions is said to have a unique role in children's experience of scaffolding. Cognitive support can provide the child with a wealth of learning strategies; emotional support may promote motivation and task persistence; and autonomy promotion may foster agency and self-responsibility (Neitzel & Stright, 2004). In their seminal work, Wood and his colleagues (1976) did not explicitly discuss these three dimensions. It could be argued, however, that the behaviours they described as part of the scaffolding process are associated with each dimension. Cognitive support is associated with task simplification, demonstration and marking of critical features. Emotional support is made manifest through controlling for frustration. In addition to that Wood mentioned the tutor's warm and sensitive manner of instruction, suggested to have had a positive effect on the study's results. Transfer of responsibility is related to recruitment and attention maintenance. What is more, throughout the article, Wood and colleagues mentioned that the tutor was to promote autonomous play; the child was to 'pace the task for himself' (Wood et al., 1976, p.92).

In two separate investigations in the USA, Neitzel and Stright (2003; 2004) treated each scaffolding dimension separately in a sample of 68 and 73 dyads respectively. Using a 5-point scale, all behaviours were coded during mother-child problem-solving task when children were aged 5 years. Cognitive support was measured by recording maternal metacognitive input and the manner of instruction. Two contrasting aspects of emotional support were coded, maternal rejecting behaviours and positive and encouraging verbal input. Transfer of responsibility consisted of two opposing behaviours, maternal over-control on the one hand and encouragement to complete task autonomously on the other (Neitzel & Stright, 2003; 2004). Each dimension was found to be uniquely associated with children's self-regulation in the classroom (Neitzel & Stright, 2003) and maternal characteristics such as educational qualifications and personality characteristics (Neitzel & Stright, 2004).

Based on Neitzel and Stright's work, Leerkes, Blankson, O'Brien, Calkins and Marcovitch (2011) tested the unique associations between emotional and cognitive support at 3 year and children's pre-academic skills a year later. Leerkes and colleagues studied a US-based sample of 263 mother-child dyads, of largely middle-class background. Their findings suggest that maternal emotional support during a problem-solving task, but not cognitive support independently predicted gains in children's pre-academic skills. However, it is possible that the lack of significant relationship between cognitive support and pre-academic skills was in part associated with the inclusion of a measure of the home learning environment in the analyses, also shown to independently explain unique variance in age 4 years pre-academic skills (Leerkes et al., 2011). Nonetheless, their findings illustrate the importance of maternal emotional support for subsequent cognitive development and especially for children at risk for developmental delays.

Others have taken a multidimensional approach to scaffolding. In a US-based sample, Landry and associates have extensively studied maternal scaffolding behaviours in populations of typically developing children and children who experienced varying levels of biological risk (Landry, Garner, Swank, & Baldwin, 1996; Landry et al., 2002; Landry et al., 2006; Smith et al., 2000). They observed maternal attention-directing behaviours in relation to specific activities, symbols and objects the child was engaged with, using different methodologies in different settings (home and laboratory) and activities (play and day-to-day interactions). In their early investigations, Landry and her colleagues (1996) observed maintenance of attention compared to redirection of attention in 126 mothers and their 6-months-old infants' play behaviour under laboratory conditions. In later investigations they focused on recording mothers' scaffolding, defined as verbal input that makes associations between actions, objects and concepts (Landry et al., 2002 [N=253]; Smith et al., 2000 [N=312]). Here they recorded scaffolding during naturalistic home visitation in which mothers were instructed to behave as they normally would with their 3-year-olds.

Landry and colleagues (2006) also showed that scaffolding was sufficiently clearly defined that parents could be trained in its use. Called the 'Playing and Learning Strategies' (PALS) intervention programme, they focused on training mothers to use several scaffolding-related strategies. In a randomized controlled trial three groups of infants aged 6-13 months, experiencing differing levels of biological risk were assigned to two study conditions, PALS (intervention) and controls (Landry et al., 2005; 2006). Mothers in the PALS condition (N=133) were trained on four types of scaffolding-related support: contingent response, emotional support, attention maintenance and cognitive/verbal stimulation. The behaviours were then observed during daily activity and toy play sessions. Maternal behaviours in all four domains were found to increase at a faster rate in the intervention group compared with mothers in the control group, irrespective of biological risk. What is more, the behaviours coded were then found to be part of an overarching construct of responsiveness.

3.3.3 Scaffolding and child age

Despite definitional discrepancies and differing methods of investigation, the common denominator between the studies discussed is the responsive and didactic nature of the process of scaffolding, aimed at promoting child autonomy. It could be argued that the way in which scaffolding is studied is associated with child's age. It is likely that children's region of sensitivity to instruction can be more easily identified from toddlerhood onwards rather than in infancy. Investigations in which the region of sensitivity was explicitly addressed included children aged between 3 and older (Meins, 1997; Pratt et al., 1988; Wood & Middleton, 1975; Wood et al., 1978), with one exception. Conner and Cross (2003) observed 45 children's region of sensitivity as early as 16 months, and then again at age 26, 44 and 54 months. Their findings are instructive; at age 16 months mothers used the child's region of sensitivity relatively less, whilst providing higher levels of support. They suggested that the longer parents and children interact, the better parents may become at understanding their child's ability in given situations. This may be another reason why scaffolding in its traditional sense is more challenging to study in infancy.

Scaffolding research in infancy (before the child is aged 2 years) often focuses on general maternal behaviours. Some studies addressed the core aspects of scaffolding: contingent response, cognitive support, emotional support and autonomy promotion (Bernier et al., 2010; Landry et al., 2006) less explicitly. Similarly, Bigelow and colleagues (2004) defined maternal scaffolding during play activity at 12 months in general terms. Yet, even their measure specified that 'optimal' scaffolding consisted of facilitation, encouragement, modeling and turn taking, in some way mimicking the principal dimensions of scaffolding.

Another issue that can occur when studying scaffolding with infants is determining the 'correct' step taken towards specific task solution. These steps may not be observed until later stages of development; thus, in infancy parental scaffolding strategies may be associated with infants' positive behaviours with mothers (Landry et al., 2006), or with more mature play (Bigelow et al, 2004). For instance, in 30 mother-infant dyads, Bigelow and colleagues showed that when mothers provided more contingent scaffolding, their year old infants were likely to engage in more functional play, whilst those who experienced very minimal scaffolding-like input were likely to be less engaged in play.

3.4 Scaffolding and individual differences

As mothers and children are likely to spend a significant portion of their time together, it is to be expected that mother-child collaborations will have a particularly significant role to play in promoting child development (Laosa, 1980). Both maternal and child characteristics are predicted to uniquely contribute to the process of scaffolding (Lowe et al., 2013; Mulvaney et al., 2006; Neitzel & Stright, 2004). In addition, the wider context within which the family is placed is likely to be relevant (Hughes & Ensor, 2009; Rogoff, 1990). The correlates of scaffolding are reviewed, first maternal then child characteristics and finally contexts.

3.4.1 Mother characteristics and scaffolding

A myriad of maternal characteristics were found to relate to effective collaborative interactions. Though, maternal 'demand characteristics' such as ethnic background and maternal age, have infrequently been addressed explicitly in relation to scaffolding. In the case of ethnic background, some studies found no associations between ethnicity and maternal scaffolding (Lowe et al., 2013). However, a recent study by Bae and colleagues (2014) showed significant differences in levels of scaffolding between 608 mothers of three U.S. ethnic groups: European American mothers and African American and Latino mothers. After controlling for child gender and verbal IQ, family SES and marital status, European American mothers were still more likely to show higher levels of scaffolding, compared with African American and Latino mothers. African American and Latino mothers did not differ in their propensity to scaffold. It is also noteworthy that mothers in all three ethnic groups did not differ significantly in any other parenting behaviours, namely: support and engagement, hostility/coercion and agency/persistence. They also found an interaction between ethnicity and scaffolding in predicting child academic attainment in African American families. This lead Bea and colleagues to conclude that scaffolding may have a specific role in promoting educational attainment for African American children. In the British context, scaffolding have yet to be linked with ethnicity, yet given that parenting behaviours and subsequent child development are to some extent a function of cultural factors, it is likely that association between scaffolding and ethnic background will be observed in the British context, that is becoming increasingly multicultural.

Maternal age has not been directly linked with scaffolding behaviours. However, despite the lack of literature, it is possible that mothers' age and scaffolding are to some extent related. More general research into parenting practices suggests that teenage mothers are likely to present a less sensitive and cognitively stimulating style of interaction (Keown, et al., 2001; McFadden & Tamis-LeMonda, 2013). In addition, maternal age (especially teenage versus non-teenage mothers) has been found to uniquely explain some variability in child cognitive development (Keown et al., 2001; Morinis, Carson & Quigley, 2012). It is possible that some of the variance in the associations between maternal age and cognitive abilities is mediated by maternal scaffolding behaviours.

Maternal scaffolding behaviours have been found to relate to 'force characteristics' such as parenting attitudes and personality traits. Associations were found between parenting styles and contingent scaffolding (Carr & Pike, 2012; Pratt et al., 1988). Adopting Baumrind's (1968; 1971) typology, Pratt and associates (1988) tested 24 parent-child couples, finding that authoritative parents were the most likely to use more effective tutoring styles focused on the child's region of sensitivity to instruction. Carr and Pike (2012) showed that, whilst only harsh parenting was associated with non-contingent behaviours (fixed failure feedback), both positive and harsh parenting accounted for marked variability in contingent scaffolding in 96 mother-child dyads with 10 year olds.

In the case of maternal personality the findings are inconclusive. Neitzel and Stright (2004) showed association between maternal openness to experience and both the capacity to regulate task difficulty and the use of metacognitive information, yet once maternal education levels were considered these effects were no longer significant. In relation to conscientiousness they found that that mothers who were more conscientious were likely to be more rejecting and controlling towards their preschools children. These associations remained significant throughout, even after taking into account maternal education and negative task characteristics. Such findings can be considered as support for Belsky and Barends' (2002) assertion that parents who report more extreme levels of conscientiousness may put too many demands on their child, using more controlling behaviours.

Another facet of maternal personality likely to be associated with scaffolding is agreeableness. Some suggest that agreeableness is associated with greater parental investment in childrearing (Bradley, Whiteside-Mansell, Brisby, & Caldwell, 1997), and indeed associations between the quality of verbal input in interactions with 2 years-olds and higher levels of maternal agreeableness were observed (Bornstein et al., 2011). In the context of scaffolding, however, Mulvaney and colleagues (2006) found that although maternal agreeableness significantly and positively correlated with mother-child scaffolding when children were 6-years-old, it was not a significant predictor of collaborative interaction after taking maternal and child cognitive abilities into account.

The investigation by Mulvaney and his colleagues employed an ecological approach to studying scaffolding, exploring a number of maternal characteristics hypothesized to predict effective problem solving at age 6 years. They tested scaffolding in a diverse sample of 92 mother-child dyads from the NICHD ECCRN Massachusetts site. As mentioned, maternal personality characteristics were not found to significantly predict effective scaffolding. Likewise, attachment security was not predictive of mother-child scaffolding, even though previous investigation did find marked associations between these constructs (Meins, 1997). They did, however, find that maternal higher verbal intelligence was highly predictive of more mother-child scaffolding, suggesting that more intelligent mothers may have a better understanding of structuring problem-solving based interactions. Nevertheless, two possible limitations in Mulvaney's design should be mentioned: first, maternal cognitive abilities were found to be highly correlated with scaffolding (r=.50) which may mask the effects of other predictors. Second, maternal sensitivity was also assessed and employed as a covariate which may have diluted the possible effects of attachment on scaffolding, as sensitive responsiveness is inextricably linked to attachment (Ainsworth, Bell, Stayton, & Richards, 1974). Nevertheless, this study elucidated some of the mechanisms associated with effective learning collaborations.

It is perhaps not surprising that higher maternal education qualifications, a 'force characteristic; is consistently found to be associated with more contingent scaffolding behaviours. Laosa (1980) showed that in two different cultural groups (Chicano and Anglo-American), teaching behaviours were a function of levels of formal education achieved by the parent, rather than belonging to a specific cultural group. Similarly, Neitzel and Stright (2003; 2004) showed consistent associations between higher levels of mothers' education and cognitive and emotional support, as well as mothers' ability to regulate task difficulty and to use higher levels of metacognitive information in interaction with their 4-6 year olds.

For children born preterm more complex maternal scaffolding behaviours were found to be associated with higher levels of education (Lowe et al., 2013), revealing that both mother and child characteristics influence the process of scaffolding. Others have found that the effects of maternal levels of education on contingent scaffolding, when child was aged 10 years, were mediated by parenting quality (Carr & Pike, 2012). As maternal education is argued to be the most influential socio-demographic factor in predicting child cognitive development (Bradley & Corwyn, 2002), it is perhaps not surprising that associations are observed with behaviours said to advance child goal-directed activities. It is possible that more highly educated mothers have a larger repertoire of 'problem-solving tools' at their expense, meaning that scaffolding may be one mechanism by which the effects of maternal education operate in influencing child cognitive development.

Another possible 'force characteristic' likely to influence maternal scaffolding behaviours is mental health. In mother-child interactions, elevated maternal depressive symptoms have been frequently shown to relate to negative behaviours such as hostility, reduced active engagement and inability to focus on child experience (Murray et al., 1996; Sohr-Preston & Scaramella, 2006). It is likely, therefore, that in the context of problem solving interactions maternal depression may have a particular role to play. Hoffman and colleagues (2006) found in 208 dyads that increased levels of depressive symptoms were associated with reduced levels of emotional, motivational and technical scaffolding observed when children were 3 and 4. Similarly, Murray and colleagues (2006) found that mothers showing higher levels of depressive symptomatology were likely to present reduced mastery motivation, promotion of representational understanding, emotional support and increases in coercive control in home-work based interaction when children were 8 years old.

Though the findings that maternal scaffolding behaviours can be predicted by depressive symptomatology are compelling, others have not observed such associations. Hughes, Roman, Hart & Ensor (2013) have recently found that maternal scaffolding at age 2 and 6 years was not associated with maternal depressive symptoms at ages 2,3,4 and 6 years, ruling out a mediation. Yet, maternal depressive symptoms were associated with children's executive function (EF) across a four-year period, and the rates of reduction in maternal depressive symptomatology marginally explained an independent portion of EF. In addition to that maternal scaffolding at age 2 years was independently associated with child EF at age 6 years, revealing a multifaceted mechanism, by which different maternal behaviours and characteristics each have an individual, and significant effect on the development of executive functions.

3.4.2 Child characteristics and scaffolding

The literature linking child gender, a 'demand characteristic', and maternal scaffolding behaviours is relatively scant. Most studies that have explored these associations found no evidence that child gender was a predictor of maternal scaffolding (Carr & Pike, 2012; Landry et al., 2006; Lowe et al., 2013; Mulvaney et al., 2006; Neitzel & Stright, 2004) but Conner and Cross's (2003) longitudinal investigation did show some gender effects. In later stages of development (44 and 54 months) mothers were more likely to support girls in the first half of a problem-solving interaction, whilst during the second half mothers were more likely to support boys. Interestingly, mothers used the region of sensitivity more often with boys in the first half of the interaction, but more readily with girls in the second half of the tasks. The authors posited that parents at later stages of the preschool years might begin to interact differently with their children according to their gender. Parents may have assumed that initially girls require more support, whilst boys may be more capable of being challenged and thus were more likely to be instructed in the region of sensitivity in the first half of the task.

Children's force characteristics such as temperament may also be associated with maternal scaffolding. Generally, child temperament has been found to relate to different parental behaviours (Belsky, 2005; Collins et al., 2000), yet in the context of scaffolding some argue that child temperament received little attention (Neitzel & Stright, 2004). Findings connecting child temperament and scaffolding are inconsistent. Mulvaney and his colleagues (2006) found no significant associations between these factors while Neitzel and Stright (2004) found some significant associations between child temperament and specific maternal scaffolding behaviours. Child difficult temperament explained a considerable variance in maternal task difficulty regulation, a relationship moderated by maternal education. More educated mothers who perceived their children as having more a difficult temperament were likely to show higher levels of task difficulty regulation. Similar patterns were observed in relation to maternal encouragement (Neitzel & Stright, 2004).

Scaffolding has also been studied in relation to child resource characteristics such as birth weight. A large body of research links maternal scaffolding behaviours with biological risk. As previously discussed, the group lead by Susan Landry has extensively researched the role of maternal scaffolding in child cognitive and socioemotional development in children born preterm (Landry et al., 1996; Landry, et al., 2002; Landry et al., 2006; Smith et al., 2000). In the PALS intervention programme, Landry and her associates (2006) found interactions between maternal scaffolding behaviours and infant biological risk. Mothers in the PALS group were likely to show significantly less negative behaviours with high-risk 6-13 months old infants compared to controls. Similarly, mothers of low-risk infants were likely to present more positive behaviours. Some, but not all, dimensions of scaffolding interacted with child biological risk to predict subsequent development. The most profound effects in child cognitive and socioemotional development associated with maternal scaffolding behaviours were observed for infants who experienced some biological risk (Landry et al., 2006). More recent investigations in the context of infant biological risk showed comparable findings. Children of mothers who used more complex scaffolding strategies were likely to show better cognitive development (Dilworth-Bart, Poehlmann, Hilgendorf, Miller, & Lambert, 2010; Dilworth-Bart et al., 2011; Lowe et al., 2013). Although birth weight and prenatal biological risk is outside the remit of this investigation the findings from these studies can inform research with typically developing infants.

As scaffolding is ultimately concerned with the advancement of children's learning and development, child ability is often considered as a force characteristic influencing the process (Carr & Pike, 2012; Mulvaney et al., 2006). Carr and Pike found that child verbal mental age predicted maternal contingent response at age 10 years, whilst Mulvaney and his colleagues showed that more advanced child cognitive ability in the first 2 years predicted more effective scaffolding at age 6 years. Others have included earlier child ability when testing for the unique contribution of maternal scaffolding behaviours to subsequent development (Dieterich et al., 2006; Hammond et al., 2012; Hughes & Ensor, 2009), finding that even after controlling for child ability (either verbal ability or EF) maternal scaffolding explained individual variations in subsequent ability. Basing their assertion on Kovas et al. (2007), Hughes and Ensor (2009) argued that controlling for earlier abilities enables one to test for environmental influences, such as scaffolding and the broader family environment, in relation to change in child abilities while reducing the probability of confounding effects due to genetic factors. Taking child ability into consideration may better reflect the role of contextual influences in child ability.

3.4.3 Context characteristics and scaffolding

Contextual factors, alongside child and mother characteristics are also likely to explain individual differences in the process of scaffolding. In the context of guided participation, Rogoff, and colleagues (1993) investigated the cultural specificity of problem-solving interactions in the context of novel object exploration and a dressing episode. They compared the behaviours of mothers and toddlers (aged 12-17 and 18-24 months) in middle-class U.S. families and Guatemalan Mayan families, observing 14 dyads in each culture. Their study revealed cultural variation in verbal and non-verbal communication during guided participation. Middle-class American caregivers were significantly more likely to offer more verbal assistance to their toddlers compared to the Mayan caregivers, whilst the latter were more likely to offer non-verbal support by way of demonstration. In the American sample, children were treated as the 'object of teaching' (Rogoff et al., 1993, p. 77), while the Mayan children were considered to be responsible for own learning. Interestingly, Rogoff and her colleagues found that higher levels of maternal education in the Guatemalan Mayan group were associated with higher levels of verbal input, similar to that seen in the American mothers, perhaps reflecting a universal discourse associated with the experience of schooling.

As previously discussed, higher levels of maternal education have been consistently associated with more contingent scaffolding (Carr & Pike, 2012; Hughes & Ensor, 2009; Laosa, 1980; Lowe et al., 2013; Neitzel & Stright, 2003), however, association between other socio-demographic factors and scaffolding are less clear. As scaffolding is a culturally related process, it may be that variations in the process can be in part attributed to demographic characteristics other than maternal education, such as income, family size and neighbourhood poverty. One possible reason why these variations have not been addressed may be associated with the populations within which scaffolding is studied. It can be argued that scaffolding is often observed in populations that are similar in their demographic characteristics, generally North American families that are either comparatively advantaged (Bernier et al., 2010; Hammond et al., 2012; Pratt et al., 1988) or relatively disadvantaged (Hustedt & Raver, 2002; Smith et al., 2002). This may limit the inferences that can be made about demographically driven individual differences in scaffolding.

In more diverse samples some associations between maternal scaffolding behaviours and contextual factors were found. In addition to maternal education, Hughes and Ensor (2009) showed that in English families of varying socioeconomic strata, maternal scaffolding at 2 years was associated with the head of household's highest occupational qualification. Mulvaney and colleagues (2006) found a positive correlation between more contingent scaffolding and lower household income-to-needs ratio in U.S. families, but the association did not remain significant after taking into account mother and child characteristics that were more closely associated with successful scaffolding. In another U.S-based sample of 75, 16-months-old infants born with biological risk, maternal scaffolding strategies were found to mediate the effects of SES (a composite measure of maternal education and household income) on child verbal working memory at age 2 years (Dilworth-Bart et al., 2011).

Research that addresses multiple context characteristics in relation to scaffolding is limited. However, as with any other proximal process, scaffolding behaviours are likely to be influenced by the attributes of the persons involved in the process as well as the contexts inhabited by these persons. It is likely that adversity experienced by families both within and outside the home may be associated with maternal scaffolding behaviours. Larger family size, previously found to be associated with reductions in the quality and quantity of parent-child interactions and subsequent intellectual ability

(Steelman et al., 2002), may also be associated with scaffolding quality. Likewise, home adverse living conditions such as over-crowding and housing inadequacy, said to be associated with more negative caregiving and to impede intellectual development (Evans, Wells, & Moch, 2003), are likely to show negative associations with mothers' ability to provide appropriate scaffolding.

Finally, the context of the neighbourhood may have a unique role to play in maternal scaffolding. Previous studies have found associations between neighbourhood affluence and children's cognitive ability and academic attainment (see Leventhal & Brooks-Gunn 2000 for review, and section 2.2.1 of the literature review). In keeping with the family stress model, it is possible that neighbourhood poverty will adversely affect the family in turn increasing the likelihood that parental caregiving will be detrimentally affected (Ceball & McLoyd, 2002; Korbin, Coulton, Chard, & Platt-Houston, 1998). The affects may be seen in parents' propensity to use more coercive and punitive behaviours (McLoyd, 1990) or less emotionally engaged caregiving practices (Klebanov et al., 1994); responses that are likely to influence children's behaviour and ability (Pebley & Sastry, 2003). This is therefore also likely to occur in the context of scaffolding, even though there is not available evidence in this respect thus far.

3.5 Maternal scaffolding and child cognitive and academic ability

As argued by Vygotsky (1978), child higher order mental abilities and the skills required to operate in a given culture, develop through interactions with 'expert' members in society. Through collaborative interactions with their parents, children in Western countries develop the language and problem solving capabilities essential for functioning in such culture. It is therefore not surprising that parental scaffolding practices have been consistently linked with child executive functioning (Bernier et al., 2010; Hammond et al., 2012; Hughes & Ensor, 2009; Landry et al., 2002), cognitive (Dilworth-Bart et al., 2011; Landry et al., 2006; Leerkes et al., 2011; Mulvaney et al., 2006; Smith et al., 2000) and academic abilities (Dieterich et al., 2006; Neitzel & Stright, 2003), skills that are highly relevant to industrialized cultures (Hackman, 2006).

Maternal scaffolding behaviours have been frequently found to predict child executive functions (EF), a relationship partially mediated by child verbal ability (Hammond et al., 2012; Landry et al., 2002). Maternal verbal scaffolding at age 2 years predicted child EF two years later, an association that remained significant even after taking family and context characteristics, as well as child EF at age 2 into account (Hughes & Ensor, 2009). Bernier and colleagues (2010) showed that mothers' autonomy promoting behaviours at 15 months, predicted child EF at age 18 and 26 months above and beyond child cognitive ability, maternal sensitivity and mind-mindedness. Observing scaffolding longitudinally, Landry and colleagues (2002) found that mothers scaffolding at age 3 predicted children's executive processing at age 4, a relationship mediated by children's cognitive skills at that age. Likewise, Hammond and associates (2012) showed that scaffolding at age 2 years indirectly predicted child EF at age 4 years through age 3 years verbal ability, whilst age 3 scaffolding had a direct and significant effect on age 4 EF.

Looking more broadly at cognitive skills, many have observed significant associations with maternal scaffolding. Evidence from studies with children who experienced biological risk illustrates the associations between scaffolding and cognitive abilities. Smith and colleagues (2000) found that more contingent verbal scaffolding at age 3 years was directly associated with growth in child verbal and non-verbal skills across the preschool years. This effect was observed for both typically developing children and those born with biological risk, but the associations were more pronounced for the latter group in the context of non-verbal ability (Smith et al., 2000). Similarly, the PALS intervention study showed comparable results; higher levels of maternal responsiveness were associated with higher child cognitive skills (Landry, 2006). In the context of typically developing children, Mulvaney and colleagues (2006) observed a significant relationship between mother-child dyadic scaffolding and child cognitive abilities in the first grade. This relationship was independent from child earlier cognitive abilities and maternal verbal IQ.

The literature is limited in the context of maternal scaffolding and subsequent academic attainment. However, a few investigations are of interest. Neitzel and Stright (2003) discussed scaffolding in the context of classroom behaviours essential for later attainment. Their findings suggested that higher maternal cognitive support was associated with greater child ability to monitor progress, seek help and engage in metacognitive talk. Additionally, mothers' who were more emotionally supportive and better at promoting their child's autonomy had children who were more likely present more self-regulatory behaviour in the classroom (Neitzel & Stright, 2003). In a study by Bae and colleagues (2014) maternal scaffolding at age 5 years predicted early reading and number concepts, but the association was observed for African American children only, and not for those in Anglo-European families. Finally, one US-based study showed associations between maternal scaffolding at age 3 and 4 years and child decoding and reading comprehension at age 10 years in 269 mother-child couples (Dieterich et al., 2006). Here, maternal verbal scaffolding recorded during day-to-day interactions was found to directly predict decoding abilities, in turn predicting reading comprehension.

3.6 The study aims

Studying a large, demographically diverse English group of 400 mothers and their infants, and taking a longitudinal approach, four major aims will be addressed. Drawing from the work of Wood and his colleagues (1976) and later permutations of the theory (Landry et al., 2006; Neitzel & Stright, 2003, 2004), the present investigation will address the issue of defining scaffolding by recording specific maternal behaviours associated with the main components of scaffolding: contingent response, cognitive support, emotional support and autonomy promotion. The first aim will be to try and ascertain whether, during semi-structured play interactions with their 10-months old infants, mothers show behaviours akin to the dimensions of scaffolding. In keeping with Landry and colleagues (2006), further tests will be carried out to assess whether the behaviours recorded correspond to an overall construct of scaffolding-like behaviours. As children are said to be actively involved in own experience (Bornstein, 2002; Sameroff, 2010; Tamis-LeMonda, Kuchiroko, & Tafuro, 2013), infant play maturity will also be addressed. To account for the bi-directionality occurring within the proximal process of scaffolding, and in keeping with Bigelow and colleagues (2004) methodology, infant advanced object play will be recorded and tested against maternal scaffolding-like behaviours.

Scaffolding was referred to as ‘an artefact of the family’ (Neitzel & Stright, 2003, p.147) a proximal process likely to be affected by mother, child and context characteristics. The second aim of the present study is to explore the role of child (gender, play maturity and temperament), mother (age, education, ethnicity, marital status, personality, parenting attitudes and mental health), and contextual factors (family size, adverse home environment and neighbourhood poverty) in relation to maternal scaffolding behaviours. Based on previous findings, it is assumed that higher levels of maternal scaffolding will be associated with child more mature play, with older maternal age and higher levels of education, as well as higher levels of agreeableness. Lower levels of scaffolding are likely to be associated with infants' unsociable temperament, mothers' more traditional parenting attitudes and higher levels of depressive symptoms. Furthermore, larger family size, more household and neighbourhood adversity are all hypothesised to predict lower levels of maternal scaffolding.

The third aim of the present study is to address the possible associations between maternal scaffolding in infancy and child cognitive ability at the start of school. Taking into account child, mother and context characteristics, the relevance of maternal scaffolding behaviours at 10 months to child cognitive ability at 18 and 51 months, will be tested. It is hypothesized that maternal scaffolding will predict child cognitive ability in the preschool years, even after taking all covariates into account. The fourth aim is to address possible associations between maternal scaffolding in infancy and child academic achievement at the end of primary school, at age 11 years, taking into account prior child cognitive ability. As previously shown by Dieterich et al. (2006) and Hammond and colleagues (2012), it is expected that the effects of maternal scaffolding behaviours at 10 months will be mediated by child cognitive ability in the preschool years.

3.7 Study hypotheses:

1. Maternal scaffolding behaviours recorded in a semi-structured play interaction between mothers and their 10-months old infants will correspond to the central dimensions of scaffolding: contingent response, cognitive support, emotional support and transfer of responsibility.

2. Child (gender, play maturity and temperament), mother (age, education, ethnicity, marital status, personality, parenting attitudes and mental health), and contextual factors (family size, adverse home environment and neighbourhood poverty) will predict individual differences in maternal scaffolding strategies.
3. Maternal scaffolding behaviours at 10 months will predict child cognitive ability at 18 and 51 months, even after taking child, mother and context characteristics into consideration.
4. Maternal scaffolding behaviours at 10 months will indirectly predict child academic attainment at age 11 years. This relationship will be mediated by child cognitive ability in the preschool years.

CHAPTER 4: METHODS

4.1 Participants

The study participants were from the Families Children and Child Care study (FCCC; www.familieschildrenchildcare.org) a longitudinal investigation into the possible effects of childcare on child development. Recruitment took place from 1999 to 2002 in hospitals and post-natal clinics in North London and Oxfordshire, catering for demographically diverse populations. The sample (N=1,201), closely reflected the socio-demographic distribution of the area populations (Malmberg et al., 2005). Eligibility criteria were: mother over 16 at time of birth and sufficiently fluent for interview in English, with no specific plan to move in the next 2 years or place the child in care. Child eligibility criteria were a singleton, minimum gestation of 37 weeks and birth weight of at least 2,500 g, no congenital abnormalities, and no more than 48 hours stay in a Special Care Baby Unit.

4.*1.1 Pilot study*

For the purpose of training, piloting and validating the observation scheme used in the present study, a sub-sample of 60 mother-child dyads was randomly selected according to pre-specified criteria. The first criterion was that mothers and children had a full dataset at 3, 10 and 51 months. Given the relationship between maternal scaffolding behaviours and child cognitive development a further selection criterion was that the sample would comprise of children from three distinct child cognitive ability groups at 51 months based on the verbal comprehension subscale of the British Ability Scales (BAS). The groups were defined as follows: low = 85 or below (mean=77.56; SD=7.70); average = 95 and 105 (mean=101.21; SD=2.86); high = 115 and above (mean=120.38; SD=6.25). Coding of maternal behaviours was conducted blind to group membership. In the low cognitive ability group three children were reported to have developmental delay, and were removed. In order to keep the groups equal 3 children were randomly removed from the average ability and the high ability groups.

The sub-sample consisted of 21 boys (41.2%) and 30 girls (58.8%); 43% (N=22) were firstborn and a further 43% were the second-born, just under 14% were either third or fourth-born. Mothers were aged between 17 and 40 years (mean=31.7; SD=5.46), and 47 (92.2%) were residing with the child's father. Of the mothers 74.5% (N=38) were of British white ethnic background, and fewer than 10% (N=5) of mothers reported that English was not their first language. Just under half of the mothers who reported on their levels of education (N=25) were educated to a degree level or above, whereas 47% (N=24) had qualifications ranging up to Advanced level or equivalent, gained usually at 18 years; 3.9% (N=2) of mothers did not provide information on levels of education. Of the families included in the pilot study N=11 (21.6%) were working class. A small number N=6 (11.6%) were of intermediate SES, and the large majority, N=34 (66.7%) were classified as managerial and professional class.

No differences were identified between the small pilot sample and the remainder of the FCCC study participants for child characteristics: gender, verbal BAS score; maternal characteristics: age, level of education, English as first language, ethnic background, employment status prior to birth of the child, mental health, personality and attitudes; or contextual factors: environmental adversity, neighbourhood deprivation, family size (See Table 4.1).

Table 4.1: Comparison between pilot study sample and the remainder of the FCCC sample (mean scores with SD in brackets or numbers of participants with percentages in brackets)

	Pilot Study	Remainder of FCCC sample	Difference
Variables	N=51	N=1150	*P*
Child			
Gender female (%)	30 (58.8)	573 (49.8)	*n.s.*
Gender male (%)	21 (41.2)	577 (50.2)	
BAS – verbal comprehension 51 months	99.72 (18.63)	99.21 (15.02)	*n.s.*
Mother Characteristics			
Mean maternal age	31.69 (5.46)	31.98 (5.26)	*n.s.*
Maternal education			
Less than university degree (%)	24 (47)	606 (52.8)	*n.s.*
Bachelors or higher degree /professional qualification (%)	25 (49)	540 (47.1)	
Maternal ethnic minority status			
Not Minority (%)	38 (74.5)	911 (79.2)	*n.s.*
Minority (%)	13 (25.5)	239 (20.8)	
Maternal first language			
English (%)	46 (90.2)	983 (86.0)	*n.s.*
Not English (%)	5 (9.8)	160 (14.0)	
Yes (%)	47 (92.2)	1038 (90.3)	*n.s*
No (%)	4 (7.8)	112 (9.7)	
Mean maternal mental health at 10 months	6.23 (4.60)	6.60 (4.67)	*n.s.*
Mean maternal agreeableness	3.78 (.36)	3.82 (.41)	*n.s.*
Mean maternal traditional attitudes	2.79 (.67)	2.91 (.69)	*n.s.*
Family SES			
Working (%)	11 (21.6)	262 (22.8)	*n.s.*
Intermediate (%)	6 (11.8)	212 (18.4)	
Professional/Managerial (%)	34 (66.7)	676 (58.8)	
Contextual Factors			
Mean adverse home environment	-.08 (.92)	.004 (1.00)	*n.s*
Neighbourhood poverty	30.80 (17.93)	29.44 (17.09)	*n.s.*
First-born (%)	22 (43.1)	594 (51.7)	*n.s.*
Siblings (%)	29 (56.9)	556 (48.3)	

4.1.2 Main study

Once the observation scheme was piloted a further sub-sample of 400 was chosen at random from the larger sample. The sample size was decided based upon the number of predictors to be included in the ensuing analyses. Some suggest that a subject predictor ratio of 10 to 1 is sufficient when using regression method (Miller & Kunce, 1973), while others suggest a more stringent ratio of 30 to 1 (Pedhazur & Schmelkin, 1991). The number of predictors in this investigation was 15 variables, and subject predictor ratio was at 27 to 1, falling slightly short from Pedhazur and Schmelkin's (1991) recommendation. The only condition for inclusion in the study was that they had complete information in the child's first year (3 and 10 months) and at 51 months and that they had not been part of the pilot study. These three time points were chosen as the criteria for inclusion because of the following reasons: at 3 months families were enrolled in the study; at 10 months the videotaped interactions data were collected; and at 51 months information pertaining cognitive ability was collected.

The randomly selected sub-sample included 400 mother-infant dyads. Of the infants, 201 (50.3%) were girls, and 205 (51.3%) were firstborn. Over 80% (N=323) of mothers were of British white origin; aged between 16 and 46 (mean=30.92; SD=5.26), and 7% (N= 28) reported that English was not their mother tongue. Almost all (N=364, 91%) of the mothers resided with the child's father, and 44.3% (N=177) were educated to degree level or above. Family SES measured by the CASOC (Rose & O'Reilly, 1998) showed that N=95 (23.8%) of the families were classified as working class. Less than 20% of the sample (N=73) were classified as intermediate class, whilst N=232 (58.0%) were identified as professional/managerial class.

As to be expected some attrition had occurred. Of the 1201 mothers interviewed at 3 months 1041 (86.7%) mothers were seen at 51 months. A comparison between the randomly selected sample (N=400) and those remaining in the study at 51 months was carried out (see Table 4.2). For all but two characteristics there was no significant difference between the two samples in terms of child, mother, and contextual factors. There were more mothers who spoke English as a first language in the sub-sample than the remaining families [x^2 (1) = 9.56; *p*= .002]. This was to be expected, as videotaped interactions in which the mother spoke a different language to English were not included. Participants included in the subsample were likely to reside in less advantaged neighbourhood than the remainder of the study participants included in the study at 51 months, this difference, however, was only marginally significant (*p*= .051). See section 4.3 for measures and for full descriptions of the variables included in the samples comparisons.

Table 4.2: Comparison between main study sample and the remainder of the FCCC sample (mean scores with SD in brackets or numbers of participants with percentages in brackets)

	Present study sample	Remainder of sample at 51 months	Difference
Variables	N=400	N=641	*p*
Child			
Gender female (%)	201 (50.2)	322 (50.2)	*n.s.*
Gender male (%)	199 (49.8)	319 (49.8)	
Unsociable ICQ 10 months	2.26 (.76)	2.30 (.75)	*n.s.*
Bayley MDI 18 months	91.89 (13.33)	93.11 (13.16)	*n.s.*
BAS verbal ability	99.65 (14.23)	98.28 (14.49)	*n.s.*
BAS non-verbal ability	65.91 (13.77)	66 (14.29)	*n.s.*
KS2 English age 11	4.71 (.65)	4.73 (.69)	*n.s.*
KS2 math age 11	4.83 (.74)	4.81 (.77)	*n.s.*
Mother Characteristics			
Maternal age	30.93 (5.26)	31.35 (5.24)	*n.s.*
Maternal education			
Less than university degree (%)	221 (55.7)	312 (48.9)	*n.s.*
Bachelors or higher degree /professional qualification (%)	177 (44.3)	326 (51.1)	
Maternal ethnic minority status			
Not minority (%)	323 (80.75)	518 (80.8)	*n.s.*
Minority (%)	77 (19.25)	123 (19.2)	
Maternal first language			
English (%)	370 (93)	557 (86.9)	*.002*
Not English (%)	28 (7)	84 (13.1)	
Residing with partner			
Yes (%)	362 (90.5)	581 (90.6)	*n.s*
No (%)	38 (9.5)	60 (9.4)	
Maternal mental health at 10 months	6.62 (4.46)	6.50 (4.71)	*n.s.*
Maternal agreeableness	3.83 (.42)	3.83 (.40)	*n.s.*
Maternal traditional attitudes	2.92 (.69)	2.85 (.68)	*n.s.*
Family SES			
Working (%)	97 (23.8)	178 (22.2)	*n.s.*
Intermediate (%)	73 (18.3)	145 (18.1)	
Professional/Managerial (%)	232 (58.0)	478 (59.7)	
Contextual Factors			
Adverse home environment	.89 (1.17)	.81 (1.14)	*n.s*
Neighbourhood poverty	30.10 (16.95)	28.00 (16.81)	*.051*
First-born (%)	206 (51.5)	326 (50.9)	*n.s.*
Siblings (%)	194 (48.5)	315 (49.1)	
Group care – First year (%)	58 (14.5)	94 (14.3)	*n.s.*
Group care – Second year (%)	48 (12)	87 (13.2)	
Group care – Third year onwards (%)	294 (73.5)	478 (72.5)	

4.2 Procedure

The study received ethical approval from the Royal Free and University College Medical School and Oxford University. All participants provided written informed consent. Home interviews, questionnaires and observations were conducted with mothers when children were 3, 10, 18, 36 and 51 months, with assessments of child development at 18, 36 and 51 months. Age 11, maths and English Key Stage 2 (KS2) results were obtained from the Department for Education (DfE) in 2013. Data included in the present study were collected at all time points.

At the 10-months home visit, researchers videotaped semi-structured play interactions between mother and infant. Mothers were asked to 'play as they normally would', in 2.5 minute play segments, with a series of four toys provided in a standardized sequential manner by the researchers. For the purpose of this study, segments involving three of the toys were coded. Play with a 'touch and feel book', stacking rings and shape-sorting box. These were chosen as the activities most likely to involve infant exploration and maternal instructive behaviour. The fourth was a musical toy without any obvious task to solve. Mother and infant coding were carried out on separate occasions, as the coding schemes were treated as two separate instruments.

4.3 Measures

4.3.1 Contextual factors

Demographics

Information about child gender, maternal age, education, ethnic background, marital status and family SES, defined using the Computer Assisted System for Occupational Coding (CASOC; Rose & O'Reilly, 1998), was collected at 3 months during maternal home interviews. In addition an environmental adversity index was calculated based on six indicators: living in rented or insecure accommodation, no kitchen/no bath, 4+ stairs, no garden, no car and crowdedness. Neighbourhood level poverty was assessed using the Child Poverty Index from the Indices of Multiple Deprivation (CPI; Noble et al., 2000). This instrument calculates the proportion of families with children aged between 0-16 who claim some form of mean-tested benefits (job seekers allowance, income support, disability working allowance and family credit) across all of 8418 English wards. By using household postcodes, each participant can be linked to their relevant ward deprivation values. A higher score on the CPI reflects higher levels of deprivation.

Home environment

Information about the home environment was obtained at the 10 months home visit from interview questions and observations using the Home Observation Measurement of the Environment Inventory (HOME; Bradley & Caldwell, 1979). The HOME inventory is a widely used instrument, measuring dimensions of the home environment related with child developmental outcomes in both normative and at-risk populations (Totsika & Sylva, 2004). The HOME sub-scales used in the current study were ‘emotional and verbal responsivity’ (Cronbach alpha α=.58) reflecting the affective and communicative relationship observed between the caregiver and the infant; and ‘provision of appropriate play materials’ (Cronbach alpha α=.64) recording whether different types of age appropriate toys can be observed about the home.

At 36 months the home learning environment was assessed using the Home Learning Environment Index (HLE; Melhuish, Phan, & Sylva, et al., 2008a). The HLE index measures parental reports on the occurrence of seven activities that provide an obvious learning opportunity, such as visiting a library, singing nursery rhymes or playing with numbers and letters. The activities are each coded on a scale of 0-7 with 0 = not occurring and 7 = occurring very frequently with a possible HLE score ranging from 0 to 49 (Cronbach alpha α=.54).

Home environment data were used as part of the pilot study to assess concurrent and predictive validity of the ratings from the videotaped interactions. It cannot be ignored, however, that the internal consistency of these items is relatively low; therefore any assumptions drawn must be made with caution.

Childcare – timing of group-care uptake

The time in which children experienced group-based childcare was included as a confounding factor, previously found to be positively related to child cognitive and academic abilities (George et al., 2012; Melhuish et al., 2008a; Sammons, 2010; Sylva et al., 2010). Mothers provided information pertaining the age in which the child first experienced group care. These data was then transformed into a categorical variable according to the year in which group care was first experienced. The categories were coded as follows: Group care in the first year = 1; Group care from in the second year = 2; Group care from the third year onwards = 3.

4.3.2 Maternal characteristics

Maternal mental health

Mother psychological wellbeing was assessed at 10 months using the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). The EPDS is a self-report measure consisting of 10 items scored on a 4 point scale from 0-3, with higher scores reflecting more depressive symptoms (Cronbach α=.85). The EPDS had been validated in large community samples, showing acceptable sensitivity and specificity with both postpartum mothers and mothers of older children (Cox, Chapman, Murray, & Jones, 1996; Murray & Carothers, 1990). Just fewer than 10% (N=39) of the mothers scored above the validated cut-off of 13 (Matthey, 2008).

Maternal personality

Mother agreeableness was measured at 18 months using the NEO Personality Inventory (NEO-PI; Costa & McCrea, 1985). The agreeableness subscale of the NEO-PI consists of twelve Likert scale questions ranging from 1= strongly disagree to 5 = strongly agree (Cronbach alpha α=.73).The NEO-PI assessing five dimensions said to account for individual differences in personality traits (Costa & McCrae, 1992). This study includes agreeableness which is said to consist of six facets: trust, altruism, modesty, straightforwardness and tender-mindedness. Furthermore, this personality trait is likely to shape one's self-image and social attitudes (Costa, McCrae, & Dye 1991). Although conscientiousness was found to relate to maternal scaffolding behaviours in the past, this personality trait was not recorded by the FCCC team, and therefore is not included in the analyses.

Maternal attitudes

At 3 months mothers completed the Parental Modernity Scale (PMS; Schaefer & Edgerton, 1985), an instrument assessing parental attitudes towards child rearing. The PMS includes two subscales, traditionalism and progressiveness. The traditionalism scale consisting of 22 questions on a Likert scale ranging from 1 = strongly disagree to 5 = strongly agree, was used in this study (Cronbach alpha α=.87). Higher scores reflect more authoritarian attitudes towards education and child rearing.

Maternal scaffolding-like behaviours

Scaffolding-like behaviours presented by the mother were coded using both frequency counts, recorded in real time and general impression codes (range 0 to 3), completed at the end of each 2.5-minute play segment. For frequency counts a new episode was coded after a 3 second gap or at the start of a new sentence. Frequency counts were converted into codes ranging from 0-3 (0=behaviour not observed, 1=limited presentation of behaviour, 2=moderate presentation of behaviour and 3=behaviour presented substantially) to correspond with the general impression codes with the specific number attached to each code based on the frequency distributions observed. The behaviours coded corresponded with the four central dimensions of scaffolding: cognitive support, transfer of responsibility (promotion of autonomy), emotional support and contingent response (see Appendix A). Out of the 400 videotaped mother-infant interactions, 10% (N=40) were double coded to achieve reliability. The same second rater, with whom reliability was achieved on 10% of the sample, coded a further 14% (N=56) of the sample. The remaining interactions were coded by RM. Intraclass correlations for the composite measures of each behavioural code (individual behaviours from the three play segments summed) are provided.

Cognitive support - Following Ware, Brady, O'Brien and Berlin (2000) coding scheme of the three-bag assessment with Early Head Start mothers and their 14 months old infants, mothers' use of language aimed at enhancing infants' cognitive and language development was recorded as frequency counts of: labelling or basic descriptions of objects or situations; asking questions; elaborating on the properties and/or the 'solution' to the toy; making connections to infant (assumed) existing knowledge and using complex vocabulary. Frequency counts alongside the type of verbalisation were considered before being converted into codes ranging from 0-3 per play segment (0=

none; 1= 1- 4 episodes; 2= 5-9 episodes and at least 3 different types of behaviours; 3= 10 ≤ episodes of cognitively stimulating language of at least four different types of behaviours). A mother was considered consistently stimulating if she presented a range of informative and lexically rich task-related statements. For example, while playing with the ring-stacking toy a mother named the ring colours and asked a couple of questions, the frequency of utterances may have been in the excess of 4 episodes yet this would warrant a code of 1 as mother presented two out of the possible five language-based behaviours under investigation. The summed item including cognitive support from each of the three play segments ranged from 0-9 (mean=4.83; SD=1.73), and ICC=.86.

Promotion of autonomy – Based on Bernier (2010) the use of language designed to encourage the infant to complete the task without further maternal intervention was recorded. Frequency counts (using the same definition of an episode as for cognitively stimulating language) were converted into codes, on the basis of distributions, and ranging from 0-3 per play segment (0= none; 1= 1episode; 2= 2-3 episodes; 3= 4 ≤ episodes of use of autonomy promoting language). Examples include "Now it's your turn"; "try to fit the shape/ring yourself"; "mummy will show you how to do it and then you have a go". The collapsed codes of autonomy promoting language for all play segments ranged between 0-9 (mean=3.92; SD= 2.62) and ICC=.88.

Emotional support – the frequency of maternal positive emotional expressivity was recorded. This behavioural code was coded for separate investigation (Malmberg et al., 2007) and used in this study to reflect maternal emotional support. Frequency counts were converted into codes ranging between 0-3 (0= none; 1= 1 episode; 2= 2 episodes; 3= 3 ≤ episodes in which mother presented positive emotional expressivity). The summed codes for emotional support ranged between 0-9 (mean=2.72; SD=2.48).

Contingent response - After each play segment, maternal contingent responses to the infant's cues, body language and verbalisations were coded using general impression codes ranging from 0 to 3. The extent to which the mother looked at the infant's face in response to his/her utterances and actions, reciprocated infant's verbalisations and physical cues, and generally monitored child activity responding in a contingent manner was recorded in similar manner to Landry et al., (2006). Following Fuligni and Brook-Gunn (2013) work with the three-bags assessment, behaviours considered non-contingent were, intrusiveness, failure to reciprocate to infant's cues and address infant's mood, and generally having an adult-centred focus on the task. Contingent response codes ranged between 0-3 (0= maternal response non-contingent throughout; 1= maternal contingent response seen less frequently than non-contingent response; 2= maternal responses are mostly contingent; 3= mother consistently responds to infant in a contingent manner). The summed codes of contingent response for the three play segments ranged between 3- 9 (mean=7.12; SD=1.76) and ICC=. 85.

4.3.3 Infant characteristics

Infant temperament

Mothers were asked to describe their infant's temperament at 10 months by completing the Infant Characteristics Questionnaire (ICQ; Bates, Freeland, & Lounsbury, 1979). Mothers reported on the infant's (un)sociability answering four questions such as 'How much does your baby enjoy playing games with you?' on a 1-7 Likert scale with 1='A great deal, really loves it' and 7='Very little, doesn't like it very much'. A lower score reflects a less sociable baby (Cronbach alpha α=.58).

Infant advanced object play

The extent to which the infant was engaged in advanced object play was coded in 15 x 10-second intervals for the ring-stacking and shape-sorting play segments. Infant play was recorded separately from maternal behaviours using a coding system broadly based on Bigelow, MacLean and Proctor (2004). Bigelow and colleagues measured 'functional play' translated here to 'constructive play' (see Appendix A – Figure A.2 and Appendix C section C.2). This type of play was recorded when infants were using the play pieces in the conventional manner attempting or managing to complete the task (e.g. removing/ restacking hoops; putting the correct shape in its corresponding slot). Each 10-second interval, in which the infant showed advanced play was coded as 1; if infant was engaged in exploration, was directed by the mother or did not engage in play, a code of 0 was given. A measure of infant 'advanced object play' was then created by calculating the proportion of 10-second intervals in which infants presented 'constructive play' out of the thirty 10-seconds segments observed with a possible range between 0-1. Infant advanced object play ranged between 0-.87 (mean= .15; SD= .13). A second rater double coded 5% (N=20) of the sample for reliability purposes. Intraclass correlation for the aggregated infant advanced object play was ICC=.83.

4.3.4 Child cognitive abilities and academic achievement - Outcomes

At 18 months infant developmental assessments were conducted using the Bayley II Mental Development Index ([MDI] BSID-II; Bayley, 1993). The MDI consists of two subscales, the motor scale and the mental scale. It aims to evaluate young children's sensory-perception problem solving, early language development, knowledge and memory (Lowe, Erickson, Schrader, & Duncan, 2012). The third and most recent version of the MDI (MDI III) was not available at the time the study was conducted.

At 51 months children's cognitive abilities were assessed with the British Ability Scales (BAS II; Elliott, Smith & McCulloch, 1996). The BAS II is associated with the Horn-Cattell theory of structure of human cognitive abilities. It attempts to ensure fairness in order to be representative of contemporary British society (Elliott et al., 1996), and is compatible with current understanding of applied psychological practice (Hill, 2005). The BAS II includes a battery of subscales individually interpretable; for the purpose of this study four sub-scales were used, divided into verbal and non-verbal ability, and treated as separate outcomes. Verbal ability at 51 months was the aggregated and averaged values of verbal comprehension and naming vocabulary subscales. Non-verbal ability at 51 months was the mean of pattern construction and picture similarities subscales. The BAS data were aggregated taking a similar approach to that taken by Barnes and Melhuish (2016).

Key Stage 2 test are taken nationally at the end of primary school when children are aged 11 in English, maths and science. Children in this sample took the KS2 tests between 2009 and 2011, in 2010 science KS2 tests were discontinued and therefore only maths and English results are taken into account in this study. Marks are standardised and range between 0 and 5; pupils are expected to achieve a level 4 or above by the end of KS2 (NPD KS2 user guide). Maths and English Key Stage 2 (KS2) results were obtained from the National Pupil Database (NPD) in the Department for Education after matching with their Pupil Identification number by date of birth, gender and most recent postcode. Scores were received for 653 of the FCCC participants, and 311 for the selected 400. For comparison between the sub-sample participants with and without KS2 results see Table 4.3.

The comparisons between those for whom KS2 tests were provided and those who did not, revealed group differences only in terms of levels of maternal education [x^2 (1)

= 5.75; *p*= .017], and timing of group care uptake [x^2 (2) = 11.27 *p*= .004]. Children born to more educated mothers (university degree and above) were less likely to have KS2 results provided compared to those whose mothers had less educational qualifications. In relation to childcare experience, children who attended group care in the first year were less likely to have KS2 results provided compared with children who began group care in later stages of the preschool years. The differences found in relation to maternal levels of education are somewhat strange as more often than not, information for those who experience higher levels of disadvantage is missing. However, as child KS2 data was matched based on the family's postcode, it may suggest that children of more educated mothers came from more 'mobile' families- meaning that these families may have had the financial capacity to move to different areas and therefore data for these children could not be match. It is also possible that some of the children whose mothers were more educated were attending private schools, thus information pertaining their educational attainment was not provided (KS2 data was provided for maintained schools only). Differences were not observed for child gender, maternal age, ethnic background, English as first language, family composition and size, or home and neighbourhood adversity.

Table 4.3: Comparison between participants from the selected subsample of 400 for whom KS test results were received and those who KS2 could not be provided (mean scores with SD in brackets or numbers of participants with percentages in brackets)

	KS2 Received	KS2 Not received	Difference
Variables	N=311	N=89	*P*
Child			
Gender female (%)	154 (76.6)	47 (23.4)	*n.s.*
Gender male (%)	157 (78.9)	42 (21.1)	
Mother Characteristics			
Mean maternal age	30.81 (5.25)	31.24 (5.40)	*n.s.*
Maternal education			
Less than university degree (%)	182 (82.4)	39 (17.6)	*.017*
Bachelors or higher degree /professional qualification (%)	128 (72.3)	49 (27.7)	
Maternal ethnic minority status			
Not Minority (%)	253 (78.3)	70 (21.7)	*n.s.*
Minority (%)	58 (75.3)	19 (24.7)	
Maternal first language			
English (%)	290 (78.0)	82 (22.0)	*n.s.*
Not English (%)	21 (75.0)	7 (25.0)	
Residing with partner			
Yes (%)	284 (78.5)	78 (80.5)	*n.s.*
No (%)	27 (29.5)	11 (8.5)	
Family SES			
Working (%)	78 (24.9)	17 (19.5)	*n.s.*
Intermediate (%)	58 (18.5)	15 (17.2)	
Professional/Managerial (%)	177 (56.5)	55 (63.2)	
Contextual Factors			
Mean adverse home environment[d]	.80 (1.14)	.94 (1.30)	*n.s.*
Neighbourhood poverty	29.88 (17.01)	30.86 (16.82)	*n.s.*
First-born (%)	160 (77.7)	46 (22.3)	*n.s.*
Siblings (%)	151 (77.8)	43 (22.2)	
Group care – First year (%)	36 (62.1)	22 (37.9)	*.004*
Group care – Second year (%)	42 (87.5)	6 (12.5)	
Group care – Third year onwards (%)	233 (79.3)	61 (20.7)	

4.4 Analytic strategy

4.4.1 Pilot study – see Chapter 5

A pilot study was conducted to ascertain the reliability and validity of the observation scheme used to assess maternal scaffolding behaviours. Given the small sample size (N=51) an exploratory Principle Component Analysis (PCA) was carried out in IBM SPSS 22 to establish the number of possible underlying factors and the degree to which each item loaded onto a specific latent factor. Intraclass correlations were carried out to assess inter-rater reliability. To confirm the instrument's convergent (interrelated, or theoretically similar) and discriminant (theoretically distinct) and predictive validity, the instrument was tested against previously collected measures of related constructs. To achieve this, bivariate correlations and one-way Analysis of Variance (ANOVA) were carried out in IBM SPSS 22 to ascertain its convergent, discriminant and predictive validity.

4.4.2 Maternal Scaffolding behaviours: Factor structure – see Chapter 6

The first research question, 'Can maternal scaffolding behaviours in infancy be treated as one overarching factor?' was addressed in chapter 6. A confirmatory factor analysis (CFA) was carried out in Mplus version 7.3 (Muthén & Muthén, 2012) to explore whether the factor structure based on the data collected in the main study were compatible with preliminary factor structure based on data collected in the pilot study. As a first step, a CFA was performed treating the behavioural code score from each play segment as a separate indicator, expected to load onto a latent factor representing overall observed behaviour. As the interactions included three different toys likely to present variability in mothers' behaviour (Malmberg et al., 2007; Yont, Snow, & Vernon-Feagans, 2003), this process aimed at addressing any possible qualitative differences between book-reading and toy play activities. Once factor structure was assumed, a model including first and second order factors was specified, with maternal behaviours as the first order factors and scaffolding-like behaviours as the second order factor.

All parameters hypothesised to load onto the latent factors were freed and latent factors means and variances were fixed at 0 and 1 respectively. This procedure was carried out so that analyses would yield an optimal value along with other model estimates, reducing differences between predicted and observed variance-covariance matrices (Brown & Moore, 2012). Since the items included in the CFA were categorical, the WLSMV estimator was used. This estimator is said to best suited for factor analysis with categorical data (Brown, 2006), employing a robust weighted least squares estimator using a diagonal weight matrix (Muthén & Muthén, 2012). The weighted least squares method is thought to increase computational speed, when numerical integration becomes more demanding, due to increases in factors and sample size (Byrne, 2013).

To assess the goodness of fit of the model chi-square statistics, root mean square of approximation (RMSEA), the comparative fit index (CFI), and the Tucker Lewis Index (TLI) are taken into account. It is expected that the chi-square statistic will be non-significant to reflect a well-fitting model (Byrne, 2013). A caveat is that this may not be the case given the size of the sample. According to Kenny (2014) the chi-square test is sensitive to sample size; in samples larger than 400 the chi-square value is nearly always significant. The RMSEA determines how well the model fit the sample data (Byrne, 2013); a value of 0.05 or less reflects a good fit, a value of up to 0.08 is an acceptable fit, whereas fit values between 0.08-0.10 are mediocre. RMSEA values of over 0.10 reflect a poor fit (Browne & Cudeck, 1993). Both CFI and the TLI measure model fit improvement, by comparing a less restricted baseline model with the hypothesised, structured model. CFI is a normed measure, its values ranging between 0-1, values closer to 1 represent better fit, 0.95 being the cut-off figure (Hu & Bentler, 1999). TLI is the non-normed measure; its values can be extended beyond the 0-1 range. Similarly to CFI, TLI closer to 1 (>0.95) reflect better model fit. It is noteworthy that TLI is penalised by model complexity (Byrne, 2013).

To ascertain whether in subsequent analyses scaffolding-like behaviours could be treated as one continuous item a Factor Mixture Analysis (FMA) was carried out in Mplus 7.3 (Muthén & Muthén, 2012) on the extracted first order factors. FMA is a 'hybrid' type model incorporating both factor analysis (FA) and latent class analysis (LCA) (Muthén & Asparouhov, 2006). Factor analysis, or latent trait analysis in this instance as the indicators are categorical in nature, provides a dimensional representation of the data by creating continuous factor scores representing a latent underlying construct. This method however, ignores the heterogeneity between individuals within the sample and is not concerned with categorising individuals on the basis of the presentation of particular behaviours. On the other hand, LCA allows for the classification of individuals into meaningful groups under the assumption of conditional independence between the items included in the analysis. According to Muthén and Asparouhov (2006), the assumption of independence is often violated, as factors are likely to vary within classes. A hybrid model or FMA can therefore be used when variations within classes occur (Muthén & Asparouhov, 2006), and in situations where a CFA was carried out and the LCA is the performed on the factors drawn from the factor model (Lubke & Muthén, 2005).

Goodness of fit was evaluated by three different indices. First the models' Bayesian Information Criterion (BIC), a measure combining the model's log likelihood value and number of parameters (Muthén & Asparouhov, 2006) was assessed. A lower BIC value is preferred (Lubke & Muthén, 2005) and a decrease by more than 10 between models can be used as evidence of preferring one model to another (Raftery, 1995). A second index was entropy; a measure of the mixture model classification specificity, ranging between 0-1 was taken into account. An entropy value nearing 1 reflects a clearer delineation of latent classes (Celeux & Soromenho, 1996) and according to Muthén (2008) an entropy value lower than 0.8 could be considered problematic. Finally the Voung-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR) was employed; a test aimed at evaluating whether extracting one less class will result in a worse fitting model. The VLMR compare the model including K classes to K-1 classes; if the results are significant it is suggested that a model containing one less class reflects a significantly worse fitting model. In SPSS 22, one-way ANOVAs tested whether significant differences in maternal scaffolding can be observed as a function of the extracted latent classes.

4.4.3 Individual differences in scaffolding behaviours – see Chapter 7

Chapter 7 addresses the second research question, 'Which individual characteristics of mother, child and context predict maternal scaffolding behaviours?' Building on the findings from the previous chapter, it was confirmed that maternal scaffolding-like behaviours could be treated as one higher-order continuous variable. In SPSS 22, bivariate correlations were carried out between maternal scaffolding-like behaviours factor, child, mother and contextual factors. Mean comparisons were performed for binary variables.

Once associations were established, multiple regression models predicting maternal scaffolding behaviours were carried out. Variables found to significantly relate to maternal scaffolding behaviours at the $p \leq .05$ were entered into a multivariate regression model using the ‘Stepwise procedure’ carried out in 4 steps, replicating the procedure used by Bornstein, Hendricks, Haynes and Painter (2007). The order of the regression steps was based on Mulvaney et al.’s (2006) analyses of the predictors of individual differences in scaffolding. In the first step (model 1) infant characteristics (infant advanced object play) were entered. Step two (model 2) included maternal characteristics: demand characteristics (age, ethnicity and mother tongue), force characteristics (personality, attitudes) and resource characteristics (education and mental health) were entered. In the third step (model 3) contextual factors were taken into consideration (adverse home environment, family size and neighbourhood poverty). The fourth regression model included simultaneous entry of variables found to relate to maternal scaffolding behaviours at the $p \leq .10$, in models 1, 2 and 3.

Due to missingness in the data on two of the predictor variables (maternal mental health and personality characteristics), multiple imputation were performed and the multivariate regressions were repeated to establish whether missingness introduced bias to the analyses (see section 4.6 for details of imputation process).

4.4.4 The relevance of maternal scaffolding to child cognitive abilities – see Chapter 8

The third research question ‘Do maternal scaffolding behaviours at 10 months predict child cognitive ability in the preschool years?’ was addressed in Chapter 8. Cognitive ability was assessed at 18 months, and verbal and non-verbal ability at 51 months. First associations between outcome variables, scaffolding-like behaviours and covariates, found to significantly predict maternal scaffolding behaviours in chapter 7, were tested using bivariate correlations for continuous items and mean comparisons for binary items.

On establishing associations between outcome and predictor variables, multivariate regression analyses (for each of the four outcomes) using the 'Stepwise procedure' in SPSS22 were performed. The order in which the regressions were entered was based on Mulvaney and colleagues (2006) model specification in which scaffolding was entered after child and mother characteristics to ascertain whether such behaviour predicted subsequent child development, over and above person characteristics. Context characteristics were then considered to explore whether the findings can be explained in more broadly in a socio-demographic context (see Mulvaney et al., 2006). In model 1 child characteristics were entered; model 2 included maternal characteristics; in model 3 scaffolding was added to the analyses and in model 4 contextual factors were included. A simultaneous, fifth, model including only variables found to relate to cognitive ability at the $p \leq .10$, in models 1, 2, 3 and 4 was calculated last.

As in chapter 7, the procedure performed by Bornstein and colleagues (2007) was replicated in this instance. Only variables found to significantly relate to maternal scaffolding behaviours at the $p \leq .05$ were entered into the multivariate model. The simultaneous model including variables found to relate to child cognitive ability at the $p \leq .10$ in prior steps were included. In instances where scaffolding-like behaviours were found to predict child cognitive ability above and beyond person and context characteristics, interaction terms were added to the model to test for possible mediation. Interaction terms were calculated by mean centring the variables of interest, then multiplying these items to reflect an interaction and to avoid possible issues with collinearity (Aiken & West, 1991).

4.4.5 The relevance of maternal scaffolding-like behaviours to child academic attainment at age 11 years – see Chapter 9

The final research question: 'Are maternal scaffolding behaviours in infancy relevant for predicting child academic attainment at age 11 years?' was addressed in Chapter 9 by constructing a full structural equation model (SEM) in Mplus 7.3 (Muthén & Muthén, 2012). First associations between child academic attainment at age 11 and maternal scaffolding-like behaviours and relevant covariates were assessed. Mean comparisons were performed for categorical variables.

On establishing associations between study covariates and English and maths attainment a structural model was specified. The model was specified in a stepped manner. In the first step, child, mother and context characteristics found to be associated with KS2 results were modelled as exogenous predictors of maternal scaffolding-like behaviours. In the next step, paths were specified between maternal scaffolding-like behaviours and child non-verbal ability at 51 months reflecting findings reported in chapter 8. Academic attainment was added to the model next, testing for direct and indirect effects. Once the final model was specified a final confounding factor was assessed. The possible effect of group-based-care was added in the final step to test its unique contribution to child academic attainment.

Model fit statistics were assessed according to the criteria specified in section 4.4.2 of this chapter. To remind the reader: RMSEA <.05; and CFI and TLI values closer to 1 (>0.95) (Byrne, 2013).

4.5 Attrition

As previously mentioned, 1201 mothers were seen at the 3 months postpartum for the FCCC study. In the subsequent wave of data collection at 10 months 1077 families took part and 1049 families did so at 18 months. At 36 months 1016 families were included in the study and at 51 months 1041 families were included. According to Stein et al. (2013) following an initial attrition between 3 and 10 months almost 95% of families included in the study were seen at least three out of the four remaining data collection waves concluding that attrition in the FCCC showed a similar pattern to that seen in UK-based cohort studies (see Schoon et al., 2002).

Bias can be introduced to the data due to attrition potentially affecting findings (Uhrig, 2008). Smith, Eryigit-Madzwamuse and Barnes (2013) found significant differences in family SES, maternal age and maternal mental health between FCCC families in which fathers did or did not provide information at 51 months. To test for any bias from including only families with data at 51 months assessment wave they were compared to those not seen on key demographic characteristics (see Table 4.4).

There were significant differences between families who remained in the study and those who were lost due to attrition at 51 months (see Table 4.4). Older mothers were more likely to remain in the study [t(1197)=2.93, *p*=.003], mother with white British background [x^2 (1) = 14.77; *p*< .001] and mothers who spoke English as a first language [x^2 (1) = 58.54; *p*< .001]. Likewise mothers not remaining in the study were more likely to be working class [x^2 (2) = 19.31; *p*< .001], but no difference was identified based on their education. Contextually, those remaining in the study had less environmental adversity in their home [t(198.691)= 5.62, *p*<.001] and neighbourhood [t(1197)= 3.56, *p*<.001].

Table 4.4: Comparison between families seen at 51 months and families not seen at 51 months

	Families seen at 51 months	Families not seen at 51 months	Difference
Variables	N=1041	N=160	*p*
Child			
Gender female (%)	523 (50.2)	80 (50)	*n.s.*
Gender male (%)	518 (49.8)	80 (50)	
Mother Characteristics			
Maternal age	31.18 (5.26)	29.87 (5.23)	*.003*
Maternal education			
Less than university degree (%)	533 (51.2)	95 (59.3)	*n.s.*
Bachelors or higher degree /professional qualification (%)	503 (48.8)	64 (40.7)	
Maternal ethnic minority status			
Not minority (%)	841 (80.8)	108 (67.5)	*.001*
Minority (%)	200 (19.2)	52 (32.5)	
Maternal first language			
English (%)	929 (89.2)	107 (66.9)	*.001*
Not English (%)	112 (10.8)	53 (33.1)	
Maternal employment status			
Working (%)	395 (37.9)	86 (53.8)	*.001*
Intermediate (%)	189 (18.2)	32 (20)	
Professional/Managerial (%)	457 (43.9)	42 (26.2)	
Residing with partner			
Yes (%)	943 (90.6)	142 (88.8)	*n.s*
No (%)	98 (9.4)	12 (11.3)	
Contextual Factors			
Adverse home environment	.84 (1.15)	1.46 (1.31)	*.001*
Neighbourhood poverty	28.81 (16.89)	33.98 (18.02)	
First-born (%)	532 (51.1)	84 (52.5)	*n.s.*
Siblings (%)	509 (48.9)	76 (47.5)	

4.6 Missing data – data imputation

There are two scenarios by which attrition (made manifest through missing data), from large longitudinal studies may affect the outcomes of interest. First, decreases in sample size may cause a reduction in the accuracy of estimates derived from the sample. Second, reasons for missingness may be associated with the outcomes of interest, introducing possible bias to the analyses (Fitzgerald, Gottschalk, & Moffitt, 1998).

According to Schafer (1997) there are three types of missing data described in the literature: (1) missing completely at random (MCAR) - data missingness is truly arbitrary and not associated with the measured variables. This means that any missingness in MCAR does not introduce bias to analyses. MCAR pattern is very unlikely to occur in social research. (2) Missing at random (MAR) – data are said to be MAR when the probability of missing data on a particular variable is not associated with its value once other factors included in the analyses are controlled for, as is the case in this investigation. (3) Not missing at random (NMAR) – missing values are not arbitrary, depending on other unobserved variables.

Multiple imputation (MI) is designed to address the possible pitfalls of missing data. Introduced by Rubin (1987) it aims to compensate for missingness by generating possible values for the missing values, creating several 'complete' datasets. By creating multiple sets of data the uncertainty involved in imputing for a single dataset is avoided.

MI is based on the assumption that data are missing at random (MAR), presuming that a missing value can be computed for an individual based on the observed data (Schafer, 1997). MI creates multiple datasets that are differently imputed, based existing values on other variables. The variations between the produced values in each of these datasets are then examined, and the results are combined using Rubin rules (1987) to produce overall estimates that take account of the possible sampling variation and uncertainty in the data (Rubin, 1987; Schafer, 1997).

Although the sample participants were selected on the basis of having complete data at 10 and 51 months, a considerable proportion of information was missing for mothers' mental health and personality at 10 and 18 months respectively reducing the sample size by 25%. To compensate, and ensure that the missingness in the data did not bias the results, multiple imputations were carried out on the missing variables when performing analyses such as multivariate regressions, affected by reductions in sample size.

To establish the pattern of missingness two procedures were carried out. The first was the Little MCAR (missing completely at random) test. If the Little MCAR significance level is $<.05$ the data is likely to be 'missing at random' (MAR) or 'not missing at random' (NMAR) (IBM SPSS 22, 2013). Next, mean comparisons and Chi-Square tests were performed, by creating two dummy variables representing observed and missing values for the two items on which missingness occurred. For the data to be MCAR no differences between the observed and missing groups should be found. The mean comparisons revealed some significant differences between the observed and missing groups, suggesting that the data is not MCAR but MAR as some of the missingness was associated with other observed variables.

Once the pattern of missingness was established, multiple imputations were performed in SPSS 22. Rubin (1987) and Schafer (1997) suggested that in order to impute a sufficiently general model, as many variables as possible should be included in the analyses even if these are not part of subsequent analyses. To produce a more accurately imputed datasets, in addition to study's explanatory and outcome variables, the following items not included in any of the analyses were used in MI model:

paternal SES, education and mental health at 3 months, and maternal mental health at 3 and 36 months, mothers' and fathers' reports of dyadic marital adjustment at 3 and 10 months and home observation data collected at 10 and 36 (see Appendix D, Table D.1 for information about missing data pattern and Table D.2 for information about variables used in creating the imputed datasets). This analysis yielded five complete datasets in which the missing values for the abovementioned items were computed. These datasets were then used in subsequent analyses that included these items as predictors.

CHAPTER 5: PILOT STUDY

5.1 Overview of analysis strategy

The following chapter presents the results of a study undertaken before carrying out the main study, aimed at piloting and validating the observation scheme and establishing inter-rater reliability, with 51 mother-infant dyads not part of the main study. The chapter is structured as follows: first item selection for maternal behaviours including the results of Principle Component Analysis (PCA), then inter-rater reliability and tests of discriminant, convergent and predictive validity of the observation scheme and refinement of codes for infant observed behaviours.

5.2 Item selection

The variety of possible maternal scaffolding-like behaviours was identified in an unpublished exploratory study with a sample of 101 mothers from the FCCC sample (Mermelshtine, 2012). In that study, maternal behaviours in two out of the five play segments, book and shape sorter, were coded using binary variables (yes/no); 18 behaviours in the former and 22 behaviours in the latter (see Appendix B, Table B.1 for Mermelshtine, 2012, coding scheme). A PCA identified four factors for each play-segment. For the book activity they were labelled: restriction, physical explanation, communication and positive feedback. For the shape-sorting activity the four factors were labelled: communication, explanation, specific task features and assistance (see Appendix B, Tables B.2 and B.3 for rotated factor scores). The study was limited in that behaviours were described only once on the basis of their presentation in the play segment; the frequency with which the behaviours occurred was not taken into account. Nevertheless, the study provided a descriptive account of the behaviours taking place within the videotaped interactions at 10 months.

Informed by this exploratory work, and existing literature (Neitzel & Stright, 2003, 2004; Wood et al., 1976) the item selection was refined to create a list of behaviours that could be generalised to other typical play situations. Nine behaviours were defined, corresponding to the four central tenets of scaffolding: cognitive support; transfer of responsibility; contingency; and affective support. The behaviours were: (1) *Cognitive stimulation* = asking questions requiring expansive answers, elaboration, use of complex vocabulary and making connections using information already known to the infant; (2) *Structure* = structuring the interaction in a sensible sequence and around the infant's abilities; (3) *Attention maintenance* = mothers' efforts to maintain the infant's attention to the task and its completion; (4) *Demonstration* = demonstrating and providing verbal explanation for carrying out the task; (5) *Physical instruction* = mother physically instructing infant; (6) *Positive regard* = mothers use of positive emotionally expressive language; (7) *Autonomy promoting language* = the frequency to which mothers used language promoting transfer of responsibility; (8) *Responsivity* = maternal response to infant cues and behaviour in a contingent manner; (9) *Frustration control* = providing comfort when infant appears frustrated. Table 5.1 presents how items are hypothesised to load onto each construct. Codes were on a 4-point Likert scales, based on the extent to which the behaviours were seen, ranging from 0-3; 0 = none; 1 = limited presentation of behaviour; 2 = moderate presentation of behaviour; 3 = substantial presentation of behaviour (see Appendix B, section B.1 for coding scheme and manual). Definitions of the number of observed occurrences of behaviours to meet each code were based on relative distributions per behaviour.

Table 5.1: Maternal Behaviours hypothesised to load onto each of four scaffolding-related constructs

Constructs			
Cognitive Support	**Emotional Support**	**Transfer of Responsibility**	**Contingency**
Demonstration	Frustration control	Physical instruction (less)	Responsivity
Cognitive stimulation	Positive regard	Autonomy promoting language	Attention maintenance
Structure			

Maternal behaviours were coded for each play segment separately. A mean composite per behaviour was then created, based on the codes from each of the three play segments. One item – 'frustration control' in the pilot coding had no variance and was removed from any further analyses. The remaining 8 behaviours were then correlated with each other to explore their associations in preparation for the Principal Components Analysis (see Table 5.2). Due to the high inter-correlation between 'Attention maintenance' and 'Responsivity' – the former was removed from further analyses. The decision to remove this item was further supported by personal communication with S. Hammond (May 2013) who commented that the definitions of responsivity and attention maintenance are qualitatively similar, the former being a higher order description of the latter.

Table 5.2: Bivariate correlations between 8 maternal coded behaviours, with means and standard deviations (N=51)

	1	2	3	4	5	6	7	8
1. Cognitive stimulation								
2. Structure	.73**							
3. Demonstration	.69**	.81**						
4. Physical input	-.08	.26	.27					
5. Positive regard	.22	.27	.27	.18				
6. Autonomy promoting language	.67**	.77**	.80**	.29*	.45**			
7. Attention maintenance	.70**	.78**	.56**	.11	.30*	.60**		
8. Responsivity	.72**	.64**	.50**	-.21	.23	.52**	.84**	
Mean	1.70	2.19	1.71	.71	.83	1.90	2.18	2.23
SD	.79	.72	.76	.72	.96	.81	.78	.76

* $p<.05$ **$p<.01$

5.3 Principal component analysis

It was hypothesised that the behaviours coded will load onto four constructs: cognitive support; transfer of responsibility; contingency; and emotional support, the hypothesised factor structure can be found in table 5.1. An exploratory principle component analysis (PCA) was carried out using oblique rotation, as the behaviours coded showed high inter-correlations (see Table 5.3) and extracted factors were not expected to be orthogonal to one another. The PCA revealed a 2-factor solution, accounting for 72.8% of the variance. The Keiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO=.78; considered good. Table 4.5 gives a summary of rotated factor scores. 'Physical instruction' had to be discarded as its anti-image correlation= .37, below the recommended .50 (Field, 2009). What is more, the factor loading for 'positive regard' item was well below the recommended .7 for a sample of this size (Field, 2009). Positive regard was removed from subsequent PCA and was treated as an individual observed item reflecting emotional support.

Table 5.3: Summary of first exploratory principle component analysis on 7 maternal behaviours yielding a two-factor structure (N=51)

	Rotated Factor Structure	
	1	2
Demonstration	.91	-.04
Autonomy promoting language	.91	-.01
Structure	.90	-.05
Cognitive support	.77	.50
Positive regard	.36	.02
Physical instruction	.23	-.92
Responsivity	.61	.62
Eigenvalues	3.71	1.39
% of the variance	53.04	19.78

In light of the finding from the exploratory analysis, a further PCA was carried out on the remaining 5 items (see Table 5.4 for rotated factor scores). The Keiser-Meyer-Olkin measure was KMO=.84; considered ‘very good’, and anti-image correlations for individual items were >.80; well above the recommended .50 (Field, 2009). Bartlett’s test of sphericity x^2 (10) = 186.56; p<.001, indicated that correlations between items were sufficiently large for PCA. One factor was extracted, having an eigenvalue larger than the Keiser criterion of 1, including all items and accounting for 73.57% of the variance. Reliability analysis revealed a Cronbach’s Alpha of α=.91 for the six items.

Table 5.4: Summary of exploratory principle component analysis of maternal behaviours with 5 items, excluding physical instruction and positive regard items (N=51)

	Rotated Factor Loading
Demonstration	.89
Autonomy promoting language	.88
Structure	.88
Cognitive support	.86
Responsivity	.73
Eigenvalue	3.62
% of the variance	72.39
Cronbach α	.91

Coded behaviours were expected to form a four-factor solution, but in statistical terms the results of the exploratory PCA suggest that in this sample scaffolding-related behaviours were likely to form one factor, including aspects of cognitive support, autonomy promotion and contingency. The behaviours observed were highly inter-correlated (see Table 5.2) which suggests that they all measure similar constructs. In the following sections tests of the instrument validity will be described, these will include the factor presented in Table 5.4 and the ‘positive regard’ item which represent emotional support to test its associations with child outcomes and similar constructs.

5.4 Inter-rater reliability

To address reliability a second coder was trained. In the initial step of the training the second coder was introduced to the observation scheme and both raters coded a number of videotaped interactions together until the second coder was competent enough to code independently. Next, nine randomly-selected cases, not included in the pilot study, were double coded. For eight out of the nine cases agreement ranged between 80 and 100 percent on all items. In cases where codes differed between raters, the videotaped interactions in question were re-watched and codes discussed until agreement was achieved.

Of the 51 mother-infant videotaped interactions included in the pilot study 43% (N=22) were coded by both raters. Composite measures were created per behaviour for the three play segments per rater. Intraclass correlations (ICC) were then calculated for the six items included in subsequent analyses: (1) Demonstration, ICC = .87; (2) Autonomy promoting language, ICC = .86; (3) Structure, ICC = .75; (4) Cognitive support, ICC=.93; (5) Responsivity, ICC = .69; (6) Positive regard, ICC = .92. All ICCs were in the acceptable range, demonstrating good reliability between the two raters (Fleiss & Cohen, 1973).

5.5 Tests of instrument’s validity

Once the factor structure and instrument’s reliability were ascertained, its predictive, concurrent/criterion and discriminant validity were tested.

5.5.1 Concurrent/criterion validity: Other measures of related behaviours

Concurrent validity was addressed, comparing the extracted factor 'scaffolding-like behaviours' and 'positive regard' (labelled from this point 'emotional support') scores with other, well-established measures associated with the same or similar constructs. The scores were correlated with home visitors' observations at 10-months using the Home Observation for Measurement of the Environment Inventory (HOME; Caldwell & Bradley, 1984) (the same time the interactions between mothers and infants were videotaped) and with the Home Learning Environment Index (HLE; Melhuish et al., 2008a) completed by researcher interview at 36 months (see Table 5.5). Maternal scaffolding-like behaviours at 10 months were significantly associated with all home environment constructs and in particular the 36 month HLE, suggesting that mothers who were more didactic and contingent in their interaction with their 10-months-old infants were likely to expose their 3-years-old children to a more educationally rich environment. Emotional support was associated with the HOME emotional and verbal responsivity, and marginally so with the HLE at 36 months.

Table 5.5: Bivariate correlations between maternal behaviours and measures of the home environment at 10 and 36 months (N=51)

	Scaffolding-like behaviours	Emotional Support
Emotional and verbal responsivity [a]	.40**	.45**
Provision of appropriate play materials [a]	.42**	.09
Home learning environment [b]	.51**	.28†

[a] Scale from the Home Observation for Measurement of the Environment at 10 months (Caldwell & Bradley, 1984)
[b] Total Home Learning Environment (HLE) score at 36 months (Melhuish et al., 2008a).
†p<.10; *p<.05; **p<.001

5.5.2 Discriminant/ concurrent validity with family characteristics

To test whether differences in maternal scaffolding-like behaviours at 10 months were associated with socioeconomic background factors, one-way ANOVAs were conducted between socioeconomic classes (working, intermediate and professional) and maternal behaviour (see Table 5.6). A significant difference was observed in maternal scaffolding-like behaviours according to family social class [$F(2, 47) = 3.52$; $p = .038$]. Tukey post-hoc test showed a significant difference between working class and professional/managerial class ($p = .031$). Mothers in the latter group were likely to demonstrate more scaffolding-like behaviours in interaction with their 10-months old infants. Maternal emotional support was not related to social class [$F(2,46) = .34$; $p = .731$]. In the case of maternal education significant differences in scaffolding-like behaviours were not observed. An independent samples t-test revealed no significant difference between mothers who were educated to a degree levels (mean=2.02 SD= .65) and those who were not (mean=1.99, SD= .59) in the presentation of scaffolding-like behaviours [$t(44)=.14$, $p=.891$]. Likewise differences were not observed in mothers' emotional support as a function of maternal education [$t(43)=.35$, $p=.731$], degree and above (mean=.82, SD=.90), less than degree (mean=.92, SD=1.06). It is possible that coding maternal education in a binary way (less than degree vs degree) meant that there was less variability in the sample. It is acknowledged that the decision to treat maternal education as a binary variable may have masked actual differences in mothers' propensity to scaffold.

Table 5.6: One-way analysis of variance between family socioeconomic classes and extracted maternal behaviour factors; means and standard deviations in brackets (N=51)

Group	Scaffolding	Emotional Support
Working Class N=10	1.51 (.69)	.70 (1.10)
Intermediate N= 6	2.07 (.66)	1.11 (.89)
Professional/Managerial N=32	2.09 (.58)	.82 (.94)
Post-hoc comparison	Work<Prof	
F	3.52*	.34

Note: Post hoc comparison – Tukey test
Work = working class; Prof= professional/managerial class
*$p<.05$

4.5.3 Discriminant and predictive validity with child outcomes

The hypothesis that maternal scaffolding-like behaviours in interaction with 10-months-olds could predict children's subsequent cognitive abilities and academic attainment was tested. The extracted scaffolding factor and the emotional support item were correlated with cognitive development assessed at 18 months (Bayley MDI). Children whose mothers showed more scaffolding-like behaviours at 10-months were likely to be more cognitively developed at 18 months (see Table 5.7).

To test whether maternal scaffolding-like behaviours could discriminate between BAS defined cognitive ability groups at 51 months a one-way ANOVA was carried out (see Table 5.8). Groups differed significantly in maternal scaffolding behaviours [$F(2,45)= 3.87$; $p=.028$] with a significant difference between the high and low groups demonstrated by a Tukey post-hoc test. Mothers of children in the high ability group demonstrated more scaffolding-like behaviours in infancy ($p=.024$). Significant group differences were not observed for maternal emotional support [F (2, 2.29) = .35; p=n.s.].

Since homogeneity of variance was not assumed for emotional support, the Welch test F statistic is reported and additional comparison based on the Kruskal-Wallis test yielded the same result.

To further test the instrument's predictive validity the scale was correlated with academic attainment at age 11 (KS2 English and maths) (see Table 5.7). Maternal scaffolding behaviours factor was associated with all outcomes whereas emotional support at 10-months did not correlate significantly with any of the outcome measures.

Table 5.7: Bivariate correlations between maternal behaviours and subsequent child cognitive ability and academic attainment (N=51)

	1	2	3	4	5
1. Scaffolding-like behaviours					
2. Emotional Support	$.33^{*}$				
3. Bayley MDI 18 months	$.39^{**}$	.08			
4. English KS2, age 11	$.33^{*}$	.08	$.50^{**}$		
5. Mathematics KS2, age 11	.28†	-.04	$.40^{**}$	$.78^{**}$	
Mean	1.97	.83	94.61	4.68	4.76
SD	0.65	.96	13.31	0.7	0.9

†*p*<.10; **p*<.05; ***p*<.01

KS2 – national standardised examination taken at age 11, at the end of primary school

Table 5.8: Results of one-way analysis of variance comparing mean maternal behaviour factors ability groups, standard deviations in brackets (N=51)

Cognitive abilities group	Scaffolding	Emotional Support
Low	1.67 (.69)	.70 (.91)
Average	1.90 (.62)	1.02 (1.22)
High	2.27 (.54)	.78 (.74)
Post-hoc comparison	L<H	
F	3.87*	.471

Note: Post hoc comparison – Tukey HSD test
L = Low cognitive abilities group; H = High cognitive abilities group
*p<.05

5.6 Infant object play

Infant play behaviour was as coded as follows: (1) no play- no engagement; (2) no independent play – guided by mother; (3) no independent play – infant observing mother; (4) exploratory play; (5) non-task related relational play; (6) constructive (end producing) play (see Appendix B, section B.2). The abovementioned behaviours were coded in 10-seconds intervals for two of the three play segments: ring-stacking and shape-sorting toys, as these can be considered to have an observed 'task solution'.

Infant object play definitions in relation to maternal scaffolding were conceived to describe the extent of 'constructive (end producing) play'. Infants who presented higher levels of constructive play behaviour (attempting or managing the task) were considered to demonstrate more advanced object play. Therefore, only item 6, describing infants' use of play pieces in the conventional/intended manner (e.g. removing/ restacking hoops; putting the correct shape in its corresponding slot) was eventually included in the analyses. Each 10-seconds interval was coded 0 or 1; a code of 0 given when infant was mostly engaged activities other than constructive play (items 1-5), and a code of 1 given when infant was mostly engaging in constructive play (item 6) attempting or managing to 'complete the task'. Scores ranged between 0 and .53; mean=.19, SD=.14, and item was labelled 'advanced object play'. Infant advanced object play significantly correlated with maternal scaffolding-like behaviours (r = .45; p = .001) and marginally so with maternal emotional support (r= .26; p= .082).

5.6.1 Tests of validity

Predictive validity of infant advanced object play was examined by correlating it with the outcome measures: cognitive abilities at 18 months. Infant functional play at 10 months was significantly and positively associated with Bayley MDI scores at 18 months (r = .32; p = .024).

A one-way ANOVA was performed to test whether infant play had discriminant validity up to 51 months. Findings suggest that infant advanced object play significantly discriminated between cognitive ability groups at 51 months [F (2, 50) = 8.38; p=.001]. Tukey post-hoc analyses revealed significant differences between high cognitive ability group (mean=.29, SD=.15) and both low (mean=.14, SD=.10) and average (mean=.14, SD=.11) ability groups. Higher levels of advanced object play were associated with more advanced cognitive development.

Finally, infant advanced object play was correlated with age 11 educational attainment outcomes. A near significant association was observed between higher maths KS2 scores at age 11 and more advanced object play at 10 months (r=.29, p = .058) whereas English KS2 scores were not significantly associated with 10 month infant play (r=.22, p = n.s.).

5.7 Summary of main findings

This chapter described the development of instruments to code maternal scaffolding-like behaviours and infant advanced object play in semi-structured play interaction when infants were 10-months-old. The pilot was based on 51 mother-child dyads made up three group defined by child of cognitive ability at 51 months: low, average and high.

1. A Principal Component Analysis revealed 1 factor reflecting maternal scaffolding-like behaviours including: cognitive stimulation, structure, demonstration, autonomy promoting language and responsivity, showing high internal consistency.
2. Good inter-rater reliability was established for coding maternal behaviour.
3. Maternal scaffolding-like behaviours were moderately associated with other instruments measuring similar constructs, supporting the instruments' concurrent and criterion validity.
4. The instrument successfully differentiated between groups defined by family social-class. Mothers from working-class families were likely to present less scaffolding-like behaviours than mothers whose families were identified as professional-class. These differences were not seen as a function of maternal education levels. Mothers who were educated to a university levels or above presented the same level of scaffolding as those who had fewer educational qualifications.
5. Maternal scaffolding-like behaviours at 10 months significantly discriminated between cognitive ability group memberships at 51 months. Children in the high ability BAS group were likely to have mothers who showed more scaffolding behaviours at 10 months.

6. The predictive validity of maternal scaffolding-like behaviours was further demonstrated by significant associations between maternal scaffolding and child cognitive abilities at 18 months and academic attainment at age 11.
7. Maternal emotional support (positive regard) was associated with similar measured constructs, yet it was not associated with child outcomes, suggesting that in this sample emotional support may be less meaningful to children's subsequent cognitive development.
8. Infant advanced object play predicted cognitive ability group membership. Those in the high ability group were likely to present more advanced play behaviours at 10 months in comparison to those of average and low cognitive abilities.
9. Infant advanced object play was associated with cognitive abilities at 18 months and marginally so with maths academic attainment at age 11.

CHAPTER 6: MATERNAL SCAFFOLDING BEHAVIOURS - FACTOR STRUCTURE

6.1 Overview of analysis strategy

Using the coding scheme presented in the previous chapter, the behaviours of 400 mother-infant dyads, randomly selected from the larger FCCC study, were coded. The same three play segments included in the pilot study were rated: book-sharing, ring-stacking and shape-sorting (see Appendix A for final coding manual and coding sheet). This chapter addressed the scaffolding proximal process in two stages. First, the dimensional representation of maternal scaffolding behaviours was tested, by conducting a confirmatory factor analysis (CFA). Next the possible heterogeneity existing between mothers in their presentation of the different elements of scaffolding-like behaviour was explored. By conducting a latent class analysis (LCA), it was made possible to group mothers according to different combinations of specific scaffolding-like behaviours. Performing both analyses addressed the first research question 'Can maternal scaffolding behaviours in infancy be treated as one overarching factor?'

6.1.1 Confirming underlying structure

1. The first stage of the analysis tested whether the behaviours presented in each play segment can be considered part of an overall underlying behaviour. By specifying each behaviour code per segment to load onto a 'general behaviour' latent factor, the six items covered in the pilot study were included: demonstration; autonomy promoting language; structure; cognitive support; contingent response (was referred to as responsivity in the pilot study); and emotional support. It is important to carry out this analysis as it has been suggested that book reading and toy play interactions elicit responses that could be qualitatively or quantitatively different (Yont et al., 2003).

2. Next, the factor structure of the observed behaviours was tested. The findings from the pilot study were that maternal contingent response, cognitive support, demonstration, structure and autonomy promoting language formed one factor, named ‘scaffolding-like behaviours’. Emotional support did not load onto that factor and was treated as a separate variable. Subsequent analyses treated the data similarly, testing whether in the larger sample emotional support remained separate or could be considered part of the overall ‘scaffolding-like behaviour’ factor. The latent factors extracted from the initial CFA were treated as first order factors, expected to load onto a second order factor representing maternal ‘scaffolding-like behaviours’.

6.1.2 Exploring heterogeneity and maternal typologies

1. A latent class analysis (LCA) was carried out on the first order-extracted factors. In each model the number of possible classes was changed; the first model testing the fit of the data in a 2-class solution, the second testing 3-class solution and so forth with the final model testing a 6-class solution. Fit indices per class solution were compared and a decision taken accordingly.

2. To validate the class solution a one-way ANOVA was carried out comparing maternal scaffolding behaviours by class membership..

6.2 Results of confirmatory factor analysis

Individual behaviour items from each play segment were hypothesised to load onto a factor reflecting the overall behaviour. Based on fit statistics, the hypothesised model did not fit the data well [x^2 (120) = 405.94, *p*< .001, RMSEA= .077, CFI=.906, TLI=.881] and could not be interpreted on the basis of scaffolding theory. A problem was identified with the 'structure' and 'demonstration' latent factors. It was found that the correlation between these items was greater than one, suggesting that the model is inadmissible necessitating re-analysis of the data.

As the CFA revealed a problem concerning 'structure' and 'demonstration', a number of models were tested to ascertain whether to include either or both behaviours in further analyses. In the first model 'structure' and 'demonstration' items were combined to create a composite mean value per play segment, expected to make up one latent factor. This analysis yielded a relatively well-fitting model [x^2 (80) = 163.03, *p*< .001, RMSEA= .053, CFI=.959, TLI=.946]. In the second model structure was completely removed. A better fitting model was attained [x^2 (80) = 143.69, *p*<.001, RMSEA= .045, CFI=.974, TLI=.966]. In the final model both structure and demonstration were removed, but emotional support retained, yielding an even better fitting model [x^2 (48) = 74.03, *p*=.0093, RMSEA= .037, CFI=.987, TLI=.982]. As the models were not nested it was impossible to compare their fit. Furthermore, the WLSMV estimator was used as all predictor items were all categorical in nature, meaning that the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) often used to assess model fit were not produced, as the estimator was not based on maximum likelihood. What is more, this model did not produce modification indices, suggesting further that it was superior to the models in which structure and demonstration were included (Byrne, 2013). Therefore, based on the model fit indicators available, the final analysis produced a better fitting model, and ’structure’ and ‘demonstration’ were removed from further analyses (see Table 6.1 for factor loading of individual items onto overall behaviour codes, range, mean and standard deviations).

Table 6.1: Summary of confirmatory factor analysis to define scaffolding-like behaviours, including individual behaviour codes, for each play segment, standardised factor loading and standard errors in brackets

	Contingent Response	Cognitive Support	Autonomy promoting language	Emotional support
Book-sharing	.72 (.04)	.71 (.05)	.78 (.04)	.66(.08)
Ring-stacking	.91 (.03)	.73 (.04)	.67 (.04)	.77 (.08)
Shape-sorting	.87(.03)	.83 (.04)	.65 (.04)	.55 (.08)
Range	-2.34 – 1.30	-2.21 – 2.36	-1.96 – 2.03	-1.33 – 2.07
Mean (SD)	-.06 (.80)	-.01 (.86)	-.00 (.84)	-.01 (.66)

A second CFA was performed testing whether the four first order latent factors presented in Table 6.1 loaded onto a second-order latent factor reflecting maternal scaffolding-like behaviours. A well-fitting model was established [x^2 (50) = 79.82, *p*=.0047, RMSEA= .039, CFI=.985, TLI=.981]. Figure 6.1 provides a visual representation of the factor structures including standardised factor loading and standard errors.

The model R^2 estimates for the reported latent variables revealed that maternal scaffolding-like behaviours accounted for 28% of the variance in contingent response, 64% and 77% of the variance in cognitive support and autonomy promoting language and 24% of the explained variance in emotional support. These findings suggest that the model fit the data well, though the extracted higher order factor better explains aspects of didactic/verbal instruction behaviours in infancy.

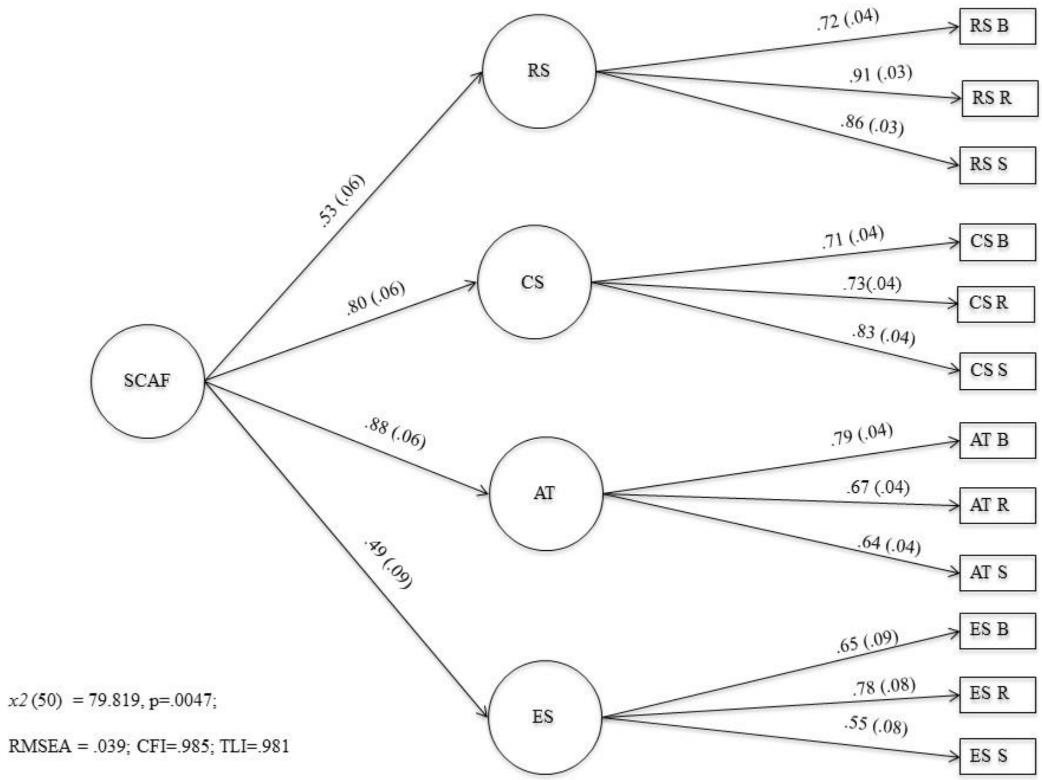

Figure 6.1: Path diagram representing the confirmatory factor analysis to define scaffolding-like behaviours, including first and second order factors

Standardised β values and standard errors in brackets
SCAF = Scaffolding-like behaviours
RS = Contingent response; CS = Cognitive support; AT = Autonomy promoting language; ES = Emotional support;
B=Book-sharing; R=Ring-stacking toy; S=Shape-sorting toy

6.3 Results of latent class analysis – typologies of maternal scaffolding behaviours

Variations amongst mothers in the presentation of scaffolding behaviours were tested with factor mixture analysis (FMA) carried out in Mplus 7.3 (Muthén & Muthén, 2012) on the four first order factors: Contingent response, cognitive support, autonomy promoting language and emotional support. This type of analysis is performed when the assumption of conditional independence between items within classes is violated, or when performing a latent class analysis on extracted latent factors, expected to be statistically associated (Muthén & Asparouhov, 2006). FM models take into account the commonality between continuous latent variables, whilst modelling the unobserved heterogeneity in the data (Lubke & Muthén, 2005). This method of exploration can help in meaningfully summarising variations between mothers in their propensity to present scaffolding-like behaviours. Furthermore, this could lead to developing a framework within which the functional differences between groups can be further discussed.

Latent class analysis is a model-based approach, meaning that decisions on cluster solutions are informed by statistical criteria (Vermunt & Magidson, 2000). As this is a data driven method, hypotheses on class characteristics were not made in advance. Instead decisions on the most suitable class solution were based on model fit statistics (Lower Bayesian Information Criterion [BIC] and entropy <.80) and requiring a minimum group size of N=20. Furthermore, the Voung-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR) was employed to test whether extracting one less class will result in a worse fitting model. Table 6.2 includes BIC values and entropy per model, and Appendix D includes means and standard errors for the four class solutions, tested but not included in the final analyses.

Table 6.2: Factor mixture analysis model fit statistics

Class solution	BIC	Entropy
2	3345.215	.811
3	3179.244	.850
4	3093.807	.848
5	**3072.821**	**.838**
6	3064.074	.808

A five-class solution was selected. This was based on the VLMR test which suggested that the use of 5 rather than 6 classes will result in a better fitting model (VLMR p value =.1161), and that having five rather than six classes is sufficient when describing the data. Furthermore, though the BIC value was lower in the six-class solution, the difference in the BIC between six and the five-class solution was less than 10. This suggests that, based on the BIC value, the six-class solution cannot be chosen over the five-class solution (see Raftery, 1995). The entropy value was above the recommended .8 reflecting a clear delineation of latent classes (Celeux & Soromenho, 1996) and the likelihood of belonging to a specific latent class ranged between 89% and 96%. It is noteworthy that the VMLR test carried out between 4 and 5 classes was significant (p=.032) suggesting in this case a five-class solution was optimal.

The five-class solution showed a clear linear trend in maternal scaffolding behaviours, essentially reflecting the continuous nature of the second order factor (see Table 6.3 and Figure 5.2). The latent classes are as follows: group 1 (N=37, 9.2%) labelled ‘very low’, group 2 (N=109, 27.3%) labelled ‘limited’, group 3 (N=125, 31.3%) labelled ‘average’, group 4 (N=105, 26.2%) labelled ‘moderate’, and group 5 (N=24, 6.0%) labelled ‘substantial’.

Table 6.3: Latent factors means for the 5-class solution (standard errors in brackets)

Items	Class 1 N=37	Class 2 N=109	Class 3 N=125	Class 4 N=105	Class 5 N=24
Contingent response	-.93 (.15)	-.43 (.08)	-.02 (.11)	.43 (.07)	.66 (.12)
Cognitive support	-1.62 (.08)	-.54 (.06)	.15 (.10)	.66 (.08)	1.19 (.12)
Autonomy promoting language	-1.55 (.06)	-.64 (.07)	.07 (.08)	.75 (.09)	1.53 (.10)
Emotional support	-.82 (.05)	-.36 (.07)	.02 (.07)	.41 (.06)	1.14 (.20)

Mean comparisons between classes were performed for each first order scaffolding behaviours (see Figure 6.2). These one-way ANOVAs, with Tukey post-hoc tests, revealed significant differences between all five groups on all scaffolding behaviour variables: autonomy promoting language [$F(4,395)=1001.88$, $p<.001$]; emotional support, [$F(4,395)=117.24$, $p<.001$], cognitive support [$F(4,395)=264.97$, $p<.001$], and contingent response. In the case of contingent response, however, equality of means was not assumed between the classes thus the Welch test statistics is reported [$F(4, 106.184)=44.38$, $p<.001$]. These differences were reflecting the linear trend observed in the second order factor of maternal scaffolding-like behaviours.

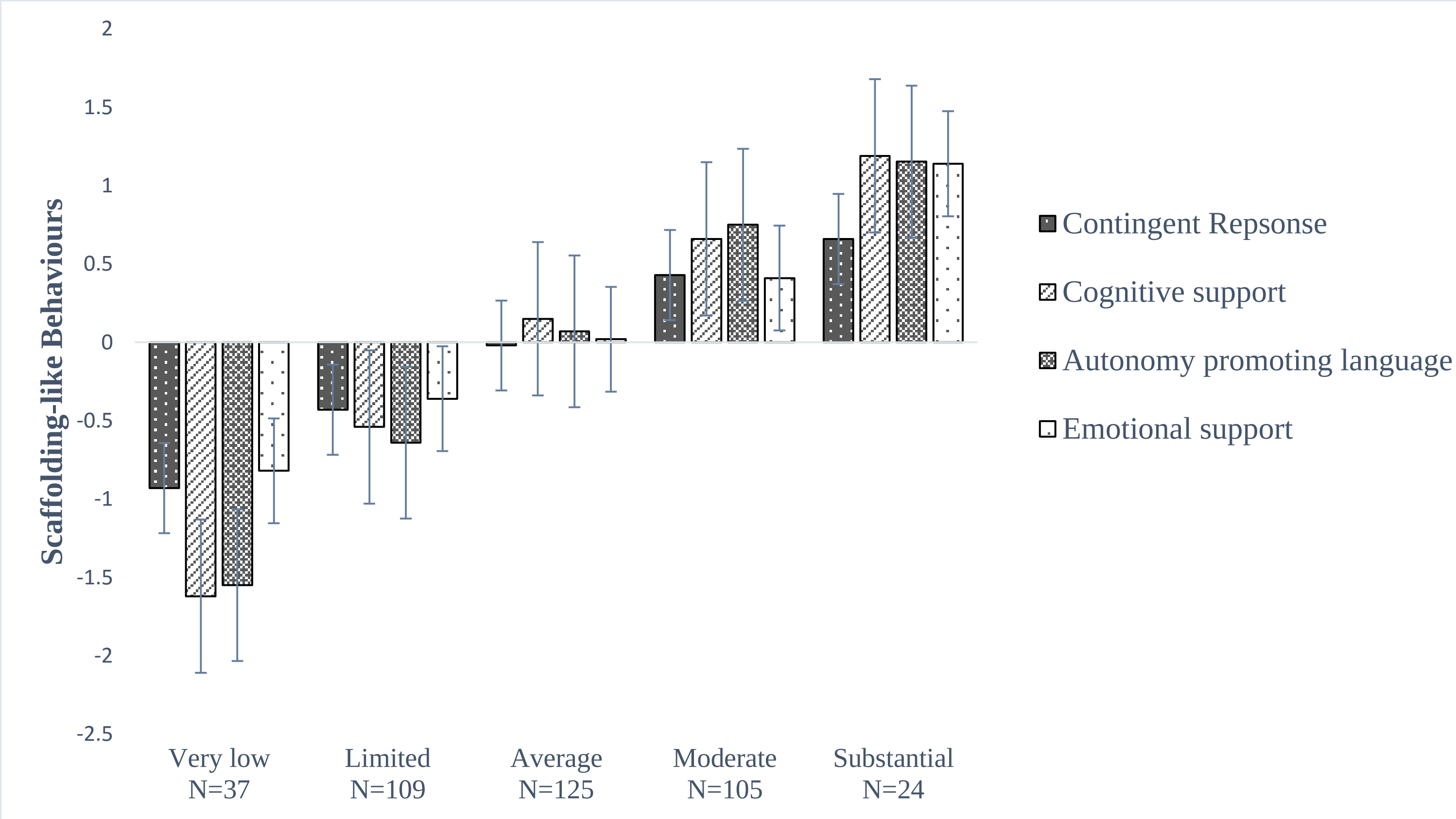

Figure 6.2: Comparisons of mean maternal behaviours comprising the first order scaffolding latent for groups defined by the 5-class solution (whisker lines represent 5% error margin)

6.4 Summary of main findings

1. A confirmatory factor analysis yielded one higher order factor labelled ‘maternal scaffolding behaviours’ comprised of: contingent response; cognitive support; autonomy promotion; and emotional support – behaviours corresponding with the four central tenets of scaffolding.
2. The factor structure extracted based on the main study sample (N=400) was slightly different to the one obtained in the pilot study (N=51). The ‘structure’ and ‘demonstration’ items were removed due to high covariance, whilst a well-fitting model confirmed that ‘emotional support’, previously treated as a separate item, was part of the underlying latent construct of maternal scaffolding behaviours.
3. The latent factor ‘maternal scaffolding behaviour’ explained most of the variance in the didactic items: cognitive support and autonomy promotion, but less so the aspect of emotional support and contingent response. This may suggest that scaffolding as measured in this study reflects a specific instruction style that is didactic in nature.
4. Mothers’ scaffolding behaviours were treated separately exploring the heterogeneity in the data. Submitting the four observed maternal behaviours to a latent class analysis, a six-class solution was found.
5. Based on fit indices (BIC, Entropy and VLMR tests) a five-class solution representing the underlying continuous latent factor was extracted from the data.
6. The five groups were labelled: ‘Very low’, ‘Limited’, ‘Average’, ‘Moderate’ and ‘Substantial’ presentation of maternal scaffolding behaviours. The presentation of each of the behaviours measured increased between classes in a linear manner.

7. Maternal verbal input in way of cognitive support; autonomy promotion and emotional support, alongside contingent response represent an underlying continuous latent factor of maternal scaffolding-behaviours, findings further supported by the latent class analysis. These findings suggest that maternal scaffolding behaviours in this study can be treated as a continuous variable when exploring individual differences in scaffolding and when looking at the relevance of scaffolding-like behaviours to child cognitive ability.

CHAPTER 7: INDIVIDUAL DIFFERENCES IN SCAFFOLDING-LIKE BEHAVIOURS

7.1 Overview of analysis strategy

The following chapter addressed individual differences in maternal scaffolding-like behaviours, treating scaffolding as a continuous higher-order latent construct. The factors associated with the way in which this proximal process manifests itself were explored by performing stepped multiple regressions, testing the relations between scaffolding behaviours, mother and child characteristics. In addition to that the relevance of contextual factors, yet to be explored in relation to maternal scaffolding-like behaviours was tested.

7.1.1 The predictors of maternal scaffolding-like behaviours

Associations between the latent, second-order scaffolding factor and person and context characteristics were carried out, by performing bivariate correlations for continuous variables and comparisons of means for binary variables. Based on these associations four multiple regression models were specified. Variables found to significantly relate to maternal scaffolding behaviours at the $p \leq .05$ were entered into a multivariate regression model using the 'Stepwise procedure' in SPSS 22, replicating Bornstein and colleagues (2007) method of analysis. Model 1 included infant characteristics; model 2 included maternal characteristics; and model 3 included contextual factors. In the fourth model variables found to relate to maternal scaffolding behaviours at the $p \leq .10$, in models 1, 2 and 3 were entered simultaneously. The order in which the models were entered into the regressions was based upon Mulvaney et al.'s (2006) analyses of the predictors of individual differences in scaffolding.

7.2 Factors related to maternal scaffolding-like behaviours

To ascertain which variables were associated with maternal scaffolding behaviours, bivariate correlations were performed between mother and child person characteristics, contextual factors and maternal scaffolding (see Table 7.1). Infant unsociable temperament as reported by mothers at 10 months was not associated with maternal scaffolding. Maternal higher SES, indicated by employment type, was positively associated with higher levels of scaffolding-like behaviours, as were maternal older age and more agreeable personality. In relation to possible risk factors, higher levels of reported depressive symptoms, traditional child-rearing attitudes (reflecting more authoritarian parenting styles), more adverse home environment and higher levels of neighbourhood poverty were all associated with the presentation of a lower levels of maternal scaffolding behaviours, as was larger family size.

Mean comparisons were carried out for binary variables (see Table 7.2). Mothers did not differ significantly in their presentation of scaffolding behaviours as a function of child gender. Maternal levels of education were associated with the presentation of scaffolding behaviours; mothers who were educated to a university degree level or above were likely to present more scaffolding behaviours compared to those who had less than a university degree qualification. Mothers who resided with a partner were likely to present more scaffolding behaviours at 10 months, than those not living with a partner. Mothers from white British background were likely to present more such behaviours compared with ethnic minority mothers. Likewise, mothers who spoke English as a first language were likely to present higher levels of scaffolding-like behaviours than mothers who spoke English as a second language.

Table 7.1: Bivariate correlations between maternal scaffolding, person (child and mother) and context characteristics

	1	2	3	4	5	6	7	8	9	10
1. Scaffolding										
2. Infant advanced object play	19**									
3. Infant unsociable temperament [a]	.09	13*								
4. Family SES [b]	.27**	.06	.10							
5. Maternal age	.18**	.02	.05	.28**						
6. Maternal agreeableness [c]	.26**	.00	-.04	.11*	.11*					
7. Maternal traditional attitudes [d]	-.26**	.03	-.10	-.40**	-.28**	-.21**				
8. Maternal mental health [e]	-.12*	-.05	.07	-.07	.01	-.16**	.05			
9. Adverse home environment [f]	-.32**	-.07	-.18**	-.51**	-.28**	-.25**	.30**	.10*		
10. Childbirths (1 - 4+)	-.15**	-.12*	-.02	-.23**	.24**	.03	.05	.06	.07	
11. Neighbourhood poverty [g]	-.29**	-.04	-.14**	-.32**	-.17**	-.16**	.24**	.18**	.41**	.08

[a] Maternal reports on the ‘unsociable’ scale from the Infant Characteristics Questionnaire – reversed coded (Bates, Freeland & Lounsbury, 1979)

[b] Family SES 1=working class; 2=intermediate; 3=professional/managerial

[c] NEO-PI agreeableness scale (Costa & McCrea, 1985)

[d] Parental Modernity Scale (Schaefer & Edgerton, 1985)

[e] Edinburgh Postnatal Depression Scale (Cox et al., 1987)

[f] FCCC Environmental Adversity Index

[g] IMD Child Poverty Index (Noble et al., 2000)

* $p<.05$ ** $p<.01$

Table 7.2: Mean comparisons between maternal scaffolding-like behaviours and maternal levels of education, residing with partner, ethnic minority, English first language and child gender; standard deviations in brackets

Variable	Scaffolding-like behaviours
Education	
Less than degree	-.17 (.82)
Degree and above	.20 (.76)
t	4.60**
Residing with partner	
No	-.35 (.86)
Yes	.03 (.80)
t	2.76**
Minority status	
No	.11 (.77)
Yes	-.51 (.82)
t	6.32**
English first language	
Yes	.06 (.77)
No	-.97 (.73)
t	6.84**
Gender	
Boy	-.01 (.83)
Girl	-.01 (.80)
t	.08

$p<.05$ **$p<.01$

7.3 The predictors of maternal scaffolding-like behaviours

7.3.1 Predictors of maternal scaffolding behaviours – Original dataset

To explore the possible determinants of maternal scaffolding-like behaviours a regression model was specified. Infant unsociable temperament and child gender were not regressed onto maternal scaffolding, as these were not found to be associated with these maternal behaviours. Perhaps not surprisingly, family SES was found to be associated quite strongly with a number of the predictor variables and especially with household poverty (r=-.51, *p*<.001). It is likely that family SES explains large portion of the variance in home and neighbourhood context. This means that these factors can be treated both as proxies for family SES, and as specific contexts within which proximal processes and in turn development occurs. Furthermore, a Spearman Rank correlation was performed, showing that family SES and maternal levels of education were highly related (*r*= .43, *p*<.001). Therefore, it was decided to remove family SES from subsequent analyses and include resource (maternal education) and context variables (home and neighbourhood adversity) associated with one's standing in society (SES), but represent physical characteristics of the person and environment.

The regression models were specified in a stepped manner. Only variables found to be associated with maternal scaffolding at p ≤.05 were included. In model 1 infant play maturity was entered. In model 2 maternal demand, force and resource characteristics were added: age, levels of education (0=less than a university degree / 1=University or higher degree, or a professional qualification), ethnic minority status (0=not minority / 1=minority), English first language (0=English first language / 1= English not first language), residing with partner (0=not residing with partner / 1= residing with partner), agreeableness (NEO-PI; Costa & McCrea, 1985), traditional attitudes (PMS; Schaefer & Edgerton, 1985), and maternal mental health collected at 10 months (EPDS; Cox et al., 1987). Contextual factors were then added in model 3: adverse home environment (FCCC, EAI), family size and neighbourhood poverty (CPI; Noble et al., 2000). In the fourth model, variables found to be associated with maternal scaffolding-like behaviours at p ≤.10 in any one of the previous three models were entered simultaneously into a linear regression (see Table 7.3).

The results of the first model suggest that infant play maturity explained a significant 4% of the variance in maternal scaffolding behaviours; infants who were more mature in their play at 10 months were likely to have mothers who presented higher levels of scaffolding-like behaviours [$F(1, 294)=10.92$, $p=.001$]. Once maternal characteristics were added in model 2, a further 20% of the variance in maternal scaffolding was explained. Mothers were likely to show more scaffolding behaviours if they were educated to a degree level or above, and if they were more agreeable. Furthermore, mothers from ethnic minority background and those who did not speak English as a first language were likely to show less scaffolding-like behaviours [$F(9, 286)=9.82$, $p<.001$]. Whether mother was living with a partner, authoritarian attitudes towards childrearing and mental health status were not found to be meaningful for predicting maternal scaffolding-like behaviours. Though slightly reduced, the effect of infant play maturity remained significant.

In model three, contextual factors were taken into account, explaining a further, significant, 2% of the variance in maternal scaffolding behaviours [$F(12, 283)=8.19$, $p<.001$]. The same pattern observed in model 2 was shown in relation to infant play, maternal education, ethnic minority status, English as first language and agreeableness. Of the contextual factors, more adverse home environment was marginally predictive of less scaffolding behaviour, suggesting that mothers who experienced more in-home poverty were likely to be less responsive and didactic in their style of interaction with their 10-months old infants, family size and neighbourhood poverty were not found to explain variability in maternal scaffolding-like behaviours.

Table 7.3: Multiple regression models predicting maternal scaffolding from maternal, context and child characteristics – original dataset

	Multiple Regression Models – Maternal scaffolding N=296									Simultaneous N=320		
	Model 1			**Model 2**			**Model 3**			**Model 4**		
Variable	B	SE	**β**	B	SE	**β**	B	SE	**β**	B	SE	**β**
Child characteristics												
Infant advanced object play	1.13	.34	.19**	1.07	.31	.18**	.99	.31	.17**	.92	.30	.15**
Mother Characteristics												
Age				.01	.01	.07	.01	.01	.07			
Education				.23	.09	.15*	.19	.09	.12*	.25	.08	.16**
Ethnic minority				-.31	.12	-.15**	-.27	.12	-.14*	-.30	.11	-.15**
English first language				-.60	.18	-.18**	-.53	.18	-.16**	-.57	.17	-.17**
Living with partner				.18	.15	.07	.07	.15	.03			
Agreeableness				.29	.10	.15**	.27	.10	.14**	.30	.10	.16**
Traditional attitudes				-.09	.07	-.07	-.07	.07	-.06			
Mental health				-.00	.01	-.02	-.00	.01	-.00			
Contextual factors												
Home adversity							-.07	.04	-.11†	-.12	.04	-.18**
Family size							-.08	.05	-.09			
Neighbourhood poverty							-.00	.00	-.06			
R^2	**.04**			**.24**			**.26**			**.25**		
ΔR^2				.20			.02					
Model F	10.92**			9.82**			8.19**			17.17**		

B = unstandardised beta coefficients; S.E. = standard errors; β = standardised beta; ΔR^2 = model R^2 change
†*p*<.10; **p*<.05; ***p*<.01

The final model, in which only variables found to be meaningful to maternal scaffolding at the $p \leq .10$ level were entered, explained a significant 25% of the variability in scaffolding behaviours [$F(6,313)=17.17$, $p<.001$]. All factors significantly predicted maternal scaffolding behaviours in the direction observed in the previous three steps. A slight reduction in β value was observed for infant play maturity, yet all other variables β's were somewhat increased, the most noticeable change occurring for adverse home environment, which was significant at $p<.01$. This may suggest that in model 3 some of the effects of home adversity were masked by the inclusion of neighbourhood adversity; these factors were found to correlate at ($r=.41$, $p<.001$). Although these items represent 2 different contexts, the findings suggest that mothers who experienced more adversity in the home were likely to experience more neighbourhood poverty, but that in-home poverty has more direct relevance to the way in which mothers interact with their infants.

7.3.2 Predictors of maternal scaffolding behaviours – Multiple imputations data

Whilst the regression model findings are of interest some of the predictors included in the analyses had a considerable proportion of missing values. Maternal reports on depressive symptoms at 10 months, and maternal agreeableness collected at 18 months were missing for 10.5% and 19.25% of the sample respectively. As linear regressions carried out in SPSS perform a listwise deletion of the predictor (χ) variables, the sample size was reduced to 296 participants out of 400 in the first regression model and 320 in the parsimonious regression model (see Table 7.3). This may introduce bias to the analysis as the sample size became substantially smaller (Carlin, Philip & Coffey, 2003). The pattern of missingness in the data was tested to ascertain whether further steps should be taken to address this.

To establish the pattern of missing data a number of tests were conducted. First, the Little MCAR (missing completely at random) test was performed in SPSS22. Taking all study's explanatory and outcome variables into consideration the Little MCAR test results were non-significant [x^2 (235) = 260.94; *p*= .118], suggesting the data might be missing completely at random, meaning that using multiple imputation (MI) data may not be necessary. However, like other statistical procedures the Little MCAR test may not provide a clear representation of the data, meaning that further testing is required to decide whether multiple imputations are necessary in any specific case (IBM SPSS Missing Values 22, 2013).

Further tests were carried out to explore whether the data is indeed MCAR or MAR (missing at random). By creating two dummy variables coded (0= missing, 1= not missing), mean comparisons and Chi-Square tests were performed for the two items on which missingness occurred. For the data to be MCAR, no differences between the observed and missing groups should be found. The mean comparisons revealed some significant differences between the observed and missing groups. Missing values for maternal mental health status were associated with more traditional attitudes [t(48.04)=3.18 *p*=.003]; more neighbourhood poverty [t(398)=2.21, *p*=.028]; and a larger family size [x^2 (3)=3.47, *p*=.037]. Missingness on maternal agreeableness was associated with more traditional attitudes to child rearing [t(398)=2.74, *p*=.006]; higher levels of home adversity [t(398)=2.353 *p*=.019]; more neighbourhood poverty [t(398)=3.72, *p*<.001]; and a larger family size [x^2 (3)=10.59, *p*=.014]. This suggests that the data are not MCAR but MAR, as some of the missingness was associated with other observed variables. It was therefore necessary to perform the same analyses with datasets in which the missing values were computed, to account for the possibility of introduction of bias due to missingness (Appendix E includes information about data used in the multiple imputation procedure).

The same regression models were entered using the imputed data (see Table 7.4). The results of these regressions were produced from five MI datasets in which the missing values were computed. SPSS22 generates a pooled dataset based on the information from the five computed datasets, providing unstandardized betas, standard errors and significant levels for individual items. The standardized β's were calculated separately employing Rubin's rule (1987), by aggregating and averaging the standardized β's per individual item, for each step of the regression model from each of the five imputed models. The R^2 and the R^2 change values for each regression step were averaged across the five imputed datasets, as was the F statistic.

Table 7.4: Multiple regression models predicting maternal scaffolding from maternal, context and child characteristics - Imputed dataset

	Multiple Regression Models – Maternal scaffolding N=400									Simultaneous N=400		
	Model 1			**Model 2**			**Model 3**			**Model 4**		
Variable	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Child characteristics												
Infant advanced object play	1.20	.31	.19**	1.05	.27	.17**	.89	.27	.14**	.92	.27	.15**
Mother Characteristics												
Age				.01	.01	.08†	.02	.01	.10*	.02	.01	.11*
Education				.24	.08	.14**	.17	.08	.10*	.18	.08	.11*
Ethnic minority				-.30	.10	-.15**	-.26	.10	-.13**	-.28	.10	-.14**
English first language				-.80	.15	-.25**	-.74	.14	-.23**	-.75	.14	-.23**
Living with partner				.14	.12	.05	.04	.13	.02			
Agreeableness				.30	.11	.16**	.28	.11	.14**	.30	.11	.16**
Traditional attitudes				-.11	.06	-.09†	-.08	.06	-.07	-.09	.06	-.08
Mental health				-.00	.01	-.02	-.00	.01	-.00			
Contextual factors												
Home adversity							-.06	.04	-.08			
Family size							-.12	.04	-.13**	-.13	.04	-.14**
Neighbourhood poverty							-.00	.00	-.09†	-.01	.00	-.11*
Average R^2	**.04****			**.28****			**.31****			**.31**		
ΔR^2				.24			.03					
Average Model F	15.58**			16.80**			14.64**			19.14**		

B = unstandardised beta coefficients; S.E. = standard errors; β = standardised beta; ΔR^2 = model R^2 change
†*p*<.10; **p*<.05; ***p*<.01

The same regression models conducted in section 6.3.1 were specified with the multiple imputation data. Similarities in parameter estimates were observed for a number of variables. Infant more mature play at 10-months remained a significant predictor of more maternal scaffolding behaviours, with average β's remaining relatively similar to the original dataset across the four models. Similarly, the average β's for maternal levels of education, minority status and agreeableness, presented a similar pattern across the four models in both the original and imputed datasets. It is noteworthy, however, that the effect of maternal levels of education was somewhat reduced in the final, stringent regression model (see Model 4, Table 7.4), from β =.16 to average β=.11. These differences may have occurred as a result of changes to the strength of parameter estimates for a number of variables not found to be meaningful for predicting maternal scaffolding-like behaviours in the original (non-imputed) dataset, which became significant following imputation.

A number of interesting changes were observed in the regression outcomes between the original and imputed datasets. The variance explained in maternal scaffolding-like behaviours in models 2, 3 and 4 was higher in the imputed dataset. The final regression (model 4) in the imputed dataset, explained 31% of the variance in maternal scaffolding-like behaviours, an increase of 6% from model 4 in the original dataset. In relation to maternal characteristics a number of pertinent changes occurred once the data was imputed. Maternal older age became a significant predictor of higher levels of maternal scaffolding behaviours, a relationship not previously observed. This may have impacted the average β decrease for maternal education, as these factors are likely to be associated. A non-significant trend was observed in model 2 for maternal traditional attitudes, those who held more authoritarian views towards child-rearing, were likely to present less scaffolding-like behaviours, yet this relationship was not found to be significant in model 3 or 4. Finally, the parameter estimates for maternal mother tongue were strengthened in the regression models with the MI data accounting for an average β=-.24 change in maternal scaffolding behaviours, compared to β=-.17 in the original dataset.

The clearest change was observed once contextual factors were taken into consideration in model 3 (see Table 7.4). In the regression models carried out with the original data, adverse home environment was found to predict lower levels of maternal scaffolding-like behaviours, whilst family size and neighbourhood poverty were not. However, in the imputed dataset, both larger family size and higher levels of neighbourhood adversity predicted a significant reduction in maternal scaffolding, whilst, home adversity did not. These changes are perhaps not surprising as missingness was found to be more strongly associated with neighbourhood poverty and larger family size, which means that once the imputed data was taken into account the effects of these factors, became significant. Mothers who had more children were less likely to have a complete dataset, suggesting that having to tend to more children may mean that these mothers are more limited in time, which may have impacted their ability to respond to all the interview questions. This may also explain the significant effect larger family size had on reduction in maternal scaffolding behaviours once the data was imputed. Furthermore, it is possible that once the missing data was computed, the effects of in-home poverty on maternal scaffolding, was captured through the context of neighbourhood poverty, as these factors were highly related.

Not speaking English as their first language (representing a small proportion of the study participants) remained the most predictive variable of lower levels of scaffolding behaviours explaining a reduction of nearly a quarter of standard deviation in such behaviour. The findings suggest that mothers who reported that English was not their first language were less likely to use elaborate language in response to their child behaviours. This finding may be somewhat problematic as it is not clear whether these mothers were on the whole less responsive to their child compared to mothers for whom English was their first language. It is in fact possible that mothers whose English was not their first language contingently responded to their infant, though by being largely reliant on language, the coding scheme may not accurately represent all mothers' behaviours.

To redress the possible bias, mean comparisons were carried out between mothers for whom English was and was not their first language on the four behaviours of which the 'scaffolding-like' higher order factor was comprised of. A significant difference was found between the groups on all four behaviours: contingent response [$t(398)=3.88$, $p<.001$]; cognitive support [$t(398)=6.84$, $p<.001$]; autonomy promoting language [$t(398)=6.43$, $p<.001$]; and emotional support [$t(398)=3.77$, $p<.001$]. It is clear that mothers who did not speak English as a first language were less likely to use elaborate language in reaction to their 10-months old infant behaviours. Although, in this sample, maternal scaffolding behaviours were lower for mothers who did not speak English as a first language, it is not clear whether these associations were relevant in the context of child cognitive and academic abilities.

7.4 Summary of main findings

1. To ascertain which factors were associated with individual differences in maternal scaffolding behaviours, three stepwise multiple regression models were specified, and a fourth model including only variables found to be predictive of scaffolding behaviours at the $p \leq .10$ in any one of the three stepwise regression models.

2. In keeping with Mulvaney et al.'s (2006) method of analysis, and the PPCT model, the regression models were specified as follows: model 1 - child person characteristics; model 2 - mother characteristics; model 3 – context characteristics.
3. Due to missingness in the data, regression analyses were conducted twice, first with the original (raw) data and then with the imputed data.
4. Some similarities were observed in analyses carried out with the original and imputed data. These similarities were:
    a. Infants who presented more mature play abilities recorded at 10 months were likely to have mothers who presented higher levels of scaffolding-like behaviours.
    b. Maternal demand characteristics (ethnic minority, and English not first language) significantly predicted reduction in the presentation of maternal scaffolding-like behaviours, whilst maternal resource characteristics (being educated to a university degree level or above) and force characteristics (more agreeableness) predicted increases in scaffolding.
5. Some differences were found in regression results between the original and imputed data, mostly in relation to context characteristics. These differences were:
    a. The negative effects of home adverse environment seen in the original dataset were not evident in the imputed data, whilst the negative effects of family size and neighbourhood poverty, not observed in the original dataset, became significant in the MI regression models.

    b. Maternal age became a significant predictor; older mothers were likely to show more scaffolding behaviours.

6. It is possible that the differences in parameter estimates and significance levels seen in relation to context characteristics were driven by the relationships between the variables in which missingness was observed and these contextual factors. The data were found to be missing at random (MAR) meaning that missingness was associated with other factors taken into consideration in the analyses.
7. The analyses conducted with the imputed data are thought to provide a more accurate picture of the predictors of maternal scaffolding behaviours than that provided by the original data, explaining more of the variance in scaffolding.
8. Individual differences in maternal scaffolding-like behaviours were a function of child behaviours (more mature play at 10 months), as well as maternal characteristics (1) demand (older age, ethnic minority and not speaking English as a first language); (2) resource (being educated to a university degree or above) and (3) force characteristics (more agreeableness), and risk factors associated with the family (larger sibship size) and neighbourhood (ward-level poverty) context.

CHAPTER 8: THE RELEVANCE OF MATERNAL SCAFFOLDING-LIKE BEHAVIOURS FOR PREDCTING CHILD COGNITIVE ABILITIES

8.1 Overview of analysis strategy

This chapter explored the relationship between maternal scaffolding behaviours in infancy and child cognitive development in the preschool years. Based on the bioecological theory, maternal scaffolding was treated as the proximal process influencing subsequent development, whilst taking into account child and mother person characteristics, contextual factors, observing development over time. The higher order factor of maternal scaffolding-like behaviours alongside person and context characteristics was used to predict child cognitive abilities in the preschool years by performing multiple regression analyses.

8.1.1 Associations between mother, child and contextual factors and child outcomes

As previously discussed maternal scaffolding behaviours have been found to relate to children's EF (Bernier et al., 2010; Hammond et al., 2011; Hughes & Ensor, 2009), cognitive (Lowe et al., 2013; Landry et al., 2006; Mulvaney et al., 2006) and academic abilities (Dietrich et al., 2006). In this chapter, the possible effects of maternal scaffolding are addressed in relation to cognitive ability in the preschool years, first by looking at its relevance to cognitive ability measured by the Bayley Mental Development Index (BSID-II MDI; Bayley, 1993) at 18 months; and second, by testing its associations with verbal and non-verbal abilities at 51 months, measured by four subscales of the British Ability Scales (BAS II; Elliott et al., 1996).

In the previous chapter it was reported that higher levels of maternal scaffolding behaviours were predicted by mothers' older age, more educational qualifications and agreeableness, and by higher levels of infant play maturity. On the other hand maternal minority background, not speaking English as a first language, larger family size and higher levels of neighbourhood poverty all predicted lower levels of presentation of scaffolding behaviours. To establish the associations between maternal scaffolding behaviours, study covariates and all child cognitive ability outcomes, bivariate correlations for continuous variables and mean comparisons in case of categorical variables were carried out in the initial step.

8.1.2 Identifying predictors of child cognitive abilities in the preschool years

Once significant associations were established, a five model, Step-wise multiple regression analyses were performed to test the relevance of scaffolding behaviours in predicting child cognitive ability at age 18 and 51 months, including relevant covariates. The model building strategy was as follows: child person characteristics were entered first (model 1) followed by mother person characteristics (model 2). The proximal process was added next (model 3) to test whether scaffolding is predictive of child ability over and above persons' characteristics. Context characteristics were entered next (model 4) to ascertain whether socio-demographic aspects could explain the findings more broadly. This process will help in establishing the individual role of each component of the model in predicting subsequent cognitive development and follows the steps taken by Mulvaney and colleagues (2006).

The fifth was a parsimonious model in which only factors found to be meaningful predictors in models 1-4 were entered simultaneously into a multiple regression model. Taking a similar approach to Bronstein and associates (2007), only predictors significantly correlated with the outcome measure at the $p < .05$ were included in the initial regression models, or those found to be significantly different across groups at $p<.05$ in the case of mean comparisons. Variables included in the final model are those in which the critical level of significance was set at $p \leq .10$ in models 1-4 to increase the likelihood of including as many potential proximal and distal factors likely to relate to cognitive ability.

In the final step, the possible effects of maternal scaffolding-like behaviours and other environmental characteristics were tested in relation to change in child cognitive ability. Informed by the work of Hughes and Ensor (2009), two further multivariate regressions were conducted in which child cognitive ability at age 18 months was entered to the simultaneous regression (model 5) when predicting child verbal and non-verbal ability at 51 months. Including prior child ability reduce the probability of genetically driven confounding influences and will control for earlier individual differences in cognitive ability. This may provide a more accurate analysis of associations between environmental effects and change in child cognitive skills. Finally, where scaffolding was found to predict child cognitive ability over and above person and context characteristics possible interactions between the remaining predictive factors were carried out. Following Aiken and West's (1991) method, interaction terms were specified after multiplying the mean-centred items of the variables of interest.

To summarise, the predictors were entered in four blocks: (1) child person characteristics; (2) maternal person characteristics; (3) maternal scaffolding-like behaviours (4) context characteristics. The final model included a simultaneous regression of all variables found to be predictive of child cognitive abilities at the $p \leq .10$ level. This procedure was carried out for general cognitive ability at 18 months, and repeated for verbal and non-verbal ability at 51 months. Additional simultaneous regression models were performed for verbal and non-verbal ability at 51 months, to account for prior cognitive ability.

8.2 Association between scaffolding, outcomes and covariates

The central aim of this study was to explore the relevance of maternal scaffolding behaviours in infancy for predicting subsequent child cognitive ability, taking into account other predictors. To establish the associations between scaffolding behaviours, covariates and outcomes of interest, bivariate correlations were conducted (see Table 8.1), followed by mean comparisons using independent samples t-tests for categorical items. The covariates included in these analyses are those found to be associated with maternal scaffolding behaviours in chapter 7.

Bivariate correlations

The correlation analyses demonstrated that all outcome variables were positively associated with maternal scaffolding behaviours recorded at 10 months. Higher levels of maternal scaffolding behaviours were associated with more advanced cognitive abilities measured at 18 and 51 months. The association is most strongly observed with child verbal ability at 51 months. This is perhaps not surprising as it is possible that mothers who tended to use more verbal scaffolding at 10-months proceeded to use more elaborative language throughout the preschool years, in effect promoting more advanced language skills.

Child and mother person characteristics were significantly associated with some of the outcomes. Children who showed more advanced play at 10 months were likely to present more advanced spatial abilities at 51 months. Maternal older age was associated with more developed cognitive abilities at all time points, while maternal agreeableness was positively associated with better cognitive ability at age 18 months and verbal ability at 51 months; these associations were not observed with spatial ability at 51 months.

Contextual factors were also associated with the outcomes. Larger family size was associated with lower verbal and non-verbal ability at age 51 months. Children experiencing higher levels of neighbourhood adversity in infancy were likely to show poorer cognitive and verbal ability at all time points.

Table 8.1: Bivariate correlations between child cognitive development, maternal scaffolding and contextual factors

	Bayley MDI[a]	BAS Verbal [b]	BAS Non-Verbal [c]
BAS Verbal	.57**		
BAS Non-Verbal	.37**	.48**	
Scaffolding	.21**	.34**	.22**
Infant advanced object play	.19**	.04	.11*
Maternal age	.17**	.22**	.16**
Maternal agreeableness	.15**	.20**	.09
Family size	-.07	-.16**	-.12*
Neighbourhood poverty	-.26**	-.37**	-.15**
Range	50.00 – 123.00	61.00 – 134.50	23.50 – 105.00
Mean (SD)	91.87 (13.34)	99.65 (13.77)	65.91 (13.77)

[a] Bayley 'Mental developmental Index'– 18 months
[b]Composite measure of verbal comprehension and naming vocabulary from the British Ability Scales – 51 months
[c] Composite measure of picture similarities and pattern construction from the British Ability Scales – 51 months
*p<.05; **p<.01

Mean comparisons

To test the associations between the outcomes of interest and categorical factors, mean comparisons were conducted. Independent samples t-tests compared children's cognitive abilities comparing those whose mothers spoke English as a first language and those who did not (coded English first language = 0; English not first language = 1), and those whose mother had minority status (coded white British background = 0; minority = 1). Similar patterns were observed for both factors. Children of mothers who did not speak English as a first language were likely to show lower verbal ability at 51 months compared with children whose mothers spoke English as a first language, but there was no significant difference in non-verbal ability. In the case of ethnic minority status of the mother, children whose mothers were of ethnic minority were likely to show lower cognitive ability at 18 months and fewer verbal skills at 51 months. There was no difference in non-verbal ability at 51 months (see Table 8.2).

Further mean comparisons were performed for maternal education and child gender. Children of mothers who were educated to a degree level or above were likely to show more developed cognitive abilities at 18 and 51 months compared to children whose mothers had educational qualifications lower than a degree level. Finally, the associations between child gender and outcome variables were explored (coded Boys = 0; Girls = 1). Girls had higher cognitive ability at 18 months. A significant difference between girls and boys was not observed in relation to verbal ability at 51 months but girls showed significantly better non-verbal ability at the same time point (see Table 8.2).

Table 8.2: Mean comparisons of outcome variables between maternal levels of education, minority status, English as first language and child gender

	Bayley MDI [a]	BAS Verbal [b]	BAS Non-Verbal [c]
English first language			
Yes	92.23 (13.30)	100.83 (13.57)	66.15 (13.64)
No	87.14 (13.23)	84.29 (13.89)	62.79 (15.41)
t	1.95	6.21**	1.25
Minority status			
No	92.96 (12.80)	101.32 (13.85)	66.32 (13.70)
Yes	87.36 (14.61)	92.68 (13.71)	64.22 (14.02)
t	3.33**	4.89**	1.20
Education			
Less than degree	89.31 (12.82)	95.78 (13.49)	62.33 (13.67)
Degree and above	95.08 (13.37)	104.53 (13.67)	70.28 (12.67)
t	4.32**	6.31**	5.93**
Gender			
Boy	90.08 (13.20)	98.24 (14.87)	63.39 (14.55)
Girl	93.63 (13.28)	101.02 (13.46)	68.39 (12.52)
t	2.66**	1.93	3.67**

[a] Bayley 'Mental developmental Index'– 18 months

[b]Composite measure of verbal comprehension and naming vocabulary from the British Ability Scales – 51 months

[c]Composite measure of picture similarities and pattern construction from the British Ability Scales – 51 months

**p*<.05; ***p*<.01

8.3 The relevance of maternal scaffolding behaviours in infancy for predicting cognitive development at 18 months

The relevance of maternal scaffolding behaviours at 10-months in predicting infant cognitive development 8 months later was tested using Step-wise multiple regression analysis in four blocks: model 1 – child characteristics – infant play maturity and gender; model 2 – maternal characteristics – age, levels of education, minority status, and agreeableness; model 3 – maternal scaffolding-like behaviours; and model 4 – contextual factors – neighbourhood poverty. A final model (model 5) included only those variables found in models 1, 2, 3 or 4 to be predictive of infant cognitive abilities at the $p \leq .10$ level (see Table 8.3).

Infant cognitive ability at age 18 months was predicted by child and mother characteristics seen in models 1-3. Child gender (girl) and more mature play at 10 months predicted more advanced abilities at 18 months; children of mothers with fewer educational qualifications and from a minority background had lower developed cognitive ability, explaining 13% of the variance. Maternal scaffolding-like behaviours measured at 10 months, did not predict child cognitive ability at 18 months, adding a non-significant 1% to the variance explained. Once neighbourhood poverty was entered (model 4), mothers' ethnic background was no longer predictive of child cognitive ability, though child gender (girl) and mature play, and maternal education remained significant predictors of more developed cognitive abilities at 18 months. This may suggest that minority status and area poverty interact in some way.

In the final step, the parsimonious model was entered simultaneously including all the variables found to be meaningful at $p \leq .10$ in the first 4 models. As maternal scaffolding was not found to be associated with infant 18-months cognitive ability, it was not included in the final, stringent model. Model 5 explained 15% of the variability in infant cognitive abilities. The results suggests that more mature play at 10 months, and being a girl was predictive of more developed cognitive abilities at 18 months, as were maternal higher levels of education. Area poverty remained a strong predictor of infant MDI scores, explaining a reduction of almost a fifth of a standard deviation in child abilities ($\beta = -.17$). Although, maternal scaffolding behaviours at 10 months were not found to significantly predict child cognitive development 8 months later, the findings suggest that differences in infant cognitive ability as early as age 18 months can be explained by a wider socio-demographic context, through area poverty and maternal levels of education, alongside earlier abilities (play maturity) and gender.

Table 8.3: Multiple regression models – predicting cognitive ability at 18 months

	Multiple Regression Models – MDI Cognitive Ability 18 months N=391												Simultaneous		
	Model 1			**Model 2**			**Model 3**			**Model 4**			**Model 5**		
Variable	B	SE	**β**	B	SE	**β**	B	SE	**β**	B	SE	**β**	B	SE	**β**
Child characteristics															
Infant object play[a]	18.51	5.10	.18**	17.85	4.91	.17**	16.47	5.01	.16**	16.57	4.95	.16**	17.39	4.84	.17**
Child gender [b]	3.27	1.32	.12*	2.99	1.27	.11*	3.01	1.27	.11*	2.99	1.26	.11*	2.98	1.26	.11*
Mother characteristics															
Age				.22	.13	.09†	.22	.13	.09†	.19	.13	.07	.20	.13	.08
Education levels [c]				4.59	1.34	.17**	4.24	1.36	.16**	3.55	1.36	.13**	3.72	1.35	.14**
Ethnic minority [d]				-4.03	1.67	-.12*	-3.47	1.71	-.10*	-2.37	1.72	.07	-2.65	1.69	-.08
Agreeableness [e]				2.93	1.66	.09†	2.50	1.70	.08	2.23	1.71	.07	2.47	1.68	.08
Proximal process															
Maternal Scaffolding [f]							1.19	.88	.07	.71	.88	.04			
Context characteristics															
Neighbourhood poverty[g]										-.13	.04	-.17**	-.14	.04	-.17**
Average R^2	.05**			.13**			.14			.16**			.15**		
ΔR^2 change				.08**			.01			.02**					
Average Model F	10.23**			9.84**			8.72**			9.15**			10.37**		

B = unstandardised beta coefficients; SE = standard errors; β = standardised betas; ΔR^2 = model R^2 change. [a]Infant advanced object play – measured at 10 months; [b] Gender (0=Boy/1=Girl); [c] Education levels (0=less than degree/1=degree and over); [d] Ethnic minority (0=no/1=yes); [e] Agreeableness – NEO-PI (Costa & McCrea, 1985); [f] Maternal Scaffolding – measured at 10 months; [g] Neighbourhood poverty – IMD Child Poverty Index (Noble et al., 2000)
†$p<.10$; *$p<.05$; **$p<.01$.

8.4 The relevance of maternal scaffolding behaviours in infancy for predicting cognitive ability at 51 months

8.4.1 Verbal ability

The relevance of maternal scaffolding behaviours in infancy for predicting child language ability at 51 months was tested next, exploring the predictors of verbal ability at approximately school entry age, using a composite measure of the BAS verbal comprehension and naming vocabulary subscales. A multiple regression model mimicked the steps taken in predicting infant cognitive ability at 18 months, albeit some changes were made to the covariates entered. Using only those variables found to be significantly associated with the outcome in question. The models were entered as follows: model 1 – child characteristics – gender; model 2 – maternal characteristics – age, levels of education, minority status, English first language and agreeableness; model 3 – maternal scaffolding-like behaviours; and model 4 – contextual factors – family size and neighbourhood poverty. A final model (model 5) included only those variables found in previous steps to be predictive of child verbal ability at $p \leq .10$ level (see Table 8.4).

Child verbal ability at age 51 months was predicted by child mother and context characteristics. Child gender (girl) marginally predicted better language skills when no other variables were taken into account, yet once mother characteristics and behaviours, and contextual factors were added this relationship became significant, perhaps suggesting that the effects of mother and environment characteristics on child verbal ability are moderated by child gender. Maternal characteristics were entered into the second regression model explaining a highly significant 23% of the variance in child verbal ability. Higher levels of maternal education predicted a significant, quarter of a standard deviation increase in child verbal skills, whilst older age was only marginally significant. Maternal minority background and whether mother spoke English as a first language predicted significant reductions in verbal ability, whereas maternal agreeableness was not relevant to child verbal skills.

Once maternal scaffolding-like behaviours were added to the regression model the effects of maternal characteristics slightly changed. Maternal age became a significant predictor of better language skills, and higher educational qualifications, minority status and English as a first language, remained predictive, but the parameter estimates were marginally reduced. Maternal scaffolding like behaviours explained a further significant 1% of the variance, predicting just under a sixth of a standard deviation increase in verbal skills at age 51 months.

In model 4 contextual risk factors were added to the model. Contextual risk explained a significant 6% of the variance in verbal skills, with larger family size and more neighbourhood poverty predicting fewer language abilities at 51 months. Children of mothers who were educated to a university degree levels or above, and of mothers who spoke English as a first language were likely to show an increase of around a fifth of a standard deviation in language skills compared with children whose mothers were less educated or who did not speak English as a first language. Once context was taken into consideration the effects of maternal scaffolding-like behaviours were no longer meaningful for predicting language abilities. All variables were relevant to predicting verbal ability at the $p<.10$ in one or more of the models, thus a performing a simultaneous regression was not necessary.

Table 8.4: Multiple regression models – predicting verbal ability at 51 months

Multiple Regression Models – BAS Verbal Ability 51 months N= 392												
	Model 1			**Model 2**			**Model 3**			**Model 4**		
Variable	B	SE	**β**	B	SE	**β**	B	SE	**β**	B	SE	**β**
Child characteristics												
Child gender [a]	2.77	1.43	.10†	2.59	1.27	.09*	2.63	1.26	.09*	2.62	1.21	.09*
Mother characteristics												
Age				.31	.13	.12*	.26	.13	.10*	.36	.13	.13**
Education levels [b]				7.38	1.35	.26**	6.70	1.36	.23**	4.99	1.34	.17**
Ethnic minority [c]				-4.43	1.72	-.12**	-3.59	1.73	-.10*	-2.63	1.70	-.07
English first language [d]				-14.59	2.58	-.26**	-12.48	2.67	-.23**	-12.23	2.57	-.22**
Agreeableness [e]				3.19	1.63	.09†	2.35	1.63	.07	2.05	1.72	.06
Proximal process												
Maternal scaffolding [f]							2.49	.90	.14**	1.32	.90	.08
Context characteristics												
Family size										-2.47	.75	-.15**
Neighbourhood poverty [g]										-.17	.04	-.21**
Average R^2	.01			.24**			.25**			.31**		
ΔR^2 change				.23**			.01**			.06**		
Average Model F	3.75			20.17**			18.69**			19.35**		

B = unstandardized beta coefficients; SE = standard errors; β = standardised betas; ΔR^2 = model R^2 change. [a] Gender (0=Boy/1=Girl); [b] Education levels (0=less than degree/1=degree and over); [c] Ethnic minority (0=no/1=yes); [d] English first language (0=yes/1=no); [e] Agreeableness – NEO-PI (Costa & McCrea, 1985); [f] Maternal Scaffolding – measured at 10 months; [g] Neighbourhood poverty – IMD Child Poverty Index (Noble et al., 2000);
†*p*<.10; **p*<.05; ***p*<.01

To test whether child mother and context characteristics remained significant once prior cognitive ability was considered a final analysis was conducted. Child cognitive ability at 18 months, measured using the Bayley MDI, was entered into the regression alongside all the predictors found to previously relate to 51 months verbal ability at $p<.10$ level (see Table 8.5). Once cognitive ability at 18 months was taken into consideration, the model explained a further 16% of the variance in 51 months verbal ability. The results remained largely similar, though the parameter estimates were somewhat reduced for all predictor variables. Mothers' older age and higher educational qualifications predicted more advanced verbal abilities whilst mother not speaking English as a first language, larger family size and higher levels of neighbourhood poverty predicted the opposite trend. The most notable change, however, was for child gender. Once previous ability was taken into account, child gender no longer predicted previous ability suggesting that child gender may influence baseline ability, but not change over time. Child 18 months cognitive ability predicted almost half a standard deviation increase ($\beta=.44$) in subsequent verbal ability at 51 months.

Table 8.5: Simultaneous regression predicting child verbal ability at 51 months from child, mother and context characteristics and taking prior cognitive ability into consideration (N=383)

Simultaneous Regression BAS Verbal Ability including prior cognitive ability			
Variable	**B**	**SE**	**β**
Child characteristics			
18 Months Cognitive ability [a]	.48	.04	.44**
Child gender	.66	1.08	.02
Mother characteristics			
Age	.29	.12	.11*
Education levels [c]	3.48	1.19	.12**
Ethnic minority	-1.68	1.50	-.04
English first language	-11.46	2.25	-.21**
Agreeableness	.96	1.54	.03
Proximal process			
Maternal scaffolding	.81	.79	.05
Context characteristics			
Family size	-2.20	0.66	-.14**
Neighbourhood poverty	-0.11	0.04	-.13**
Average R^2	.47**		
Average Model F	34.49**		

B = unstandardized beta coefficients; SE = standard errors; β = standardised betas
*p<.05; **p<.01

8.4.2 Non-verbal ability

The relevance of maternal scaffolding behaviours for predicting child non-verbal cognitive ability at 51 months was tested next. Non-verbal abilities were measured using a mean composite measure of the picture similarities and pattern construction subscales of the BAS (Elliott et al., 1996). The same procedure as in previous multiple regression analyses was conducted. Model 1 included child characteristics – play maturity and gender; model 2 mother characteristic- age and education; model 3 comprised of maternal scaffolding-like behaviours; and model 4 included contextual factors – family size and neighbourhood poverty. A final model (model 5) included only those variables found in previous steps to be predictive of child non-verbal ability at the $p \leq .10$ level (see Table 8.6).

The pattern of factors predicting child non-verbal ability at 51 months was somewhat different to that observed in the previous regression models. Both infant play maturity at 10 months and gender (girl) predicted more developed spatial abilities at age 51 months, yet once maternal scaffolding-like behaviours were entered into the regression (model3) infant play maturity no longer predicted child abilities. Higher levels of maternal scaffolding behaviours remained a significant predictor of more advanced non-verbal ability at 51 months over and above child, mother and context characteristics in models 3, 4 and 5.

Child non-verbal ability was also found to relate to some but not all socio-demographic predictors. Mothers' level of educational qualification (university degree level or above) predicted a quarter of a standard deviation increase in child non-verbal ability. Family size and neighbourhood poverty, on the other hand did not significantly predict these skills.

Table 8.6: Multiple regression models – predicting non-verbal ability at 51 months

	Multiple Regression Models – BAS Non-Verbal Ability 51 months N= 398												Simultaneous		
	Model 1			**Model 2**			**Model 3**			**Model 4**			**Model 5**		
Variable	B	SE	**β**	B	SE	**β**	B	SE	**β**	B	SE	**β**	B	SE	**β**
Child characteristics															
Infant object play[a]	10.91	5.20	.10*	11.18	4.98	.11*	8.16	5.04	.08	7.28	5.05	.07	7.44	5.05	.07
Child gender [b]	4.86	1.36	.18**	4.62	1.30	.17**	4.69	1.29	.17**	4.72	1.29	.17**	4.83	1.28	.18**
Mother characteristics															
Age				.17	.13	.06	.12	.13	.04	.19	.14	.07			
Education levels [c]				7.30	1.38	.26**	6.52	1.39	.24**	5.92	1.42	.21**	6.75	1.33	.24**
Proximal process															
Maternal scaffolding [d]							2.47	.84	.15**	2.07	.87	.12*	2.43	.83	.14**
Context characteristics															
Family size										-1.38	.80	-.09†	-1.06	.76	-.07
Neighbourhood poverty [e]										-.04	.04	-.04			
Average R^2	.04**			.13**			.15**			.16**			.15**		
ΔR^2 Change				.09**			.02**			.01					
Average Model F	9.03**			14.40**			13.49**			10.24**			13.75**		

B = unstandardised beta coefficients; SE = standard errors; β = standardised betas; ΔR^2 = model R^2 change.
[a]Infant advanced object play – measured at 10 months; [b] Gender (0=Boy/1=Girl); [c] Education levels (0=less than degree/1=degree and over); [d] Maternal Scaffolding – measured at 10 months; [e] Neighbourhood poverty – IMD Child Poverty Index (Noble et al., 2000);
†*p*<.10; **p*<.05; ***p*<.01

The findings from the final multiple regression suggested that mother and child characteristics, alongside maternal behaviours at the end of the first year of life are associated with child non-verbal development, accounting for a significant 15% of the variance in non-verbal ability. Contextual risk factors were not predictive of such abilities perhaps suggesting that these skills may be less vulnerable to environmental risk.

In the final step, the role of prior cognitive ability was tested. Bayley MDI scores at 18 months were entered to the regression simultaneously with all items previously found to be associated with child non-verbal ability at 51 months at $p<.10$ (see Table 8.7; Model 1). The addition of child prior cognitive ability to the model explained an additional 6% of the variance in non-verbal ability at age 51 months. The parameter estimates of the variables previously found to predict non-verbal ability were slightly reduced though the effects remained significant. Even after controlling for child cognitive ability at 18 months, child gender (girl), mother's higher educational qualification and more maternal scaffolding-like behaviours, predicted better non-verbal skills at 51 months.

As scaffolding remained a significant predictor of non-verbal ability alongside child cognitive ability and gender and maternal education, tests of possible moderation were performed. The following interaction terms were added to the stringent regression model: (1) gender x maternal scaffolding; (2) education x maternal scaffolding; (3) gender x maternal education (4) gender x maternal education x maternal scaffolding. A significant interaction was observed between maternal scaffolding-like behaviours and levels of education. Model 2 in Table 8.7 includes the final model in which only significant predicotrs at $p<.05$ were entered in addition to the significant interaction. This model explained an additional 1% variability, overall accounting for 22% of the variance in child verbal ability at 51 months. Figure 8.1 illustrates the interaction between maternal scaffolding-like behaviours and education levels in predicting child non-verbal ability at age 51 months. Maternal education partially moderated the effects of scaffolding-like behaviours on child non-verbal ability. The combined effect of more maternal educational qualification and higher levels of scaffolding-like behaviours predicted more advanced non-verbal ability at approximately school entry age.

Table 8.7: Simultaneous regression predicting child non-verbal ability at 51 months from child, mother and context characteristics and taking prior cognitive ability into consideration (N=389)

Simultaneous Regression BAS Verbal Ability including prior cognitive ability						
	Model 1			**Model 2**		
Variable	**B**	**SE**	**β**	**B**	**SE**	**β**
Child characteristics						
18 months cognitive ability	.28	.05	.27**	.30	.05	.29**
Infant object play	3.20	4.99	.03			
Child gender	3.92	1.26	.14**	3.78	1.25	.14**
Mother characteristics						
Education levels	5.52	1.32	.20**	5.35	1.31	.19**
Proximal process						
Maternal scaffolding	1.80	.81	.11*	2.17	.79	.13**
Context characteristics						
Family Size	-1.06	.73	-.07			
Interactions						
Maternal scaffolding x Maternal education				3.61	1.59	.10*
Average R^2	.21**			.22**		
Average Model F	18.03**			22.31**		

B = unstandardized beta coefficients; SE = standard errors; β = standardised betas
**p*<.05; ***p*<.01

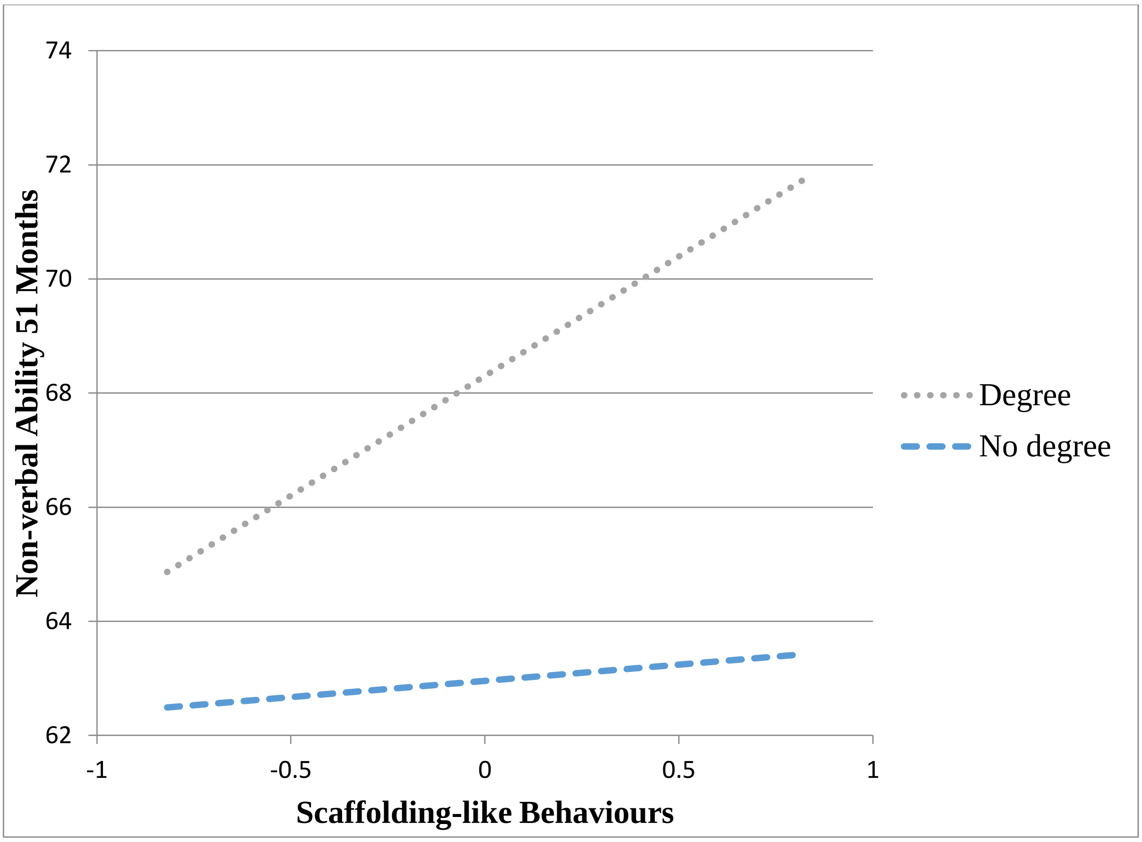

Figure 8.1: Association between maternal scaffolding-like behaviours and child non-verbal ability at 51 months moderated by maternal levels of education

One final analysis was conducted. In light of the significant interaction found between maternal levels of education and maternal scaffolding in relation to child non-verbal ability, it was necessary to test whether similar effects were observed in relation to child verbal ability. The simultaneous regression shown in Table 8.5 was carried out separately for each group of maternal education (less than university degree/university degree or above) with findings showing relatively similar parameter estimates. One notable difference was observed between neighbourhood poverty; the effects of neighbourhood adversity on the language skills of children of less educated mothers were more profound. A moderation analysis between education and neighbourhood effects was carried out using Aiken and West's (1991) procedure, yielding non-significant results.

8.5 Summary of main findings

1. This chapter explored the relevance of maternal scaffolding behaviours at 10 months for child cognitive development at 18 months, and verbal and non-verbal ability at 51 months, taking child, and mother and context characteristics into consideration.
2. Once associations between outcomes of interest, maternal scaffolding behaviours and mother, child and context characteristics were established, a series of five multiple regression models was conducted separately for each of the outcomes on interest.
3. The regression models followed the same structure for each of the three outcome measures: model 1 – child person characteristics; model 2 – maternal person characteristics; model 3 – maternal scaffolding behaviours; model 4 – context characteristics; model 5 – simultaneous model including all items found to be significant at the $p \leq .10$ level. Variables were included in the model if they were found to significantly correlate with individual outcome measures.
4. At 18 months, infant more mature play at 10 months and gender (girl) were found to predict more advanced cognitive ability. Furthermore, children whose mothers had less than a university degree (or a professional qualification) and those experiencing more neighbourhood adversity were likely to show poorer cognitive development.
5. Maternal scaffolding behaviours were not found to be meaningful for predicting child cognitive development at 18 months once child, mother and context characteristics were taken into consideration.
6. More advanced verbal ability at 51 months was predicted by child gender (girl) mothers' older age and higher educational qualifications. On the other hand,

mother not speaking English as a first language, larger family size and higher levels of neighbourhood adversity predicted poorer verbal ability.

7. At 51 months, maternal scaffolding behaviours were found to significantly predict child verbal ability over and above child and mother characteristics. However, once environmental adversity was considered the effect of scaffolding became insignificant.
8. Controlling for child prior ability (at 18 months), child gender no longer predicted verbal ability at 51 months. Yet, the associations between mothers' age, education, and primary language, as well as family size and neighbourhood poverty with these abilities remained stable.
9. In the case of non-verbal ability at 51 months a different pattern of results was observed. Child gender (girl) and mother education (university degree and above) predicted more advanced spatial skills. Contextual factors did not predict, or added significant variance in explaining child non-verbal ability.
10. Higher levels of maternal scaffolding behaviours at 10 months significantly predicted higher child non-verbal ability at 51 months over and above child, mother and contextual factors.
11. Even after taking child prior ability at 18 months, the associations between 51 months non-verbal and maternal scaffolding, child gender, and maternal levels of education remained significant.
12. Maternal levels of education were found to moderate the effects of scaffolding-like behaviours on child non-verbal ability, suggesting a combined effect of maternal educational qualification and higher levels of scaffolding in predicting more advanced non-verbal skills at 51 months.

13. The discrepancies between the models predicting verbal and non-verbal ability at 51 months may suggest that the mechanisms by which these abilities are developed are, to some extent different.
14. The effects of maternal scaffolding at 10 months for predicting child cognitive ability were more evident at later stages of development; this may suggest that early scaffolding behaviours are associated with gains in cognitive ability over time.

CHAPTER 9: THE RELEVANCE OF MATERNAL SCAFFOLDING-LIKE BEHAVIOURS TO CHILD ACADEMIC ATTAINMENT AT AGE 11 YEARS

9.1 Overview of analysis strategy

This final results chapter is aimed at consolidating the findings from previous chapters, using structural equation modelling (SEM) to predict child educational attainment at age 11. The second-order latent construct of maternal scaffolding-like behaviours was found to be meaningful for predicting non-verbal but not verbal abilities at age 51 months, above and beyond child, mother and context characteristics. Thus, the possible paths of influence on child academic attainment were modelled only in relation to non-verbal ability. First bivariate correlations and mean comparisons were performed between child cognitive development and academic attainment outcomes, maternal scaffolding-like behaviours and possible confounding variables. Once significant associations were established paths models were specified. The models were built in a gradual manner, first entering maternal scaffolding-like behaviours and its predictors. Paths between scaffolding, covariates and child non-verbal ability at 51 months were estimated next, followed by paths to child academic attainment at age 11 years. In the final step of the analyses group childcare, representing an additional context, was included as a possible confounding factor, found in other studies to be associated with academic performance (George et al., 2012; Melhuish et al., 2008a; Sammons, 2010; Sylva et al., 2010).

9.1.1 Associations between academic attainment at age 11 and mother, child and contextual factors

Associations between academic attainment at age 11 years and child, mother and context characteristics were tested first. For parsimony reasons only variables found to be significantly associated with child outcomes at age 51 months and 11 years were included in the SEM analyses. Bivariate correlations and mean comparisons were carried out between child cognitive ability and educational attainment at age 11 years and maternal scaffolding, child (gender, play maturity in infancy and cognitive ability at 18 months), mother (age, personality, education, minority status and English first language) and context (family size, neighbourhood poverty and group care experience) characteristics.

9.1.2. The relevance of maternal scaffolding-like behaviours at 10 months in predicting child educational attainment at age 11- a structural equation model

Once association between child academic attainment at age 11 years and study covariates were established a structural equation model was constructed. The analysis was carried out in a stepped manner in Mplus 7.3 (Muthén & Muthén, 2012). A baseline model was specified first. The study covariates found to be associated with KS2 maths and English attainment, were loaded onto the second order latent factor of maternal scaffolding-like behaviours. Next, child non-verbal ability at 51 month was added to the model. In keeping with the findings from chapter 8, direct paths of influence were specified between maternal scaffolding, maternal education, child gender and non-verbal ability measured by a composite measure of the picture similarities and the pattern construction subscales of the British Ability Scales (BAS: Elliott, 1997). To control for previous cognitive ability, a direct path was added between 18 months Bayley MDI scores and non-verbal ability at 51 months.

After constructing the initial model the final research questions were addressed:

1) Are maternal scaffolding behaviours in infancy relevant for predicting child academic attainment at age 11 years? This question was explored by adding

child educational attainment to the structural model. English and maths test scores were entered as separate outcomes that were allowed to correlate. Direct and indirect paths between the scaffolding latent construct, non-verbal ability at 51 months and control variables were tested in relation to age 11 academic attainment.

2) Is group care experience up to 51 months relevant for predicting child academic attainment at age 11 years? In addition to mother, child and context characteristics, a further confounding context variable was explored. In the final step of the analysis, the timing in which children began group-care was added to the model as a possible factor associated with child cognitive ability at 51 months and subsequently with educational attainment at 11 years.

9.2. Associations between English and Maths test results at age 11 years, scaffolding, and covariates

Bivariate correlations were conducted between KS2 English and Maths scores, child non-verbal abilities at age 51 months, maternal scaffolding and study covariates (see Table 9.1). Maternal agreeableness was not used in subsequent analyses, as it was not significantly associated with non-verbal ability or KS2 outcomes. To avoid repetition only associations with KS2 results and other factors will be discussed henceforth. Children whose mothers were showing more scaffolding behaviours at 10 months were likely to show better academic attainment at age 11 years (English r = .19, Maths r = .21), as were children whose mothers were older at time of birth (English r = .21, Maths r = .21). Children were likely to show poorer academic attainment in English at age 11 years if they were born to a larger family (English r = -.17), and both English and maths were likely to be lower if their family resided in a less affluent neighbourhood when they were younger (English *r* = -.14, Maths *r* = -.12; see Table 9.1).

Relatively high, significant positive associations were observed between child cognitive ability at 18 months and later academic attainment (English *r* = .40, Maths *r* = .34, see Table 9.1) and between non-verbal ability at 51 months and later academic attainment (English *r* =.46, Maths *r* =.52, see Table 9.1), whilst there was no significant association between infant play maturity at 10 months and academic attainment at age 11 years. Finally, experience of group care was associated with academic attainment; using a variable documenting start in a group before age 1, between age 1 and 2 years, and after age 2 the younger the start the higher the KS2 scores were likely to be (English *r* = -.22, Maths *r* = -.27) with a similar negative association with non-verbal ability at 51 months (*r*=-.20). To clarify these results one-way ANOVAs were performed to ascertain where the differences between groups occurred (see Table 9.2). Interestingly, all mother, child and context characteristics were also associated with group care experience. Children who experienced group care earlier were likely to show more advanced play abilities at 10 months (*r* = -.10) and have mothers who used more scaffolding-like behaviours (*r* = -.21). Furthermore, earlier uptake of group care was associated with maternal older age (*r* = -.12), smaller family size (*r* = .24) and less neighbourhood deprivation (*r* = .29; see Table 9.1).

Table 9.1: Bivariate correlations between age 11 test results, non-verbal ability at 51 months, maternal scaffolding and covariates, including means and standard deviations in brackets

	1	2	3	4	5	6	7	8	9	10	11
1. English KS2[a]											
2. Maths KS2[a]	.75**										
3. BAS Non-verbal ability [b]	.46**	.52**									
4. Bayley MDI 18 months [c]	.40**	.34**	.37**								
5. Infant play maturity [d]	.08	.08	.11*	.19**							
6. Maternal scaffolding-like behaviour [e]	.19**	.21**	.22**	.21**	.19**						
7. Maternal age	.21**	.21**	.16**	.17**	.02	.18**					
8. Agreeableness [f]	.08	.05	.09	.15**	.00	.26**	.11*				
9. Family size [g]	-.17**	-.10	-.12*	-.07	-.12*	-.15**	.24**	.03			
10. Neighbourhood poverty [h]	-.14*	-.12*	-.15**	-.26**	-.04	-.29**	-.17**	-16**	.08		
11. Group experience [i]	-.22**	-.27**	-.20**	-.22**	-.10*	-.21**	-.12*	.01	.24**	.29**	
Mean	4.71	4.83	65.91	91.87	.15	-.01	30.90	3.83	30.10		
(SD)	(.65)	(.74)	(13.77)	(13.34)	(.13)	(.81)	(5.28)	(.42)	(16.96)		

[a]National English and Maths exams taken at the end of primary school at age 11 years;
[b]Composite measure of picture similarities and pattern construction from the British Ability Scales – 51 months; [c] Bayley 'Mental developmental Index'– 18 months; [d] Infant play maturity recorded at 10 months; [e] Maternal scaffolding-like behaviour recorded at 10 months; [f]Agreeableness – NEO-PI (Costa & McCrea, 1985);
[g]Sibship size (1-4); [h]IMD Child Poverty Index (Noble et al., 2000); [i] Experience of group care –1= group care started before age 1; 2=group care started between age 1 and 2 years; 3= group care started from age 2 onwards
* p<.05 **p<.01

Mean comparisons

To test the associations between English and maths KS2 results and categorical factors, mean comparisons were conducted (see Table 9.2). First one-way ANOVAS were performed to ascertain where the differences occurred in child academic attainment as a function of the age starting group care experience, categorised by year. Children who attended group care in the first year of life showed significantly better English KS2 results compared with children who started group care after age 2 years. In relation to math KS2 results, children who experienced group care in the first year, performed significantly better than children who experienced group care from the second year or later. The same pattern was observed for non-verbal ability at 51 months.

Independent samples t-tests compared children's English and maths test scores comparing those whose mothers spoke English as a first language and those who did not (coded English first language = 0; English not first language = 1), and those whose mother had minority status (coded white British background = 0; minority = 1). Similar patterns were observed for both factors with no significant differences in children's test scores as a function of these constructs (see Table 9.2).

Mean comparisons for maternal education (coded less than a degree=0; degree or above=1) showed that children of mothers who had higher educational qualifications were likely to show better attainment aged 11 years. Finally, gender (coded boy=0; girl=1) was also associated with English test results, females were likely to outperform males. No significant gender differences were observed for maths KS2 results. Non-verbal ability at school-entry age was also only associated with maternal education and child gender. Therefore maternal minority status and whether mothers' first language was English were not used as control variables in subsequent analyses.

Table 9.2: Mean comparisons of non-verbal ability at 51 months, English and maths test results at age 11 years by age starting group care, maternal level of education, minority status, English as first language and child gender

	Non-verbal ability	English KS2	Math KS2
Group care experience			
First year start	72.93 (11.28)	5.07 (.37)	5.38 (.38)
Second year start	65.65 (15.85)	4.78 (.66)	4.90 (.69)
Third or fourth year start	64.59 (13.48)	4.64 (.66)	4.73 (.76)
F / Welch statistic	(2, 395) 9.11**	(2, 16.89) 16.89**	(2, 81.80) 32.69**
English mother's first language			
Yes	66.15 (13.64)	4.70 (.64)	4.82 (.74)
No	62.79 (15.41)	4.70 (.73)	4.86 (.78)
t	1.25	.06	.20
Maternal Minority status			
No	66.32 (13.70)	4.68 (.67)	4.82 (.75)
Yes	64.22 (14.02)	4.80 (.53)	4.86 (.74)
t	1.20	1.40	.36
Maternal Education			
Less than degree	62.33 (13.67)	4.54 (.64)	4.64 (.74)
Degree and above	70.29 (12.67)	4.95 (.59)	5.10 (.67)
t	5.95**	5.80**	5.66**
Gender			
Boy	63.39 (14.55)	4.56 (.71)	4.81 (.78)
Girl	68.39 (12.52)	4.85 (.55)	4.84 (.71)
t	3.68**	4.01**	.39

For one-way ANOVA Welch statistic is specified, as equality of means was not assumed
**$p < .01$

9.3 Maternal scaffolding behaviours in infancy and academic attainment at age 11 years

9.3.1 Baseline models

To determine whether maternal scaffolding behaviours predicted academic attainment at age 11 years, a series of structural equation models were specified. In the first step the factor analysis performed in chapter six to establish the factor structure of scaffolding-like behaviours was conducted. To remind the reader, the model fit statistics were [x^2 (50) = 79.819, *p*=.0047, RMSEA= .039, CFI=.985, TLI=.981]. In the following step, the predictors of maternal scaffolding behaviours were added to the model. The items included were: infant play maturity, maternal age, maternal education, family size and neighbourhood poverty. A well-fitting model was observed [x^2 (104) = 156.116, *p*=.0007, RMSEA= .036, CFI=.970, TLI=.964]. All variables significantly predicted maternal scaffolding-like behaviours. For parameter estimates of individual items see model 1 in Table 9.3. Higher levels of maternal scaffolding behaviours were predicted by infant's more advanced play at 10 months, maternal older age and higher educational qualifications. Less maternal scaffolding behaviours were predicted by larger family size and residing in a more disadvantaged neighbourhood.

Next, child non-verbal ability at age 51 months was added to the model. Informed by the analysis in chapter eight, direct paths were specified from maternal scaffolding behaviours and maternal levels of education to predict non-verbal ability. Child gender and prior cognitive ability were included in this stage of the analysis. A path from scaffolding to child cognitive ability at 18 months was not specified as in the previous chapter scaffolding was not found to predict cognitive ability at that age above and beyond person and context characteristics. To test whether maternal scaffolding behaviours mediated the effects of child play maturity in infancy, maternal age, family size and neighbourhood poverty on child non-verbal ability, indirect effects between these factors were specified. A relatively well-fitting model was established [x^2 (144) = 224.88, *p*<.001, RMSEA= .038, CFI=.952, TLI=.944], (see Model 2, Table 9.3 for parameter estimates).

The relationships between the predictor variables and maternal scaffolding behaviours remained relatively stable between model 1 and model 2. As observed in the previous chapter, child gender (girl), maternal scaffolding-like behaviours and maternal education (university degree or above) were predictive of more advanced child non-verbal ability at age 51 months as was 18 months cognitive ability. Indirect effects were also found. Maternal scaffolding behaviours were found to mediate the positive effects of infant play maturity, and the negative ones of neighbourhood poverty on child non-verbal ability (see Table 9.3). Maternal scaffolding-like behaviours were not found to mediate the effects of maternal older age or larger family size on child non-verbal ability.

Table 9.3: Parameter estimates of SEM including unstandardized and standardised regression coefficients, 95% CIs (LB- lower bound, UB- upper bound), significance and variance explained. Model 1 - predicting maternal scaffolding; Model 2 predicting 51 months non-verbal ability

		Unstandardised				**Standardised**		
		B	**SE**	**LB**	**UB**	**β**	**P-value**	**R^2**
Model 1								
Maternal scaffolding								.24
	Infant play maturity	.98	.30	.38	1.54	.21	<.001	
	Maternal age	.02	.01	.00	.03	.16	.011	
	Maternal education (degree and above)	.17	.08	.02	.32	.29	.014	
	Family size	-.11	.04	-.19	-.02	-.16	.006	
	Neighbourhood poverty	-.01	.00	-.01	-.00	-.25	<.001	
Model 2								
Maternal scaffolding								.21
	Infant play maturity	.92	.30	.33	1.41	.21	<.001	
	Maternal age	.02	.01	.00	.03	.16	.014	
	Maternal education (degree and above)	.16	.08	.01	.31	.28	.020	
	Family size	-.10	.04	-.19	-.02	-.16	.008	
	Neighbourhood poverty	-.01	.00	-.01	-.00	-.22	<.001	
Child non-verbal ability								.21
	Cognitive ability 18 months	.29	.05	.19	.39	.28	<.001	
	Child gender (girl)	3.81	1.30	1.27	6.35	.28	.003	
	Maternal scaffolding	4.87	1.40	.57	6.33	.36	<.001	
	Maternal education (degree and above)	3.45	1.47	2.13	7.60	.15	.012	
Indirect effects via maternal scaffolding								
	Infant play maturity	3.17	1.53	.18	6.16	.03	.037	
	Maternal age	.06	.04	-.01	.12	.02	.082	
	Family size	-.36	.21	-.76	.05	-.02	.081	
	Neighbourhood poverty	-.03	.01	-.05	-.00	-.03	.032	

9.3.2 Are maternal scaffolding behaviours in infancy relevant for predicting child academic attainment at age 11 years?

Once the baseline model was established, child academic attainment at age 11 years was added to the structural model. Maternal scaffolding-like behaviours, maternal age, maternal education, neighbourhood poverty, and child cognitive and non-verbal ability at ages 18 and 51 months respectively were loaded onto maths KS2 results. In the case of English test scores, family size and child gender were controlled for in addition to the above-mentioned items. Given the highly significant correlation between maths and English test results (r=.75, p<.001), these items were allowed to covary. A well-fitting model was produced [x^2 (170) = 251.48, *p*<.001, RMSEA= .035, CFI=.955 TLI=.944]. Maternal scaffolding, maternal age and neighbourhood poverty did not directly predict educational attainment at age 11 in either maths or English. Thus for reasons of parsimony these paths were removed and a more stringent model specified. The fit indices for the stringent model were as follows: [x^2 (176) = 252.69, *p*=.0001, RMSEA= .034, CFI=.957, TLI=.949]. Table 9.4 includes parameter estimates for predictors of English and maths KS2 results, including indirect effects.

The findings of the full model revealed that English and maths test results at age 11 years were associated with different child, mother and context factors. First, English and math attainment at age 11 years were strongly associated (β=.68; S.E =.03; *p*<.001). Better English KS2 performance was associated with child gender (girl) and higher cognitive abilities in the preschool years, both at 18 months and at 51 months. In addition to that, maternal educational qualifications (degree level and above) were associated with better English test results. Having a larger family was negatively associated with English test results; children who have more siblings were likely to show poorer educational achievement in English aged 11 years (see Table 9.4).

In the case of maths KS2 results, children who showed better cognitive abilities in the preschool years and those whose mothers were educated to a degree level or above were likely to show better attainment (see Table 9.4). Child non-verbal ability at 51 months was found to be more strongly associated with math KS2 results than with English KS2 results. The opposite trend was observed for general cognitive skills measured at 18 months. These were more strongly associated with English KS2. It is noteworthy, however, that cognitive abilities at both 18 and 51 months uniquely predicted significant variance in child academic attainment at age 11 years.

Although maternal scaffolding-like behaviours did not directly predict educational attainment at age 11, it was found that child non-verbal ability at 51 months mediated the effects of maternal scaffolding-like behaviours at 10 months on KS2 math (β=.07, S.E.=.03, *p*=.028) and English (β=.05, S.E.= .02, *p*=.037) scores.

The parameter estimates observed in the initial model remained similar; more mature infant play, maternal older age and higher educational qualifications predicted more maternal scaffolding, whilst larger family size and neighbourhood poverty predicted less scaffolding. Similarly, child gender (girl) and higher maternal education directly predicted better non-verbal skills at 51 months. The indirect effects reported in Table 9.3 remained the same, maternal scaffolding behaviours at 10 months mediated the effects of infant play maturity and neighbourhood poverty on child non-verbal skills. See Figure 9.1 for the full model including standardised parameter estimates and standard errors. It is of note that a separate model in which infant play maturity, maternal education and neighbourhood poverty were modelled to predict 18 months cognitive ability was also tested. The model fit statistics were decidedly worse [x^2 (178) = 290.83, *p*<.001, RMSEA= .040, CFI=.942, TLI=.929], thus model was not used further.

Table 9.4: Parameter estimates of structural equation models predicting English and maths academic attainment at age 11 years; including unstandardized and standardised regression coefficients, 95% CIs (LB- lower bound, and UB- upper bound), significance and variance explained.

		Unstandardised				**Standardised**		
		B	**SE**	**LB**	**UB**	**β**	**P-value**	**R^2**
English KS2								.33
	Child gender (girl)	.16	.07	.03	.29	.25	.019	
	Child cognitive ability 18 months	.01	.00	.01	.02	.25	<.001	
	Child non-verbal ability 51 months	.01	.00	.01	.02	.29	<.001	
	Maternal education (degree and above)	.18	.07	.03	.32	.27	.015	
	Family size	-.11	.04	-.18	-.04	-.15	.002	
Indirect effects via child non-verbal ability								
	Maternal scaffolding behaviour	.05	.02	.00	.10	.05	.030	
Math KS2								.32
	Child cognitive ability 18 months	.01	.00	.00	.02	.17	.002	
	Child non-verbal ability 51 months	.02	.00	.02	.03	.42	<.001	
	Maternal education (degree and above)	.20	.09	.03	.37	.27	.019	
Indirect effects via child non-verbal ability								
	Maternal scaffolding behaviour	.08	.04	.01	.16	.07	.028	

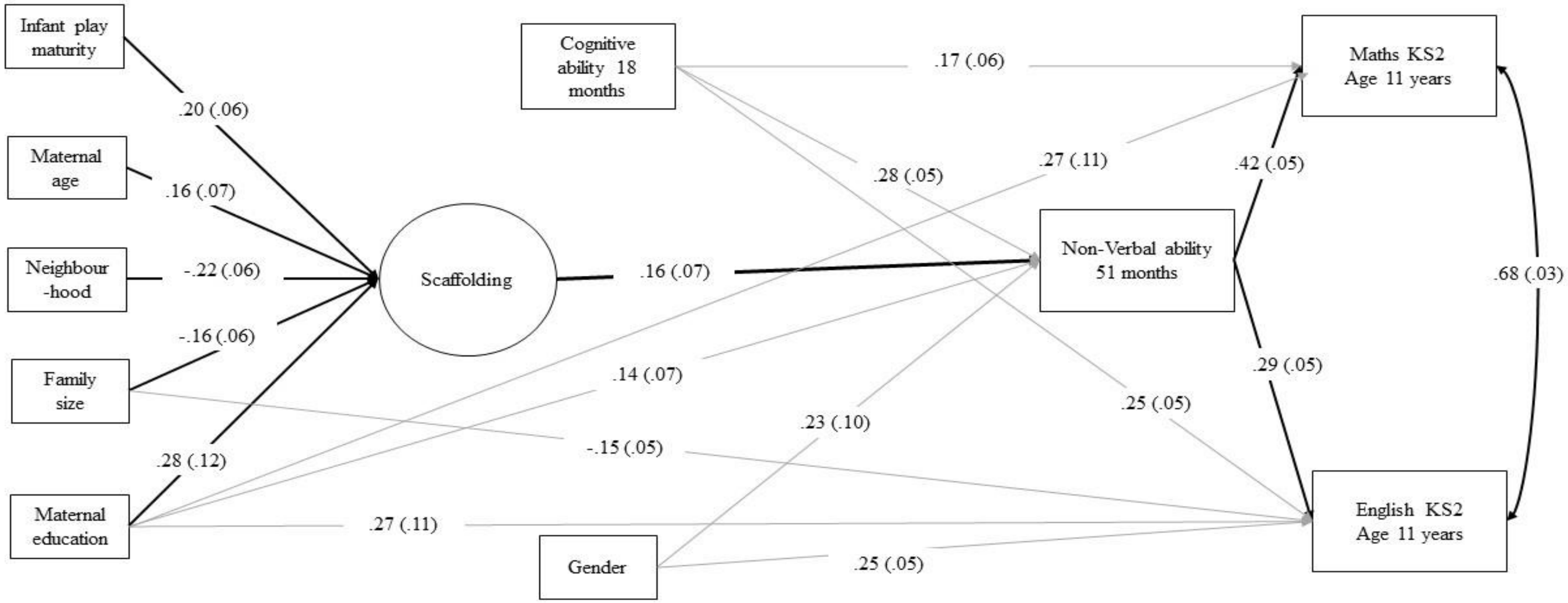

Figure 9.1: Full structural equation model predicting English and maths KS2 results from mother, child and context characteristics; including standardised parameter estimates and standard errors in brackets. All paths are significant at the p<.05

9.3.3 Is group care experience relevant for predicting child academic attainment at 51 months and 11 years?

In the final step the possible role of infant and preschool group child care experience was added to the model as a possible confounding factor likely to influence non-verbal ability at 51 months and academic attainment at the end of primary school. The timing of first attending group care was found to be significant. Specifically, children attending group care in the first year were likely to have higher cognitive development and educational attainment, compared with those who experienced group care later in the preschool years. To test the effects of the timing of group care experience, two dummy variables were entered into the model; the first representing second year start of group care, and the second representing third year or later start. The comparison category was experience of group care in the first year.

Both group care experience dummy variables were loaded onto child non-verbal ability and math KS2 results. A path between 'year three and later exposure' dummy was modelled in the case of English KS2 outcomes. A well-fitting model was obtained [x^2 (201) = 259.58, *p*=.0034, RMSEA= .027, CFI=.967, TLI=.960]. Group care timing was not found to be a significant predictor of child non-verbal ability. Similarly, maths and English KS2 results were not predicted by timing of group care experience. The uptake of group-care starting from the third year onwards reached a near-significant association with poorer non-verbal ability at 51 months (β = -.28, S.E =.15, *p*=.062). The model was modified, removing the paths between group-care timing and academic attainment and leaving the path between year 3 and 4 uptake of group care and non-verbal ability at 51 months. Fit indices for the modified model were [x^2 (190) = 257.31, *p*=.0008, RMSEA=.030, CFI=.962, TLI=.955], suggesting a good fit. However, the effects of the timing of group care on child non-verbal ability remained non-significant.

9.3.4 Multigroup analysis

One final analysis was performed. In chapter 8 it was found that levels of maternal education moderated some of the effects of maternal scaffolding-like behaviours on child non-verbal ability at 51 months. Therefore, it was decided to perform a multigroup invariance analysis to test whether the significant paths observed in the structural equation model were equivalent across maternal education groups. The same model was specified using the factor scores for the second-order latent factor of scaffolding-like behaviours. Maternal education was used as the following grouping variable: ‘Less than a university degree’, ‘University degree and above’, and not as a predictor.

The first model in which all parameters were freely estimated showed a good fit [x^2 (32) = 33.66, *p*=.3869, RMSEA= .016, CFI=.996, TLI=.993]. See Table 9.5 for multigroup analysis in which all variables were freely estimated. At the outset it seemed as if some of variation was observed in some of the parameter estimates as a function of maternal education group. To assess whether these differences were significant each parameter was tested for equality across groups, using the ‘model test’ command in Mplus 7.3 (Muthén & Muthén, 2012). This test computes the ‘Wald statistic’, an omnibus test assessing possible invariances, by describing the possible effects of introducing restrictions to the analysis model (Muthén & Muthén, 2012). An insignificant Wald statistic meant that the paths were equal across the two populations.

Table 9.5: Multigroup analysis, testing for invariance in parameter estimates across two groups of maternal education, all parameters were freely estimated including unstandardized and standardised regression coefficients, 95% CIs (LB- lower bound, UB- upper bound), significance and variance explained

	Less than degree education							**University degree and above**						
	Unstandardised				**Standardised**			**Unstandardised**				**Standardised**		
	B	**SE**	**LB**	**UB**	**β**	**P-value**	**R^2**	**B**	**SE**	**LB**	**UB**	**β**	**P-value**	**R^2**
Maternal scaffolding							.18							.10
Infant play maturity	1.26	.36	.56	1.97	.21	.001		.76	.47	-.16	1.69	.12	.102	
Maternal age	.03	.01	.01	.05	.17	.012		.01	.02	-.02	.04	.05	.540	
Family size	-.05	.06	-.16	.07	-.05	.427		-.22	.07	-.36	-.09	-.24	.001	
Neighbourhood poverty	-.01	.00	-.02	-.01	-.26	<.001		-.01	.00	-.02	.00	-.16	.036	
Child non-verbal ability 51 months							.17							.14
Child gender (girl)	4.77	1.72	1.41	8.13	.35	<.001		2.40	1.74	-1.00	5.80	.19	.150	
Cognitive ability 18 months	.37	.07	.24	.51	.35	<.001		.22	.08	.05	.38	.23	.010	
Maternal scaffolding	.30	1.12	-1.89	2.48	.02	.790		4.41	1.23	2.00	6.81	.27	<.001	
English KS2 11 years							.26							.29
Child gender (girl)	.22	.01	.09	.35	.34	.004		.22	.07	.09	.36	.38	.001	
Child cognitive ability 18 month	.01	.00	.01	.02	.27	<.001		.01	.00	-.00	.02	.17	.049	
Child non-verbal ability 51 months	.01	.00	.01	.02	.23	<.001		.02	.01	.01	.03	.40	<.001	
Family size	-.09	.03	-.16	-.03	-.13	.006		-0.03	.04	-.12	.05	-.04	.449	
Maths KS2 11 years							.20							.31
Child cognitive ability 18 months	.01	.00	.00	.02	.16	.026		.01	.01	-.00	.02	.12	.22	
Child non-verbal ability 51 month	.02	.00	.01	.03	.36	<.001		.03	.01	.02	.04	.52	<.001	

The parameter of interest was scaffolding, thus in the first omnibus test the path between scaffolding and non-verbal ability was tested. A Wald statistic of 6.149 with 1 degree of freedom *p*=.0132 was observed, providing evidence that the effects of maternal scaffolding behaviours on child non-verbal ability were to some extent a function of maternal education, even once the full structural model was estimated. This replicates the findings from chapter 8. Each of the variables included in the model were tested individually for invariances across maternal education groups. The findings revealed no significant differences between the groups in the parameter estimates of any of the other variables.

Next, a model was specified in which all paths were held equal across the two groups. The fit indices were as follows: [x^2 (46) = 54.34, *p*=.1866, RMSEA= .031, CFI=.982, TLI=.977]. Following this a parsimonious model was specified in which the restriction on the path between maternal scaffolding-like behaviours and non-verbal ability at 51 months was removed, allowing for the path to be freely estimated in each of the groups. The model fit statistics did not improve although the model still showed very good fit [x^2 (45) = 49.16, *p*=.0723, RMSEA= .038, CFI=.965, TLI=.956]. In the 'less than degree' group scaffolding did not significantly predict child non-verbal ability at 51 months (β=.04, S.E.=.07, *p*=.612), whilst in the 'degree or above' group, scaffolding significantly predicted more advanced non-verbal ability (β=.25, S.E.=.07, *p*<.001). See Table 9.6 for parameter estimates of the parsimonious model.

The results of the restricted model show similar patterns to those seen in the analysis carried out with the full sample (see Figure 9.1). Infant play maturity and maternal age predicted more scaffolding-like behaviours, whilst family size and neighbourhood poverty predicted lower levels of these behaviours. Similarly, across the two groups, child gender (girl) and prior, more advanced, cognitive ability at age 18 months predicted more advanced non-verbal ability at age 51 months. In the two groups, maths and English KS2 results were predicted by more advanced cognitive abilities at 18 and 51 months. Furthermore, girls in both groups were likely to outperform boys, in English KS2 exams, whilst children born into larger families were likely to perform less well in English compared with children born to smaller families. Table 9.6 includes parameter estimates of the parsimonious multigroup comparison model.

Table 9.6: Multigroup analysis, restricted model testing for invariance in parameter estimates across two groups of maternal education; including unstandardized and standardised regression coefficients, 95% Cis (LB- lower bound, UB- upper bound) significance and variance explained

	Less than degree education							**University degree and above**						
	Unstandardised				**Standardised**			**Unstandardised**				**Standardised**		
	B	**SE**	**LB**	**UB**	**β**	**P-value**	**R^2**	**B**	**SE**	**LB**	**UB**	**β**	**P-value**	**R^2**
Maternal scaffolding							.14							.10
Infant play maturity	1.08	.29	.52	1.65	.18	<.001		1.08	.29	.52	1.65	.18	<.001	
Maternal age	.02	.01	.01	.04	.15	.010		.02	.01	.01	.04	.15	.010	
Family size	-.12	.05	-.21	-.03	-.14	.006		-.12	.05	-.21	-.03	-.14	.006	
Neighbourhood poverty	-.01	.00	-.02	-.01	-.22	<.001		-.01	.00	-.02	-.01	-.22	<.001	
Child non-verbal ability 51 months							.12							.19
Child gender (girl)	3.72	1.21	1.35	6.10	.28	<.001		3.72	1.21	1.35	6.10	.28	<.001	
Cognitive ability 18 months	.29	.05	.19	.40	.28	<.001		.29	.05	.19	.40	.28	<.001	
Maternal scaffolding	.57	1.12	-1.63	2.77	.04	.612		4.21	1.19	1.87	6.17	.25	<.001	
English KS2 11 years							.26							.26
Child gender (girl)	.22	.05	.13	.31	.36	<.001		.22	.05	.13	.31	.36	<.001	
Child cognitive ability 18 month	.01	.00	.01	.02	.23	<.001		.01	.00	.01	.02	.23	<.001	
Child non-verbal ability 51 months	.01	.00	.01	.02	.29	<.001		.01	.00	.01	.02	.29	<.001	
Family size	-.07	.03	-.12	-.02	-.10	.010		-.07	.03	-.12	-.02	-.10	.010	
Maths KS2 11 years							.23							.26
Child cognitive ability 18 months	.01	.00	.00	.01	.14	.012		.01	.00	.00	.01	.14	.012	
Child non-verbal ability 51 month	.02	.04	.02	.03	.41	<.001		.02	.04	.02	.03	.41	<.001	

9.4 Summary of main findings

1. Taking child, mother and context characteristics into account, maternal scaffolding behaviours were found to directly predict child non-verbal but not verbal ability at 51 months. The possible associations between scaffolding-like behaviours in infancy and subsequent academic attainment at age 11 were hypothesised to relate to non-verbal ability at school-entry age.
2. A structural equation model was specified in which child, mother and context characteristics were predicting the second-order factor of maternal scaffolding-like behaviours.
3. In keeping with the findings from chapter 7, infant more mature play at 10 months, maternal older age and higher educational qualifications (a degree or above) predicted higher levels of maternal scaffolding behaviours, whilst having a larger sibship size and living in a less affluent neighbourhood predicted the lowered levels of scaffolding.
4. In keeping with the findings from chapter 8, child gender (girl), more maternal scaffolding-like behaviours and mothers' higher levels of education were associated with more advanced non-verbal ability at age 51 months.
5. Maternal scaffolding-like behaviours were found to mediate the effects of infant advanced object play at 10 months, and neighbourhood poverty on non-verbal ability at 51 months.
6. Math KS2 educational attainment at age 11 years was directly associated with more advanced cognitive ability at age 18 months and with spatial ability at 51 months as well as higher levels of maternal education. Likewise, better performance in English KS2 tests at age 11 years was directly

predicted by these two factors. Yet, English academic attainment was also directly associated with child gender (girl) and with smaller family size.

7. Non-verbal ability at 51 months fully mediated the effects of maternal scaffolding-like behaviours on both math and English KS2 results at age 11 years.
8. The age of onset of group care experience was not found to be associated with child non-verbal ability at 51 months or with educational attainment at age 11 once other factors were taken into account.
9. The association between maternal scaffolding-like behaviours and child cognitive and academic abilities remained stable even after taking the possible confounding effects of childcare into consideration.
10. Controlling for child, mother and context characteristics, maternal scaffolding behaviours in infancy directly predicted non-verbal ability at age 51 months, and indirectly predicted educational attainment at age 11 years.
11. To assess whether the relationship between child, mother and context characteristics, maternal scaffolding and child cognitive and academic abilities differed as a function of maternal level of education a multigroup comparison was conducted.
12. Parameter estimates between maternal-scaffolding-like behaviours and non-verbal ability differed significantly between mothers who were educated to a degree level and above and mothers who did not have a university degree. In keeping with the findings from chapter 8, this finding suggests that children of more educated mothers who were presenting more scaffolding-like behaviours at 10 months were likely to show more advanced non-verbal ability at 51 months.

CHAPTER 10: DISCUSSION

10.1 Summary

The process of scaffolding consists of age-appropriate contingent instruction that is cognitively and emotionally supportive, aimed at promoting child autonomy. Several person and context characteristics have been found to predict individual variations in scaffolding, in turn predicting child intellectual development. By studying a large and relatively diverse sample in the English context, the present study aimed to contribute to the literature in the following ways: first, by exploring whether behaviours akin to the four dimensions of scaffolding would be identifiable during mother-infant play interaction; second, by investigating the factors likely to influence individual variations in these behaviours; third, by testing the relevance of these behaviours for child cognitive abilities in infancy and at the end of the preschool period; and fourth, by testing the relevance of these behaviours for child academic achievement at the end of primary school. The results partially supported the study hypotheses.

Supporting hypothesis one, the findings showed that maternal behaviours in interaction with their 10-months olds corresponded with the main facets of scaffolding. It was further demonstrated that these behaviours could be represented by one overarching factor labelled 'scaffolding-like behaviours'. Addressing hypothesis two, the extent to which mothers presented these behaviours was associated with child play behaviour, mothers' demand (age, ethnicity and primary language); force (agreeableness); and resource (levels of education) characteristics, as well as contextual factors (family size and neighbourhood poverty). In relation to hypothesis three, the relevance of maternal scaffolding-like behaviours in infancy for child cognitive abilities in the preschool years reflected a fragmented account. After considering person and context characteristics, maternal scaffolding-like behaviours were associated with children's non-verbal ability at 51 months, a relationship moderated by maternal levels of education. This pattern was not seen for verbal ability measured at the same time point or cognitive ability tested at 18 months, here contextual factors were found to be more meaningful. Finally, testing hypothesis four, it was found that non-verbal ability at 51 months mediated the effects of maternal scaffolding behaviours on children's academic attainment at age 11 years. In the sections below each of the hypotheses will be addressed and the findings discussed in light of previous research evidence. This is followed by a discussion on the study's strengths and limitations and possible future directions, concluding with final remarks.

10.2 Factor structure of scaffolding-like behaviours

Despite definitional and methodological differences the four dimensions of scaffolding, whether explicitly or not, repeatedly appear when scaffolding is under investigation. In this study maternal behaviours corresponding to the four dimensions of scaffolding were recorded during play interactions when children were 10-months. It is important to mention that these recorded play sessions were originally administered by the FCCC team to assess maternal sensitivity in general terms, and not in the context of learning-based activities. However, given that the interactions included apparatus potentially challenging for children of that age to 'solve', it was hypothesised (hypothesis one) that mothers' behaviours could be interpreted in the context of scaffolding dimensions, meaning that mothers may show specific instruction behaviours based around the play materials provided.

In the piloting stage, behaviours similar to those described by Wood and his colleagues (1976) as part of the process of scaffolding were coded. These were divided in line with the four dimensions of scaffolding. Mothers' behaviours were mainly recorded on the basis of impression codes alluding to the extent to which the mother was presenting a specific instruction-related activity. The ensuing analyses revealed a one-factor solution including aspects of contingency, cognitive support and autonomy promoting language. Emotional support was not found to be part of the factor structure. It is possible that the use of emotional-affective language was not associated with mothers' propensity to present scaffolding-like behaviours in the pilot sample. What is more, as infant frustration was practically non-existent, it was impossible to assess maternal reaction in the face of a frustrated infant. Unlike Landry and her colleagues (2006) who found four main dimensions of the overarching construct of maternal responsiveness (conceptualised as scaffolding support), the pilot study revealed just one factor structure. It may be that the pilot sample size used (N=51) was not sufficiently large to reveal several factors, yet the internal reliability suggested a good fit. Irrespective of the sample size, the pilot study results revealed that the extracted factor showed adequate validity and reliability.

The extracted factor was labelled 'scaffolding-like behaviours'. The decision to name the factor in this way was motivated by the way in which scaffolding-related behaviours were recorded in this study. Essentially, the current investigation focused on mothers' instruction-based behaviours coding mother behaviours separately from infant activity, and not in a sequential manner. Consequently their behaviour could not be defined as scaffolding in the traditional, bi-directional sense. Nevertheless, higher levels of mothers' scaffolding-like behaviours were found to be positively associated with infant more mature play, recorded in the same interactions but coded separately. This reflects to some extent the bi-directional nature of the activity, and support previous findings by Bigelow and colleagues (2004), suggesting that year-old infants were likely to show more ‘functional play’ when their mothers were showing higher levels of scaffolding behaviours.

The pilot study results suggested that the coding scheme was both valid and reliable, thus, a sample of 400 mother and child dyads was randomly selected. The selection criteria specified that in addition to 10-months observation data, children should have data pertaining to cognitive ability collected at 51 months. To test whether the pilot study results translated into the larger sample a factor analysis was carried out. The variables used were contingent response, cognitive support, emotional support, structure, demonstration, and autonomy promoting language. The factor analysis with the larger sample revealed a different pattern of results.

The discrepancies in the results between the pilot study and the main study may be due to a number of factors associated with methodology. First, following discussions with collaborators it was suggested that the behavioural codes could be more explicit. In light of these discussions, the coding scheme was further refined (see Appendices A and C). In order to capture the intensity of maternal behaviours more explicitly, the frequencies of verbal and physical instruction strategies were recorded, and then converted into Likert scale type codes from 0 = minimal to 3 = substantial. Apart from maternal contingent response, all ratings were based on frequency counts transformed into behavioural scale codes. Some suggest that the use of frequency counts in observations may mean that some of the bi-directional qualities of an interaction are lost (Bakeman & Gottman, 1997). Yet, it could be argued that, when wishing to sample the intensity of a specific behaviour, frequencies may prove a more suitable option (Aspland & Gardner, 2003), whilst some suggest that combined impression codes and frequency counts, capture observed parental behaviours most accurately (Darling & Steinberg, 1993).

In the larger sample, physical instruction behaviours (structure and demonstration) were no longer part of the overarching latent factor. Model fit was not achieved whilst these two factors were included in the analyses. It is possible that by trying to quantify the way in which mothers physically structured the interaction around the child, the quality of such activity was somewhat lost. The difference in the results may have also been associated with the inclusion of maternal emotional support. The results of the pilot study suggested that in that specific sample of 51 mother-infant dyads, emotional support was not part of the overarching construct of scaffolding-like behaviours. In the main study sample of 400, maternal emotional language was not documented. However, as the literature consistently suggests that emotional support is meaningful for the process of scaffolding to be successful (Hughes, 2015; Hoffman et al., 2006; Landry et al., 2006; Mulvaney et al., 2006; Neitzel & Stright, 2003, 2004; Wood et al., 1976), it was decided to use previously coded counts of maternal positive emotional expressivity already available in the FCCC database.

The final reason for the inconsistent results may be associated with the type of analyses preformed in each stage. A principal component analysis (PCA) was performed in the pilot study, whilst a factor analysis (FA) including first and second order factors was performed in the main study. A PCA is normally used when developing an instrument, for exploring and reducing data (Dunteman, 1989) whereas, a FA is carried out based on a theoretical model, with the aim of extracting meaningful factors, whilst considering measurement error (Bentler & Kano, 1990). Some argue that the two methods yield similar results (Velicer & Jackson, 1990), whilst others have challenged this view (Bentler & Kano, 1990). In the context of the present investigation, the pilot study included a relatively small sample and was exploratory in nature, thus more fitting for a PCA. In the larger sample, a hypothesized model specifying one higher-order factor (scaffolding-like behaviours) could be tested against the data- thus a FA was more suitable.

It is noteworthy that the way in which the FA model was specified was somewhat different to the way in which the PCA was conducted. In the pilot study the behavioural categories from each play segment (book, ring-stacking toy and shape-sorting toy) were summed and averaged; a PCA was carried out on the mean composite measures. In the larger sample a first order FA was performed on individual behaviour codes from each of the three play segments, meaning that instead of adding up and averaging each code, it was empirically tested whether the behaviours observed in each segment represented a consistent pattern of the activity in question. This corrected for possible measurement, or random errors said to regularly exist when real data are analysed (Bentler & Kano, 1990). It was important to perform the analysis in this manner as a previous study with a sub-sample of the FCCC, using a growth modeling approach with these parent-infant interactions showed variations in maternal mood and levels of sensitivity across play segments (Malmberg et al., 2007). It is of note that taking a different approach, and performing a multilevel CFA may have been preferential. As the activities coded were qualitatively different (reading a book vs playing with a toy), a multilevel CFA may have revealed more nuanced differences between and within dyads, giving a more accurate picture of context effects.

When reflecting on the disparities between the pilot and the main study, one must acknowledge that these were relatively stark. It is possible that all of the explanations mentioned above had a role to play in these differences. The factor likely to be most influential, however, is revising the coding scheme from impression-based codes to frequency counts. Changing the coding system is likely to have generated a qualitative difference in the way in which scaffolding was captured in the two studies, which could explain the differences in the factor structure and its correlates. Despite the distinct differences between the pilot and the main investigations, it was important to report the results for both studies, and to openly present the process of developing the observation tool. The current evolution of the coding scheme is by no means perfect. The scheme assesses scaffolding in general terms, not taking into account ‘contingent shifting’. This means that Wood and colleagues’ (1975; 1976; 1978) traditional approach to scaffolding is not fully captured. In terms of design, the scheme is better-aligned with work carried out by Landry and colleagues (2006) in which responsive instruction behaviours (or scaffolding support) were coded using a combination of ratings and frequencies.

The main study results provided empirical support for one overarching factor consisting of contingent response and verbal input reflecting cognitive support, emotional support and transfer of responsibility. As some researchers tested each dimension separately (Landry et al., 2006; Neitzel & Stright, 2003; 2004), a latent class analysis was conducted to ascertain whether mothers’ behaviours should be tested individually or as one overarching factor. It could be argued that scaffolding-like behaviours are primarily driven by contingent response, whereas the type of response (verbal input in this case) is secondary, being reliant on the mother to ‘correctly’ respond to her child’s behaviour (McFadden & Tamis-LeMonda, 2013) . The findings, however, showed that the most suitable solution (five classes) was one in which a linear increase pattern for all four behaviours was observed, suggesting that the extracted higher order factor could be treated as one continuous variable.

Given the results of the analysis showing that the class structure was comparable to the factor structure extracted in the preceding step, it could be argued that carrying out a LCA was redundant. Conjecture is therefore offered in light of the latent class analysis. The LCA outcomes suggest that mothers, whose behaviour was deemed more contingent, were also presenting higher levels of verbal input. If a different class solution was extracted, for example a group of mothers in which contingency and verbal input were diverging, it could be assumed that in some cases mothers were contingent but not verbal, or vice versa. If this kind of discordant behaviour was observed some assumptions associated with the idea of 'fixed failure feedback' – when mothers respond to the child at the same level of intervention even after the child failed to carry out a task (Carr & Pike, 2012) would be upheld. In this instance mothers who were repeatedly talking at the child, but were failing to respond contingently to the child behaviour could have been considered to present fixed failure feedback. It was not the case in this investigation, suggesting that verbal input and contingency in this study are interlinked. It may be that mothers who were more verbal were categorised as more responsive. One must therefore acknowledge that this could have skewed the observational data toward mothers who were using more verbal input.

Irrespective of the discrepancies between the pilot study and the main investigation, and the possibility that contingency and verbal input were, to a large extent, interrelated, the first hypothesis was thus empirically supported. Maternal behaviours reflecting the four main aspects of scaffolding can be observed in semi-structured play interaction as early as 10 months. These behaviours can be treated as part of a higher-order latent construct of scaffolding-like behaviours. The findings support the notions put forward by Netizel and Stright (2003) and more recently by Hughes (2015) that interactions in which scaffolding behaviours are under investigation, include support in four domains - contingency, emotional, cognitive and autonomy. This also supports Pea's (2004) assertion that scaffolding can be observed organically in interactions between parents and their children; interactions that are not aimed specifically at problem solving, but could inadvertently promote learning and skill acquisition.

10.3 Individual differences in scaffolding-like behaviours

An ecological approach was taken to explore the possible individual variations in mothers' propensity to use scaffolding-like behaviours in infancy. Following Bronfenbrenner and Morris's (2006) bioecological framework, maternal scaffolding-like behaviours were treated as the *proximal process;* an enduring type of interaction experienced by the developing child, likely to promote learning. The possible relevance of person and context characteristics to the proximal process in question was tested. In previous scaffolding-focused investigations specific person and context characteristics were tested. For example, Neitzel and Stright (2004) looked at maternal personality traits, whilst others have explored parenting styles (Carr & Pike, 2012; Pratt et al., 1988), and mental health (Hoffman et al., 2006) and their associations to parental scaffolding. However, one specific study (Mulvenay et al., 2006) adopted an ecological approach, testing several child, mother and context characteristics in relation to mother-child scaffolding at age 6 years.

The approach taken in this investigation is similar to that implemented by Mulvaney and colleagues (2006); maternal scaffolding-like behaviours were treated as a part of a larger ecological system. Unlike Mulvaney and his colleagues, this study introduced a number of factors not previously tested in relation to scaffolding such as maternal age, family size and neighbourhood adversity. In the first stage of the analyses zero-order correlations revealed that mothers' propensity to use verbal scaffolding-like strategies was significantly associated with all factors except child gender and temperament. In the case of the former, the findings are in line with previous studies in which parental scaffolding did not differ as a function of child gender (Carr & Pike, 2012; Landry et al., 2006; Mulvaney et al., 2006; Pratt et al., 1988). In relation to the latter, the literature is less consistent. Associations between child temperament and scaffolding were previously shown by Neitzel and Stright (2004), yet Mulvaney and his colleagues (2006), found no such associations. The findings from this study support Mulvaney's findings.

The multivariate analysis carried out in the second step revealed some meaningful associations between the proximal process (scaffolding-like behaviours) and the remaining factors. In keeping with Bigelow and her associates (2004), more mature infant play predicted higher levels of maternal scaffolding-like behaviours. This association remained even after taking all other variables into consideration. As consistently found in previous studies, scaffolding was positively associated with mothers' educational qualifications (Carr & pike, 2012; Laosa, 1980; Neitzel & Stright, 2003, 2004; Rogoff et al., 1993). Scaffolding can be understood in the context of a socio-cultural framework, thus, it is by no means surprising that Western mothers who have more educational qualifications would be inclined to treat a play interaction as a learning opportunity (see Hart & Risley, 1995), transmitting specific cultural Western values associated with problem-solving and reasoning. Interestingly, maternal age, likely to be highly associated with maternal levels of education, uniquely explained variation in mothers' behaviours. Older mothers were likely to use more scaffolding-like strategies, a relationship that became more pronounced once risk factors such as larger family size and neighbourhood poverty were taken into account. This may suggest that the negative effects of young childbearing age is interlinked with multiple risk factors and does not act in isolation (Moore & Brooks-Gunn, 2002; Tang et al., 2014; Turley, 2003).

Mothers' more agreeable personality was also found to uniquely explain significant variation in scaffolding-like behaviours. Previous findings by Mulvaney and colleagues (2006) showed no significant associations between these factors. It is possible that the inconsistency in outcomes between Mulvaney et al. and this study are related to a number of factors. First, Mulvaney and colleagues included in their analyses maternal sensitivity alongside child and mother cognitive abilities; these factors were not included in the present analysis, but are likely to explain a large proportion of variance in scaffolding. Second, their method of observation treated scaffolding bi-directionally, recording mother and child behaviour concurrently. It might be that mothers' personality traits explain maternal scaffolding-like behaviours more readily when recording only mothers' behaviours (see Neitzel & Stright, 2004), rather than the actual process, as seen in Mulvaney et al. (2006).

Contextual risk factors and some maternal characteristics were associated with reductions in scaffolding-like behaviours. Mothers from minority background were likely to show less scaffolding-like behaviours than mothers of white origin. This mirrors recent findings by Bae and colleagues (2014) in a large American sample, showing that mothers from Hispanic and African American background were likely to use significantly less scaffolding strategies than European American mothers. Additionally, in the current study mothers for whom English was not a primary language were likely to present less scaffolding-like behaviours. This finding was to be expected, as the coding scheme was largely based on language input. It may have been that reductions in scaffolding support provided for mothers who did not speak English as a first language were association with language difficulties. A sensitivity analysis for mothers who spoke English as a primary language may have addressed this issue. Yet, the number of women who spoke English as a second language was relatively small

(7%), meaning that running a sensitivity analysis may not yield significant differences. Nevertheless, future studies should adopt this strategy, which may provide a more valid representation of the coding scheme.

Factors in the wider context were also shown to be meaningful for individual differences in scaffolding behaviours. Larger family size and neighbourhood adversity were both associated with less maternal scaffolding. This suggests that pressures within and outside the home may constrain a mother’s ability to interact with her infant in a more contingent and enriching manner. These findings illustrate that, alongside mother and child characteristics, more distal risk factors are also meaningful in explaining maternal scaffolding-like behaviours.

A number of factors previously found to be associated with individual variations in scaffolding were not found to be meaningful for maternal scaffolding behaviours in this investigation. Maternal mental health and attitudes towards childrearing, adverse home environment and family composition did not predict individual differences in scaffolding. These disparities may be due to a number of reasons. In relation to maternal mental health, in this study around 10% of mothers scored above the clinical cut-off of 13 on the EPDS (Matthey, 2008), suggesting that a marked number women in this subsample experienced varying levels of depression. Irrespective of that, mothers’ depressive symptomatology in this sample was not associated with socio-demographic factors, said to exacerbate the detrimental effects of poor mental health on the way in which mothers interact with their children (McFadden & Tamis-LeMonda, 2013; McLoyd, 1998). This may explain why a significant association between maternal mental health and scaffolding was not observed. Conversely, mothers’ attitudes towards childrearing correlated moderately with most of the demographics included in the models, which may have diluted its effects.

In relation to family composition, others have found meaningful relationships between mothers' marital status and maternal behaviours with their infants (McFadden & Tamis-LeMonda, 2013), yet, this investigation did not reveal such results. It is possible that the lack of effect was associated with the inclusion of more strongly related factors in the model. What is more, McFadden and Tamis-LeMonda's sample consisted of low-income families, in which the buffering role of being married may be more profoundly experienced (Fletcher, 2009). Finally, the effects of adverse home environment, measured by the FCCC Environmental Adversity Index (EAI), did not predict scaffolding-like behaviours in infancy. The EAI measures some aspects of household chaos such as overcrowding, said to be an indicator of environmental confusion (Matheny, Wachs, Ludwig, & Phillips, 1995), but generally this scale measures household poverty. The EAI was highly associated with neighbourhood adversity; those experiencing more household poverty were also likely to experience higher levels of neighbourhood poverty. This indicates that in families experiencing higher levels of disadvantage overall, the larger community context may influence parenting practices more readily than poverty experienced in the home. Furthermore, the distribution of the EAI was skewed, whilst the neighbourhood poverty item, measured by the index of multiple deprivation (Noble et al., 2000), had a larger spread of values and was normally distributed, thus likely to be a better indicator of adversity experienced by the family.

When investigating individual differences in scaffolding it became necessary to conduct multiple imputation for missing data. Even though the discussion refers to the analyses carried out with the imputed datasets, it is essential to briefly discuss some of the differences observed between the original and the imputed datasets. The main differences between these data were observed in the associations between contextual risk factors and mothers' behaviours. In the original data, home adverse environment significantly predicted mothers' behaviours, whilst larger family size and neighbourhood adversity did not. In the analyses performed with the imputed data the opposite pattern was seen. This supports the 'missing at random' assumption (Rubin, 1987); mothers who did not report on mental health and personality (the missing items) were likely to have a greater number of children, and experience more neighbourhood poverty. Determining whether these mothers were more or less depressed or agreeable is impossible, yet it can be deduced from this pattern of missingness and the analyses that followed, that mothers experiencing elevated levels of risk might be less inclined to respond to questions that are more sensitive in nature. This supports previous findings showing that missingness is often associated with disadvantage (Melhuish, Belsky, Leyland, Barnes, & the NESS team, 2008b; Wang, Schmitz, & Dewa, 2010), but also indicative that any interpretations should be made with caution, as imputed data cannot be treated as 'real' data.

Despite its exploratory nature, overall hypothesis two was supported, particularly by identifying the relevance of environmental adversity for individual variations in maternal scaffolding-like behaviours. However, factors such as parenting styles and depressive symptoms, previously shown to be predictive of maternal scaffolding behaviours, were not found to explain significant variations in mothers' behaviours in the current study.

10.4 The relevance of scaffolding-like behaviours to predicting child intellectual abilities

The third hypothesis of the current study predicted a positive association between maternal scaffolding-like behaviours and child cognitive abilities. Being an activity that promotes reasoning and problem-solving abilities, contingent scaffolding is expected to relate to child intellectual development. To test for associations with cognitive development, multivariate regressions analyses were performed to predict child cognitive ability at 18 months and verbal and nonverbal ability at 51 months. To examine the fourth aim of the study associations were examined with academic attainment at age 11 using a full structural equation model.

10.4.1 Cognitive ability in the preschool years

The hypothesis that maternal scaffolding-like behaviours will predict child intellectual development over and above proximal and distal factors was partially supported. Associations between maternal scaffolding-like behaviours and child cognitive development at 18 and 51 months were observed for some but not all aspects of cognitive development. After taking into account person and context characteristics, scaffolding measured at 10 months significantly predicted child non-verbal ability at 51 months, but not verbal ability.

After considering persons and context characteristic, significant associations between maternal scaffolding at 10 months and child cognitive development 8 months later were not observed. At 18 months, more developed cognitive ability was associated with 10-month infant play maturity. The measure used was relatively crude, however it captured infants' emerging motor and cognitive skills. Infant play was deemed more mature if the 'task' was solved; i.e. the infant manipulated the toys as intended. It is possible that infants, who showed better 'problem-solving ability', were able to infer cause and effect, which in turn promoted further learning (Goswami, 2015). Gender was also found to be meaningful for predicting 18 months cognitive ability. Although some argue that there is little and contrasting support for gender differences in infant cognitive ability (Halpern, 2007; Miller & Halpern, 2014; Spelke, 2005), in the current study girls were found to show higher cognitive ability at 18 months, a difference that remained stable across development.

Mother and context characteristics were also associated with infant cognitive ability at 18 months. In keeping with a large body of literature, in this study higher maternal educational qualifications were predictive of higher infant cognitive ability (Bradley & Corwyn, 2002; Eccles, 2005; Davis-Kean, 2005; Harding, 2015; Magnuson, 2007). Infants of mothers who were educated to a university degree level or above were likely to outperform those whose mothers were less educated. Maternal education was the only person characteristic markedly associated with infant 18 months cognitive ability after taking all other factors into account. Maternal minority status was initially found to predict lower cognitive ability at the same time point. Yet, this effect became non-significant once ward-level poverty was taken into account. This may suggest that minority status and area poverty interact in some way. It is possible that poverty underpins the associations between maternal ethnicity and child cognitive development (Conger & Donnellan, 2007; Davis-Kean & Sexton, 2009).

At 51 months maternal scaffolding-like behaviours were found to be more relevant to child cognitive development, but the strength and significance level of this relationship varied according to the type of cognitive ability under investigation. Verbal and non-verbal abilities were treated separately in this study. Even though these dimensions could be considered part of an overarching ‘general cognitive ability’ (Keith, Low, Reynolds, Patel, & Ridley, 2010), the four BAS subscales used in this investigation (verbal comprehension, naming vocabulary, pattern construction and picture similarities) naturally split into verbal and non-verbal dimensions. What is more, in previous scaffolding research (Smith et al., 2000) the distinction between verbal and non-verbal abilities was made, finding that maternal verbal scaffolding at age 3 years was associated with both. Yet, they also showed that maternal scaffolding was only associated with gains in non-verbal ability, and especially for children experiencing biological risk.

In similar fashion to 18 months cognitive ability, higher verbal ability at 51 months was associated with child gender (girl), and more maternal educational qualifications. In addition to that, children of older mothers were likely to have better verbal ability at the same time point, generally supporting previous findings (Sutcliffe et al., 2012). Children of mothers from minority background and those who did not speak English as a first language were likely to have less advanced verbal ability at 51 months. The effects of the former became non-significant once contextual risks were introduced, mirroring the 18 months outcomes, and further supporting the assertion that the effects of ethnicity on subsequent abilities are likely to be a function of poverty-related factors. Likewise, maternal scaffolding-like behaviours were initially predictive of higher verbal ability but became non-significant with the introduction of contextual risk factors. The effects of living in a disadvantaged neighbourhood and being part of a larger sibship outweighed the possible positive effects maternal scaffolding behaviours may have had on verbal ability.

In the case of non-verbal ability a different pattern of results was observed. In support of the study’s third hypothesis, maternal scaffolding-like behaviours predicted non-verbal ability at age 51 months, above and beyond person and context characteristics. In fact, the only factors found to be meaningful for predicting more developed non-verbal ability (in addition to scaffolding) were child gender (girl), and higher levels of maternal education. More mature infant play at 10 months was significantly associated with 51 months non-verbal ability, but once maternal scaffolding-like behaviours were taken into account this effect disappeared. It is possible that the effects of more mature play on subsequent non-verbal ability were mediated by maternal behaviours. Infants who were more able at 10 months may have elicited more contingent response form their mothers, which in turn enhanced child subsequent learning and development. This suggests that although infants are thought to be a less active partner during early interactions with caregivers, they are likely to have a significant role to play in shaping their own development (Bornstein et al., 2007; Lugo-Gil & Tamis-LeMonda, 2008; Song, Spier, & Tamis-LeMonda, 2014).

It is of interest that child verbal and non-verbal skills were measured at the same time point (51 months), yet, maternal scaffolding-like behaviours significantly predicted the latter only. On the other hand, contextual risk factors were associated with the development of verbal ability but not visual-spatial skills. In this study, verbal ability was more directly associated with the living environment of the developing child, whilst non-verbal ability was better explained by mother and child behaviours and prior abilities. This finding suggests a specific role of scaffolding in supporting the development of problem solving skills. Given the characteristics of the coding scheme it was anticipated that maternal scaffolding-like behaviours in this investigation would have had a more significant relationship with the development of verbal ability. This outcome is inconsistent with previous findings in which verbal scaffolding was directly predictive of subsequent verbal ability (Dieterich et al., 2006; Hammond et al., 2012; Smith et al., 2000). However, even though the method used to measure scaffolding-like behaviours largely relied on verbal input, it is possible that in elaborating on the task, making references to cause and effect, and encouraging the infant to attempt solution mothers facilitated the growth in reasoning and goal-directed activities, partially supporting Smith and colleagues' (2000) findings.

It could be argued that the findings of this study show that non-verbal skills are more closely associated with mothers' capabilities (education) and a more didactic style of interaction, which may be indicative of shared genetic influences for the development of such skills. However, even when taking 18 months cognitive ability into account, though somewhat reduced, the same pattern of effects was observed for both verbal and non-verbal abilities at 51 months. This suggests that environmental factors uniquely influenced change in these abilities, reducing the likelihood that the effects observed are purely due to confounding genetic influences (Hughes & Ensor, 2009). It is of note, however, that a recent investigation showed that genetic factors are significant contributors in parental input during interactions with their children (Dale, Tosto, Hayiou-Thomas, & Plomin, 2015). Yet, Dale and colleagues' analysis was carried out with a sample of twins, meaning that the findings are family general rather than child specific, and likely to be low in accuracy. Future scaffolding studies may want to adopt a genetically sensitive design, perhaps with adoptive siblings, to try and address genetically influenced individual differences in the propensity to and efficacy of these behaviours.

A notable finding when predicting child non-verbal ability is the interaction observed between maternal levels of education and scaffolding-like behaviours. Children of mothers who were educated to a degree level or above and were showing more scaffolding behaviours were likely to show more advanced non-verbal skills at 51 months. A number of competing interpretations for this outcome are offered. Firstly, Neitzel and Stright (2004), found similar interactions between maternal education and specific scaffolding behaviours, showing that more educated mothers were able to adjust task difficulty around their child, in accordance with the child's temperament. The combined effect between scaffolding and education found in this investigation further supports the notion that more educated mothers, who may be more likely to view play activities as a learning opportunity, are likely to provide their children with more enriched learning experience, in turn promoting children's development of reasoning and problem solving abilities.

Further interpretations of this interaction can perhaps be attributed to the methodology used in this study. One possibility is that the observational ratings only have ecological validity for the children with more educated mothers. It may be that for these children (but not for children with less educated mothers), maternal behaviours in the videotaped interactions reflected everyday behaviour. A final, competing interpretation may relate to using an aggregate index of scaffolding behaviour. In this study, contingency and verbal input were coded in similar manner to Landry et al. (2006), rather than to the Wood and associates (1975, 1976, 1978) classical approach to scaffolding, the former recording contingency in general terms, whereas the latter focusing on the 'tutor' shifting their behaviour in response to child performance in a more systematic way. Using this particular method may have masked qualitative differences between more / less educated mothers. It is possible that the overall scores reflected variation in total talk for less educated mothers, but variation in contingent shifting for more educated mothers.

10.4.2 Academic attainment at age 11 years

The fourth hypothesis proposed that maternal scaffolding-like behaviours in infancy would have relevance to academic attainment at age 11 years. To address this a structural equation model was constructed. It was already shown in the current study that maternal scaffolding-like behaviours were significantly associated with 51 months non-verbal ability over and above person and context factors. Thus, the paths of influence were specified including only non-verbal ability as a possible mediating factor. In relation to 51 months non-verbal ability, the structural model confirmed the findings from the preceding analyses. In addition, it was found that maternal scaffolding-like behaviours mediated the positive effects of infant play maturity and the negative effects of neighbourhood poverty. These findings support the family stress model (Conger & Donnellan, 2007; Hackman et al., 2015) in that caregiving practices are negatively influenced by economic stress, in turn impeding child intellectual development.

The possible indirect effects of maternal scaffolding-like behaviours on child academic attainment were tested next. Here, the fourth hypothesis was supported. Child non-verbal ability at 51 months fully mediated the effects of scaffolding in infancy on educational attainment at age 11 years. Whilst, maternal scaffolding behaviours were indirectly associated with English and maths exam results at the end of the primary school years (KS2), several child and family related factors directly explained some variance in both outcomes. A pattern of results similar to those observed when predicting verbal and non-verbal skills at 51 months was revealed. Maths attainment was predicted by mother and child abilities (education and non-verbal skills) whilst English KS2 test results were associated with several additional factors.

Cognitive ability measured as early as 18 months was found to predict significant variance in child academic attainment a decade later independently from non-verbal ability at 51 months. This may reflect the cumulative effect through which early cognitive abilities influence academic success, independent of other proximal and distal factors associated with attainment. Interestingly 18 months cognitive ability was more strongly associated with English rather than maths KS2 results, perhaps indicating that the nature of the instrument used to measure cognitive ability in infancy (Bayley MDI) is very much reliant on the child’s verbal ability and comprehension.

Yet again, the effects of maternal education (having a university degree level or above) uniquely explained around a quarter of standard deviation increase in both English and maths KS2 results. This reflects a continuous and overarching effect of mothers’ education irrespective of scaffolding behaviours. It is possible that, by gaining more educational qualifications, mothers can more readily access and use different aspect of human capital that are facilitative for child intellectual development (Harding et al., 2015). Though only scaffolding behaviours were explored in this study, other factors are likely to be implicated in the relationship between maternal education and child academic attainment outcomes. For example, the home learning environment, a factor not included in this analysis, is one principal mechanism by which maternal education relates to more advanced cognitive and academic abilities (Harding, 2015; Magnuson, 2007; Melhuish et al., 2008a). What is more, this may also reflect genetic heritability, as recent findings suggest that academic attainment is can be explained, to a large extent (62% in the case of GCSE’s results) by genetically heritable traits (Krapohl et al., 2014).

Child, mother and context factors accounted for significant variability in English test results at age 11 years over and above maternal scaffolding and child cognitive ability. In keeping with Calvin and associates (2010) and Middlemass (2014) girls outperformed boys in English KS2 results; however, unlike Calvin and Middlemass’ reports, in this study no gender differences were observed in predicting maths KS2 results. Having more siblings predicted lower English attainment. It is possible that in this sample having more siblings may have impeded development by diluting family resources overtime, and reducing parental involvement in child schooling (Steelman et al., 2002). Although the mechanisms by which having a larger family size relate to intellectual capabilities were not tested further, it could be argued that in remaining significantly predictive across development this factor had a cumulative effect on child intellectual functioning.

Finally the uptake of group childcare was not found to be relevant in predicting the development of intellectual abilities. These findings can be explained in a number of ways. The measure used to test childcare effects was somewhat rudimentary, not taking into consideration the quality of care experienced, previously found to be a meaningful factor in explaining childcare effects on cognitive and educational abilities (Barnes & Melhuish, in press; Belsky, Vandell et al., 2007; Sylva et al., 2011; Sylva et al., 2012; Vandell et al., 2010). It is also likely that childcare attendance was associated with better financial means (Barnes & Melhuish, in press; Eryigit-Madzwamuse & Barnes, 2014) meaning that timing of group care uptake may have co-varied with socioeconomic characteristics of the family. These findings are in keeping with previous investigations conducted with the FCCC sample, showing that maternal family and sociodemographic factors rather than childcare experience more closely explain child cognitive development (Barnes & Melhuish, 2016; Eryigit-Madzwamuse & Barnes, 2014; Stein et al., 2012).

As maternal education was found to moderate the effects of maternal scaffolding-like behaviours on child non-verbal ability at 51 months, its possible moderating role was tested by conducting multigroup comparisons between levels of maternal education. There was evidence in support of inequality in the causal structure between the two maternal education groups in the paths between scaffolding and child cognitive abilities. This was the only inequality in causal structure observed; reflecting the interaction found between maternal educational qualifications and higher levels of scaffolding-like behaviours when predicting child non-verbal ability at 51 months. In this study the pervasive positive effects of mothers' higher educational qualifications are notable and are consistent with Bradley and Corwyn's (2002) assertion that maternal education is the most strongly predictive socioeconomic factor of children's subsequent cognitive development.

10.5 Strengths and limitations

The present study had a number of notable strengths. First, by analysing secondary data, the breadth of the information collected meant that numerous factors, previously found to be associated with maternal scaffolding behaviours and child intellectual development could be explored simultaneously and across development. This also meant that the bioecological theory (Bronfenbrenner & Morris, 2006) could be employed as the leading framework in this investigation. All four aspects of the theory were taken into account, testing the way in which mother and child *person characteristics* and *contextual factors* influence the *proximal process* of scaffolding, which in turn is associated with child intellectual development *over time.* This adds to a relatively small body of research in which the PPCT model is employed (Tudge et al., 2009), and providing further explication to individual differences associated with the process of scaffolding.

A second strength of the study was its sample size and diversity. Previous scaffolding studies included smaller samples ranging between 14 (Rogoff et al., 1993) and 312 (Smith et al., 2000), though an exception is a recent study by Bae and colleagues (2014) who studied 608 mother-child dyads. Certainly in the British context, this is the largest sample in which scaffolding behaviours have been investigated. Additionally, the demographic characteristics of the families included in the study were relatively diverse both in terms of SES and ethnicity. In relation to the latter, some claim that in the British context, comparisons between ethnic groups on the effects of family processes on children's outcomes are limited (Hughes et al., 2013). This study provided some evidence that in UK-based families, maternal behaviours vary as a function of minority status. White British mothers were likely to present more scaffolding-like behaviours compared to mothers from minority background, a finding that echoes a recent US-based study (Bae et al., 2014). This is a particularly pertinent finding as the UK population is becoming increasingly ethnically diverse. For example, when the FCCC data were collected (1999-2002) the UK minority population was just under 10% of the entire population (ONS, 2012). Latest census data suggest that the UK minority population currently stands at 20% (ONS, 2012). One caveat should be considered however; in this study the examination of prediction for separate ethnic groups could not be performed, as the numbers of mothers from each minority group were small. It may be that group-specific trends exist, as observed in US-based studies (Bae et al., 2014; Brady-Smith et al., 2013), that this study was not sensitive enough to test.

Finally, and most importantly, the coding scheme developed to record scaffolding-like behaviours during brief mother-infant interaction was associated with both context recorded by home visitors and maternal reports. It was directly associated with child outcomes 3.5 years later, and indirectly with educational attainment a decade later. This is not to say that these specific behaviours, at that specific age were solely responsible for children's outcomes. Yet it is highly likely that mothers who presented this kind of behaviour as early as the first year continued to provide more cognitively enriching, contingent and encouraging type of instruction to their children across development. In fact some have shown relative stability in the way mothers interact with their children (Dieterich et al., 2006; Hackman et al., 2015; Hammond et al., 2012). This may further contributed to facilitate children's more developed reasoning and problem-solving skills. Thus, some conjecture could be offered that these behaviours may represent the antecedents of contingent scaffolding behaviours. However, an obvious limitation of this study is the fact the scaffolding-like behaviours were not tested longitudinally.

In addition to the limitation mentioned above, a number of other limitations should be discussed. Although the sample was diverse in its characteristics, selection was based on data at the final time point and attrition from the FCCC study was more pronounced in disadvantaged families (Malmberg et al., 2005). This is a fairly common issue in longitudinal research (Melhuish eta l., 2008b; Stein et al., 2012), but is an indication that any interpretations should be made with caution. Moreover, the study was correlational in nature, meaning that cause and effect could not be assumed, further necessitating cautious explication. Furthermore, in being a purely environmental study, genetic influences could not be established, though it is of note that only recently it was shown that a large portion of the variance in parental language style in interaction with 3-4 year olds and its subsequent associations with child language development at 4.5 years were a due to shared genetic effects in a sample of 8395 twins (Dale et al., 2015). Nevertheless, although operationalising the complex pattern of associations between different levels of contextual elements is somewhat problematic (Bornstein et al., 2007), this study revealed the unique contributions of 'ecologically nested variables' (Bornstein et al., 2007, p.212) to mother behaviour and child abilities.

A further limitation relates to factors found previously to be associated with child intellectual development and scaffolding but not considered in this investigation. Maternal and child cognitive ability at the time of the observations, factors found to explain a large variance in scaffolding (Mulvaney et al., 2006), were not included in this study. This information was not collected for mothers, whilst for children cognitive ability testing began at 18 months. Measuring mother and child cognitive abilities concurrently or prior to measuring scaffolding would enable better control for specific environmental effects separate from mother and child abilities, that are likely to be highly heritable (Hughes & Ensor, 2009; Kovas et al., 2007). What is more, school-level context factors were not available in this study. It is acknowledged that this study is limited in this sense, as academic attainment is partly explained by school-related factors (Barnes, et al., 2006; Duckworth, 2008; Leckie et al., 2010)

Another important limitation of the current study is overlooking the role of fathers in influencing child intellectual ability. Fathers are increasingly more involved in childrearing, and evidence suggests unequivocally that fathers have a significant role to play in child intellectual and emotional development (Flouri & Malmberg, 2012; Lamb, 2012; Ramchandani & Iles, 2014; Malmberg et al., 2015). Future studies could benefit from observing scaffolding behaviours of both mothers and fathers, either by testing the unique contribution of each parent separately (Pratt et al., 1988) or by recording co-parental interaction behaviours, recently found to promote infant cognitive ability in infants experiencing biological risk (Gueron-Sela, Atzba-Poria, Meiri, & Marks, 2015)

10.6 Contributions and future directions

A number of original contributions were made in the present investigation. The first contribution relates to the breadth of factors included in the study aimed at explicating individual variations in scaffolding behaviours. This is the first investigation to explicitly treat scaffolding behaviours as a proximal process, positioned within a larger ecological system. In keeping with Neitzel and Stright (2003), Mulvaney et al., (2006) and Hughes and Ensor (2009) who previously argued that scaffolding behaviours are part and parcel of the family system, this study included fifteen possible predictors associated with child, mother and the greater environment when attempting to explain individual variations in the process of scaffolding.

Associated with the abovementioned contribution, another significant addition to the literature relates to factors, which explain individual variations in scaffolding. Alongside the findings that maternal agreeable personality is associated with the presentation of scaffolding, in contrast to findings by Mulvaney and colleagues (2006), other factors, not previously shown to be meaningful to scaffolding, such as maternal older age and family size, were found to predict individual differences in scaffolding behaviours. Most notably, however, is the effect of neighbourhood poverty, shown to directly predict significant reductions in mothers' inclination to scaffold their children. This finding, in particular, suggests that scaffolding, can be understood within a much larger ecological system, one in which the environment outside the home directly affect learning-based interaction within the home. This also highlights the importance of targeted interventions that promote more contingent and cognitively stimulating interactions for mothers who experience high levels of disadvantage.

The final and perhaps the most important contribution of the present investigation is the association observed between maternal behaviours when children were as young as 10 months with academic attainment measured a decade later. Previous scaffolding studies focused on the predictive role of scaffolding during relatively limited developmental periods, with the exception of Dieterich and colleagues (2006) who looked at scaffolding when children were aged 3 and 4 years and abilities were measured at ages 8 and 10 years. This study extends these findings by observing scaffolding at a much younger age and finding long-standing associations with attainment at age 11 years. This reiterates the importance of early parent-child interactions that provide children with rich information appearing in response to specific behaviours, in turn promoting skill acquisition and problem solving abilities.

Irrespective of its contributions, the present investigation raised a number of pertinent questions. The findings showing an interaction between maternal education levels and scaffolding in relation to child non-verbal ability at age 4 years was perhaps the most puzzling. This finding indicates that the combined effect of maternal education (degree and above) and higher levels of scaffolding predicted more advanced child abilities. This raises the question of whether scaffolding is a behaviour that holds meaning only when the 'scaffolder' is highly educated. As previously mentioned, it is possible that children of more educated mother experience this kind of instructive interaction on a regular basis (and not just during a videotaped interaction during home visitation), perhaps explaining why children of less educated mothers showing comparable levels of scaffolding were not presenting the same levels of non-verbal abilities as those whose mothers were both educated and were providing more scaffolding support. This begs a further explication of the role of parental education in the way parents choose to interact with their children.

The interaction between maternal education and scaffolding raises another question, one associated with heritability. It is indeed possible that mothers who had a higher level of educational qualifications, had children who were more cognitively able. A possible way of disentangling heredity and the role of scaffolding behaviours in predicting child ability is by carrying out genetically sensitive studies with adoptive and non-adoptive families. This would allow testing the role of scaffolding and whether, and to what extent, scaffolding could be genetically mediated (i.e. do genetic factors explain the extent to which some children benefit more or less from different scaffolding strategies?).

In relation to scaffolding and child abilities a further surprising outcome was found. Scaffolding was found to predict child non-verbal abilities over and above environmental factors, whilst in the context of verbal ability scaffolding did not remain a significant predictor after taking proximal and distal factors into consideration. These findings are in support of Smith and associates' (2000) study, though they also found a weaker yet significant association with verbal ability. This calls for further examination of the role of maternal scaffolding in relation to the development of different abilities. Even though these abilities are highly related, the mechanisms by which they develop are different. Future studies can explore these mechanisms further, demarcating the four dimensions of scaffolding and testing for unique relationships with children's verbal and non-verbal abilities. It may show that more verbal aspects of scaffolding are more closely related to children's verbal ability, whilst contingency is more strongly associated with non-verbal skills.

Another question raised by this investigation relates to the framework within which it is positioned. The PPCT model used in this investigation provided a flexible approach to testing a whole host of child, mother and context factors in predicting both scaffolding and cognitive and academic abilities. Since the PPCT model allows for testing multiple predictors, it could act for both testing and generating new theories (Bronfenbrenner & Morris, 2006). This assertion is also true in this instance. The study found multiple factors associated both with scaffolding behaviours and child abilities, with outcomes occurring in the expected direction. These findings will allow for assessing relationships between specific factors on a more granular level. For example given the differences observed in maternal scaffolding associated with minority status, it would be beneficial to observe scaffolding in a more ethnically diverse sample. This would enable the analysis to take a person-centred approach (Brady-Smith et al., 2013), testing possible variations in scaffolding as a function of ethnic group. What is more, this may reveal specific interaction between ethnic group and scaffolding in relation to child cognitive development (Bae et al., 2014), which will facilitate developing more targeted interventions.

Another avenue that could be explored is the relevance of child gender for the impact of scaffolding, a relatively under-researched area in the field. As gender is relevant to child cognitive development, and so does scaffolding, it is possible that these factors interact in some way. Future studies could follow Conner and Cross (2003) study carrying a multilevel CFA, and testing whether mothers' behaviour changes between or within observational settings as a function of gender. This could support, or refute, Conner and Cross's (2003) findings showing parents' inclination to support girls more readily during the early stages of a problem-solving task and boys in the later stages. One may theorise, therefore, that girls capitalise on the help they receive earlier on in an interaction, whilst boys perhaps lag behind, left to work out the task solution by themselves.

A further area to explore is the longitudinal nature of scaffolding. Although Bronfenbrenner and Morris (2006) referred to a proximal process as an enduring activity, occurring on a regular basis and putting change in motion, this investigation addressed the proximal process of scaffolding at a single time point. This is one of the study's shortcomings that could be addressed in future investigations. To test whether maternal-scaffolding like behaviours as recorded in this study are indeed the antecedents of future contingent scaffolding behaviours, longitudinal investigations of these behaviours could be undertaken.

A final avenue to explore in the future is the role of multiple environments in which scaffolding behaviours might occur. Previous research has shown that children were showing better educational performance if they experienced high quality stimulation in three different settings: home, childcare and school (Crosnoe et al., 2010). Although, their finding suggest that stimulation in the family context was the most important setting out of the three, both childcare and school stimulation had a significant role to play in subsequent outcomes. A similar investigation could be conducted in the context of scaffolding to explore whether contingent instruction of goal-directed activities in different settings has a cumulative and/or buffering effect for children's subsequent outcomes. Taking an ecological approach to scaffolding, this could inform development of interventions aimed at multiple settings, rather than a single context.

10.7 Conclusions

In sum, the present study brought together two complementary theories: Bronfenbrenner and Morris's (2006) bioecological model, and Wood, Bruner and Ross's (1976) scaffolding theory. Maternal scaffolding behaviours were treated as a proximal process, influenced by the characteristics of the mother and child, and by the context within which this process takes place. Working within a bioecological framework showed simultaneous and unique contributions of different persons and context factors to maternal scaffolding-like behaviours in infancy. Maternal scaffolding in the first year explained significant variance in children's non-verbal ability at 51 months, reflecting the specific role scaffolding has in promoting independent problem solving (Hughes & Ensor, 2009) and its complex relationship with maternal levels of education. Finally, maternal scaffolding-like behaviours at 10 months were indirectly associated with English and maths national exam results carried out a decade later at age 11 years, indicating that mothers' behaviours as early as the first year continue to be relevant to child intellectual development alongside proximal and distal contextual factors.

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APPENDICES

Appendix A: Main study coding manual and coding sheet

Appendix A includes the final coding manual (section A.1) and coding sheet used to record maternal scaffolding-like behaviours in the main study's sample (N=400). The behaviours coded included transfer of responsibility (autonomy supporting language); cognitive support; structure; demonstration; and contingent response. In light of the results of the factor analysis discussed in chapter 6, only transfer of responsibility, cognitive support and contingent response were included in the final factor structure, alongside previously recorded information pertaining maternal positive emotional expressivity (labelled emotional support). Figures A.1 and A.2 include the coding sheets for maternal scaffolding behaviours and infant play maturity respectively.

A.1: Maternal scaffolding behaviours – final version of coding manual

Transfer of Responsibility (ToR)

Use of language, which encourages the infant to complete the task independently, emphasis is on the infant carrying out the task

0 - None	**1 - Minimal**	**2 - Moderate**	**3 - Substantial**
No transfer of responsibility language used	Minimal use of transfer of responsibility language: once during play segment	Moderate use of transfer of responsibility language: 2-3 times during play segment	Substantial use of transfer of responsibility language: 4 times or more during play segment

Notes for clarification

0. Code 0 if ToR does not occur during individual play segment.
1. Code 1 if ToR appears once during individual play segment.
2. Code 2 if ToR appears 2 to 3 times during individual play segment.
3. Code 3 if ToR appears 4 or more times during individual play segment.

- New episode is coded if there are 3 seconds gap between each transfer of responsibility language use or if the next episode is part of a new sentence.

- Language which can be considered ToR: ‘now it’s you turn’; ‘why don’t you try it?’; ‘try to fit the shapes / hoops yourself’; ‘you / infant’s name do it’; ‘go on, you do it’; ‘infants name turn’; ‘mummy will show you how to do it first, then you’. The emphasis is transferring the responsibility onto the infant.

- The emphasis of this item is on the mother transferring the responsibility of completing the task to the infant, direct reference to the child must be observed in order to code for the behaviour. For example, if mother says ‘put this here’, ToR should not be coded for.

Cognitive Support (CS)

Mother's attempts at enhancing infant's development by presenting behaviours related to effortful teaching in the way of asking questions, elaborating on the task, using complex vocabulary and making connections between the task and the infant's current knowledge and experiences.

0 - None	1 - Minimal	2 - Moderate	3 - Substantial
Cognitive stimulation not presented	Minimal presentation of cognitive stimulation. Showing up to 2 different aspects of cognitive stimulation	Moderate presentation of cognitive stimulation Showing up to 4 different aspects of cognitive stimulation but not making connections to infant's existing knowledge	Substantial presentation of cognitive stimulation. Showing all aspects of cognitive stimulation frequently including making connections to infant's existing knowledge

Notes for clarification

CS occurrences are: questions, description, elaboration, use of complex vocabulary and connection-making.

0. Code 0 if CS does not occur during individual play segment.
1. Code 1 if CS appears 1 to 4 times during an interaction or showing 1 to 2 different aspects of CS.
2. Code 2 if CS appears 5 to 9 times or showing 3 to 4 different aspects of CS but no connection making.
3. Code 3 if CS appears 10 or more times and showing at least 4 aspects of CS including connection making.

- New episode is coded if there are 3 seconds gap between each cognitive support event or if the next episode is part of a new sentence. For example if mother is counting or naming colours of play pieces, use the 3 seconds gap rule.

- Examples of CS: Description of toy, shapes, colours, size and pictures in a book; asking questions regarding the task at hand; relating aspects of the task to infant's assumed existing knowledge 'this toy/book is different to yours'; elaborating on the task beyond descriptions (adjective phrases such as 'lovely colour', 'soft fur') and using complex language.

Structure (ST)
Mother's efforts in organising the interaction in a sensible sequence for the task

0 - None	1 - Minimal	2 - Moderate	3 - Substantial
No structure is provided throughout the interaction	Limited efforts at structuring the task Minimal presentation of either structuring or sequencing to enable infant to complete the task	Moderate efforts structuring the task Interaction mostly sensibly sequenced	Suitable structure is provided throughout The interaction is sensibly sequenced

Notes for clarification

0. Code 0 if structure is not provided during the individual play segment.
1. Code 1 if structure appears limited. Mother must present a sequence to enable infant to complete the task at least once **OR** present some structuring at least once; one of the behaviours must appear at least once, **'either or'.** <u>If mother is not reading the book but still showing book-sharing behaviours a code of 1 will be given.</u>
2. Code 2 if structure appears moderately. Mother must present a sequence to enable the task to be completed at least once **AND** structure the task around the child at least once. **'both behaviours must appear at least once'**
3. Code 3 if structure appears regularly. Mother must present a sequence to complete the task at least once and provide structure throughout the task regularly. **'both behaviours must appear at least once and at least once more in order to gain a code of 3'**

- Examples of sensible sequencing: reading out from book page by page, showing book-sharing activities, removing/re-stacking hoops according to size, removing play pieces from box, putting lid back on, and showing how to put play pieces through the corresponding slot.

- Examples of structuring interaction: passing the next play piece to infant according to task sequence, rearranging play pieces to facilitate task completion, moving play pieces closer to infant if beyond reach.

- Code 9 if infant appears to recognise the task, completing it without maternal intervention.

Demonstration (Demo)

Mother models how to complete the task at hand, not simply demonstrating but also providing verbal explanation

0 - None	**1 - Minimal**	**2 - Moderate**	**3 - Substantial**
Demonstration does not occur	Low levels of demonstration may appear without verbal input /or low levels of verbal input may be observed without physical demonstration.	Moderate levels of demonstration may appear. Both verbal input and physical demonstration should appear but not in conjunction.	Substantial physical demonstration teamed with verbal input presented

Notes for clarification

0. Code 0 if mother does not demonstrate (verbally and physically) during an individual play segment
1. Code 1 if minimal physical demonstration appears OR minimal verbal explanation is observed. One of these behaviours must occur at least once.
2. Code 2 if demonstration and verbal explanation appear moderately, but not in conjunction. In order for a code 2 to be given mother must show **both** behaviours at least once, or show the behaviours conjointly but only once.
3. Code 3 if both demonstration and verbal explanation occur frequently and in conjunction (twice and over); mother is showing whilst telling how to carry out the task.

- Examples for demonstration: completing task whilst verbalising which actions are taking place. During book-sharing interaction turning pages whilst saying ‘Mummy is turning the page’. In toys sections use of language such as ‘this one goes in here’, ‘this hoop comes next’ whilst showing how to carry out the activity is considered good quality demonstration.

- Code 9 if infant appears to recognise the task, completing it without maternal intervention.

Contingent Response (Res)
Mother's contingent responses to infant's cues, body language and verbalisations

0 - None	1 - Minimal	2 - Moderate	2 - Substantial
Mother does not respond to infant's behaviour in a contingent manner	Mother's responses to infant are mostly not contingent. Minimal presentation of appropriate responses to infant's behaviour	Mother's responses are mostly contingent. Moderate presentation of appropriate responses to infant's behaviour	Mother's responses are continuously contingent with infant's behaviour

Notes for clarification

0. Code 0 if mother is not responding to infant's verbalisation and cues, not looking at infant's face and not following infant's initiations.
1. Code 1 if mother's responses are mostly incongruent with infant's behaviours; mother is rarely looking at infant's face and not following infant's initiations. In order to achieve a code of 1 mother have to show a contingent response at least once, but is mostly non-responsive.
2. Code 2 if mother's responses are mostly congruent with infant's behaviours; moderate levels of looking at infant's face and following infant's initiations. For a code of 2 responsive behaviours should appear more often than non-responsive ones, yet some behaviours that can be considered non-responsive can occur.
3. Code 3 if mother presents responsive behaviours, congruent with infant's actions throughout the interaction. In order to achieve a code of 3, mother must not present any behaviour incongruent with infant's behaviours.

- The following behaviours are considered responsive: Often observing infant's face, reciprocating to infant's verbalisations and physical cues, following infant's initiation (non-intrusive), monitoring child activity and responding accordingly.

- The following behaviours are considered non-responsive: Intrusiveness, failure to reciprocate infant's verbalisations and physical cues, failure to address infant's mood or needs, having an adult-centred focus on the task (Fuligni & Brooks-Gunn, 2013).

- Please note – Take into account that it is not always possible to observe if mother looking at infant's face due to camera positioning –therefore code for the most prevalent seen behaviour.

Date: ____________________

Coded by: ________________

Previously coded: ___________

Child ID							

	Rate 0-3	Rate 0-3						Rate 0-3			Rate 0-3				Rate 0-3
TOY	ToR	Cognitive Support						Structure			Demonstration				Contingent Response
		D	E	Q	C	V	Score	ST	Seq	Score	P+V	P	V	Score	
Book **Time:**__:__ - __:__															
Ring **Time:** __:__- __:__															
Shape Sorter **Time:**__:__- __:__															

Refer to coding manual for full descriptions of observed activities and codes.

Scores indicate a rating for the whole time period (per play segment). Ratings are between 0 and 3 and are as follows:

(1) Mother not presenting any of the activity under observation; **(2)** Mother presenting limited attempts of the activity under observation; **(3)** Mother presenting moderate attempts of the activity under observation; **(4)** Mother consistently presents the activity under observation.

Time = duration of each play interaction.

Transfer of responsibility, cognitive Support, structure and demonstration codes are based on the frequencies of specific behaviours. Please write down the frequencies, then calculate the final score – please refer to the coding manual for breakdown of codes.

Cognitive support behaviours: D = description; E = elaboration; Q = questions; C = connection making; V = vocabulary; **Structure**: ST = structuring; Seq = sequencing; **Demonstration**: P+V = physical and verbal in conjunction; P = physical only; V = verbal only.

Figure A.1: Maternal scaffolding behaviours coding sheet

Date: ____________________

Coded by: ________________

Previously coded: ___________

Child ID							

Ring	**Start Time**	**10 sec**	**20 sec**	**30 sec**	**40 sec**	**50 sec**	**60 sec**
	_ _ : _ _						
					*********	*********	*********
Shape Sorter	Start Time	10 sec	20 sec	30 sec	40 sec	50 sec	60 sec
	_ _ : _ _						
					*********	*********	*********

Play categories

Indicate which activity (play category) is most evident in each 10s interval. When coding is completed add up all of the events per category and specify this in the frequency table for each segment.

1. No play – no engagement
2. Play physically guided by mother
3. No play – infant observing mother
4. Exploratory / not as intended play
5. Non-task related relational play
6. Constructive (end-producing) play

- Remember if infant manages task ignore any other activities within the 10 second segments.
- Please work from left to right starting from the left hand side of the top row

Figure A.2: Infant object play maturity coding sheet – codes remained the same as those used in the pilot study

Appendix B: Information from exploratory unpublished study

Appendix B includes coding scheme and subsequent statistical analyses results of the exploratory study carried out by Mermelshtine (2012). Table B.1 includes the coding scheme used, Tables B.2 and B.3 rotated factor scores for of maternal behaviours in book-sharing and shape-sorting play interactions respectively.

Table B.1: Coding scheme used in exploratory study

Demographics

1	Is mother speaking in English?	Yes	No	Mixture
2	Is TV on?	Yes	No	
3	Is music playing the background?	Yes	No	
4	Other people present?	Yes	No	
5	Gender of the infant	Girl	Boy	Unsure

Book

Start Time: ___________ / End Time: ____________

Mother's Behaviour

Reads out from the book?	Yes	No
Describes the pictures or surfaces in the book?	Yes	No
Asks questions about the book?	Yes	No
Elaborates on the book beyond basic description?	Yes	No
Uses symbols to reference pictures? (making animal sounds, labelling)	Yes	No
Gives negative feedback on infant's behaviour (at least twice)? **R**	Yes	No
Uses praise throughout the interaction (at least twice and in reaction to infant's actions)?	Yes	No
Uses infant's name to draw back to task when attention is waning?	Yes	No
Responds to infant's vocalisation and verbalisation with a vocal or verbal response?	Yes	No
Uses positive affective input? (smiling, warmth)	Yes	No
Uses physical demonstration? (saying 'stroke Henry' whilst stroking it)	Yes	No
Guides infant's hand to interact with the book?	Yes	No
Keeps the book out of the infant's reach throughout most of the interaction? **R**	Yes	No
Suitably positioned for reading the book?	Yes	No
Points at the pictures?	Yes	No
Allows the infant to freely explore the book?	Yes	No
Often looks at infant's facial expression to monitor his/her response?	Yes	No
Controls infant's motor activity throughout most of the interaction? (restricts infant's movement) **R**	Yes	No

Mother's general style of verbal interaction (excluding reading from the book):

1	Speaks rarely, only a few words normally in response to infant's action.
2	Generally talkative, but does not elaborate on the task and uses short simple sentences.
3	Consistently talkative, uses appropriate grammar and pronunciations, provides explanations and elaborates on the task.

Infant's behaviour

Acts upon the book? (Banging on the book, hitting pages, grasping, random pointing, chewing)	Yes	No
Page turning and opening and closing the book?	Yes	No
Feels the interactive surfaces of the book? (following mother's direction)	Yes	No
Responds to mother's comments? (Laughing, making noises, looking)	Yes	No
Responds to name?	Yes	No
Imitates mother's actions? (in relation to book)	Yes	No
Shows interest in the book throughout most of the interaction?	Yes	No
Shows interest in other objects in the environment throughout most of the interaction?	Yes	No
Stays in contact with mother throughout the interaction?	Yes	No

R = Reversed coded item

Shape Sorter

Start Time: ___________ / End Time: ____________

Mother's Behaviour

Comments on main features of the task? ('this is a red triangle')	Yes	No
Provides verbal explanation?	Yes	No
Asks questions about the task? ('Where does the triangle go?' etc.)	Yes	No
Uses praise throughout the interaction? (at least twice and in reaction to infant's actions)	Yes	No
Gives negative feedback following infant's actions? (at least twice) **R**	Yes	No
Uses infant's name to draw back to task when attention is waning?	Yes	No
Makes neutral comments following infant's actions? (at least twice, not praise nor criticism)	Yes	No
Makes sure that infant is in a suitable position to play with the toy?	Yes	No
Makes noise with play pieces? (banging pieces together, shaking the box)	Yes	No
Demonstrates the task?	Yes	No
Instructs non-verbally? (pointing at slots)	Yes	No
Guides infant's hand?	Yes	No
Passes infant the play pieces which fit in the hole in from oh him/her?	Yes	No
Lifts the lid to show play pieces to infant?	Yes	No
Places play pieces on top of lid by correct hole?	Yes	No
Uses lid as a feature in 'Peek a Boo' game?	Yes	No
Builds a tower from the play pieces?	Yes	No
Often looks at infant's facial expression to monitor his/her response?	Yes	No
Allows infant to chew on play pieces?	Yes	No
Uses positive affective input? (smiling, warmth)	Yes	No
Is mother intrusive? (interrupting when infant is in mid flow/not allowing for free exploration) **R**	Yes	No
Is mother goal-oriented? (ignores child lack of interest and carries on with the task) **R**	Yes	No

Mother's general style of verbal interaction:

1	Speaks rarely, only a few words normally in response to infant's action.
2	Generally talkative, but does not elaborate on the task and uses short simple sentences.
3	Consistently talkative, uses appropriate grammar and pronunciations, provides explanations and elaborates on the task.

Infant's Behaviour

Chews on the play pieces	Yes	No
Makes noise with play pieces? (banging together or on the floor)	Yes	No
Putting and removing lid from box?	Yes	No
Moves play pieces in and out of the box when not covered by lid?	Yes	No
Attempts the task, but not choosing the correct hole?	Yes	No
Attempts the task choosing correct hole, but not managing the task?	Yes	No
Manages to fit at least one shape in the correct hole independently?	Yes	No
Shows/gives play pieces to mother?	Yes	No
Responds to mother's comments? (Laughing, making noises, looking)	Yes	No
Responds to name?	Yes	No
Imitates mother's actions? (with relation to the task)	Yes	No
Shows interest in the toy throughout most of the interaction?	Yes	No
Shows interest in other objects in the environment throughout most of the interaction?	Yes	No
Stays in contact with mother throughout the interaction?	Yes	No

R = Reversed coded item

Table B.2: Rotated factor loading for remaining 11 variables, illustrating the components of maternal behaviour during book-sharing interaction

	Rotated Factor Loading			
	Restriction	Physical Explanation	Communication	Positive Feedback
Allows for free interaction	*.89*	-.06	.14	.07
Keeps book out of infant's reach (R)	*.85*	.07	-.03	-.02
Controls infant's motor activity (R)	*.53*	-.03	-.17	.50
Uses physical demonstration	.12	*.80*	.09	-.02
Points at pictures	-.05	*.74*	-.07	.08
Uses symbols to reference pictures	-.01	.09	*.68*	.10
Suitably positioned to interact with the book	-.08	-.09	*.64*	.00
Asks questions about the book	.27	.27	*.59*	.06
Uses positive affective input	.12	-.13	.20	*.71*
Uses praise	-.17	.20	.03	*.66*
Responds to infant's vocalisations	.13	.13	.06	*.56*
Eigenvalues	2.93	1.94	1.28	1.21
% of the variance	20.93	13.88	9.13	8.65
Reliability	α = .64	*r* = .36**	α = .54	α = .35

Note, Items that make up specific factors are those in italics.

Table B.3: Rotated factor loading for remaining 11 variables, illustrating the components of maternal behaviours during shape-sorting play interaction (N=101)

	Rotated Factor Loading			
	Communication	Explanation	Specific Task Features	Assistance
make natural comments following infant's actions	*.74*	-.02	.21	.02
uses positive affective input	*.64*	-.17	.05	-.27
often looks at infant's facial expression	*.59*	-.35	-.30	.10
gives less negative feedback	*.58*	.14	-.19	-.23
asks questions about the task	*.55*	.28	.02	-.09
provides verbal explanation	.23	*.79*	.08	.10
demonstrate the task	-.13	*.77*	-.08	.14
lift lid to show infant the play pieces	-.16	-.17	*.76*	.05
comments on main features of task	.28	.23	*.75*	.02
passes play pieces to infant	-.03	.03	-.07	*.83*
guides infant's hand	-.28	.19	.18	*.56*
Eigenvalues	2.50	1.92	1.28	1.04
% of the variance	20.80	16.03	10.69	8.65
Reliability	α = .66	*r* =.40**	*r* = .24*	*r* = .22*

Note, Items that make up specific factors are those in italics.

Appendix C: Pilot study coding schemes

Appendix C includes maternal scaffolding behaviours coding scheme and infant object-play manual used in the pilot study. Section C.1 includes coding manual and Figure C.1 shows the coding sheet used to record maternal behaviours. Section C.2 provides an explanation for the way in which infant play maturity was coded. Note that for infants, six categories of play were recorded, but only category 6 (end producing play) was used in further analyses.

C.1: Maternal scaffolding behaviours coding manual and coding sheet

1. *Cognitive Support:*

Cognitive stimulation

0) Does not provide cognitive stimulation in the way of asking questions, elaboration, vocabulary and making connections
1) Makes limited attempts at providing cognitive stimulation in the way of asking questions, elaboration, vocabulary and making connections
2) Makes moderate attempts to provide cognitive stimulation in the way of asking questions, elaboration, vocabulary and making connections
3) Providing frequent and substantial cognitive stimulation throughout in the way of asking questions, elaboration, vocabulary and making connections

Structure

0) Does not provide any structure to the interaction/instruction
1) Makes limited attempts at providing a structure to the interaction/ instruction or ensures that infant is sitting in comfortable position to interact with the toy but making limited efforts to structure the task
2) Makes moderate attempts at structuring the interaction in a sensible sequence, instructing in accordance with the infant’s abilities

3) Structuring the interaction in a sensible sequence and around the infant's abilities throughout

Explicit instruction – Verbal and demonstrative

0) Does not provide any explicit verbal and demonstrative instruction
1) Providing low amount of explicit verbal and demonstrative instruction
2) Providing moderate amount of explicit verbal and demonstrative instruction
3) Providing substantial explicit verbal and demonstrative instruction

2. *Emotional support:*

Frustration control

0) Child does not appear frustrated N/A
1) Does not attempt to control infant's frustration
2) Offers minimal comfort and/or simplifying the task when child appears frustrated
3) Offers moderate comfort and/or simplifying the task when child appears frustrated
4) Offers substantial comfort and/or simplifying the task when child appears frustrated

Positive regard – Mothers' use of emotionally expressive language (frequency counts)

3. *Transfer of responsibility:*

Explicit instruction - Physical

0) Does not provide any explicit physical instruction
1) Providing low amount of explicit physical instruction
2) Providing moderate amount of explicit physical instruction
3) Providing substantial amount of explicit physical instruction

Autonomy promoting language **-** Mother's use of language relating to transfer of responsibility (promoting autonomy – frequency counts)

4. *Contingency:*

Responsivity

0) Does not respond to infant's cues and behaviours in a contingent manner
1) Offers minimal contingent responding to infant's cues and behaviours
2) Offers moderate contingent responding to infant's cues and behaviours
3) Offers substantial contingent responding to infant's cues and behaviour

Attention maintenance

0) Does not maintain infant's attention to the task and or persist in attempts to carry out the task.
1) Makes limited efforts in maintaining infant's attention to task, and in maintaining persistence in carrying out the task
2) Makes moderate attempts in maintaining infant's attention and persistence in carrying out the task.
3) Consistently and persistently makes attempts to maintain infant attention to and persistence with the task.

Child ID | | | | | | |

Mother coding scale:

Date: ___________________
Coded by: _______________
Previously coded: __________

	SCALE								
	Rate 0-3	Rate 0-3	Rate 0-3	(9=missing) Y/N	Frequency counts	Rate 0-3	Frequency counts	Rate 0-3	Rate 0-3
TOY	Cognitive Stimulation	Structure	Demonstration inc verbal input)	Frustration Control	Positive regard	Physical instruction	Transfer of responsibility	Responsivity	Attention maintenance
Book **Time: __:__ - __:__**									
Ring **Time: __:__ - __:__**									
Shape Sorter **Time: __:__ - __:__**									

Others present? __________ **Any Comments?** ____

- Refer to coding manual for full descriptions of observed activities and codes.
- Please only code the first 2.5 minutes of each play segment even if the play segment extends over 2.5 minutes.
- Please do not code interactions, which do not involve the mother and the infant.
- Time = duration of each play interaction.

Scores indicate a rating for the whole item (per play segment). Ratings are between 0 and 3 and are as follows:

• Mother not presenting any of the activity under observation

• Mother presenting limited attempts of the activity under observation

• Mother presenting moderate attempts of the activity under observation

• Mother consistently presents the activity under observation.

• Please record frequency counts for maternal use of positive regard and transfer of responsibility related language

• Frustration control yes/no answer. Code 9 when child is not presenting frustrated behaviour.

Figure C.1: Coding sheet used to record maternal behaviours in pilot study

C.2. Infant coding manual – definitions of play codes

Code	Type of activity	Explanation
1	No play - disengagement	Infant moving away from mother and or toy
2	Play Guided by Mother	Mother physically instruct infant to interact with the toy
3	Infant observing mother	Infant observing mother, but not manipulating play materials in any way
4	Exploratory play	Infant is engaged in basic manipulation /exploration of toy: sucking, fingering, banging, waving and throwing play pieces, banging play pieces together or on the floor, dragging play pieces on the floor
5	Non-task related relational play	Playing with play pieces in a purposeful way but not in the conventional manner. For example: playing peek-a-boo with play pieces, placing play pieces on head, using play pieces as bangles (usually imitating mother's actions)
6	Constructive (end producing) play	Infant uses play pieces in the conventional manner attempting or managing to complete the task (removing/ restacking hoops; putting the correct shape in its corresponding slot)

Appendix D: Latent class analyses of maternal scaffolding-like behaviours

Appendix D includes means and standard errors of the four latent class solutions not included in the final analyses.

Table D.1: 2-class solution - Latent factors means and standard errors in brackets

Items	Class 1 N=179	Class 2 N=221
Contingent response	-.55 (.07)	.35 (.03)
Cognitive support	-.68 (.08)	.55 (.06)
Autonomy promoting language	-.71 (.07)	.58 (.06)
Emotional support	-.41 (.05)	.35 (.03)

Table D.2: 3-class solution - Latent factors means and standard errors in brackets

Items	Class 1 N=185	Class 2 N =44	Class 3 N=171
Contingent response	-.30 (.07)	-.86 (.15)	.43 (.05)
Cognitive support	-.29 (.07)	-1.51 (.12)	.70 (.06)
Autonomy promoting language	-.33 (.07)	-1.43 (.10)	.73 (.06)
Emotional support	-.21 (05)	-.78).06)	.45 (.06)

Table D.3: 4-class solution - Latent factors means and standard errors in brackets

Items	Class 1 N=39	Class 2 N =161	Class 3 N=45	Class 4 N=155
Contingent reposnse	-.89 (.15)	.28 (.12)	.62 (.09)	-.41 (.08)
Cognitive support	-1.58 (.10)	.44 (.16)	1.07 (.14)	-.41 (.09)
Autonomy promoting language	-1.50 (.08)	.43 (.17)	1.28 (.27)	-.47 (.09)
Emotional support	-.81 (.05)	.21 (.03)	.87 (.36)	-.27 (.06)

Table D.4: 6-class solution - Latent factors means and standard errors in brackets

Items	Class 1 N=35	Class 2 N=53	Class 3 N =84	Class 4 N=94	Class 5 N=110	Class 6 N=24
Contingent response	-.99 (.16)	-.94 (.13)	-.21 (.13)	.22 (.09)	.40 (.08)	.67 (.12)
Cognitive support	-1.64 (.08)	-.40 (.09)	-.54 (.07)	.25 (.08)	.64 (.10)	1.18 (.12)
Autonomy promoting language	-1.56 (.06)	-.29 (.10)	-.71 (.05)	.11 (.07)	.75 (.09)	1.53 (.10)
Emotional support	-.82 (.05)	.16 (.13)	-.53 (.05)	-.07 (.14)	.44 (.06)	1.18 (.21)

Appendix E: Multiple imputation of missing data

Families included in the present investigation were randomly chosen from the FCCC sample if they participated in the videotaped play activity 10-months and if children's cognitive abilities were assessed at 51 months. Although, most mothers and children had a complete set of data, some information was missing. As multivariate regression analyses were performed in chapter 7 and 8, missingness in the data had to be addressed. This is because linear regression methods use a process of listwise deletion of the predictor (χ) variables, which cause for reduction in sample size when missingenss occurs.

Missing data was found at two time points. At 10 months 10.5% of mothers did not report on depressive symptoms (EPDS; Cox et al., 1987), whilst at 18 months 19.25% of mothers did not provide information on agreeableness (NEO-PI; Costa & McCrea, 1985). This reduced the sample size by 25%. Two analyses were performed in order to establish the pattern of missing data. The Little MCAR test was carried out first resulting in a non-significant result significant [x^2 (210) = 234.87; *p*= .115], which may suggest that the data was missing completely at random (MCAR). In the second analyses were conducted for each variable separately, by creating a missing/not-missing dummy variables for each item. These analyses indicated that the data was missing at random (MAR), given that some mean differences between missing/not-missing groups were observed as a function of other predictor variables. It was established that the data was MAR, necessitating the use of multiple imputation data. Table E.1 includes pattern of missing data for study's variables.

Table E.1: Missing data patterns for predictor and outcome variables, study variables not included in table did not have any missing data points

Wave	51 month	18 months	10 months	10 months	10 months	11 years	11 years
N	BAS verbal	Bayley	Temper -ament	Maternal mental health	Maternal agreeabl-eness	KS2 Maths	KS2 English
43					X		
9			X	X	X		
20			X	X			
6			X	X	X	X	X
9					X	X	X
61						X	X
5	X						
5		X			X		

Patterns with less than 1% missing data (fewer than 4 cases) not included

In order to impute a sufficiently general model, as many related variables should be included when carrying out multiple imputations, even if these items are not included in any future analyses (Rubin, 1987; Schafer, 1997). A strength of the FCCC sample is the breadth of information collected at all data gathering waves, pertaining mothers, fathers and the home environment. Thus, to produce a more accurately representative imputed datasets, additional information pertaining parental mental health, dyadic adjustment, paternal demographics and the home environment was included. Table E.2 provides descriptive statistics for additional data used in creating the multiple imputation datasets.

Table E.2: Descriptive statistics for additional study variables used to create imputed datasets. Means and standard deviations are provided for continuous variables, for continuous variables number of participants in each category are provided along with percentages.

Items	N	Mean	SD
Continuous variables			
Maternal mental health 3 months [a]	400	6.65	4.04
Dyadic adjustment mother 3 months [b]	395	4.41	1.37
Maternal mental health 36 months [c]	357	10.33	4.51
Partner age	400	30.55	11.30
Partners education [d]	400	3.81	1.78
Partner mental health 3 months [a]	270	1.73	.65
Dyadic adjustment partner 3 months [b]	240	4.82	.417
Categorical variables		**N**	**(%)**
Partner ethnic minority	400		
White British		310	77.5
Ethnic minority		90	22.5
Partner employment [e]	363		
Working class		115	31.7
Intermediate		62	17.1
Professional		186	51.2
Family SES [e]	400		
Working class		95	23.8
Intermediate		73	18.3
Professional		232	58

[a]Edinburgh Postnatal Depression Scale (Cox et al., 1987)

[b]Dyadic Adjustment Scale (Spanier, 1976)

[c]General Health Questionnaire (Goldberg & Hillier, 1979)

[d]Continuous measure of partner's educational qualification- higher scores = higher educational qualification

[e]Occupational status (CASOC; Rose & O'Reilly, 1998)

Note, occupational status was not recorded for 37 fathers who were not residing with mothers