The Role of the Home Literacy Environment in the Early Literacy Development of Children at Family-risk of Dyslexia

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Abstract

This thesis examines the role of early home literacy environment (HLE) in the literacy development of a sample of children at family-risk of dyslexia via an affected first-degree relative (FR) and a typically developing control group (TD). The first study described the HLE of 4-year-old FR children. Two distinct factors were identified: storybook exposure and direct instruction of orthographic forms. The amount of interactional literacy-related input that FR and TD children received at home was broadly equivalent.

Second, the relationship of the early HLE to language and emergent literacy skills both concurrently and longitudinally (at age 5) was investigated. Storybook exposure predicted a wider range of child outcomes than previous research has suggested. Notably, a relationship between storybook exposure and phoneme awareness emerged later for FR than TD children. Direct instruction predicted children's decoding skills in the first year of school. A pair of path models predicting decoding and reading comprehension skills at age 6 revealed multiple indirect pathways from early HLE to reading outcomes two years later. The magnitude of several longitudinal relationships was larger for FR than TD children. A direct pathway from early storybook exposure to reading comprehension was identified in the FR group only. Effects of family SES on reading outcomes were fully mediated by the HLE variables and oral language.

In an observation study, the linguistic and socio-emotional quality of shared storybook interactions was found to be equivalent between FR and TD mother-child dyads. Children's orientation to print at age 4 predicted word reading ability a year later, and interactional affective quality predicted children's oral language skills. These findings are discussed, with a focus on the potential for rich early literacy-related experiences in the home to act as a protective factor in the literacy development of children at elevated risk of reading difficulty.

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Author’s Declaration

I declare that the work presented within this thesis is my own work and has not been previously submitted for any other degree or qualification. Selected aspects of the work have been presented elsewhere:

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Chapter 1: The Home Literacy Environment in Typical Reading Development

The single most important activity for building the knowledge required for eventual success in reading is reading aloud to children.

(Anderson, Hiebert, Scott & Wilkinson, 1985, p. 15).

1.1 Introduction

1.1.1 The Development of Reading

Reading is a core skill, the successful acquisition of which is fundamental to children's educational attainment. However, individual differences in reading achievement are wide (Bowey, 2005) and it is therefore of considerable theoretical interest to define the processes, abilities and environmental inputs that underpin its development.

A number of models have been proposed which attempt to delineate identifiable behavioural stages through which children pass on the journey towards proficient reading (see Ehri (2005) for a review). For purposes of economy, only Frith's (1985) model will be described here, since it incorporates the major features of most other behavioural models. Frith identifies three discrete stages in typical reading development. First, at the logographic stage, children attach individual word labels to particular letter strings (most commonly their own name) without understanding how to break the relationship down into component grapheme-to-phoneme correspondences. The presence of this type of paired associate learning in early reading development is supported by experimental evidence from samples of young children learning new words (e.g. Byrne & Carroll, 1989) and adults learning novel orthographies (e.g. Byrne & Fielding-Barnsley, 1989). Frith's alphabetic stage of reading development marks the beginning of children's use of phonemic information to decode words. Connections between individual letters and sounds are strengthened as children acquire letter-sound knowledge and, under guidance from experienced others, begin to use sounding out and blending strategies. Finally, at the orthographic stage, complex connections between letter groups and sounds are formed and reading becomes increasingly automatic, until the child achieves adult levels of accuracy and fluency in decoding.

While useful as an overarching descriptive framework of reading development, such stage models tell us very little about the individual differences in the intercept, slope and endpoint of children's reading trajectories. Byrne (1998) conceptualises learning as a 'division of labour' between the learner and environmental input, highlighting the importance of a full understanding of each subcomponent of the reading process, since "[o]nce we know what the child contributes to acquiring a component of reading and the nature of that contribution, we will know what is left over to teach." (Byrne, 2005, p.107).

A key aspect of Byrne's argument is that the contribution made by individual learners to reading development varies widely, and indeed it is now well established that individual differences in reading ability are evident very early on in children's school careers and are largely stable over time (e.g. Cunningham & Stanovich, 1997; Wagner et al., 1997). This is likely to be in part attributable to genetic factors; for example evidence from twin studies indicates that a core genetic factor explains a substantial portion of covariance between phonological awareness, rapid naming and reading (Petrill, Deater-Deckard, Thompson, DeThorne, & Schatschneider, 2006). However, as discussed in Chapter 2, the behavioural genetics literature also suggests an important role for the environment in components of early reading (e.g. Petrill et al., 2006; Samuelsson et al., 2005). It is probable that the literacy-related practices and attitudes that children experience in the home during the preschool years constitute part of this environmental influence.

1.1.2 The Emergent Literacy Perspective

It is clear that reading acquisition cannot be viewed as an isolated developmental stage, beginning only when children enter the educational system. The emergent literacy perspective (Clay, 1966; Teale & Sulzby, 1986) conceptualises reading acquisition as part of a developmental continuum, with its roots in the earliest years of children's lives as they learn to understand and produce language. From this perspective, then, there is no clear boundary between pre-reading and reading. A central idea of emergent literacy is that children begin to acquire knowledge of written language concurrently and interdependently with oral language during the preschool years, in the social contexts which bring them into contact with the printed word (Whitehurst & Lonigan, 1998). Central amongst these social contexts is the home literacy environment, in which children are exposed to literacy-related materials and experiences in interaction with family members: parents, older siblings, grandparents and other carers. The emergent literacy perspective, then, draws on social constructivist theory, viewing knowledgeable others as mediators of children's interactions with the environment (Vygotsky, 1978;

Wood, Bruner, & Ross, 1976). It is in the context of these child-adult-environment interactions that cognitive development takes place.

Emergent literacy comprises a set of developmental precursors to reading and writing. A number of systems have been proposed in to classify these early skills. Mason and Stewart (1990) identified four key domains of emergent literacy, namely the concepts and functions of literacy, writing and composing, knowledge about letters and words, and receptive language, including listening comprehension. Whitehurst and Lonigan (1998) divided these components of emergent literacy into two broad domains. 'Outside-in' factors relate to meaning and context, and include conceptual knowledge (the semantic representations onto which phonological and orthographic representations are mapped), oral language skills (vocabulary, morpho-syntax and pragmatics) and understanding of story-reading conventions (e.g. that text reading begins at the top of the page, proceeds from left to right, and so on). Conversely, 'inside-out' factors refer to the building blocks of decoding, specifically phonological awareness, letter-sound knowledge and invented spelling. Whitehurst and Lonigan (1998) demonstrated that inside-out skills are strongly related to reading in Grade 1, when decoding print is typically the key learning objective. However, as decoding becomes increasingly automatic and the focus of literacy education switches to comprehension in Grade 2, outside-in skills are predictive of reading attainment.

However, Sénéchal, LeFevre, Smith-Chant and Colton (2001) made a strong argument that emergent literacy should be considered separately from oral language, on the basis that the two constructs are likely to have distinct ontogenies. In other words, while oral language generally emerges through children's natural interactions with their social environments, exposure to specific materials and instruction is required in order for children to acquire print knowledge and phonological awareness skills. Sénéchal et al. (2001) therefore propose that emergent literacy should be conceptualised as knowledge and skills specific to literacy development, broadly divided in conceptual knowledge (i.e. print concepts) and procedural knowledge (e.g. letter knowledge, word segmentation and blending). It is this conceptualisation of emergent literacy which is adopted in this thesis; oral language and emergent literacy are conceptualised as distinct constructs.

It is the purpose of this thesis to examine the environmental factors encountered in the early years of life which contribute to individual differences in oral language, emergent literacy and consequently reading attainment. Specifically, the research reported here aims to examine the role of the home literacy environment in the language and literacy development of children with and without a family history of dyslexia. This research was conducted with a sample of young children at family-risk of reading difficulties, alongside a group of typically developing peers, as part of the Wellcome Language and Reading Project conducted at the Centre for Reading and Language, University of York. This opening chapter comprises a review of the literature on social and environmental correlates of reading development more broadly.

1.2 Social Contexts of Literacy Development: Socioeconomic Status and Family Environment

Socioeconomic status (SES) is a construct of fundamental concern to developmental psychologists, since social and economic disadvantage has been adversely linked to a wide range of health, cognitive and socio-emotional outcomes in children (Bradley & Corwyn, 2002). The association between SES and cognitive development begins in infancy and is particularly robust in relation to verbal skills (Bowey, 1995; Hart & Risley, 1995). However, the link between distal socio-economic factors and child outcomes is purely descriptive, and provides no information about the mechanisms by which socio-economic disadvantage operates on children's development. It seems likely that the family environment, encompassing interactions with family members and resources available in the home, mediates the association between SES and child outcomes.

Moreover, there is little consensus on how to define and measure SES. It has become increasingly clear that SES cannot be conceptualised as a unitary construct, but rather comprises a number of inter-related factors that may operate on children's development at multiple levels (Arnold & Doctoroff, 2003). Family income is one commonly-used indicator, but parental educational level and occupational status may be more sensitive measures since they tend to be more stable over time. Stronger effects are generally found in studies that create composite SES variables, rather than relying on a single indicator (Bradley & Corwyn, 2002). Several authors have noted higher levels of academic underachievement in children from ethnic minority backgrounds in western societies (Arnold & Doctoroff, 2003; Leventhal & Brooks-Gunn, 2000). However, ethnic minority status confers a higher risk of family poverty, and both indicators often account for the same variance in child outcomes, leading some researchers to posit 'distance from the dominant culture' as a risk factor encompassing both socio-economic and ethnic dimensions (Lawrence & Shipley, 1996). Likewise, single parent family status is often listed as an indicator of deprivation, but Ricciuti (1999) found no independent effect of family type on a range of academic and behavioural outcomes in a large sample of American children.

The importance of the *timing* of socioeconomic deprivation during childhood has been highlighted by several authors (e.g. Bradley & Corwyn, 2002; Brooks-Gunn & Duncan, 1997). There is increasing evidence to suggest that the deleterious effects of family poverty are particularly strong when it occurs in the early years of life, when children typically spend most time in the family home. On the other hand, if a family experiences poverty when children have reached adolescence, the impact on child outcomes is reduced, presumably via the protective influence of school environment and peer relationships.

Finally, it is important to note that the effects of SES and family structure on children's development are not uniform across cultures. Chiu and McBride-Chang's (2010) analysis of questionnaire data and reading scores garnered from some 200,000 15-year-old children over 41 countries indicated that family-level variables are moderated by country-level variables in their influence on reading such that, for example, negative effects associated with single parent family status were eradicated in collectivist cultures, in which members of the extended family are more likely to play an active role in children's upbringing.

The *bioecological model* of development forms a useful theoretical framework for conceptualising the complexity of environmental influences on children's development (Bronfenbrenner, 1979; Bronfenbrenner & Ceci, 1994). Bioecological models make a critical distinction between environment and process, arguing that development occurs through increasingly complex interactive processes between an active, evolving organism and the people, objects and symbols in its environment over extended time periods (a *process-person-context-time* (PPCT) model; Figure 1.1.). Proximal processes occur at the microsystem level, incorporating face-to-face interactions with family members and peers within the immediate environment of the child. The personal characteristics of all involved in these interactions contribute to development. Distal processes refer to contributions made by environmental contexts that are psychologically remote to the child (i.e. exosystems and macrosystems), such as parents' workplace and governmental policy. A central proposition of the bioecological perspective on human development is that influence between different contextual levels and the developing organism is not unidirectional, nor is the nature of interactions static over time. Bronfenbrenner's ideas have been developed by numerous theorists, who take a transactional approach to children's development (Belsky, Steinberg, & Draper, 1991; Sameroff, 2010).

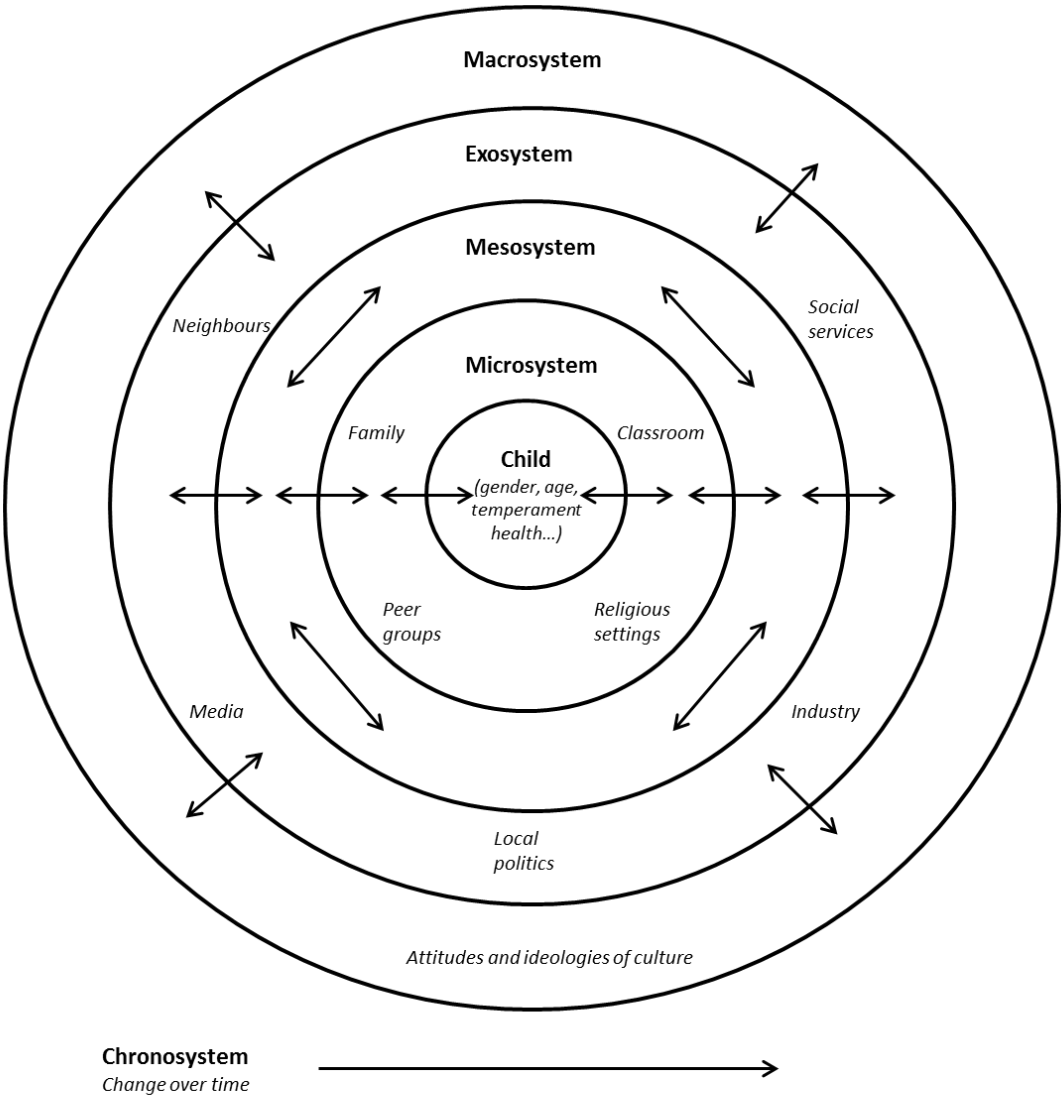


***Figure 1.1*. The bioecological model of development (Bronfenbrenner & Ceci, 1994)**

In summary, disentangling the relative impact of social and environmental variables at the family, community, and cultural levels on children's development is no mean feat. Multilevel modelling techniques have allowed researchers to identify multiple direct and indirect pathways between socioeconomic status and child outcomes, with risk factors operating additively, multiplicatively and via mediation. However, any study can only hope to capture a fraction of the dynamic and multidirectional relationships between the developing child and his or her environments.

1.2.1 Socioeconomic Status and Home Literacy Environment

An important mechanism by which SES operates on children's reading development is the literacy-related resources and interactions that young children experience in the home, especially during the preschool years (Bus, van IJzendoorn, & Pellegrini, 1995). The umbrella term 'home literacy environment' (HLE) is commonly used to refer to a constellation of variables, including frequency and quality of shared storybook reading with family members, attempts by parents to teach children about letters and words, the availability of printed materials in the home, parental modelling of literate behaviours, and parental attitudes to and beliefs about reading, which may influence a child's success in learning to read.

The interrelationship of SES and HLE has been addressed by a large body of research. The Millennium Cohort Study is a multi-disciplinary project tracking the development of approximately 19,000 children born in the United Kingdom between 2000 and 2001. As part of this study, questionnaires were completed by parents tapping family SES (poverty, housing tenure and financial difficulties), HLE (how often family members read stories and visited a library with the child) and maternal mental health (clinical diagnosis of depression and self-ratings of post-natal depression and general malaise). Structural equation modelling of these data alongside measures of children's cognitive and behavioural development at age 3 revealed that the effects of economic deprivation on children's early cognitive skills were partially explained by HLE, but not by maternal depression. On the other hand, economic deprivation and maternal depression acted as cumulative (though inter-correlated) risk factors for children's externalising and internalising behaviour problems (Kiernan & Huerta, 2008). The idea that learning environments within the family are associated with cognitive development, while family stress and mental health are associated with behavioural outcomes, has been replicated in a number of other large-scale datasets (e.g. Chazan-Cohen et al., 2009). Interestingly, however, in a large-scale US study of children attending the Head Start programme, HLE also mediated a small but significant proportion of the effect of economic deprivation on young children's social functioning (Foster, Lambert, Abbott-Shim, McCarty, & Franze, 2005). Although these studies necessarily employ rather broad-brush measures of HLE, the robust pattern of relationships amongst the family environment variables provides powerful evidence for the mediating role of HLE in children's early cognitive development.

However, the fact that HLE was identified as a partial, rather than total, mediator in the Millennium Cohort Study dataset is indicative of within-SES group variation in HLE. This conclusion is supported by a number of smaller-scale studies (Chaney, 1994; Sénéchal, 2006; Smith & Dixon, 1995; van Steensel, 2006). For example, Payne, Whitehurst and Angell (1994) investigated the effects of HLE on the oral language skills of 323 4-year-old children, recruited through the Head Start programme, and therefore all classified as low SES. After controlling primary caregiver IQ and educational level, HLE still contributed a unique 12% of variance in these children's receptive and expressive language scores. The sample used in this study was relatively homogenous in terms of SES, and furthermore an attempt was made to eliminate a genetic explanation for HLE variation by controlling for caregiver IQ. Therefore, the fact that composite HLE scores showed variance across the sample and remained a predictor of children's language is suggestive of the protective role that rich home literacy experiences may play in mitigating the risk posed by low SES for children's language and literacy development.

Payne et al.'s (1994) results were largely replicated in a sample of African-American 5- and 6-year-old children from low-SES families, of whom only 50% performed within national norms on measures of verbal ability and externalising/internalising behavioural problems (Krishnakumar & Black, 2003). In plotting the pathways between a number of distal and proximal environmental risk factors, these authors identified the key mediating influence of HLE on the relationship between economic deprivation and vocabulary, although unlike in the Millennium Cohort Sample, maternal depression also mediated this relationship. Conversely, economic deprivation and maternal depression acted as additive risk factors for children's problematic behaviours. Importantly, these data also highlighted the stability of poor cognitive performance and problematic behaviours over time, and pointed to an *early* role for environmental risk factors; in other words, when children's performance on the cognitive and behavioural measures at age 5 were entered as autoregressors into the models, SES and HLE variables lost their predictive power on the child outcomes at age 6. This finding points to the conclusion that HLE may be particularly influential in children's cognitive development before school entry and during the first year of formal education. It may be surmised that, after this point, the predictive value of the HLE is attenuated by other environmental factors, such as school and peer-group.

Evidence that environments outside the home may compensate for an impoverished HLE is provided by an SEM analysis of data from 317 kindergarten children (Christian, Morrison, & Bryant, 1998). In this study, a composite measure of HLE uniquely predicted children's vocabulary, letter knowledge, reading and general knowledge, though not arithmetic ability. Furthermore, when the sample was divided into quadrants along HLE and maternal education dimensions, those children whose mothers had lower educational levels but who experienced a rich HLE outperformed 'high maternal education–low HLE' children on all outcome measures, again indicating the value of HLE as a protective factor against distal environmental risk. An interesting additional finding of this study was that children in the 'low maternal education-low HLE' group performed better on measures of reading and arithmetic if they had spent more months in childcare. Whilst this is not a straightforward relationship, since there exists much variation in the quality of childcare on offer to young children in Western societies (Burchinal, Peisner-Feinberg, Bryant, & Clifford, 2000), it is illustrative of the interleaving effects of different environmental contexts on children's development.

1.2.2 Socioeconomic Status and Components of Early Literacy Development

The link between family socioeconomic status and children's reading ability is well established, with low family SES often highlighted as a marker of risk of poor reading achievement (Phillips & Lonigan, 2005). Several studies have therefore attempted to delineate SES effects on early predictors of reading attainment, namely oral language and components of emergent literacy (phonological processing and early print-related knowledge) in order to clarify the mechanisms by which family SES operates on children's reading development.

As noted previously, the evidence for SES effects on children's verbal ability, and especially vocabulary knowledge, is strong (e.g. Bowey, 1995; Chaney, 1994), such that SES accounts for more than 40% of variance in the rate of 3-year-olds' vocabulary growth (Hart & Risley, 1992). Fish and Pinkerman (2003) compared the language skills of young children from middle- and low-income families during the preschool years. While vocabulary at 15 months of age (measured by parental report) was equivalent between the SES groups, by 4 years old children within the middle-income group were outperforming those in the low-income group in a composite measure of oral language. Within the low-SES group, children's language ability at age 4 was predicted by a number of individual and contextual variables, namely vocabulary in infancy, child temperament, maternal interaction style and number of books in the home.

Evidence that the amount and quality of language input in the home varies as a function of SES is also plentiful. In a seminal study, Hart and Risley (1995) closely observed parental and child use of language in professional families, working-class families and families living on welfare. Their findings indicated that children from professional families heard approximately 3.5 times more words per hour than welfare families (2153 as compared to 616 words per hour). The early language input experienced by children predicted vocabulary at age 3, when the difference in vocabulary knowledge between children from the highest and lowest socio-economic backgrounds was already stark.

Similarly, an observation of mother-child interactions during a structured picture identification task, free play and a mealtime revealed main effects of socio-economic class on a number of key maternal language variables, including amount of speech, mean length of utterance and use of superordinate and subordinate category labels (Lawrence & Shipley, 1996). The only linguistic category in which low SES mothers produced more exemplars was the use of directive language.

Likewise, a micro-analysis of the linguistic input of 53 low-SES mothers during play, shared reading and mealtime interactions conducted by Weizman and Snow (2001) revealed that only 1% of words uttered by mothers could be classed as 'sophisticated vocabulary' (i.e. vocabulary items outside the 3,000 words most frequently spoken to children according to teacher ratings). Nonetheless, individual differences in the quality of maternal lexical input, as well as how often these higher-level vocabulary items were embedded within instructive interactions between mother and child, were associated with children's vocabulary, after controlling for children's IQ and maternal education level. The effects of family SES on children's oral language skills are likely, therefore, to be mediated by the quality of linguistic input that children experience at home in the early years of life. The results of these studies indicate both inter- and intra-SES group differences in the quality of home language environment. In turn, it is highly probable that children's oral language skills represent one key mechanism via which family SES operates on reading (Phillips & Lonigan, 2005).

The research literature on SES differences in early phonological awareness skills is more mixed. Raz and Bryant (1990) and Bowey (1995) both reported SES group differences in phonological awareness, including both rhyme- and phoneme-based tasks, in 5-year-old children. Moreover, a longitudinal analysis of the phonological awareness skills of 238 middle-income and 117 low-income children suggested that SES effects were evident prior to school entry, with the middle-income group showing enhanced performance on tasks of elision and blending at age 4 (though not on rhyme and alliteration oddity tasks) (Lonigan, Burgess, Anthony, & Barker, 1998). In this study, performance on phonological awareness tasks at age 3 was near floor for all children, but the rate of development of phonological awareness during the preschool years was slower in the low-SES group. Nonetheless, the strength of correlation between phonological awareness and reading at age 5 was equivalent across the groups. Lonigan et al. (1998) offered oral language skills and cumulative effects of home literacy environment as two potential drivers of the increasing SES gap in phonological awareness ability. In fact, these two variables are likely to interact, such that children's developing oral language skills elicit more literacy interactions in the home, which in turn boost language skills.

However, other studies have found SES effects on phonological awareness to be largely a *product* of SES differences in reading. The association between phonology and reading is bi-directional, such that in addition to early phonological awareness being a reliable predictor of reading development, increasing proficiency in word reading boosts phonological awareness (Hulme & Snowling, 2009). For instance, Chaney (1994) reported no direct pathway between maternal education and phonological awareness; rather environmental variables were related to early oral language and print concepts, both of which in turn correlated with phonological awareness. Similarly, analyses of data from a larger sample of children, divided into SES groups by school catchment area, indicated that SES effects on phonological awareness disappeared when the two groups were matched for reading age (Duncan & Seymour, 2000). Overall, the relationship between family SES and phonological awareness is less clear-cut than that between SES and oral language, and may be accounted for by SES differences in children's oral language and print knowledge (Chaney, 1994).

A final sub-component of children's emergent literacy is knowledge about print. This construct encompasses both *print concepts*, i.e. the range of knowledge about the function of print necessary for reading, including the ability to distinguish print from other symbols, understanding that reading proceeds from left to right and from the top to the bottom of the page (Adams, 1990), and *print forms*, i.e. knowledge of letter sounds, letter names and word units. An analysis of SES effects on preschool children's knowledge about print showed that children from higher SES backgrounds showed early advantages on a composite measure of print concepts, while group differences were larger still on a composite measure of print forms (Smith & Dixon, 1995). However, this study conflated phonological awareness and letter knowledge tasks in its print forms composite, thereby undermining the validity of the findings.

More recently, the results of a larger-scale study examining SES effects in the growth of decoding and reading comprehension indicated that knowledge about print may be the most important mediator of SES effects on decoding (Hecht, Burgess, Torgesen, Wagner, & Rashotte, 2000). These authors reported a hierarchical latent variable model, in which SES remained a unique predictor both of Grade 2 word reading and of reading growth between Grades 2 and 4, after controlling for verbal IQ and three aspects of pre-reading ability (print knowledge, phonological awareness and rapid automatised naming (RAN)). However, the predictive value of SES (here tapped by both parents' educational level and occupational status) was substantially attenuated by print knowledge. Hecht et al. (2000) therefore concluded that an important indirect pathway between SES and decoding operates via children's early understanding of the nature of print.

There is a thus a body of evidence in support of the notion that SES differences in oral language and emergent literacy are observable before children begin the process of learning to read formally at school. Children from lower SES families exhibit early disadvantages in oral language and print knowledge, which in turn predict the rate of reading development. A direct association between family SES and phonological awareness is more controversial, since some authors report SES effects on phonological awareness before school entry, while others suggest that such differences are driven by oral language and knowledge of print. As addressed in section 1.2.1, the home literacy environment is a key candidate mechanism by which family SES operates on these early reading-related skills.

1.3 Defining the Home Literacy Environment

The research reviewed above provides a convergent picture of the HLE as an important environmental construct which is associated with children's language and reading development, and which may buffer against distal risk factors such as economic deprivation. It is therefore pertinent to ask how particular aspects of the child's early literacy-related experiences in the home are differentially related to child outcomes.

1.3.1 Storybook Exposure

Over the last fifty years, there has been a prevailing view in Western societies that reading storybooks to young children confers significant educational and socio-emotional advantages (Scarborough & Dobrich, 1994). Education policy in Europe and North America has routinely sought to encourage parents to read regularly with their young children in an effort to boost literacy levels, as the quotation at the beginning of this chapter, taken from a US governmental report published in 1985, illustrates. It is perhaps unsurprising, therefore, that many early studies used a single dimension, frequency of shared storybook reading in the home, as a proxy for the home literacy environment (e.g. Share, Jorm, McLean, & Matthews, 1984; Wells, Barnes, & Wells, 1984).

1.3.1.1 Early studies of children's storybook exposure

The first systematic review of the literature on the HLE, conducted by Scarborough and Dobrich (1994), found that while shared storybook reading was consistently associated with concurrent emergent literacy and oral language measures, as well as later reading outcomes, the magnitude of the effect was relatively modest, accounting for approximately 8% of the variance in all three domains. Scarborough and Dobrich also analysed the results of intervention studies, and found that training parents to modify shared reading practices did produce modest effects, particularly on oral language, suggesting a causal relationship between HLE factors and child outcomes. However, these authors concluded that, since HLE measures tend to be correlated with SES and do not produce a larger effect on child outcomes than SES factors, children's early literacy experiences in the home, were not sufficient to equip children with the prerequisite skills for reading achievement. Scarborough and Dobrich (1994) therefore challenged the prevailing orthodoxy that reading books to children is an educational panacea.

However, these conclusions are compromised by methodological weaknesses within the studies they reviewed. A number of ripostes to Scarborough and Dobrich (1994) questioned whether their effect size might be an underestimate of the contribution of the HLE to child language and literacy development, pointing to the diverse measures of HLE used in these early studies, the questionable validity and reliability of some of the measures (Dunning, Mason, & Stewart, 1994) and small sample sizes limiting power (Lonigan, 1994). Dunning et al. (1994) argued that, while 8% of variance constitutes a fairly small effect, it is not negligible, particularly when it is considered that many of the studies reviewed used one single variable, shared storybook reading, as a proxy for the HLE. Moreover, Lonigan (1994) pointed out that Scarborough and Dobrich's interpretation failed to consider both direct and indirect pathways from shared storybook reading in the preschool years to later literacy attainment. Small effects of shared reading on emergent literacy and oral language skills may magnify over the first years of primary education (so-called 'Matthew effects'; Stanovich, 1986), and therefore a consideration of direct effects only may produce an incomplete picture of the role of early literacy experience in reading development.

A meta-analysis of studies using the frequency of joint reading in the home as a predictor of child language and literacy outcomes was conducted by Bus et al. (1995). On the basis of 24 published and five unpublished studies, this analysis supported Scarborough and Dobrich's findings to the extent that shared reading was found to predict approximately 8% of unique variance in children's language, emergent literacy and later reading skills. However, by standardising effect sizes to Cohen's *d* across studies, and weighting effects according to sample size, Bus et al. (1995) found medium-sized effects of shared reading on oral language (d=.67), emergent literacy (d=.58) and reading (d=.55). These authors noted the considerable heterogeneity of results among their 29 studies, with Cohen's *d* ranging from 0 to 1.51, and sought to explain this variation according to a number of predictor variables. While the socio-economic status of the samples did not predict variance in the results, and neither did the type of measure used to tap shared reading (simple frequency score versus composite HLE measure), Bus et al. (1995) found that effects were larger with younger children, arguing that the school environment and children's independent reading may become more influential predictors of attainment as children progress in their primary education, and therefore the role of the HLE becomes less important.

1.3.1.2 Measuring storybook exposure

In line with the early reviews by Scarborough and Dobrich (1994) and Bus et al. (1995), several subsequent studies have shown that the frequency of storybook exposure in the early years reliably predicts a number of child outcomes. However, children's age when parents begin reading storybooks with them has been mooted as a stronger correlate of oral language than frequency counts (e.g. DeBaryshe, 1993), suggesting that the effects of storybook exposure may be cumulative over time. Payne et al. (1994) used a composite measure derived from nine questionnaire items (frequency and duration of shared reading, child's age at the onset of shared reading, number of books in the home, frequency of library visits, frequency of children's requests to be read to, frequency of children's independent reading, frequency of caregiver reading and caregivers' enjoyment of reading) to tap HLE. Their analysis showed that aggregating predictor and outcome scores yielded stronger inter-correlations. However, it is possible that pooling across receptive and expressive language domains may mask differential effects of HLE on children's ability to understand, as opposed to produce, spoken language. Other studies have indicated that the effects of storybook exposure may be most strongly related to children's language comprehension (DeBaryshe, 1993).

Griffin and Morrison (1997) developed a Home Literacy Environment Questionnaire which assessed the frequency of shared reading and of library visits, the presence of literacy resources in the home, parents' own literate behaviours and the frequency of activities which might be expected to displace literacy activities, such as hours of television viewing. The authors went on to report that in a sample of 295 American kindergarten children, the HLE measure predicted unique variance in children's concurrent receptive vocabulary, general knowledge and reading recognition. The predictive power of pre-school HLE in general knowledge and reading recognition, but not receptive vocabulary, was maintained when the children were tested in Grade 2.

However, self-report measures are vulnerable to a number of response biases, and when reporting on an activity so universally approved as reading storybooks to children, it might be expected that parental report, as tapped by HLE questionnaires, would be susceptible to the effects of social desirability. To circumvent this confound, Stanovich and West (1989) developed a method designed to tap children's exposure to storybooks in the home more objectively: *Title* and *Author Recognition Checklists*. Parents (or older children) are presented with a list of titles of well-known storybooks targeted at the relevant age-group, which includes a number of invented foils, and simply asked to tick the titles which they recognise as authentic. A similar list of the names of authors of popular children's storybooks can be used as an alternative, or in addition, to the *Title Recognition Checklist*. Stanovich and West (1989) found their *Author Recognition Test* to be a robust and independent predictor or orthographic processing in a sample of American undergraduates. Stainthorp (1997) found scores on an adapted *Author Recognition Checklist for Children* (CART-UK) to be well correlated with British children's reading performance.

These checklist tools are clearly an indirect way of measuring storybook exposure; their rationale being that parents who recognise more titles and authors of children's literature are more likely to engage in frequent shared storybook reading with their children. However, data from checklists typically show convergent validity, correlating with parent reports of storybook exposure, and predictive validity, correlating with children's later oral language skills. For instance, Frijters, Barron and Brunello (2000) found that a composite HLE measure taken from five parental-report items correlated with children's receptive vocabulary (r=.24) in a sample of Canadian 5- and 6-year olds, but that the association was stronger when a Parental Title Recognition Checklist was added as an indicator of storybook exposure (r=.39). A direct effect of HLE on oral language was highlighted by a multiple regression analysis, where shared reading (parental report and checklist) and children's interest in literacy accounted for 21% of the variance in children's receptive vocabulary.

Unusually, Evans, Shaw and Bell (2000) found that their parental-report measure of the frequency of shared reading did not correlate with a Children's Title Recognition Checklist. However, given that the checklists were posted to parents rather than administered face-to-face by researchers, the validity of this measure may have been compromised. Evans et al. (2000) went on to show that, in their sample of 67 Canadian children, after accounting for children's age, cognitive ability and parental education level, storybook exposure as reflected by the checklist scores did not account for unique variance in any language or literacy outcomes. This pattern of results is discrepant with the broader literature, and perhaps reflects the use of a relatively small, mixed SES sample. Parental education level was well correlated with storybook exposure in this study, and these two variables may largely have accounted for the same variance in child outcomes. However, as discussed previously, parental education is a purely descriptive environmental predictor of language and reading development, whereas storybook exposure constitutes a plausible mechanism by which differences in parental education level operate on development.

1.3.1.3 Predictors of children's exposure to storybooks

As discussed in section 1.2.1 above, although children's storybook exposure tends to be associated with parental education level, there also exists intra-SES class variation in how often parents read with their children. In other words, more educated parents are more likely to engage in more storybook reading with their children, but these two variables are not perfectly correlated.

A number of studies have sought to identify other environmental correlates of storybook reading in the home. For example, in a nationally representative US sample of respondents to the National Household Education Survey, Yarosz and Bartlett (2001) found that the frequency of shared reading reported by parents was predicted by maternal education, ethnicity (with white parents reporting more shared reading than Hispanic or Afro-American respondents), the language spoken in the home and number of siblings. The effect of number of siblings was non-linear, such that a steep decline in reported shared reading was observed from zero to two siblings, but the decline from three siblings upwards was less marked. Notably, family income did not predict levels of shared reading in this study. Similarly, a large-scale study of Head Start families, found that the chances of being read to daily was greater for firstborn and female children, and in families where mothers were better educated and more verbal (Raikes et al., 2006).

Data from the Family and Child Experiences Survey (FACES) conducted with families attending Head Start centres in the US, suggest that parental involvement in home learning more broadly is negatively associated with immigrant status, Hispanic ethnicity, father-only households and male gender of the child (Hindman, Miller, Froyen, & Skibbe, 2012). Positive associations were found between home involvement and warm, supportive and consistent parenting styles.

Therefore, in addition to the well replicated finding that children's exposure to storybooks in the home is predicted by parental education level, there is some evidence to suggest that levels of shared storybook reading may be lower in larger families and in households that are more distant from the dominant culture in terms of ethnicity and/or language spoken in the home. It is possible that there are gender effects in storybooks exposure, with girls being read to more than boys, but this finding has not been universally replicated (e.g. Sénéchal, LeFevre, Hudson, & Lawson, 1996). Finally, parenting styles that are authoritative without being overly controlling are associated with greater involvement in children's early learning in the home.

1.3.1.4 Storybook exposure and oral language ability

In recent studies, the most commonly observed effect of early storybook exposure is on children's vocabulary knowledge (e.g. Farrant & Zubrich, 2013; Hammer, Farkas & MacZuga, 2010). For example, analysis of a large-scale Australian survey identified that children who experienced low levels of storybook reading in the home were 2.5 times more likely to have poor vocabulary scores at age 4 than those who experienced high levels of shared reading (Farrant & Zubrich, 2013). However, Sénéchal, Pagan, Lever and Ouellette (2008) investigated the effects of shared storybook reading in the home on a broader range of language skills. As in previous studies, exposure to storybooks (here tapped by a factor defined by frequency of shared reading, frequency of library visits and checklist measures) was uniquely predictive of children's expressive vocabulary. Additionally, storybook exposure was a predictor of receptive morphology, suggesting that the more complex linguistic structures to which children are exposed during storybook exposure are important to the development of structural language skills. However, the relationship of storybook exposure with receptive syntax was accounted for by parents' own print exposure. Other research has pointed to a link between adults' orientation to literature and their own language skills (Stanovich & West, 1989), so it may be that parents with higher levels of print exposure talk to their children in more syntactically complex ways in daily interactions other than storybook reading. Contrary to hypotheses, Sénéchal et al. (2008) found that storybook exposure did not correlate with children's narrative skills (researcher rated linguistic complexity, cohesion and story grammar in a story telling task). Although this last result is surprising, this study provides good evidence that storybook reading in the home does not only foster children's vocabulary, but also other domains of oral language.

A large-scale study, which investigated the effects of shared reading in a sample of low-income mothers and children during the first three years of life, found that approximately 50% reported reading at least several times a week at all three time points (Raikes et al., 2006). These authors found a 'snowball effect' of shared reading on children's vocabulary; after the effects of concurrent shared reading and early vocabulary skills were controlled, frequent reading at three time points (14, 24 and 36 months) predicted vocabulary at age 3. This, along with the predictive power of age of onset of storybook reading (DeBaryshe, 1993), suggests that the effects of shared reading on children's language development are cumulative over the preschool years.

Overall, then, the link between children's exposure to storybooks in the home and language development is well established, although the validity of the assumption that this correlation exists across cultural groups has been challenged (Shapiro, Anderson, & Anderson, 1997). It may be assumed that children learn implicitly through exposure to the higher-level vocabulary and more complex morpho-syntax of the written language register. Familiarisation with narrative structures and the conventions of storybooks may also foster a literate orientation (Bus et al., 1995), which can have a long-term impact on children's motivation to read.

1.3.1.5 Storybook exposure and emergent literacy

Evidence on the explanatory power of shared reading in the development of children's emergent literacy skills is more mixed. Phonological awareness is robustly associated with oral language skills, but opinions as to the nature of the correlation varies. Advocates of the lexical restructuring account (e.g. Fowler, 1991) have argued that as children's vocabularies grow, lexical representations become increasingly segmental, and that children with advanced language skills are therefore also likely to show advanced phonological awareness. On the other hand, it is possible that the instructions of phonological awareness tasks, which are often fairly complex, introduce a language load confound (McBride-Chang, 1995). Burgess (2002) found that HLE measured when children were between 4 and 5 years old contributed unique variance to phonological awareness one year later, after including an autoregressor in the model, whereas a composite measure of oral language did not. However, it is not clear which specific aspects of the HLE might foster phonological awareness since this study used a multi-component model, nor whether the relationship might be mediated by oral language. Moreover, other studies have shown no correlation between HLE indicators and phonological awareness (e.g. Hood, Conlon & Andrews, 2008; Sénéchal & LeFevre, 2002).

Finally, there is little evidence to suggest that children pick up orthographic knowledge implicitly from exposure to storybooks in the home (e.g. Hood et al., 2008). Contrary to the claims of adherents to the 'whole language approach' (Stahl & Miller, 1998), focusing on the meaning and narrative structure of text alone does not render learning to read as effortless as learning to talk. It seems that more explicit instruction is required to help children 'crack the code' of printed text, and this process of direct literacy instruction often begins in the home before children have entered the education system.

1.3.2 Direct Literacy Instruction in the Home

Shared storybook reading in the home fosters the development of outside-in components of emergent literacy, and most robustly vocabulary knowledge. 'Inside-out' skills, on the other hand, are code-focused, concerning the development of an understanding of the rules for translating orthographic into phonological representations. Both phonological awareness and letter knowledge are robust predictors of children's later reading attainment (e.g. Lervåg, Bråten, & Hulme, 2009). However, as discussed above, early phonological awareness and letter-sound knowledge do not show a reliable correlation with shared reading in the home.

However, studies which have measured the frequency with which parents explicitly teach their children about letters and words have identified a relationship between this more ‘formal’ HLE practice and children’s performance in inside-out measures, such as letter-sound knowledge (Evans et al., 2000; Hood et al., 2008; Phillips & Lonigan, 2005; Sénéchal, LeFevre, Thomas, & Daley, 1998; Sénéchal, 2006). Direct instruction, but not storybook exposure, has also been linked to the development of children’s print concepts (Levy, Gong, Hessels, Evans, & Jared, 2006). Since no ‘objective’ measure akin to the *Title* and *Author Recognition Checklists* exists, levels of direct instruction in the home are typically gauged by parental-report questionnaire measures only. In a series of studies on the relationship of Canadian children’s early literacy experiences in the home with emergent literacy and later reading skills, Sénéchal and colleagues have reported a dissociation between shared storybook reading and direct literacy instruction. In other words, it is not necessarily the same families who place high value on reading stories to their children who also spend the most time engaging in letter or sound-based activities together. Sénéchal et al. (1998) found that, while early shared storybook reading predicted 7% of the variance in children’s oral language skills at the end of Grade 1, direct instruction predicted 6% of the variance in written language skills. Since oral and written language skills combined predicted 20% of the variance in children’s end-of-year reading performance, Sénéchal et al. (1998) argued that the relationship between HLE and reading is mediated by proficiency in both oral and written language skills.

Sénéchal and LeFevre (2001) followed up the sample of children from their earlier study in Grade 3. By dividing the children into four groups according to the two HLE measures, they found that children who experience high levels of both shared reading and direct instruction in the home during the preschool years showed a clear trend to perform well at the outset of reading instruction at school in Grade 1 and to continue to read well in Grade 3, while the opposite was true of children who experienced little of either type of HLE interaction. Their most striking finding was that children who received high levels of direct instruction but little storybook reading started out reading well in Grade 1, but tended to have lost their advantage by the time reading was assessed two years later. Conversely, children who were read to frequently but received little direct literacy instruction in the early years read less well than those children who had been explicitly taught about letters and words on a regular basis in Grade 1. By Grade 3, however, these children had almost caught up with the readers in the 'high storybook reading – high direct instruction' group. This pattern of results is interesting because it suggests that parents' efforts to help their children with early decoding skills can have an impact on their children's basic reading at the outset of their school careers when the emphasis is on single word reading using grapheme-to-phoneme correspondence and synthesis. However, this advantage does not last into Grade 3. By this stage more complex literal and non-literal comprehension skills are required, which may be depressed unless early direct instruction is combined with frequent storybook exposure in the preschool years. In other words, the benefits of advanced early decoding skills may be short-term, if not supported by proficient broader oral language ability.

Martini and Sénéchal (2012) focused on the nature of direct instruction of print forms in the home, reporting that the majority of parents in their middle-class Canadian sample reported engaging in teaching their 5-year-old children about letters and words often or very often. Explicit literacy instruction took place in multiple contexts, and parents used various teaching tools, including picture books, alphabet books, environmental print and shopping lists. The questionnaire items used in this study loaded onto two factors: teaching the alphabet, and teaching reading. Only the latter factor was a direct predictor of these children's emergent literacy skills. It is increasingly clear from the literature on HLE that storybook reading alone is not sufficient to equip children with strong orthographic skills, and this study is therefore significant, as it is the first published which provides a detailed picture of the ways in which parents teach children about the code before school entry.

1.3.2.1 The Home Literacy Model

The longitudinal results reported by Sénéchal and colleagues were used as the basis for a Home Literacy Model (Sénéchal & LeFevre, 2002), which forms the theoretical backdrop to the questionnaire study reported in this thesis, and will therefore be elaborated here.

According to the Home Literacy Model there are a number of indirect pathways from preschool HLE variables to reading at the end of Grade 3 (Figure 1.2). Both oral language (predicted by shared reading) and knowledge of print forms (predicted by direct instruction) relate to phonological awareness skills in Grade 1. The relationship of the HLE with phonological awareness is fully mediated by oral language and print knowledge. In turn, early decoding skills and phonological awareness are directly predictive of reading at the end of Grade 1, when the emphasis is on accuracy. Oral language at the start of Grade 1, on the other hand, does not relate to early reading, but is both directly and indirectly (via children's exposure to books) predictive of reading at the end of Grade 3, when comprehension skills become more important. This model provides a useful framework for understanding the mechanisms by which early HLE experiences indirectly affect reading via oral language and emergent literacy skills.

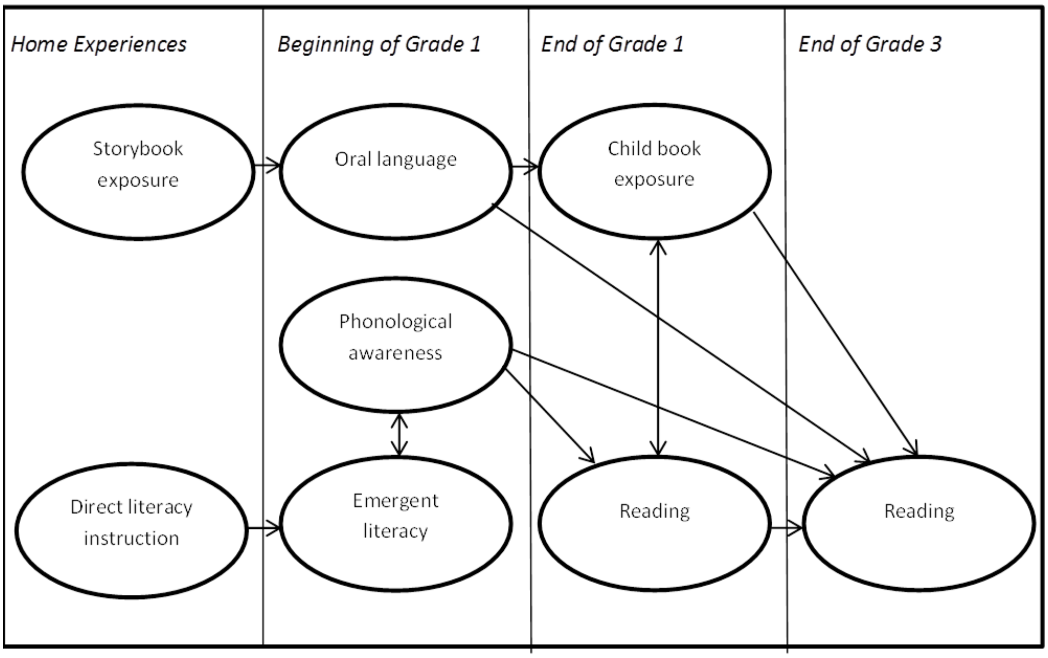


Figure 1.2. **The Home Literacy Model (Sénéchal & LeFevre, 2002)**

Sénéchal (2006) replicated and extended her previous findings with a sample of French-speaking Canadian children. Again, the two aspects of preschool HLE (shared reading and direct instruction) were independent in this sample. Shared reading was associated with children's vocabulary in Grade 1, and its relationship to reading comprehension in Grade 4 was mediated by vocabulary. Importantly, shared reading also predicted unique variance in the frequency with which children read for pleasure in Grade 4, measured by child report. Thus, it seems that children's early experiences of storybook reading in the home may have long-lasting effects on their motivation to read as they get older. Direct instruction also predicted decoding skills in Grade 1, as well as individual differences in reading fluency in Grade 4. As predicted by Sénéchal and LeFevre's (2002) Home Literacy Model, the relationship of HLE variables with phonological awareness was wholly mediated by oral language and letter knowledge. Furthermore early HLE experiences showed no direct relationship to Grade 4 spelling; rather, the relationship was mediated by Grade 1 pre-literacy skills.

The Home Literacy Model was supported further by Hood et al. (2008) in a study with a sample of Australian pre-schoolers. Again, shared reading and parental teaching were only weakly inter-correlated and showed the same differential associations with language and emergent literacy skills in Grade 1. In line with the predictions of Sénéchal and LeFevre's (2002) model, neither HLE practice was correlated with children's phonological awareness in Grade 1. However, parental teaching of letters, words and name-writing at pre-school age was found to have an indirect effect on children's phonological awareness, spelling and reading accuracy and fluency in Grade 2, with letter-word identification in Grade 1 acting as a complete mediator. In contradiction to Sénéchal and LeFevre's findings, early shared storybook reading was not related to Grade 2 reading; however this anomaly is likely to be an artefact of the younger age of the children in this sample and the measures used to assess reading. While the reading outcome measure in the Canadian study combined decoding and comprehension, the latter of which is most likely to be influenced by storybook exposure, those in the Australian study focused on accuracy and fluency exclusively.

The work of Sénéchal and colleagues on typically developing children's early literacy-related experiences in the home has elucidated the role of proximal environmental factors in reading development. First, it is clear that reading storybooks to their young children is not the only way in which parents can influence children's progression in reading in the early years of school. More didactic activities, such as teaching children the alphabet or letter sounds, can impact on children's early decoding ability, as can less formal ways of orienting children to the phonological domain of language, for example games of 'I Spy' or singing nursery rhymes together (Evans & Shaw, 2008). Sénéchal's research has also highlighted the potentially long-term impact of the preschool HLE on reading accuracy, fluency and comprehension. Activities in the home during the preschool years which scaffold children's reading from the outside in by nurturing oral language are related to reading comprehension and children's motivation to read independently years later. In contrast, activities which help children approach the task of learning to read from the inside out, by giving them the tools to break words down into their phonemic components and eventually crack the code of written language, are associated not only with very early reading ability, but also with later reading fluency. This may be due at least in part to Matthew effects, whereby children who enter the school system with strong basic skills are likely to continue reading well throughout their educational careers. Moreover, it may be conjectured that parents who provide literacy-rich environments in the preschool years will continue to offer high levels of input as their children progress through primary school, in terms of support with homework and provision of opportunities for their children to engage with the written word independently. It is clear that attempts to describe the HLE in terms of the frequency of storybook reading in the home alone, and to relate this measure only to pre-literacy skills or early single word reading ability, is likely to give an incomplete picture of the role of the home environment in reading development.

1.3.3 Quality of Parent-child Interaction during Shared Storybook Reading

Frequency counts of shared reading interactions reduce HLE activities to their simplest form and cannot explain *how* children's language skills are boosted through exposure to storybooks. Intuitively, one might expect there to be considerable variation in how parents deliver texts to their children, the amount and nature of discussion around the story, and the child's active contributions to the reading session. Several researchers have therefore attempted to capture the quality of adult-child reading interactions, primarily using observational methods, in order to provide a more nuanced picture of children's early literacy-related experiences in the home. These studies have typically sought to differentiate the shared reading interactions of relatively small samples of adult-child dyads according to the amount and type of extra-textual talk, in particular the levels of linguistic abstraction used, the focus on print features, and affective tone or warmth.

1.3.3.1 Extra-textual talk during shared reading

Observational studies show that parents tend to use richer, more complex language in shared reading episodes than in other interactions with their children (Dunn, Wooding, & Hermann, 1977). Similarly, very young children make use of richer vocabulary and continue topic discussions initiated by parents more often during shared book reading than during toy play or mealtimes (Hoff, 2010). Therefore, the extra-textual talk around storybooks contributed by parents and children is a potentially valuable focus for research in understanding how adults scaffold children's developing language.

The nature of parental talk during shared reading evolves with the age of the child, suggesting that parents are instinctively sensitive to the linguistic competence of their children. For example, Sénéchal, Cornell and Broda (1995) made video recordings of 9-, 17- and 27-month-olds infants having six unfamiliar storybooks read to them by their primary caregiver. Parents of the youngest children employed attention-recruiting utterances, such as "Look! A horse!" and also frequently labelled and described pictures in an explicit effort to build their babies' vocabulary. The extra-textual utterances of parents of the older infants were qualitatively different, including higher frequencies of questions and feedback to their children. In the 27-month-old group, children's responses to parents' questions and feedback had become more sophisticated, so that more complex dialogic routines were observed. Parents also seemed to be sensitive to their children's attention to the storybook, typically pointing to a picture within one second of their child directing his or her gaze towards the page.

Several researchers have attempted to make links between extra-textual talk during shared reading and children's language skills. For example, in one study, parents' labelling of pictures during book reading was negatively correlated with their 1- to 2-year-old children's vocabulary size, whereas questions and, above all, relating aspects of the story to their children's own experience showed positive links to both children's vocabulary and mean length of utterance (Blake, Macdonald, Bayrami, Agosta, & Milian, 2006). While these results may indicate that encouraging children to participate actively in the talk surrounding storybooks enhances oral language, the correlational nature of the results and lack of longitudinal data also allow for another interpretation, i.e. that parents are likely to instigate more sophisticated dialogue during shared reading if their children have advanced language skills.

In an analysis of the shared reading interactions of parents with 2-, 3- and 5-year-old children, Goodsitt, Raitan and Perlmutter (1988) found that verbal exchange around the content of the story increased with age, while simple labelling or requests for labels declined, as did off-task comments by the children. These results again point to parents' ability to modify the complexity of their speech according to the cognitive competence of their children. Goodsitt et al. (1988) also identified an effect of storybook familiarity: content-related utterances were more frequent when children were well-acquainted with the book, whereas labels and utterances relating to general world knowledge were more common with novel stories. Similarly, Adams and Bullock (1983) observed repeated readings of an unfamiliar storybook over a period of two weeks, and noted that mothers of very young children tended to label pictures with basic-level categories (e.g. 'dog') at the first reading. As the book became familiar to the children, however, mothers were more likely to introduce subordinate category labels (e.g. 'poodle'), while children were more likely to make verbal contributions to the interaction. Moreover, DeTemple and Snow (1996) reported that parents contributed more verbal input during readings of unfamiliar books, while children produced more talk when familiar books were being read to them.

The finding that the nature of the storybook being read can affect the quality of interaction was also highlighted by a study reporting that picture books without accompanying text elicited more content-related utterances from both parents and children than books with text (Sénéchal et al., 1995). Moreover, mothers were found to use more decontextualised language, a greater variety of verb tenses and more references to mental states when reading storybooks than didactic books with their 18- to 25-month-old infants (Nyhout & O'Neill, 2013). However, the reverse pattern was observed in a sample of mothers reading to 3- to 4-year-old children; here more cognitively demanding extra-textual utterances, longer mean length of utterance and more diverse vocabulary were used by both parents and children during interactions around information books than storybooks (Hammett Price, van Kleeck, & Huberty, 2009). These studies highlight the three-way interaction taking place when adults and children read together; parental, child and book characteristics can all influence the nature of the linguistic exchange.

Parents tend use highly repetitive ordered sequences during shared reading with young children. Conversational turns including attention-orienting, questioning and labelling are assumed to strengthen connections between words and their referents (Ninio & Bruner, 1978). As children's linguistic competence increases with age, parents continue to scaffold semantic skills by introducing increasingly abstract language into their talk around stories (Sorsby & Martlew, 1991). Danis, Bernard and LeProux (2000) analysed the shared reading interactions of 17 French-speaking parent-child dyads, when the children were 3 years old. Parental and child extra-textual utterances were coded according to four levels of abstraction. Both partners most commonly talked at the concrete level (perceptual identification), although adults also frequently linked different parts of the visual display (perceptual relationship) and talked about characters or scenes that were not immediately present on the page (displaced reference). Analysis of the directional dependencies between talk turns revealed that both adults and children tended to respond to an utterance by their conversational partner at the same level of abstraction, so that for example a displaced reference by a child would typically be answered by a displaced reference by the adult, showing reciprocal adaptation in conversation. However, parents also sometimes raised the abstraction level in response to the child, illustrating the role that adults can play in scaffolding the semantic complexity of children's mental representations.

A further observational study focused on the levels of linguistic abstraction produced by parents and 3-year-old children during shared storybook reading and links to children's language a year later (Van Kleeck, Huberty, Hamilton, & McGrath, 1997). Extra-textual talk was coded according to four levels of abstraction that were conceptually similar to the coding system used by Danis et al. (2000): (1) matching perception, (2) analysis/ integration of perception, (3) reordering/ inference regarding perception, (4) reasoning about perception. Parental talk at levels (1), (2) and (4) of abstraction predicted their children's ability to produce the highest level of abstract language (reasoning about perception) at age 4. Van Kleeck et al. (1997) argued that parental scaffolding operated in two ways. Firstly by providing plenty of concrete language (levels (1) and (2)), which was readily understandable for their children, parents created an atmosphere of success around storybook reading, so that children felt that they could respond appropriately to most of their parents' questions and prompts. However, by introducing more complex utterances at level (4), parents fostered growth in their children's linguistic ability.

Effects of extra-textual talk on language development have recently been replicated in a large-scale observational study of storybook reading with 130 3- to 4-

year-old children, both at home and at preschool (Hindman, Connor, Jewkes, & Morrison, 2008). This study reported independent and additive main effects of parent, teacher and child use of decontextualised language during storybook reading on vocabulary levels at the end of the preschool year, after controlling maternal education, ethnicity and children's vocabulary level at the start of the year. Moreover, the effect was stronger for children with higher initial vocabulary levels. Contextualised talk during storybook reading, such as labelling and description of illustrations, did not contribute variance to vocabulary scores. However, in a follow-up study with 153 children attending Head Start centres, teachers' use of both contextualised and decontextualised language during storybook reading predicted vocabulary growth; moreover, the effect of contextualised language was strongest for children with the lowest initial levels of vocabulary (Hindman, Wasik, & Erhart, 2012). Most recently, Hindman, Skibbe and Foster (2013) reported longitudinal effects of parental extra-textual talk on the vocabulary development of more than 700 preschool children, as part of the Early Childhood Longitudinal Study. Here, due to the large sample size, coding of extra-textual talk was dichotomous, rather than based on frequency counts (i.e. a score of 1 was recorded if a given category of parental talk, such as explanations of vocabulary items, was observed at any point during an interaction). The use of a variety of meaning-related talk by mothers was associated with maternal education level, and predicted children's vocabulary at age 4. In this study, where contextualised and decontextualised categories of meaning-related talk were not distinguished, no moderating effect of children's level of vocabulary two years earlier was observed. Overall, these three studies provide good evidence that adults' and children's use of meaning-related extra-textual talk during early storybook reading is predictive of children's vocabulary growth, and thus go some way to clarifying the mechanisms by which storybook exposure operate on vocabulary development. However, the magnitude of the effect may depend on the interaction of children's existing developmental level and the level of cognitive demand of the talk itself. Children with lower language levels may particularly benefit from content-related talk at the concrete level, whereas children with more advanced language skills benefit from being stretched with more cognitively demanding, abstract verbal exchanges.

The wide variation in the amount and type of extra-textual talk typically exhibited by adult-child dyads during shared reading episodes has been commonly noted (e.g. Newman, 1996). Hammett, van Kleeck and Huberty (2003) focused on how patterns of variation in types of extra-textual utterances vary systematically across parents. The utterances of 96 parent-child dyads were coded for abstraction, references to print and behaviour management/ feedback. Cluster analysis revealed four distinct patterns of parental input. By far the most common were those parents who produced limited comments in all categories, while a second reading style was characterised by a moderate number of utterances, mostly behaviour management or feedback and content-related talk at the most concrete level. Finally, a small number of parents provided high levels of extra-textual talk, and this group could be divided further into those who focused more on print conventions as opposed to those who talked about the content of the story using high levels of abstraction. Given the predictive power of parental extra-textual talk for children's vocabulary growth reported by Hindman and colleagues, it is noteworthy that many parents in the study by Hammett et al. (2003) contributed relatively little extra-textual talk. Other authors have noted that parents rarely explain the meaning of new vocabulary items encountered in books when listening to 5- to 7-year-old children read aloud, dubbing these shared reading encounters a ‘missed opportunity’ for vocabulary building (Evans, Reynolds, Shaw, & Pursoo, 2011).

Similarly, there is little evidence from observational studies that shared storybook reading is used by parents as a vehicle to teach children about orthographic features, such as letters, printed words or punctuation (e.g. Hindman et al., 2008; Sonnenschein & Munsterman, 2002). This trend appears to be mirrored by children. A case study of the unprompted questions asked by nine children during shared storybook reading between the ages of 3 and 5 revealed a general trend for questions about pictures to be the most common, followed by questions about story meaning and word meanings (Yaden, Smolkin, & Conlon, 1989). Questions about graphic forms were the least frequently observed, although one child asked a disproportionate number of questions about letter and word forms. This child’s mother reported that he also showed keen interest in environmental print. Although clearly lacking in generalisability, this descriptive analysis is at least suggestive that there may be early individual differences in children’s orientation to print forms.

Evans and Saint-Aubin (2005) conducted two eye-tracking experiments with French-speaking Canadian mothers and their 4- to 5-year-old children. Results revealed that children hardly fixated on print, regardless of its position on the page. The authors cited the lack of attention paid by parents and children to text as evidence against shared reading in the early years being a crucial precursor to reading success, but if, as predicted by Sénéchal and LeFevre’s (2002) Home Literacy Model, storybook reading fosters oral language rather than code-related skills, these eye-tracking data are not unexpected. In general, parents appear to approach storybook reading as an opportunity to enrich their children’s comprehension, vocabulary and abstract representations, whether through the text alone or in combination with content-related extra-textual talk, rather than as a context within which to teach decoding skills. However, variation in the small proportion of time spent fixating on print during shared reading is predicted by children's emergent code-related skills (Evans, Williamson, & Pursoo, 2008) and hence may reflect differences in children's intrinsic motivation to engage with letter and word forms.

1.3.3.2 Shared reading intervention studies

The correlational studies discussed thus far suggest that individual differences exist in the quality of parent-child interactions during storybook reading, and that these differences are likely associated with aspects of children's language and literacy development. However, this evidence is not in itself indicative of causality; experimental interventions are necessary in order to investigate the putative causal relationship between HLE variables and child outcomes.

A number of experimental studies have adopted a Vygotskian theoretical framework, drawing on the idea of child as apprentice within the Zone of Proximal Development to explain the learning processes in operation during shared reading (Vygotsky, 1978). The role of the more experienced partner in a reading interaction is thus to scaffold the child's comprehension of the text, remaining sensitive to his or her current level and potential development. Within this framework, the number, type and placement of adults' extra-textual utterances during storybook reading is expected to influence children's learning.

Reese and Cox (1999) randomly assigned 48 New Zealand pre-schoolers to one of three adult reading style groups during a six-week intervention. The 'describer' condition consisted of five questions and five comments focusing on perceptual features of the picture books, which were interpolated throughout the reading of the book. The 'comprehender' condition used questions and comments at a higher level of abstraction, including inferences and predictions. In the 'performance' condition, adults did not make extra-textual utterances during the storybook reading, but made five comments before, and five requests for evaluation/judgement after, reading the story. Children in the describer condition showed the greatest gains in receptive vocabulary and print concepts, although those children who showed the highest scores at pre-test benefitted more in the performance condition. However, the surprising finding that the comprehender style did not benefit comprehension skills raises questions as to the optimal parental behaviours for boosting children's vocabulary.

Blewitt, Rump, Shealy and Cook (2009) attempted to test the benefits of scaffolding for children's vocabulary through a shared reading intervention which included a control group. In their study, experimenters posed questions to 3-year-old children, which differed in level of cognitive demand (all low-demand/ all high-demand/ low- followed up by high-demand; the latter represents scaffolding). Although children in all three treatment conditions showed gains in one-word receptive vocabulary at post-test, only children in the scaffolding condition showed improvements in deeper-level expressive vocabulary, assessed with a definitions task. Blewitt et al. (2009) suggest that scaffolding techniques work because low-level discussion around the text allows children to feel confident in their understanding, while high-level discussion facilitates the development of elaborative knowledge of words. Classroom-based interventions using storybook reading with early primary-aged children have suggested that vocabulary learning is facilitated when target items are regularly reviewed by teachers (Biemiller & Boote, 2006), and when rich definitional and contextual information is provided (Coyne, McCoach, & Kapp, 2007) in comparison to incidental exposure to new vocabulary through reading of storybooks alone.

As noted previously, the abstraction level of adults' and children's talk around storybooks is highly inter-dependent (Danis et al., 2000). Children typically contribute less extra-textual talk than adults, but the importance of encouraging children to participate actively in shared reading interactions has been highlighted in studies using the 'dialogic reading' training programme (Whitehurst et al., 1988). Dialogic reading involves training parents and/or teachers to encourage the child to become a storyteller, by being sensitive to the child's input and using elicitation techniques, as well as informative feedback. In the first randomised control trial of a shared reading intervention, Whitehurst et al. (1988) trained parents in dialogic reading techniques and children in the experimental group received four weeks' intervention. These children showed improvements in receptive and expressive vocabulary, as well as mean length of utterance post-test, in comparison to the control group, and these gains were retained nine months after the intervention.

These findings have been replicated and extended, especially to homogeneous low SES samples, by a number of other studies (e.g. Hargrave & Sénéchal, 2000; Justice, Meier, & Walpole, 2005; Sénéchal, Thomas, & Monker, 1995; Valdez-Manchaca & Whitehurst, 1988; Zevenbergen, Whitehurst, & Zevenbergen, 2003). Of particular pertinence to the current research, Lonigan and

Whitehurst (1998) compared the effects of a dialogic reading intervention delivered by parents and teachers to low-SES preschoolers. They found that, while all treatment groups showed improvements in vocabulary and MLU after the intervention, those who had experienced dialogic reading in the home showed the greatest gains. A recent meta-analysis of the added value of dialogic reading training for children's vocabulary development found an overall Cohen's *d* of .59, representing a medium effect size, on samples of 2- to 3-year-old children (Mol, Bus, de Jong, & Smeets, 2008). However, this effect size reduced substantially with children of 4 to 5 years old, and also when children were at risk of reading difficulties through family history or language impairment (Fielding-Barnsley & Purdie, 2003).

Lever and Sénéchal (2011) extended the literature on the effects of dialogic reading to young children's narrative skills. After a six-week dialogic reading intervention, their sample of Canadian 5-year-olds showed improved use of story grammar and decontextualized language in their retelling of the stories, though no treatment effects on linguistic complexity or narrative cohesion were demonstrated.

Thus, there is relatively robust evidence to suggest that shared reading interventions can lead to oral language gains in some children, namely younger pre-schoolers who are at social, but not developmental, risk of reading difficulties. However, a meta-analysis of intervention studies that have used parental reading of storybooks to boost *reading* skills yielded a small, non-significant effect size (Sénéchal & Young, 2008). Studies which involved training parents to engage in specific reading activities with their young children, however, showed a moderately large effect on reading (d=1.15). This finding again suggests that parent-child shared reading may chiefly influence language skills, and that more targeted, code-based activities are necessary to influence early reading development.

Classroom-based intervention programmes that have compared the results of storybook reading training with training in code-related skills also show specific effects on emergent literacy. For example, a joint writing intervention, in which young children engage in games and activities encouraging letter knowledge, phonological awareness and functional writing, showed effects on the orthographic and phonological skills of low SES pre-schoolers (Aram & Biron, 2004). Aram (2006) found that Israeli pre-schoolers who were given a storybook reading intervention made more progress in vocabulary than controls, whereas a second intervention group who received training in alphabetic skills showed specific gains in letter knowledge and phonological awareness. Moreover, children who received a combination of both interventions demonstrated greater gains in alphabetic skills that the storybook-reading-only group, and greater vocabulary gains than the alphabetic-skills-only group. This evidence converges with Sénéchal and LeFevre's (2002) Home Literacy Model, in that the effects of different types of early literacy input dissociate; 'informal' storybook reading is related to outside-in skills, whereas 'formal' training in code can enhance inside-out skills.

However, there is relatively little evidence to indicate that shared reading intervention directly benefits young children's phonological awareness skills, and where gains in phonological awareness have been demonstrated, these tend to be in the context of a classroom-based programme. For example, Whitehurst and colleagues added a phonemic awareness curriculum to the dialogic reading programme in a year-long classroom intervention with pre-schoolers enrolled attending Head Start (Whitehurst et al., 1994). A composite measure of children's phonological awareness did not show significant improvement after the intervention, although there was an isolated effect on tasks of phoneme identification. A problem with this design, however, is that it was not clear whether this effect is accounted for by the dialogic reading or phonemic awareness components of the intervention.

To address this issue, Lefebvre, Trudeau and Sutton (2011) conducted a comparison of a classroom reading intervention which combined dialogic reading with targeted phonological activities, for example syllable segmentation and phoneme identification, and a dialogic reading-only condition. These authors found that children in the combined intervention group showed improved scores on a battery of phonological awareness tests. However, it is not clear that this didactic intervention protocol would transfer easily to shared reading interactions in the home. Overall, it is yet to be demonstrated that phonological awareness can be boosted by home-based storybook reading strategies.

A final strand of shared reading interventions uses the print referencing strategies developed by Ezell, Justice and colleagues (Ezell, Justice, & Parsons, 2000; Justice & Ezell, 2000). Print referencing involves training adults to use verbal and non-verbal cues to direct children's attention to features of the print itself during shared reading. This could include tracking text with a finger, pointing to individual letters or words, making comments or asking questions about print. This training programme was developed within a Vygotskian framework, taking as its rationale the idea that, simply by encouraging children to view print as worthy of attention in its own right, adults can scaffold children's mastery of print function and form (Justice & Ezell, 2004). As discussed previously, observational research has indicated that in naturalistic storybook reading interactions, children spend very little time focusing on print (Evans & Saint-Aubin, 2005). However, by orienting children towards print, material that is somewhat beyond their present capabilities, adults can facilitate the development of emergent literacy skills. Systematic recordings of gaze direction have shown that adding non-verbal or verbal print referencing by adults can significantly increase young children's attention to print during shared reading interactions (Justice, Pullen, & Pence, 2005).

Intervention studies using print referencing have shown effects on young children's knowledge of print function, print forms and early word reading. For instance, in a large-scale randomised control trial with 4-year-old children at risk of reading difficulties (either for socio-economic or developmental reasons), children who received shared reading with print referencing showed enhanced print concepts and letter knowledge, but not oral language, after 30 weeks' intervention (Justice, Kaderavek, Fan, Sofka, & Hunt, 2009). Moreover, another large sample of low SES pre-schoolers who received this intervention showed better word reading, spelling and reading comprehension than controls two years post-test (Piasta, Justice, McGinty, & Kaderavek, 2012). These results are promising, since print referencing involves minimal training for parents/teachers and can easily be integrated into everyday storybook reading. Moreover, the authors reported high-quality intervention practices, including random group assignment and rigorous fidelity monitoring of pre-school teachers' implementation of the intervention, increasing confidence in the results (Piasta et al., 2012). This line of research presents a viable technique for boosting the emergent literacy skills of at-risk children before the onset of formal education.

In sum, intervention research has demonstrated that introducing minor modifications to the way in which adults interact with children during storybook reading can influence the development of preschoolers' oral language and emergent literacy. Both dialogic reading and print referencing have been effective in enhancing the skills of low SES children. However, while there is some evidence to suggest that print referencing may be a useful early intervention tool for children at developmental risk of reading difficulty (e.g. Justice, Skibbe, McGinty, Piasta, & Petrill, 2011), these children do not seem to benefit from dialogic reading as much as typically developing children (Mol et al., 2008).

1.3.3.3 Affective quality of shared reading interactions

Several studies have focused on the affective quality of reading interactions instead of, or in addition to, the verbal input of adults and children. It is to be imagined that early experiences of books that are warm, supportive and engaging increase children's motivation to read independently as they acquire literacy skills. In one such study, the reading interactions of 61 mother-child dyads were coded for verbal and affective quality, and content-related talk by the participants was found to be associated with positive ratings of affect (Baker, Mackler, Sonnenschein, & Serpell, 2001). Conversely, parental attempts to encourage these first-grade children to decode words were negatively associated with affective ratings. While neither the various types of extra-textual talk nor the dyadic affect ratings were directly predictive of children's reading accuracy or comprehension two years later, the affective quality predicted how often children engaged with complex reading material independently in Grade 3.

Likewise, Sonnenschein and Munsterman (2002) observed children being read to by an older family member at the end of their preschool year, at 4 or 5 years old. In general, affective ratings for the dyads were high, but significantly more so when a parent was the reader rather than an older sibling. Again, a positive correlation between extra-textual talk around the story content and positive affect emerged, and affective quality was a powerful predictor of children's motivation to read as measured by a questionnaire administered to children using puppets. It seems, then, that a supportive and warm atmosphere during storybook reading may encourage children's later motivation to engage with the written word. It is possible that attempts by parents to incorporate direct reading instruction into shared storybook interactions with their children, if not handled sensitively, may detract from affective quality. The fact that so few try to teach their children to read during storybook reading in naturalistic settings suggests that many parents are alive to the potentially counterproductive effects of an overly didactic approach, and instead aim to facilitate their children's reading development by making story-time fun and engaging their children's interest in books.

Bus and van IJzendoorn (1995) examined the relationship between shared reading and attachment security among a sample of low- and middle-income Dutch families. They hypothesised that children exhibiting insecure attachment would be less enthusiastic and co-operative during reading interactions, and that their primary caregivers would be less effective in involving their children in dialogue around the story. Those dyads that scored poorly for attachment during a reunion episode, following the Strange Situation Technique (Ainsworth, Blehar, Waters, & Wall, 1978) reported reading together significantly less frequently than securely attached dyads. Furthermore, both insecurely attached children and their parents produced more off-task utterances during a shared reading observation than other participants. These results hint at the depth and range of factors that may underlie variation in the frequency and quality of shared reading between families.

A Dutch study of family influences on reading development took a multi-faceted view of the HLE, incorporating children's opportunity to engage with print (e.g. the frequency of shared reading, number of children's books in the home) and both the instructional and socio-emotional quality of interactions with parents (De Jong & Leseman, 2001; Leseman & de Jong, 1998). The quality of parent-child discussion and socio-emotional quality (including parental supportive presence, respect for the child's autonomy, effective structuring of the interaction and limit setting) were coded in the contexts of a storybook reading and a puzzle solving activity on three occasions, when children were 4, 5 and 6 years old. At age 7, distal socio-economic effects on children's vocabulary were found to be fully mediated by the opportunity and instructional quality of preschool HLE, but the early socio-emotional quality of early parent-child interactions made no additional contribution to language or reading outcomes (Leseman & de Jong, 1998). However, the authors found that the effects of early HLE on reading comprehension increased between Grades 1 and 3, such that both instructional and socio-emotional interaction quality were both significant predictors of children's reading comprehension at age 9 (De Jong & Leseman, 2001). Interestingly, these effects of instructional and socio-emotional quality of parent-child interactions were not domain-specific; in other words, quality measures recorded during puzzle-solving interactions were as good at predicting comprehension outcomes as those during shared reading interactions. It is to be presumed that a socio–emotionally supportive interaction style of the parent may enhance children's willingness to engage in parent-child learning interactions in the pre-school years, and may also increase children's motivation to engage with learning materials, including books, independently as they progress through primary education. Parents' role in supporting children's developing concepts of themselves as able learners may therefore have long-lasting effects, as De Jong and Leseman's (2001) results indicate.

In conclusion, the studies reviewed in this section provide some useful clues as to optimal parental and child behaviours during early shared reading interactions, and how these relate to language and reading development. First, there is correlational evidence that both contextualised and decontextualised talk about story content among parent—child dyads predicts children's vocabulary development, although the strength of this relationship may depend on the child's existing vocabulary knowledge (Hindman et al., 2008; Hindman et al., 2012). Second, intervention studies suggest that encouraging young preschool children to participate actively in reading interactions can boost vocabulary skills (e.g. Whitehurst et al., 1988), while more specialised programmes such as joint writing (Aram & Biron, 2004) and print-referencing (Justice et al., 2009) can have lasting effects on children's phonological and orthographic knowledge. Finally, positive affective quality of early parent-child interactions predicts motivational factors, including older children's independent engagement with books, and comprehension skills (De Jong & Leseman, 2001; Sonnenschein & Munsterman, 2002). Taken as a whole, this body of research gives an insight into the multiple and interacting mechanisms by which early experiences in the home foster children's cognitive development.

1.3.4 Parental Literacy-related Beliefs and Behaviours

The components of the home literacy environment considered thus far have primarily consisted of literacy-related input experienced by the child in interaction with a more experienced other, most often a parent. However, it is possible that environmental factors specific to the parent are also influential in children's literacy development. Research addressing this issue has chiefly focused on two factors: parental beliefs about reading and parental modelling of literate behaviours through their own engagement with print in the home.

Some studies have explored the association between children's literacy attainment and parental beliefs about the purpose of reading (for reviews, see Baker, Scher, & Macklin, 1997; Phillips & Lonigan, 2005). For instance, Sonnenschein et al. (1997) conducted a series of interviews asking parents about their views on the main purpose of reading, and how they could best help their children learn to read. In addition, parents were asked to keep home diaries documenting their children's activities over the course of a week. These data were coded and a composite score formed representing parents' position along a 'fun-skills' dimension in their beliefs about the main purpose of reading. This measure correlated with SES, such that lower SES parents tended to emphasise skills development, whereas those from higher SES backgrounds were more likely to view entertainment as the primary purpose of reading for young children. Those parents who adopted an 'entertainment perspective' also engaged in more shared reading in the home, and their children showed enhanced emergent literacy skills. In a similar vein, Baker and Scher (2002) found that parents who valued reading as a source of entertainment had first-grade children who showed higher intrinsic motivation to read.

There is some evidence to suggest that parental beliefs about the importance of making shared reading fun relate to positive affective quality in storybook reading interactions with their children. A recent study found that parents who stated that reading should be for enjoyment tended to praise children more during shared reading and these interactions were rated as showing more positive affect (Meagher, Arnold, Doctoroff, & Baker, 2008). Interestingly, there was an interaction with gender, such that boys whose parents adopted this entertainment perspective were rated as being more engaged with the storybook reading than those whose parents took a skills-based approach. Parents who emphasised the importance of reading for learning tended to exhibit more scaffolding behaviours and ask more questions of their children during storybook reading.

Other authors have focused on how parents view their own role in their children's reading development. DeBaryshe (1995) reported that mothers with a higher level of education were more likely to believe that they themselves could play an important role in teaching their child to read ('facilitative perspective'), whereas mothers from lower SES backgrounds were more likely to believe that teaching their child to read was primarily the responsibility of the school ('conventional perspective'). DeBaryshe (1995) described parental belief systems as the 'linchpin' between family SES and literacy-related behaviours in the home; in her causal model based on this dataset, maternal beliefs were predicted by SES and parental literacy, and in turn predicted children's language skills, via home literacy practices. A more recent study used cluster analysis to identify 'facilitative' and 'conventional' belief types amongst mothers of 4-year-old children (Wiegel, Martin, & Bennett, 2006). These belief systems showed high stability over time. Again, the facilitative belief system was associated with more enriching home environments, and with enhanced print knowledge and interest in reading in children, both concurrently and longitudinally.

It is clear, then, that parents differ in their beliefs about reading development along a number of dimensions. In general, these beliefs correlate with parents' observed or self-reported literacy-related behaviours, both independently and in interaction with their children (DeBaryshe, Binder, & Buell, 2000; Lynch, Anderson, Shapiro, & Shapiro, 2006). Parental beliefs may well represent a mediating mechanism through which SES operates on the HLE. The evidence for a predictive role for parents' own literacy-related behaviours in children's reading development, however, is less clear cut.

The family survey employed by Storch-Bracken and Fischel (2008) in their study of early literacy development in a large sample of pre-schoolers from low SES homes was structured according to three factors: child's interest in reading, parent's interest in reading and parent-child reading interactions. The 'interest' factors incorporated items tapping both enjoyment and frequency of reading. Both child interest and parent-child interactions were moderately correlated with a range of child outcomes, including letter knowledge, print concepts and vocabulary, but correlations between parent interest in reading and child outcomes were weak and non-significant. Furthermore, child interest correlated only weakly with parent interest. Similarly, in a study which aimed to test six different conceptualisations of the HLE in relation to a range of child outcomes, Burgess, Hecht and Lonigan (2002) found that a passive model, which posited learning as taking place via observation of parents modelling literate behaviours in the home, did not predict unique variance in oral language, phonological awareness or letter-sound knowledge. The HLE models which were predictive of the development of these skills all included an active and/or interactive role for the child (e.g. looking at books independently, sharing stories with parents). Further, a study of Australian pre-schoolers and their families indicated that the types of print materials (traditional, environmental or technological) that parents read independently correlated with the types of material read with their young children, but not with the children's own literacy orientation (Brown, Byrnes, Raban, & Watson, 2012).

Therefore, while parents' own literacy-related behaviours in the home are likely to be linked to their reading beliefs and the type of literacy-related activities that they engage in with their children, it does not appear that children's literacy development is enhanced by observing their parents read for pleasure themselves, in the absence of interactive literacy activities (see also Payne et al., 1994; Scarborough, Dobrich, & Hager, 1991).

Finally, and pertinent to the current research, Martini and Sénéchal (2012) extended the component of the Home Literacy relating to direct instruction in the home to include variables tapping parental beliefs and child interest in print. The inclusion of these variables in addition to questions regarding parent-child interactions around print improved the explanatory power of the model for the variation in children's literacy skills in Grade 1. The effects of parental beliefs about reading and child interest in print on literacy skills were mediated by the amount of direct instruction that took place in the home. This study highlights one last factor that, whilst not environmental, should be considered in a transactional model of environmental influence on development: children's interest in print.

1.3.5 Child Interest in Literacy

It is of theoretical interest to differentiate parent-child interactions in the home from intrinsic child motivational factors. Child interest in literacy is typically measured by parental report, for instance by asking how often children engage with printed materials independently, how often they ask to be read to, and by parental ratings of their children's enjoyment of storybooks. Alternatively, children's engagement during storybook reading interactions may be rated in observational studies. In a small number of recent studies, researchers have used self-report metrics; for example by asking children to assign smiley, neutral or frowning faces to pictures of activities related to literacy, such as storybook reading or writing letters (Frijters et al., 2000). Such scales have typically shown good reliability and validity even with preschool children (Baroody & Diamond, 2010).

It is to be expected that parent-child literacy-related interactions in the home and children's interest should be closely related; early, frequent and stimulating shared storybook reading with parents might be assumed to kick-start children's desire to engage with books independently. Indeed, in factor analyses of parent-report questionnaire data, shared storybook reading and child interest have often loaded onto the same factor; however, conflating these two potentially distinct constructs into a composite measure of HLE risks compromising validity (Scarborough & Dobrich, 1994). It could equally well be the case that children with high motivation to engage with books elicit more frequent reading interactions, characterised by more stimulating interaction and more positive affect than those with children who show little interest in books. Intrinsic attitudinal characteristics could reflect individual differences in temperament and/or cognitive ability; in other words, high ability children might enjoy the challenge of literacy-based activities and thus develop increased motivation to engage with print (Farver, Xu, Eppe, & Lonigan, 2006). Conversely, Scarborough and Dobrich (1994) suggested the possibility of a 'broccoli effect' for young children low in intrinsic motivation whose parents nonetheless engage them in frequent storybook reading; enforcing repeated disagreeable experiences could serve to consolidate a child's dislike of book reading. Within a bioecological systems framework, person characteristics (such as children's and parents' intrinsic interest in reading), environmental contexts (e.g. home and school) and processes operating between these various factors (e.g. quality of parent-child shared reading interaction in the home) could plausibly contribute to myriad developmental outcomes for children.

Many authors have proposed that there is a link between children's interest in print and children's emergent literacy skills, such that that intrinsic interest is as good a correlate of early reading development as shared storybook reading, if not better (Baker et al., 2001; Scarborough & Dobrich, 1994; Storch & Whitehurst, 2002). An early study of precocious readers conducted by Durkin (1966) reported data from maternal interviews suggesting not only that early readers showed greater interest in literacy before school entry than average readers, but also that the higher frequency of storybook reading experienced by these children was driven by their clear interest in books. Similarly, a study of precocious talkers found that child interest, as measured by engagement during storybook reading, correlated with measures of oral language at age 2, and print concepts at age 4 (Crain-Thoresen & Dale, 1992). Morrow (1983) grouped children into high and low interest groups, based on a composite measure of teacher rating and observations of children's engagement with books during free play. Those in the high interest group performed at a higher level than those in the low interest group on measures of emergent literacy, oral language and fine motor skill.

These early studies suggest a link between child interest and cognitive outcomes, but do not address the relationship of child interest to HLE. More recent studies that have sought to do this have presented somewhat conflicting results. Frijters et al. (2000) formed shared reading and child interest factors, based on data from a family questionnaire, title recognition checklist and pictorial self-report scale of child interest. Regression models indicated that the two factors together explained 21% of the variance in 5-year-old children's receptive vocabulary and 18% of the variance in letter-sound knowledge. Interestingly, shared reading was more influential in vocabulary development than child interest, whereas a substantial portion of variance in letter-sound knowledge was accounted for by child interest, after accounting for shared reading. This result suggests that children with high motivation may orient more to code, in addition to meaning, when interacting with literacy-related materials. The finding has been replicated by Baroody and Diamond (2010), who focused on the development of code-specific skills. In this study, neither passive HLE (parents modelling literate behaviours) nor active HLE (child-adult interactions) were related to children's letter knowledge, print concepts or letter-word identification. Unusually, self-report of literacy interest gathered from 4- to 5-year-old children was also unrelated to the HLE measures. However, child interest contributed significant variance to children's code-related skills, after controlling for parental education level and children's receptive language. An interesting finding of this study was that child interest was a weaker predictor of code-related skills in children whose receptive language was below average, when compared to children with normal-range language scores. The authors suggest that children with weak language skills may have difficulty understanding the explicit instruction around letters and words offered by parents and therefore, even if intrinsic interest is high, they derive less benefit from environmental input.

Studies that have used a parent-report measure of children's interest in literacy tend to find that it is correlated with HLE, which may indicate social desirability biases. For example, Storch-Bracken and Fischel (2008) found a significant relationship between the two constructs, but in common with the two studies described above, regression analyses indicated that child interest was uniquely predictive of code-related skills (letter-sound knowledge), whereas HLE was a predictor of meaning-based measures including vocabulary and story concepts. One study that has found a relationship between child interest and language skills was conducted with a sample of low SES Latino pre-schoolers (Farver et al., 2006). Here the parent-report measure of child interest acted as a mediator between HLE and vocabulary. It is worth noting that most parental reports of children's interest do not differentiate between interest in stories as opposed to letters and words. It is plausible to imagine that the specific nature of children's interests could boost different skills. On the other hand, the analyses of Hood et al. (2008) revealed that, while parental report of children's interest in reading correlated with both shared reading and parental teaching of letters and words in the home, child interest did not relate directly to any child outcome.

1.3.5.1 Home literacy interactions with language-impaired children

As indicated by the results of Baroody and Diamond (2010) discussed above, children with language difficulties may experience early home literacy activities differently from typically developing children. Observations of parent-child shared reading interactions involving language-impaired children have suggested some qualitative differences from those with children with normal-range language skills. For example, Barachetti and Lavelli (2011) found that mothers of children with specific language impairment (SLI) made more supportive repairs to children's contributions than mothers of age-matched controls. Another study, focusing on a small sample of five mother-child dyads, indicated that parents of children with SLI rarely point at text or ask contextualised or decontextualised questions during shared reading (Crowe, 2000). However, given evidence from other observational studies suggesting that many parents of typically developing children rarely focus on print and contribute relatively few extra-textual utterances (e.g. Hammett et al., 2003; Hindman et al., 2008), as well as the lack of comparison group in Crowe's (2000) study, caution should be taken in interpreting these findings. Questions of low and high cognitive demand were observed by parents of children with SLI in an observation of 14 mother-child dyads (McGinty, Justice, Zucker, Gosse, & Skibbe, 2012). However, these questions did not tend to elicit high-level extra-textual contributions from the children, in contrast to the contingent dependencies reported in typically developing parent-child dyads by Danis et al. (2000). Moreover, children's verbal participation did not influence mothers' use of more challenging questions in this study.

Stadler and McEvoy (2003) reported that parents of children with SLI talked less about the phonological representations associated with letters during readings of an alphabet book than parents of typically developing children. Notwithstanding this, parent-administered print-referencing interventions have shown promising results with language-impaired children (e.g. Justice et al., 2011).

Taken together, these studies suggest that verbal interactions around storybooks between language-impaired children and their parents may be uniquely challenging. Since children with oral language impairment often refuse invitations to produce speech, and many present with co-morbid attention difficulties (Tirosh & Cohen, 1998), it is perhaps unsurprising that shared reading episodes with these children are chiefly adult-directed. Parents may be less likely to prioritise reading with preschool children with particularly poor language skills, since the linguistic and attentional demands of storybook reading may be perceived as beyond their children's current capabilities (Marvin & Mirenda, 1993). In a nationally representative sample of families of preschool children with a range of disabilities, storybook exposure was found to predict a small but significant portion of variance in children's vocabulary and later reading comprehension skills in children with less severe disabilities (Carlson, Bitterman, & Jenkins, 2012). However, there were no associations between early HLE and child language or literacy outcomes in children with more profound disabilities. While these results are difficult to interpret, since the sample included children with language impairments, autism spectrum disorders and visual impairments amongst others, they provide an interesting indication that the benefit derived from early literacy experiences in the home may depend on children's cognitive and linguistic capabilities.

The burgeoning literature on children's interest in literacy suggests some interesting avenues for future research. First, the relationship between child interest and HLE (whether conceptualised as active or passive) is still unclear, and seems to depend partly on whether child interest is measured by parental or child report. There is an increasing amount of evidence to suggest that children's interest in books may contribute additional variance to a range of outcomes once HLE has been accounted for, and this is particularly clear in the case of code-specific skills. It could be that some children orient more to symbols in the early years of life, and that parents respond in kind, such that the child receives more explicit instruction in letters and words. Evidence for this hypothesis would point to genetic influences on children's early literacy-related experiences. Finally, differences in willingness and/or ability to engage with literacy materials in children with impaired language skills, and the extent to which formal and informal literacy interactions can influence language and literacy development in this population, warrants further research attention.

1.4 Summary: The Home Literacy Environment and Reading Development: Direct and Indirect Pathways

The large body of research reviewed in this chapter provides a relatively convergent picture of the importance of children's early literacy-related experiences in the home to their future success as readers. Over the last 20 years, research has moved beyond attempts to establish that environmental factors are influential in reading development, since this is now uncontroversial. Recent studies use a range of measures in order to clarify what the most significant indicators of environmental influence are, and to demonstrate their effects on different components of language and literacy development. The home literacy environment is not a simple construct, but rather encompasses a range of practices, attitudes and beliefs, which operate at multiple levels on development, and which are in turn shaped by the cognitive and motivational characteristics of the child.

Figure 1.3 sets out a theoretical model of the direct and indirect pathways that may exist between aspects of the HLE and children's reading, based on the many studies reviewed here. The primary function of socioeconomic status is seen to be in predicting parental attitudes towards reading, which in turn predict the types of interactions which parents engage in with their children and children's early interest in books. These HLE practices and child motivational factors may be particularly instrumental in shaping children's language and emergent literacy skills, the precursors of reading and writing which are strongly predictive of later educational attainment. While the role of the HLE in the development of phonological awareness is not yet established, there is now a weight of evidence to suggest that exposing children to the written register of language through exposure to storybooks in the preschool years can boost vocabulary, morphosyntax and children's motivation to read independently. In addition, parental teaching of letters and words accounts for individual differences in children's knowledge of print functions and forms at school entry. While other family-level factors, such as resilience to stress, discipline practices and levels of chaos in the home, may contribute to development in numerous ways, it is only the 'family as educator' model that has been causally linked to children's reading (Bennett, Wiegel, & Martin, 2002). The role of the HLE in the language and reading development of children at developmental risk of reading difficulties is therefore of considerable interest to researchers and educators.

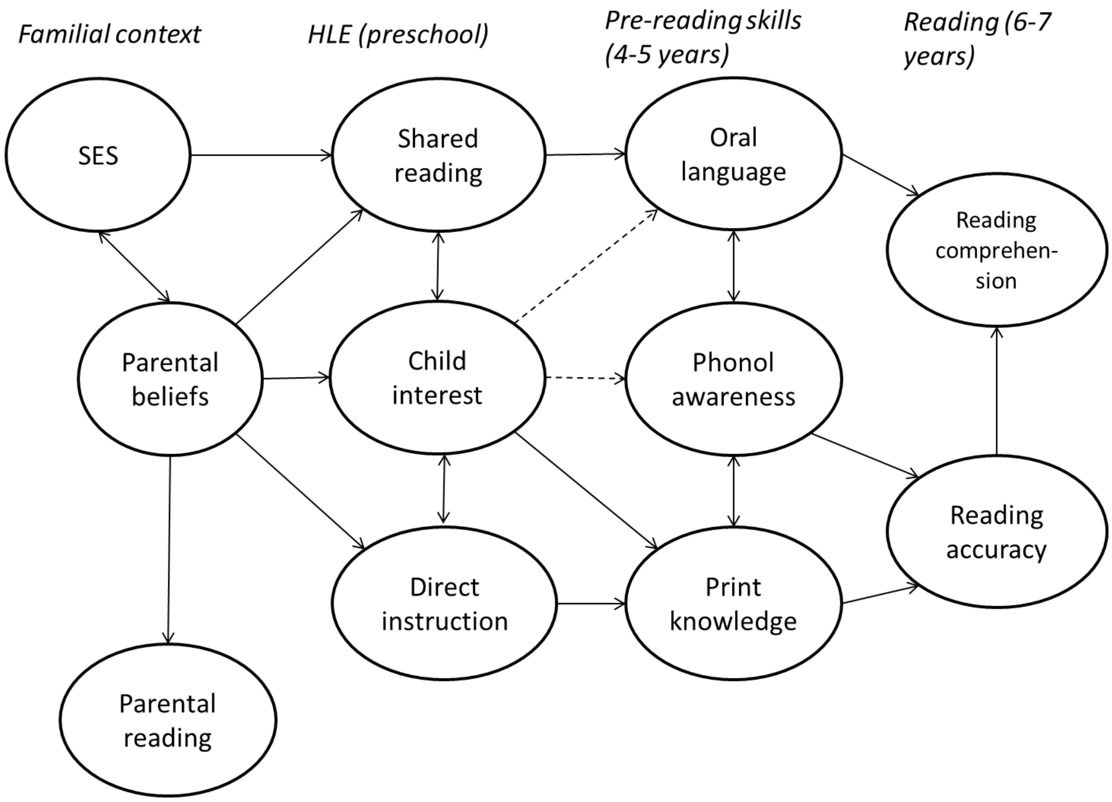


***Figure 1.3.* Theoretical model of the role of the HLE in reading development**

Chapter 2: Genetic and Environmental Influences in Dyslexia and the Wellcome Language and Reading Project

2.1 Introduction

This chapter reviews current scientific understanding of developmental dyslexia, with a primary focus on evidence from behavioural genetic and family-risk studies. The data presented in this thesis form part of a longitudinal family-risk study, the Wellcome Language and Reading Project; the methodology of this study is described in the final part of this chapter.

Dyslexia is a relatively common neurodevelopmental disorder, which can be defined as an unexpected difficulty in learning to read and spell that cannot be explained by lack of educational opportunity or an underlying neurological condition (Hulme & Snowling, 2009). Until recently, the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association, 1994) recommended a diagnosis of dyslexia when an individual's "reading achievement, as measured by individually administered standardized tests of reading accuracy or comprehension, is substantially below that expected given the person's chronological age, measured intelligence, and age-appropriate education." This definition was problematic on two counts. First, a large body of research points to core deficits in reading accuracy, reading fluency and spelling, but comprehension is not a primary deficit associated with the disorder (Bishop & Snowling, 2004). Second, the notion that reading impairment should be defined in relation to an individual's intelligence has been challenged over the last 20 years (Stanovich, 1994; Snowling, 2012). The use of such a 'discrepancy definition' of dyslexia has been largely abandoned, in favour of an approach that seeks to identify core underlying cognitive deficits in individuals with dyslexia (Vellutino, Fletcher, Snowling, & Scanlon, 2004). There is now compelling evidence to suggest that core cognitive deficits associated with dyslexia, and in particular a deficit in phonological processing, are comparable across individuals throughout the spectrum of general cognitive ability (Hatcher & Hulme, 1999).

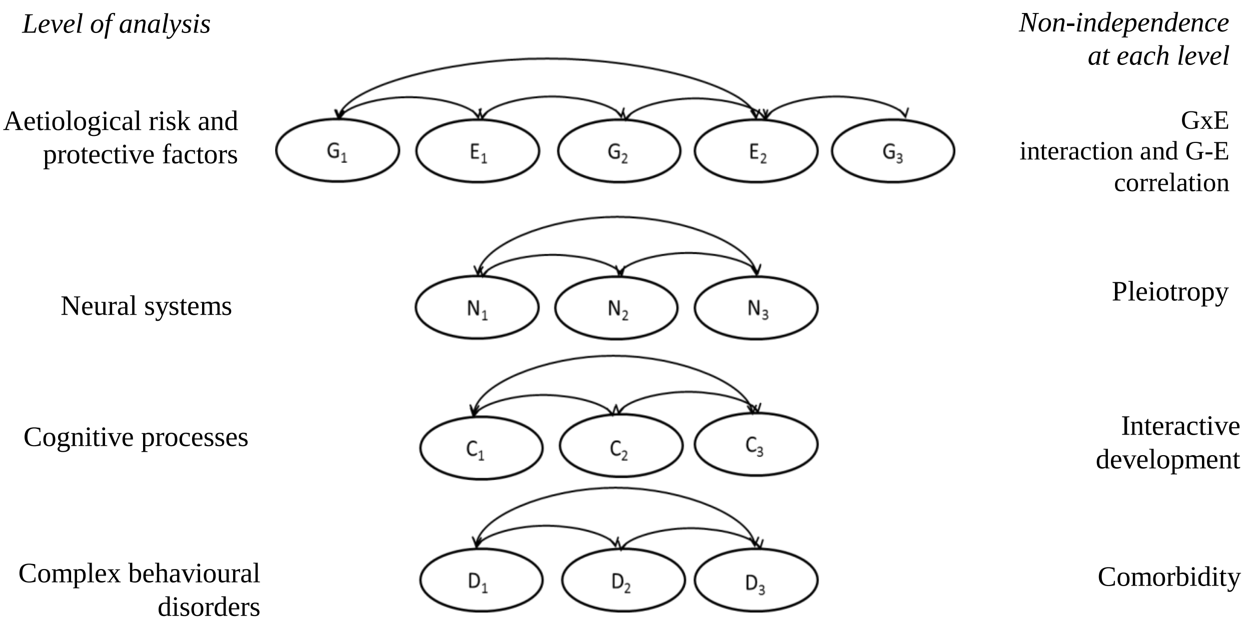
In the newly published DSM-V (American Psychological Association, 2013), dyslexia is no longer represented as a discrete diagnostic category, but rather subsumed within a broader classification of 'specific learning disorders'. The manual notes that "dyslexia is an alternate term used to refer to a pattern of learning difficulties characterized by problems with accurate or fluent word recognition, poor decoding and poor spelling abilities". Although reference to IQ and reading comprehension deficits are absent from this new definition, the removal of dyslexia as a diagnostic category in its own right has proved controversial amongst researchers (Colker, Shaywitz, Shaywitz, & Simon, 2012).

Prevalence estimates for developmental dyslexia range from 3% to 10% (Hulme & Snowling, 2009; Shaywitz, Shaywitz, Fletcher, & Escobar, 1990; Yule & Rutter, 1976). An obvious difficulty in obtaining accurate prevalence data is that no universally agreed threshold of impairment exists for diagnosis, and therefore studies employ different criteria to categorise individuals as having a reading disability. Since dyslexia is a complex, multifactorial disorder, whose biological underpinnings are not yet well understood, cut-offs for categorisation along cognitive or behavioural dimensions, such as 'reading accuracy', are inevitably somewhat arbitrary. As is the case with many developmental disorders, prevalence estimates are higher in males than females; gender ratios range from 4:1 (Finucci, Isaacs, Whitehouse, & Childs, 1983) to approaching 1:1 (DeFries & Alarcón, 1996). It has been argued that this imbalance may be partly attributable to referral bias, with boys more likely to be referred for assessment than girls (Vogel, 1990). However, data from four independent epidemiological studies yielded higher prevalence of reading difficulties in boys in all samples, providing strong evidence that dyslexia is indeed more frequent in males than females (Rutter et al., 2004).

Evidence that dyslexia is characterised by a core cognitive deficit in the representation and processing of phonological forms abounds (e.g. Bradley & Bryant, 1983; Snowling, Goulandris, Bowlby, & Howell, 1986; Snowling & Hulme, 1994; Vellutino et al., 2004). Although it is likely that atypical reading development has a reciprocal effect on phonological skills (Morais, Cary, Algeria, & Bertelson, 1979), the well-replicated finding that children who go on to have reading difficulties show phonological deficits before beginning to learn to read suggests that impaired phonological processing is a proximal cause of dyslexia (Pennington & LeFly, 2001; Snowling, Gallaher & Frith, 2003). Attempts to demonstrate that the phonological deficit is a manifestation of a broader perceptual impairment, for example in speech perception (Adlard & Hazan, 1998; Serniclaes, Van Heghe, Mousty, Carré, & Sprenger-Charolles, 2004), auditory processing (Tallal, 1980; Witton, Stein, Stoodley, Rosner, & Talcott, 2002) or visual processing (Lovegrove, Bowling, Badcock, & Blackwood, 1980), have generally identified such deficits only in sub-groups of dyslexic samples. At the present time, therefore, there is a lack of compelling evidence to indicate that dyslexia is underpinned by a global deficit in auditory or visual perception.

However, research into comorbidities between developmental disorders has driven a more complex perspective on underlying causal pathways. Dyslexia is commonly comorbid with SLI, attention deficit hyperactivity disorder, developmental co-ordination disorder and mathematics disorder (Catts, Adlof, Hogan, & Ellis Weismer, 2005; Wilcutt & Pennington, 2000) and there is emerging evidence for overlap between these disorders at the genetic level (Kovas & Plomin, 2007). Pennington (2006) has argued for a move away from simple single-deficit cognitive models of developmental disorders towards multiple deficit models, in which the presentation of cognitive profiles and/or behavioural symptoms consistent with a given disorder is dependent on a host of genetic and environmental factors, which operate multifactorially and probabilistically (Figure 2.1).

While there is strong evidence that dyslexia is to a large extent underpinned by genetic factors (see sections 2.2 and 2.3 below), the expression of an individual's genetic inheritance in cognition and behaviour is likely to depend on complex interplay between genetic and environmental factors, such as gene-environment interactions (GxE), as well as gene-environment correlations (R_{GE}). GxE interaction denotes individual differences in sensitivity to environmental input due to genetic inheritance. R_{GE} processes, on the other hand, may be active, evocative or passive. Active gene-environment correlations refer to the individual seeking out particular environments that suit his or her genetic make-up. Evocative R_{GE} processes entail environments adapting to the individual's genetically determined characteristics. Finally, passive R_{GE} processes denote situations in which the individual's genetic characteristics closely match his or her environments, for example because of shared genetic material between parent and child. The early literacy-related experiences that children encounter in the home are a strong candidate for interaction and/or correlation with ‘genes for reading’. It is plausible, therefore, that the home literacy environment may operate as a protective, or additional risk, factor for children at developmental risk of reading difficulties.



G = genetic risk or protective factor; E = environmental risk or protective factor; N = neural system; C=cognitive process; D=disorders
Note: causal pathways between levels not represented

Figure 2.1. **Multiple deficit model (Pennington, 2006)**

2.2 Behavioural Genetic Approaches to Reading Dis/ability

Behavioural genetic studies provide a useful way in which to investigate genetic and environmental influences on a given trait and associated disorders. Twin studies constitute a key method within this perspective. The underlying logic of this method is that monozygotic (MZ) twin pairs share 100% of their segregating genetic material, while dizygotic (DZ) pairs share on average 50% (like non-twin sibling pairs). Therefore, if correlations on a dimensional trait (e.g. reading accuracy) or concordance rates in a categorical disorder (e.g. dyslexia) are higher within MZ twin pairs than DZ twin pairs, genetic influence can be inferred, since all twin pairs are assumed to experience shared environments to the same degree. (For a full description of the twin method, see Plomin, DeFries, Knopil, & Neiderhiser (2013)). In recent years, a number of large-scale longitudinal twin studies have greatly enhanced understanding of the aetiology of reading disability.

2.2.1 Heritability in Reading Dis/ability

Studies that have evaluated the genetic and environmental contributions to individual differences in reading ability in the general population have produced consistently high heritability estimates. For example, in the large-scale Twins Early Development Study (TEDS), genetic influences accounted for two thirds of the variance in 7-year-old children's performance on a timed word reading task (h^2=.65-.67) (Harlaar, Spinath, Dale, & Plomin, 2005). Similarly, data from the International Longitudinal Twin Study (ILTS), which tracks the early development of twin samples in the USA, Australia and Scandinavia, suggest that by the end of Grade 1, children's word recognition, phonological decoding, spelling and reading comprehension are substantially heritable (h^2=.71-.81) (Byrne et al., 2007). It should be noted that these results were obtained from analyses of the American and Australian samples only, since the reading of Scandinavian children at this age showed a markedly different aetiology, as discussed in section 2.2.2 below.

Genetic correlations between different component reading skills are also typically high. It is important to note that the genetic correlation of two traits is independent of their respective heritability; in other words, genetic correlations represent the amount of genetic influence on two traits that is common to both, and as such may be high even when two traits are only modestly genetically influenced. For example, a preliminary analysis using a small sample of twin pairs between the ages of 8 and 17 showed reading comprehension to be highly heritable (Keenan, Betjemann, Wadsworth, DeFries, & Olson, 2006). Moreover, two sources of genetic variance, accounted for by word reading and listening comprehension respectively, accounted for all of the genetic influences on reading comprehension. This pattern of genetic correlations was recently replicated in the ILTS dataset, such that all genetic and environmental influences on reading comprehension in Grade 4 in this sample were explained by those in common with decoding and vocabulary (Olson et al., 2011).

The first concrete evidence for a genetic aetiology of dyslexia came from an early twin study conducted as part of the Colorado Reading Project (DeFries, Fulker, & LaBuda, 1987). Within a small sample of twins, probands were identified on the basis of a discriminant function score, encompassing word reading, reading comprehension, spelling, verbal memory, coding and perceptual speed. The mean score of the proband group was over 2.5 standard deviations lower than the sample mean, and regression to the sample mean was substantially higher in DZ than MZ co-twins. The resultant group heritability estimate (h_g^2) was .29; in other words, approximately 30% of the dyslexic group deficit was accounted for by genetic variation. This implies that environmental variation between twin pairs must also play a role in the observed group differences; however subsequent heritability estimates for reading disability using larger samples have been substantially higher.

The Colorado Learning Disabilities Research Centre twin study has been on-going since the 1980s, and has accumulated data on dyslexia and related disorders from many hundreds of twin pairs. In this study, probands are identified by a school history of reading difficulties and discriminant analysis of reading accuracy, comprehension and spelling ability. Building on the findings of DeFries et al. (1987), analysis of the reading scores of a large sample of twins from the Colorado study produced a group heritability estimate of .58 in the dyslexic group (Wadsworth, Olson, Pennington, & DeFries, 2000). Furthermore, group heritability was higher in probands with an IQ of 100 or higher (fitting the discrepancy definition of dyslexia) than in those with an IQ of below 100 ('garden variety' poor readers; Stanovich, 1988). Moreover, when IQ was entered as a continuous covariate in the DF regression model, group heritability increased as a function of IQ. It may be, therefore, that environmental variation is more influential in the reading development of poor readers with lower IQ scores.

Differences in the aetiology of dyslexia between genders have not been conclusively demonstrated. In the large UK-based TEDS sample of twins, group heritability in reading difficulties (defined as the tenth centile and below in a test of reading fluency administered by telephone) was higher in boys than girls (Harlaar et al., 2005). However, in the Colorado sample, a non-significant trend was found in the opposite direction, since concordance rates were higher for girls than boys (Hawke, Wadsworth, & DeFries, 2006). In this study, probands were identified using a discriminant function encompassing a range of literacy measures, so it is possible that the inconsistent findings of these two studies reflect differences in definition of reading disorder.

Gayán and Olson (2001) focused on component deficits of reading disability using data from the Colorado twin study; specifically phonological decoding, phonological awareness and orthographic coding. Group heritability of word reading in this analysis was .54, while the estimate for group shared environmental influences was also moderate and significant (c_g^2=.39). Across the component tasks, group heritability was high, while shared environmental contributions were small and not always statistically significant. These results suggest that, while there is substantial genetic overlap between word reading and related component skills, word reading may be more amenable to environmental influences, such as exposure to print, than specific phonological and orthographic processes. In a follow-up study, Gayán and Olson (2003) reported substantial genetic overlap between reading, component orthographic and phonological skills, and IQ. Group shared environmental influences for all latent constructs were small and often non-significant. However, as the authors acknowledge, behavioural genetic analysis assumes that genetic effects are non-additive, and where additive genetic effects are present, shared environmental influences may be under-estimated (Gayán & Olson, 2003; Nation, 2006). Indeed, in a separate set of analyses, in which group additive genetic effects (d_g^2) were investigated in the place of group shared environmental effects, estimates for d_g^2 were moderate for word reading and large for orthographic coding. Therefore, estimates of environmental contributions to group deficits in these constructs may be overly conservative.

In sum, twin studies of reading disability have produced comparable heritability estimates to those obtained from investigations of reading ability in the general population, suggesting that dyslexia is not aetiologically distinct from typical reading, but rather represents the lower extreme of the normal distribution of reading ability (Harlaar et al., 2005). There is convergent evidence to indicate that reading is substantially heritable across the spectrum of ability, although differences in word reading may be more influenced by environmental factors than component phonological and orthographic skills (Gayán & Olson, 2001). Furthermore, environmental factors appear to be more influential in the reading skills of dyslexic readers with lower IQs, perhaps reflecting greater environmental variation in this population (Samuelsson & Lundberg, 2003; Wadsworth et al., 2000). However, most of the studies reported above have used samples of older children; recently, longitudinal twin studies have sought to investigate the aetiology of emergent literacy skills in younger samples.

2.2.2 Genetic and Environmental Influences in Language and Emergent Literacy

As discussed in Chapter 1, non-phonological oral language ability and emergent literacy skills (including phonological awareness and print knowledge) are well-established precursors of reading development (Lervåg et al., 2009; Sénéchal et al., 2001). However, until recently little has been known about the aetiology of these cognitive traits.

The International Longitudinal Twin Study recruited twin pairs in four countries before school entry, in order to investigate genetic and environmental influences in key precursor skills for reading. Across twin samples from the USA, Australia and Scandinavia, substantial and significant contributions of shared environment were reported in preschool vocabulary knowledge (Byrne et al., 2002; Samuelsson et al., 2005) and receptive grammar in kindergarten (Byrne et al., 2005). Substantial shared environmental influence on oral language skills was also reported within the TEDS data set (Hayiou-Thomas et al., 2006). Here, a 'general language' latent factor, defined by a range of measures tapping semantics, syntax and some aspects of phonology which were administered to 4½-year-old twins, showed modest heritability and substantial effects of shared environment (h^2=.34; c^2=.50). Oral language ability, therefore, appears to be amenable to early environmental input.

Heritability estimates tend to be higher for measures of early phonological awareness. Within the ILTS twin samples, small but significant shared environmental influences on phonological awareness were reported at preschool age (Byrne et al., 2002), but these were no longer significant at the kindergarten assessment, when phonological awareness was highly heritable (h^2=.63) (Byrne et al., 2005). Similarly, a latent 'articulation' factor, defined by tests of articulation and non-word repetition, was found to be more highly heritable than general language skills in the TEDS sample (h^2=.56; c^2=.15) (Hayiou-Thomas et al., 2006). These findings suggest that phonological skills may be more strongly influenced by genes than broader oral language skills.

Finally, early print knowledge appears to be substantially influenced by environmental factors. A latent factor representing print knowledge at preschool showed very modest heritability in the ILTS data set (h^2=.23; c^2=.68) (Samuelsson et al., 2005). Interestingly, although phonological awareness showed substantially higher heritability than print knowledge at the same age, it was only the genetic source shared between these two variables that influenced reading skills at kindergarten age (Byrne et al., 2006). A similar pattern of results was reported in the TEDS twin sample at age 4, when a parental report measure of children's print knowledge showed substantial influence of shared environment (h^2=.21; c^2=.63) (Oliver, Dale, & Plomin, 2005). Taken together, these studies indicate that both early oral language and print knowledge skills are substantially influenced by differences in children's environments.

Samuelsson et al. (2005) analysed these early pre-reading skills in relation to the HLE within the ILTS sample. In this study, the measure of HLE was a parental questionnaire, the items of which loaded onto four factors: storybook exposure, direct instruction of orthographic forms, children's print motivation and parental modelling of literate behaviours. The Scandinavian families scored significantly lower than the US and Australian families on the measures of storybook exposure and direct instruction, which the authors argue reflects a sociocultural tradition to avoid teaching young children to read in favour of supporting socio-emotional development in Scandinavia. There were no national differences in children's print motivation, parental modelling or parental education level. In line with the broader HLE literature reviewed in Chapter 1, the HLE factors in this study showed stronger correlations with broad oral language skills and print knowledge than with phonological awareness and RAN. Interestingly, the Scandinavian children scored significantly more poorly than the other national samples on all pre-reading measures, and effect sizes were largest in print knowledge and vocabulary. This finding provides good indirect evidence for a causal role of parent-led literacy interactions in the home on children's language and emergent literacy skills. It should be noted that, after entering formal education at age 7, the Scandinavian children showed no deficits in reading or spelling (Samuelsson et al., 2008).

In their genetically sensitive analyses of these data, Samuelsson et al. (2005) found high correlations on the HLE measures between MZ and DZ twin pairs; however, correlations were slightly higher for MZ twins. Since this could reflect the influence of genetic factors specific to the child on the HLE, the authors focused on parent-initiated HLE interactions only in further analyses; there were no differences in the strength of correlations between MZ and DZ pairs on these items. Two sources of shared environment were identified in analysis of children's pre-reading skills; the first accounted for variance in oral language, print knowledge, phonological awareness and RAN, the second especially in print knowledge, but also in phonological awareness and RAN. At kindergarten age, children's reading showed markedly different aetiologies across the national samples (Australia: h^2=.84; USA: h^2=.64; Scandinavia: h^2 =.33). Shared environmental influences showed the reverse pattern (Australia: c^2=.09; USA: c^2=.25; Scandinavia: c^2=.52). A very similar aetiological pattern emerged in analysis of children's spelling skills at this age (Samuelsson et al., 2007, 2008). These clear differences in magnitude of genetic and environmental contributions to children's early literacy skills across national samples are likely to reflect variation in early-years educational practices. In Australia, the preschool curriculum emphasises literacy, which is likely to reduce the environmental range experienced by these children. There is more variability in preschool curricula in the USA (Byrne et al., 2005), while Scandinavian children are very unlikely to encounter preschool literacy instruction. An interesting finding from this study is that the shared environmental source influencing pre-reading skills at preschool is continuous with the smaller environmental effects on early reading at school age. This may suggest that the home and/or preschool setting are the important environmental factors in children's early literacy development and that differences in school environment do not contribute additional variance (Byrne et al., 2009). However, classroom-based intervention research strongly challenges this conclusion (e.g. Foorman & Torgesen, 2001).

Many of the findings reported by the ILTS researchers have been largely replicated by a US research group. Petrill and colleagues combined the twin methodology with an adoption study, in order to investigate the role of environmental factors in early literacy development (Petrill et al., 2006). If estimates of shared environmental influence are similar across families where parents and children are not genetically related, this supports a causal role of environment independent of genetic interaction. In combining data from the Western Reserve Reading Project and Northeast-Northwest Collaborative Adoption Project correlations among kindergarten twin and sibling pairs on a range of pre-reading skills followed an MZ>DZ>adopted siblings pattern. The fact that scores were weakly to moderately correlated between genetically unrelated adopted siblings indicates a role for environmental factors. Petrill et al. (2006) reported high heritability and negligible environmental influence on RAN, significant genetic and environmental influences on phonological awareness and word reading, and strong shared environmental contributions to letter knowledge. These estimates were similar between the twin and adoptive sibling pairs. The authors conclude that environmental factors are more influential in 'content-based' than 'process-based' component pre-reading skills (Petrill et al., 2006); a conclusion corroborated by the findings from the ILTS and TEDS samples reported above (Hayiou-Thomas et al., 2006; Samuelsson et al., 2005).

In longitudinal analyses of data from this project, the genetic and environmental sources identified at the kindergarten assessment showed considerable stability over time (Petrill et al., 2007, 2010). A year later, vocabulary, phonological awareness and letter knowledge showed significant genetic and shared environmental stability. Independent genetic influences were identified on RAN and word knowledge at the second testing point. Shared environmental overlap was substantial for vocabulary, phonological awareness and letter knowledge, but a new shared environmental source influencing letter knowledge and word knowledge came online in Grade 1 (Petrill et al., 2007). It is possible that this reflects classroom effects, in contrast to the lack of new environmental influences found at school entry in the ILTS data. In a growth curve analysis of reading-related skills between the ages of 6 and 8, genetic influences were significant for the intercept of all variables; shared environmental influences were significant for all measures except RAN, in line with the kindergarten data discussed above (Petrill et al., 2010). In contrast, genetic influences on the rate of growth were observed in phonological awareness and RAN only, whereas shared environment significantly contributed to the growth of letter knowledge, phonological awareness, word identification and phonological decoding. An extension of this model after six years of testing identified a quadratic slope in the growth of reading skills (Logan et al., 2013). Whereas independent genetic sources accounted for variance in the intercept and slope of most reading skills, the same shared environmental sources accounted for variance in intercept and growth rate of word reading, nonword reading, reading comprehension and RAN between the ages of 6 and 12. Overall, results from this study point to a greater role for early shared environmental factors than other research, including ILTS, would suggest. The substantial contribution of shared environment to the rate of growth in children's reading skills through middle childhood suggests a key role for preschool environmental influences, which are likely to include the HLE.

One study from the Western Reserve Reading Project has focused specifically on the HLE in relation to language development (Hart et al., 2009). In this study, the growth in expressive vocabulary was examined in relation to the HLE between ages 6 and 8 in a genetically sensitive design. Consistent with other behavioural genetic studies, shared environmental influences on vocabulary were moderate and significant at all three time points, although the effect size diminished somewhat as a function of children's age. HLE, measured by parental questionnaire, accounted for 13-27% of the shared environmental influence on vocabulary over time, equating to 6-9% of the total growth in expressive vocabulary. Dropping HLE from the model significantly worsened its fit to the data. These results suggest a significant and lasting, though small, effect of HLE on vocabulary growth through middle childhood. The factors accounting for the shared environmental sources involved in language development that are not explained by HLE are not clear, although the authors suggest levels of chaos in the home as a potential candidate (Hart et al., 2009).

A final behavioural genetic study that has focused on early cognitive development, though not specifically reading, is the Quebec Newborn Twin Study. Lemelin et al. (2007) considered genetic and environmental contributions to school readiness, operationalised as performance of a range of tests tapping colour and shape recognition, picture description, letter and number knowledge at 5 years old. Each of these four components of school readiness was individually predictive of teachers' rating of children's school achievement at 7 years old. All four school readiness components were found to be substantially influenced by shared environment; genetic sources could be dropped from the model without significant loss of fit for all components except number knowledge. These findings converge with data from other studies in indicating that content-based early skills may be particularly amenable to environmental influences (Hayiou-Thomas et al., 2006; Petrill et al., 2006; Samuelsson et al., 2005).

Forget-Dubois et al. (2009) investigated the predictors of school readiness within the same sample. In a path model, which accounted for 33% of the variance in children's school readiness at age 5, general cognitive ability was identified as the most significant predictor. In addition, a double mediation effect was identified, such that family SES predicted children's oral language skills, and this effect was partially mediated by the HLE. Furthermore, HLE predicted school readiness, and this effect was partially mediated by children's oral language skills. In other words, a causal chain was indicated proceeding from family SES, via home literacy environment to children's language skills and thence to school readiness. These results give an indication of the complex and indirect pathways by which early home environmental factors may operate on cognitive development.

2.2.3 Conclusions: The Aetiology of Dyslexia

The behavioural genetic literature reviewed above provides a coherent picture of the aetiology of reading ability and disorder. Data from TEDS, ILTS and the Western Reading Reserve Project converge in suggesting a developmental shift in aetiology through reading development, such that environmental factors are important in early content-related pre-reading skills, namely oral language and print knowledge. Phonological skills, on the other hand, are substantially heritable from early in development, and genetic influences increasingly come online as reading becomes more established in middle childhood. The aetiology of dyslexia is comparable to that of reading as a trait in the general population. By the age at which children are typically identified as having reading difficulties, most literacy-related skills are strongly heritable. However, there is emerging evidence that early environmental factors may be influential in the *rate of growth* of a range of reading skills (Logan et al., 2013). Overall, this aetiological pattern may reflect the fact that children's environments become more influenced by genes through development through processes of gene-environment interaction and/or correlation.

Molecular genetic studies indicate that there are likely to be many genes exerting small effects on reading phenotypes, none of which is necessary or sufficient to explain the extreme phenotype of dyslexia in its own right (for reviews, see Parrachini et al., 2007; Pennington & Olson, 2005; Plomin & Kovas, 2005). Potential quantitative trait loci identified on chromosomes 2, 3, 6, 15 and others are likely to operate in combination with each other and with environmental risk factors in influencing the dyslexic phenotype. Many of the genes involved in various developmental disorders are 'generalist', in that the same genes are implicated in the normal distribution of traits and associated disorders, certain genes are implicated in different component traits involved in a given disorder, and there is overlap in the genes associated with phenotypically comorbid disorders (Plomin & Kovas, 2005). The functional properties of the genetic markers associated with dyslexia are not yet well understood, although at least three (*DCDC2*, *KIAA0319* and *ROBO1*) are thought to play a role in early brain development, and particularly in neuronal migration (Parrachini et al., 2007). The post-mortem discovery of evidence of misplaced cells (heterotopias) in the brains of individuals with dyslexia lends some support to the idea of atypical neuronal migration in developmental dyslexia (Galaburda, Sherman, Rosen, Aboitiz, & Geschwind, 1985). However, the cascading effects of early structural abnormalities of the brain on cognitive development are likely to depend on multiple interactions with modifier genes and environmental factors.

The role of the environment is perhaps underestimated in behavioural genetics, while the studies reviewed in Chapter 1, which focus specifically on the role of the HLE in reading development, neglect the fact that certain variables which are apparently ‘environmental’ may be partly genetically driven, through processes of gene-environment interaction and correlation. Ascertaining the extent to which environmental factors are independent from genetic influence is extremely challenging, but the adoption studies reported by Petrill and colleagues suggest that early literacy interactions in the home are influential in reading development, even when parents and children are genetically unrelated (Petrill et al., 2006). There is a need for further longitudinal adoption studies, in order to elucidate the magnitude of environmental effects on reading, independent of genetic interaction.

Finally, the fact that heritability estimates for reading disability are high does not mean that poor reading is not amenable to intervention. The relationship between genetic inheritance and expressed phenotype is complex and as yet poorly understood. In line with Pennington’s (2006) multiple risk model, an important focus for research in developmental disorders is to identify specific genetic and environmental risk factors in order to understand how they interact to influence the development of phenotypic traits. A possible implication of genetic research in dyslexia is that if the genetic constraints that slow early growth in pre-reading skills in at-risk children also affect the rate of growth of later reading skills, these children may need more continuous intervention than typically developing children.

2.3 Family-risk Studies of Dyslexia

Another way of investigating the development of reading difficulties is through the use of prospective family-risk studies. The logic of this method is that, since dyslexia is known to be substantially heritable, children with an elevated risk of developing reading difficulties can be identified before they start to learn to read at school, via affected parents and/or older siblings. Based on the heritability estimates presented in section 2.2.1, it would be expected that approximately 50% of children identified in this manner would go on to show reading difficulties themselves. By measuring the early profiles of these children, cognitive and environmental predictors of reading difficulty can be identified. Furthermore, the early cognitive profiles of those at-risk children who do and do not develop dyslexia can be compared. Family-risk studies can therefore inform the development of early intervention programmes for children at developmental risk of reading difficulties. Since tracking large samples of children over several years is an expensive and time-consuming undertaking, there have been relatively few family-risk studies of dyslexia conducted to date, but these studies have informed current psychological models of reading disability. The transfer of knowledge between genetic and psychological research into developmental disorders is bidirectional, and ultimately a full understanding of a given disorder will incorporate explanations at the genotypic and phenotypic levels. This section reviews early studies using family-risk designs, before focusing on two major prospective studies of dyslexia conducted in Finland and the Netherlands.

2.3.1 Early Family-risk Studies

The first study to use a prospective design in relation to dyslexia was conducted by Scarborough (1990; 1991). In a relatively small sample of family-risk (FR) children (n=34) assessed from the age of 24 months, 65% were poor readers (defined as scores at least 1.5 standard deviations below the control group mean) by the end of Grade 2, as opposed to 5% of the typically developing (TD) control group. Moreover, retrospective analyses revealed that those FR children who went on to show reading deficits (FR-dyslexic) also displayed weaknesses in various aspects of oral language at preschool age. Specifically, receptive and expressive vocabulary at age 3 was impaired compared with FR children who did not go on to have reading difficulties (FR-not dyslexic) and TD children. Additionally, FR-dyslexic children showed impoverished syntactic and phonological proficiency in measures taken from their language use during free play, and impaired letter knowledge and phoneme awareness at age 5. Early deficits in tasks of phonology, morphology and letter knowledge were also observed in the FR-dyslexic group in a Danish prospective study (Elbro, Borstrøm, & Petersen, 1998). These studies therefore provided the first evidence that the phonological deficit associated with dyslexia might be a manifestation of a broader oral language deficit.

Scarborough et al. (1991) reported some differences in the HLE experienced by FR-dyslexic children, as compared with the FR-not dyslexic and TD groups. Children in the FR-dyslexic group were read to less often by fathers at 24 months and less often by mothers at 30 months, though not at other preschool testing points. Mothers in the FR-dyslexic group also reported observing their children engage independently with printed material relatively rarely, suggesting that part of the reduced exposure to print in this group might be child-driven. The authors reported that mothers of FR-dyslexic children often commented that their children's lack of interest in storybooks was the major reason why they engaged in storybook reading relatively infrequently. Although caution must be taken in interpreting this anecdotal evidence, it is suggestive that early differences in children's interest in print may influence the literacy input that they receive in the home. If children's interest in print is largely intrinsic, i.e. genetically influenced, this would suggest that evocative gene-environment correlation processes may determine the quality of children's home literacy environments.

A second family-risk study of dyslexia also found broad early deficits in phonological processing in at-risk children who went on to have reading difficulties (Pennington & LeFly, 2001). In this study, 34% of the FR group was classified as dyslexic at assessment in Grade 2; the lower prevalence than that reported by Scarborough (1990) is likely to reflect more stringent classification criteria (i.e. standardised scores of 80 or less on two of three reading tests in Pennington & LeFly (2001) as opposed to 1.5 standard deviations below the TD mean on a reading task in Scarborough (1990)). In the TD control group, phonological awareness at 5 and 6 years old was the strongest predictor of reading achievement, although letter knowledge at age 5 was the key predictor of spelling outcomes. Interestingly, the FR-dyslexic group showed a later developmental shift, whereby letter knowledge at 5 and 6 years old was the most robust predictor of all literacy outcomes, but was supplanted by phonological awareness at the beginning of Grade 2. This finding suggests that children with dyslexia follow the same developmental pathway as typical readers in terms of pre-reading skills, but that the shift from letter knowledge to phonological awareness as the key predictor of reading takes place at least two years later for FR-dyslexic children, likely reflecting the slow development of phonological skills in this group. Environmental predictors of reading were not assessed in this study. Although high- and low-risk groups were matched for parental education level in an attempt to control for environmental variables, it is likely that there was still variance in HLE within the sample, which may have acted as a protective or additional risk factor for the FR children.

A further important finding from Pennington and LeFly's (2001) study was that FR-not dyslexic children exhibited mild impairment on early implicit and explicit phonological measures at kindergarten age and on literacy measures at the end of Grade 2. This TD>FR-not dyslexic>FR-dyslexic pattern indicates that family-risk of dyslexia is continuous, such that those FR children who do not meet diagnostic criteria for dyslexia nonetheless demonstrate mild difficulties in phonological and letter-sound correspondence tasks compared to low-risk groups. Further evidence for the dimensional nature of family risk was provided by a longitudinal study conducted by Snowling and colleagues (Gallagher, Frith, & Snowling, 2000; Snowling et al., 2003; Snowling, Muter, & Carroll, 2007). When the FR group in this study was classified as either reading impaired or unaffected based on early reading skills at age 6, no differences emerged in the language and cognitive profiles of TD and FR-not dyslexic children, while FR-dyslexic children demonstrated impairments on a range of early speech and language measures (Gallagher et al., 2000). However, when the sample was reclassified based upon word reading, reading comprehension and spelling scores collected at age 8, 66% of the FR group showed literacy difficulties, and retrospective analyses revealed a stepwise TD>FR-not dyslexic>FR-dyslexic pattern on a number of measures tapping phonological processing and orthographic knowledge at preschool age, and on literacy tasks at age 6 (Snowling et al., 2003). The authors postulated a delayed development of the orthographic – phonological pathway set out by the Triangle Model of reading (Plaut et al., 1996). At-risk children who possess relatively strong oral language skills could plausibly make early use of the semantic pathway to bootstrap weak phonological skills, but residual weaknesses persist in tasks tapping phonological processing and knowledge of grapheme-phoneme correspondence in the absence of semantic or contextual clues. Indeed, a follow-up of these children at age 12-13 revealed persistent weakness in reading fluency and orthographic knowledge in the FR-not dyslexic group, while reading comprehension was unimpaired, consistent with the idea of the protective role of strong oral language skills (Snowling et al., 2007).

At the final assessment point of their longitudinal study, Snowling et al. (2007) also collected data on family environment. Children in the FR-dyslexic group scored lower on checklist measures of print exposure that children in the FR-not dyslexic and TD groups, and this pattern was replicated in items from a parental interview which tapped children's interaction with print. In addition, there was a non-significant trend for parents of FR-dyslexic children to report reading for pleasure less often themselves than parents of FR-not dyslexic and TD children. Since early data on the HLE were not available for this sample, it is not possible to establish the direction of the effect, since it is possible that FR-dyslexic children's reduced engagement with print is a consequence of atypical reading development. Similarly, reduced reading for pleasure among parents of FR-dyslexic children may be affected by concerns about their children's educational progress; the authors report significant influence of children's reading difficulties on maternal wellbeing (Snowling et al., 2007). However, in combination with Scarborough's (1991) finding that FR-dyslexic children show reduced levels of independent engagement with print before learning to read, these results are suggestive of reduced print exposure throughout development in children with reading difficulties, a plausible example of active gene-environment correlation.

The studies discussed in this section added to the understanding of the early development of children at family-risk of reading difficulties in several important ways. First, FR children who go on to have dyslexia follow the same trajectory of development in pre-reading skills as TD children, but at a slower rate, confirming the notion that dyslexia represents the low extreme of the normal distribution of reading ability. Significantly, phonological awareness becomes a key predictor of reading success at least two years later than in TD children (Pennington & LeFly, 2001). Second, family-risk of dyslexia is continuous, such that FR children who do not go on to meet clinical criteria for dyslexia nonetheless show early deficits in phonological processing and orthographic knowledge (Pennington & LeFly, 2001; Snowling et al., 2003). The fact that weaknesses in the FR-not dyslexic group were not observed by Scarborough (1990) may be attributable to the small number of children in this sample, the younger age at which their cognitive skills were assessed, and/or the use of naturalistic language samples, as opposed to standardised tests in the other studies. Third, FR-dyslexic children show some differences in engagement with print compared to FR-not dyslexic and TD children. Although HLE was not a primary focus of these studies, Scarborough et al. (1991) retrospectively reported lower levels of shared reading and independent engagement with print in the preschool years in the FR-dyslexic group. Similarly, Snowling et al. (2007) reported reduced print exposure in children with dyslexia in the early adolescent years. These studies, then, raised questions about the role of family environment (both in terms of

HLE and parents' own literacy abilities) in the literacy development of children at family-risk of dyslexia. These issues have been addressed further by two large-scale prospective family-risk studies: the Jyväskylä Longitudinal Study of Dyslexia and the Dutch Dyslexia Programme.

2.3.2 The Jyväskylä Longitudinal Study of Dyslexia

One of the most comprehensive family-risk studies of dyslexia to date is being conducted by a group of Finnish researchers at the University of Jyväskylä. Children were recruited to this study prenatally in the early 1990s, and assessed at least annually from birth into young adulthood. The overarching aim of the study is to identify early precursors of dyslexia, by analysing brain structure and function, early speech perception, language and cognitive skills, and family and environmental factors (Lyytinen et al., 2008). Findings from the Jyväskylä study have largely confirmed the cognitive precursors of reading difficulties identified by studies using English-speaking samples, with letter knowledge, phonological awareness and RAN emerging as key predictors of literacy achievement (Lyytinen et al., 2006; Puolakanaho et al., 2007; Torrpa et al., 2010). The analyses of home environment reported by the Finnish group will be reviewed here.

Since letter knowledge is a key predictor of reading, the cognitive and environmental precursors of its development were examined by the Jyväskylä research team (Torppa, Poikkeus, Laakso, Eklund, & Lyttinen, 2006). Finnish is a transparent orthography, comprising 23 consistent grapheme-phoneme correspondences; letter names are also nearly identical to letter sounds. Therefore, the task of learning letters is more straightforward than in an opaque orthography, such as English, in which many letter forms have several possible phonemic representations. Nonetheless, Torppa et al.'s (2006) trajectory analysis of the growth of letter knowledge between the ages of 4;06 and 6;06 in their sample of children revealed marked individual differences. Three broad trajectories of letter knowledge growth were identified over four time points: precocious, linear growth and delayed. TD children were over-represented in the precocious cluster, while FR children represented the majority of the delayed cluster. A logistic regression analysis was employed to identify predictors of cluster membership. For FR children, parental instruction of letters and phonological awareness assessed at age 3 were the only significant predictors of letter knowledge growth. These variables were also significantly predictive in the TD group, along with maternal education and RAN. More than 50% of the children who displayed delayed letter knowledge development also showed poor reading fluency and/or comprehension in Grade 1. This study converges with behavioural genetic research (e.g. Samuelsson et al., 2005) in providing evidence for environmental influences on letter knowledge. In concordance with the Home Literacy Model (Sénéchal & LeFevre, 2002), explicit instruction of orthographic forms by parents, but not storybook exposure, was found to be predictive of letter knowledge. However, Torppa et al.'s (2006) study was the first to investigate environmental influences on letter knowledge in an at-risk sample, and provides evidence that, while having a parent with dyslexia confers an elevated risk of slow letter knowledge development, parental instruction of letter forms may mitigate this risk.

Another finding of the Jyväskylä study relates the role of the HLE in the development of phonological awareness (Torppa, Poikkeus et al., 2007). The wider HLE literature has produced conflicting evidence as to whether early exposure to print is a direct or indirect predictor of phonological awareness (e.g. Burgess, 2002;

Sénéchal & LeFevre, 2002). In the Jyväskylä data, neither storybook reading in the home nor children's interest in reading differed between the FR and TD groups, although there was greater variance in storybook reading when children were 2 years old in the FR group. Storybook reading and children's interest correlated with measures of vocabulary in both groups. A relationship between storybook reading and phonological awareness was observed in the FR group only; however, this effect was shown to be mediated by vocabulary. In concordance with the broader HLE literature, therefore, early storybook reading was primarily associated with oral language development in this study, and effect sizes were modest. However, it is interesting to note that correlations between storybook reading, children's interest in reading and early cognitive skills were stronger in FR than TD children (Torppa, Poikkeus et al., 2007).

In a follow-up to this study, which included assessment of classmates of the participating children, five reading subtypes were identified after the first two years of school (Torppa, Tolvanen et al., 2007). These subtypes were: poor readers (characterised by poor fluency, accuracy and comprehension), slow readers (characterised by poor fluency and intact comprehension), poor comprehenders (showing intact fluency but impaired reading comprehension), average readers and good readers. As expected, FR children were found to be over-represented in the poor reading and slow reading groups, though not in the poor comprehension group. Moreover, retrospective analysis revealed that children who were classified as poor readers in Grade 2 had experienced less shared storybook reading with parents in the preschool years than good and average readers. Furthermore, poor readers and poor comprehenders read independently less often than the other groups at ages 6 and 7. Classroom membership was also found to be significantly associated with reading status, accounting for around 10% of the variance in the larger sample's reading scores (Torppa, 2007).

Taken together, these three studies from the Jyväskylä group are suggestive that home influences may operate differently in early literacy development where children have a genetic susceptibility to dyslexia. Parental teaching of letter forms, early storybook reading in the home and children's interest in books seem be more strongly associated with the pre-reading and early reading skills of FR than TD children. However, the nature of this difference is difficult to specify. It is possible that children with genetic constraints on their reading development are more sensitive to environmental risk and/or protective factors (a gene-environment interaction (GxE)). Alternatively, genetic and environmental influences could be correlated (r_{GE}) such that, for example, parents with weak reading skills are more likely to provide impoverished early literacy input, or children who have inherited genetic constraints on reading development are less likely to seek out literacy-rich environments. Given the lack of difference between groups on various measures of HLE in the Jyväskylä dataset, Torppa (2007) concludes that evidence for gene-environment correlation is scant. However, the precise nature of the genetic and environmental causal mechanisms underlying reading development cannot be inferred with confidence in a design which is not genetically sensitive.

2.3.3 The Dutch Dyslexia Programme

The Dutch Dyslexia Programme is a multidisciplinary study of dyslexia run by three research centres in the Netherlands. The programme comprises genetic studies, intervention research and a prospective longitudinal study of reading disability, to which children were recruited at age 5. The role of family environmental factors in the reading development of this at-risk sample has been reported by van Bergen and colleagues (van Bergen et al., 2011; van Bergen, 2013; van Bergen, de Jong, Maassen, & van der Leij, submitted).

A subsample of children participating in this study, tested in and around Amsterdam, was classified as FR-dyslexic (n=22), FR-not dyslexic (n=45) or TD (n=12) based on their reading scores at age 10. Dyslexic status was accorded if a child scored within the lowest 10% on a test of reading fluency (van Bergen et al., 2011). Parental and HLE variables were then analysed retrospectively in an attempt to differentiate FR children who went on to display reading difficulty from those who did not. Parents of children in the FR-dyslexic group were found to have poorer reading fluency than those in the FR-not dyslexic group, confirming the continuous nature of family-risk. In addition, parents in the TD group reported a significantly higher level of education than those in the FR-dyslexic group. Measures of HLE in this study comprised three questionnaire items, tapping the frequency of shared reading, children's library membership and the number of books available in the home. None of these items distinguished the FR-dyslexic and FR-not dyslexic groups, and the authors concluded that whether or not an at-risk child went on to develop dyslexia could not be determined by early HLE experiences (van Bergen et al., 2011). However, it is possible that the older age of children at recruitment to this study masked home literacy effects, since the broader literature suggests that the early HLE is particularly influential in children's language and literacy development (Krishnakumar & Black, 2003: Torppa et al., 2006).

In a further study using a larger national sample (N=196), van Bergen et al. (submitted) found that fathers of TD children spent significantly more time reading and writing than fathers of children in the FR-dyslexic and FR-not dyslexic groups, although parents with and without dyslexia showed equivalent levels of print exposure overall. In terms of the HLE, there was a trend for TD families to own more books in the home than FR families, but this difference did not reach significance after adjustment of the alpha level to correct for multiple non-parametric group comparisons. In line with van Bergen et al.'s (2011) findings, the frequency of shared book reading in the home did not differ between the groups.

Overall, then, the Dutch study has yielded little evidence that the HLE influences reading outcomes in FR children. However, it should be noted that the HLE was operationalised as three single items on a questionnaire in this study, and is therefore likely to lack sensitivity. Moreover, the effects of the HLE on the pre-reading skills with which it is most commonly associated, particularly vocabulary and letter knowledge, were not reported, and so indirect effects on reading outcomes via emergent literacy may have been missed.

2.3.4 Conclusions: Cognitive and Environmental Precursors of Dyslexia

The family-risk studies reviewed in this section provide a largely consistent picture of the cognitive precursors of dyslexia. Children at family-risk of dyslexia, and in particular those who go on to show reading difficulties themselves, consistently show early impairment in the key precursors of reading, namely phonological awareness, letter knowledge and RAN (Puolokanaho et al., 2007; van Bergen et al., 2011). Furthermore, there is convincing evidence for broader weaknesses in early speech and language skills in many FR children who go on to develop dyslexia (Lyytinen et al., 2005; Snowling et al. 2003).

The evidence for environmental risk factors in dyslexia is far less clear. Of the family-risk studies discussed here, the Jyväskylä study has investigated the role of environmental influences in most depth. This dataset has provided indications that the HLE is more strongly related to pre-reading skills in at-risk groups (Torppa et al., 2006; Torppa, Poikkeus et al., 2007) and that those FR children who become poor readers experience less rich exposure to literature in the preschool years (Torppa, Tolvanen et al., 2007). However, the extent to which these findings are underpinned by their relationship with genetic factors is not clear. Children's interest in printed materials is equally likely to be a cause or a consequence of shared reading with parents, and the mixed empirical evidence for reduced interest in print in FR children makes it difficult to disentangle genetic and environmental influences (Scarborough et al., 1991; Snowling et al., 2007; Torppa, Poikkeus et al., 2007).

In line with the multiple deficits model (Pennington, 2006), it is likely that children who go on to develop dyslexia inherit a combination of genetic risk factors from parents. Each risk allele that is inherited is likely to exert a small effect on neurobiological development. These children may also experience less exposure to literacy material in the home, in some cases driven by a genetically-mediated resistance to engage with print. Gene-environment interactions and correlations are likely to be multiple and complex in this population. Furthermore, these children are expected to show deficits in several cognitive domains, for instance phonological processing, visual-verbal mapping and speed of processing, before learning to read. Aetiological and cognitive overlap between disorders means that, for example, some children who display a phonological deficit may present with comorbid dyslexia and SLI (Bishop, McDonald, Bird, & Hayiou-Thomas, 2009) and children with slow speed of processing may present with comorbid dyslexia, ADHD (Wilcutt, Pennington, Olson, Chhabildas, & Hulslander, 2005) and/or mathematics disorder (van der Sluis, de Jong, & van der Leij, 2004). The aetiological and cognitive profiles of children with dyslexia are complex and heterogeneous. However, the behavioural genetic and family-risk literatures clearly suggest that there is space for the environment to exert effects on literacy development in the preschool years, and particularly on print knowledge and oral language skills. The HLE is a plausible source of shared environmental influence on reading, in interaction with a genetically-driven and continuous phonological deficit in families with a history of dyslexia.

2.4 The Wellcome Language and Reading Project: Methodology

The studies reported in this thesis form part of the Wellcome Language and Reading Project, a longitudinal family-risk study tracking the development of oral and written language in a sample of young children from the north of England.

2.4.1 Aims

A principal aim of the Wellcome project is to clarify the underpinning cognitive deficits, and environmental correlates, of two common developmental disorders: dyslexia and SLI. Several models have been proposed to explain the developmental relations between these two disorders (for a review, see Ramus, Marshall, Rosen, & van der Lely, 2013). Modular accounts view dyslexia and SLI as qualitatively distinct; the former associated with a core phonological deficit, the latter with grammatical impairment. Conversely, non-modular theories propose multiple continuous risk factors; the severity of impairment along these dimensions determines the behavioural presentation of the disorder (Bishop & Snowling, 2004; Pennington, 2006). By recruiting children at family-risk of dyslexia, alongside those with oral language impairment and typically developing controls, similarities and differences in the language and reading development of these groups can be identified.

The Wellcome project addresses the following research questions regarding the nature and overlap of dyslexia and SLI:

(a) How persistent are the language deficits in children with SLI?

(b) How frequent are reading difficulties in children with a preschool diagnosis of SLI, and how do such reading problems relate to these children's underlying language skills?

(c) What proportion of children at family-risk of dyslexia develops a reading disorder? Can reading status be predicted from language and cognitive measures obtained before reading instruction has begun?

(d) Do some children at family risk of dyslexia resemble those with SLI?

In addition, gathering information about the HLE experienced by children at risk of reading difficulties, either via family history of dyslexia or oral language impairment, allows for investigation of the ways in which the environment shapes the developmental pathways of children with these disorders. Achieving a more precise picture of which emergent literacy skills are most amenable to environmental influence has potentially important educational applications. Ultimately, it is hoped that a more precise understanding of the role of cognitive risk factors and environmental influences in dyslexia and SLI will inform the development of early educational interventions for children affected by these disorders. A further set of research questions addressed by components of the Wellcome project described in this thesis, then, is:

(a) Is the HLE similar for children at family- risk of reading difficulties and typically developing children?

(b) Do environmental influences operate on emergent literacy skills in a similar manner for children with and without family-risk of reading difficulties?

(c) Is early HLE similarly predictive of later reading skills in children with and without family-risk of reading difficulties?

While data on the HLE was collected for all children participating in the Wellcome project, the studies contained in the following chapters focus on those in the FR and TD groups only. The data for children with SLI are excluded from the current analyses for purposes of scale.

2.4.2 Recruitment and Classification

Families were recruited to the Wellcome Language and Reading project via advertisements placed in local newspapers, nurseries, webpages of agencies supporting children with reading and language difficulties and through speech and language therapy services. At referral, children were classified as typically developing (TD) if there was no reported family history of dyslexia and parents had no concerns about speech or language development. Family-risk (FR) status was assigned if (a) either parent self-reported as dyslexic; (b) either parent achieved a standardised literacy score (a composite derived from scores on tests of phonological decoding and spelling) of less than 90 in the research assessment; (c) either parent met the 'discrepancy definition' at the research assessment (i.e. standardised literacy score of less than 96 and a non-verbal IQ standardised score at least 22.5 points higher) or (d) a full sibling had received a diagnosis of dyslexia from an educational professional. Finally, children were classified as having a specific language impairment (SLI) on the basis of parental reports of concerns about their child's speech and/or language development. At referral, FR status overrode SLI status, such that if a child had both a family-risk of dyslexia and impaired language, s/he was assigned to the FR group (FR-SLI). A sample of 242 children was recruited at this stage, none of whom met the exclusionary criteria of chronic illness, deafness, known neurological disorder, monozygotic twin status, English as a second language or local authority care provision. The recruitment and classification procedures employed are displayed schematically in Figure 2.2.

After the *t1* assessments, children's standardised language scores were inspected in order to ensure that all SLI children met the research criteria for language impairment (failure on two of four standardised language tests; see Figure 2.2 for details). This resulted in 10 SLI children being excluded from the sample, since they did not meet the requisite criteria. Furthermore five TD children met the research criteria for language impairment and were therefore reclassified as SLI.

Recruitment via nurseries, press advertisements, leaflets, SLT drop-in clinics, dyslexia support groups

Exclusionary criteria used at referral: monozygotic twin status, chronic illness requiring multiple hospital visits, deaness, autism spectrum disorders, English as an additional language, care provision by local authority, known neurological disorder (e.g. cerebral palsy), known genetic or other developmental disorder (eg 22q deletion syndrome)

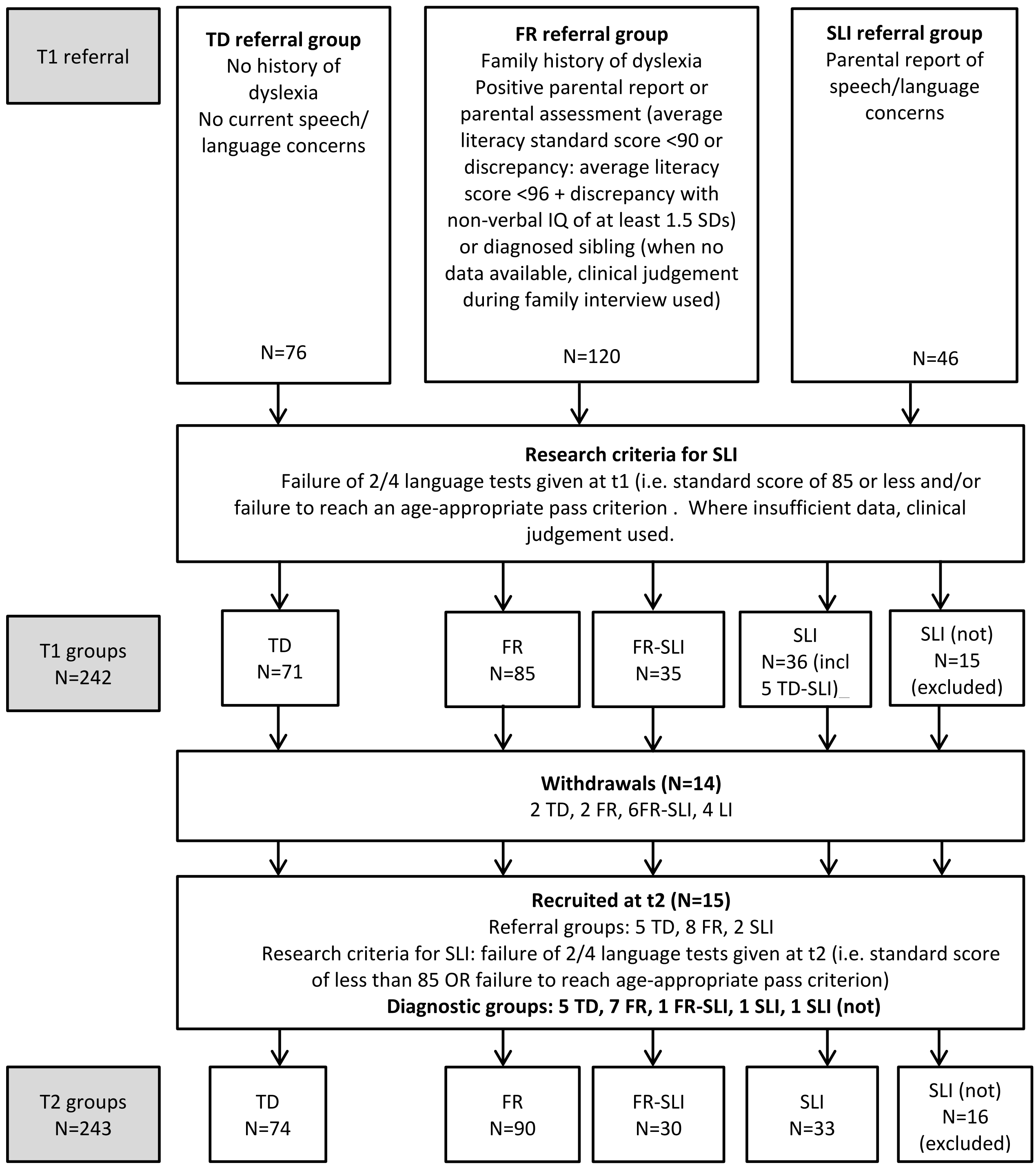


Figure 2:2. **Recruitment and classification procedures employed in the Wellcome project**

Between the first and second time points of the study, 14 families withdrew from the project (2 TD; 8 FR (including 6 FR-SLI); and 4 SLI). A further 15 children were recruited to the project for entry at *t2*. These participants were classified as follows: 5 TD; 8 FR (including 1 FR-SLI); 1 SLI; 1 SLI who did not meet research criteria for language impairment and was therefore excluded from the study. The full sample at *t2* therefore totalled 227 children, after exclusions.

2.4.3 Design

The Wellcome project is a longitudinal prospective study, which to date has tracked the development of over 200 children between the ages of 3;06 and 7 years old. During this five-year period, children were assessed at five time points on an age-appropriate battery of cognitive tests. In the preschool years, the battery included tests of language ability, implicit and explicit phonology, speech perception, auditory perception, executive function, non-verbal ability, letter and number skills. As children progressed through the early years of school, more extensive tests of literacy were included in the battery, which tapped reading accuracy, phonological decoding, spelling and reading comprehension.

In addition, standardised tests of reading fluency, phonological decoding, spelling, phonological awareness, verbal and non-verbal ability were administered to all consenting parents during the early stages of the project, and at each time point family interviews were conducted with primary caregivers to gauge family status, home literacy environment and parental concerns about children's development. Parents and teachers also regularly completed questionnaires on children's behaviour, attention and motor skills. Finally, a reading intervention was delivered to 60 participating children who were showing poor early reading skills at age 6. Figure 2.3 represents the design of the Wellcome project schematically.

2.4.4 Ethical Considerations

Ethical clearance for the study was provided by the Department of Psychology's Ethics Committee, University of York, and by the NHS Research Ethics Committee. Upon contacting the research team to express an interest in participating, parents were provided with an information pack detailing the aims and design of the project. Written consent was obtained from parents, both for their child's and their own participation in the study. It was made clear in the consent forms that families could withdraw from the study at any time without risk of penalty, and that it was not necessary to participate in all aspects of the study, for example parental assessment, if they did not wish to do so. Verbal assent was obtained from children at the outset of each cognitive assessment, and every effort was made to ensure that children were comfortable and engaged during the assessment sessions. Children were given a small reward, for example a toy, pencil case or storybook, after each assessment.

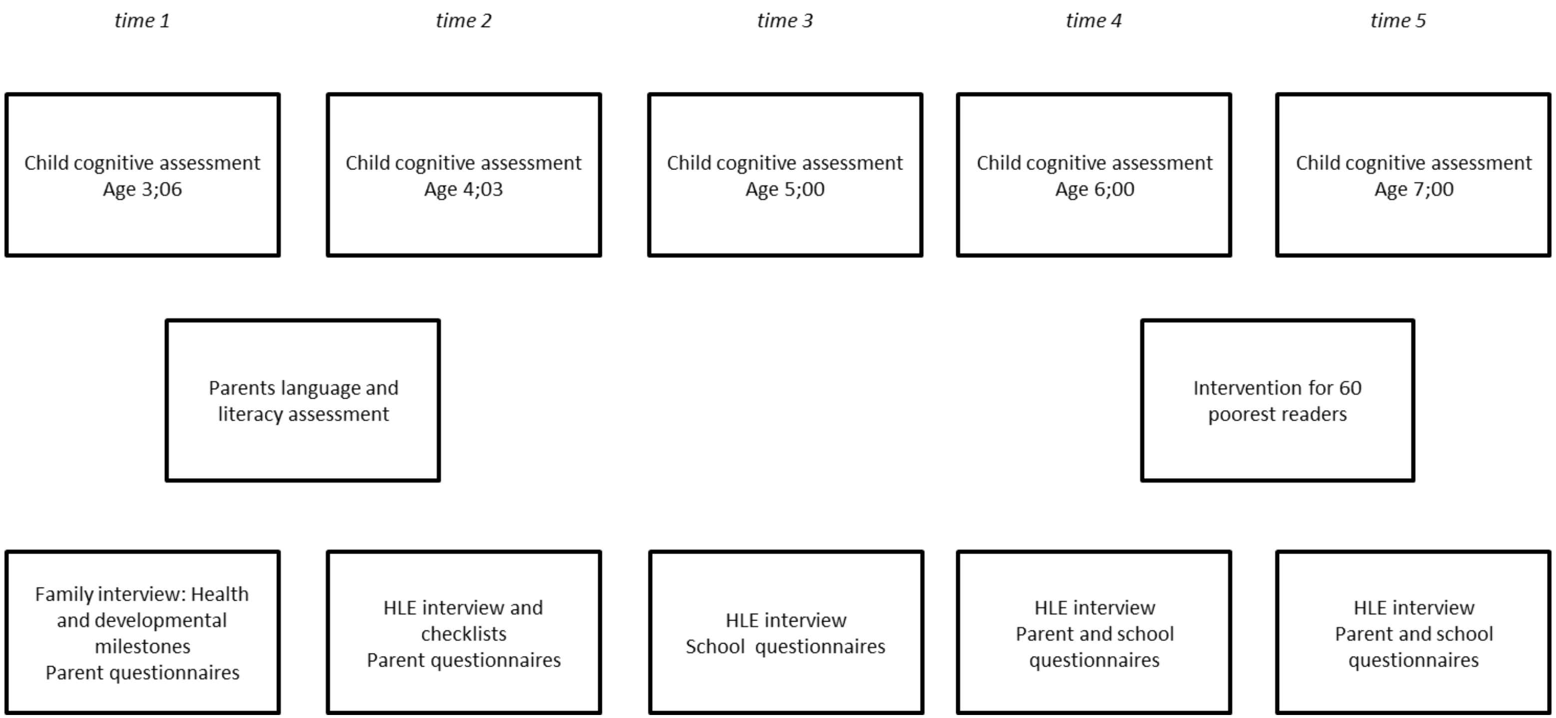


***Figure 2:3*. Wellcome project data collection, time points 1-5**

After each child assessment, parents were provided with a brief report, outlining their children's performance on a number of standardised tests of language, literacy and general cognitive ability. Information was not provided to parents about tests for which standardisation data were not available and it was made clear in the reports that, since the results were not derived from a full clinical assessment, caution should be taken in their interpretation. Where children showed particular difficulty, for instance in a language or auditory task, it was suggested in the report that parents seek advice from a relevant health or educational professional (e.g. speech and language therapist, audiologist).

Each child and participating parent was assigned a unique code in order to ensure anonymity of data. All personal information pertaining to participating families was kept in a password-protected spread sheet and consent forms were stored securely. Only members of the research team had access to project data, and information about children was not shared with schools without explicit parental consent.

Chapter 3: Home Literacy Environment Measures: Design, Reliability and Descriptive Analysis

This chapter concerns the measures of HLE, family composition and family SES that were used at *t2* of the Wellcome project. Issues of design, reliability and validity are discussed in relation to the interview and checklist tools, and inter-correlations and group differences for each variable are presented. The HLE variables are then subjected to confirmatory factor analysis (CFA) in order to reduce dimensions in preparation for the regression analyses contained in the following two chapters. Finally, a thematic analysis of qualitative interview data on parents' beliefs about literacy practices in the home and reading development is presented.

3.1 Study 1: A Quantitative Description of the Home Literacy Environment of Family-risk and Typically Developing Children

3.1.1 Participants

In total, data were collected from 245 children at *t2* of the Wellcome project; 78 of these children were classified as TD, 124 as FR and 43 as SLI (see section 2.4.2 for classification criteria). Family-risk of dyslexia took precedence over language impairment at classification, so that some children in the FR group also had a language impairment. Attrition from *t1* was 6% (n=15 of 244), the majority of whom were from the clinical groups (3 TD; 7 FR; 5 SLI). A further 16 children joined the project at *t*2 (6 TD; 8 FR; 2 SLI).

For the purposes of the current analyses, a number of exclusions were made from the *t2* sample. First, children with a language impairment, but no family history of dyslexia, were removed from the sample as discussed in section 2.4.1. In addition, 5 children who were classified TD at referral, but who met the research criteria for language impairment, were excluded. Data on the HLE were unavailable for a further 3 children (of whom 2 were classified FR, and 1 TD), because these children were tested at school and parents were not available to be interviewed. Finally, the full Wellcome project contained 6 sibling pairs. Since the family environment is the focus of this thesis, it was decided to include only one sibling of each pair in order to avoid duplicating family-level data. One sibling from each pair was therefore removed at random from the dataset. After these exclusions, the final sample consisted of 188 children and their parents.

Sample characteristics are presented in Table 3.1 below. The FR group contained more boys than girls, while the gender split was equal in the TD group. However, the association between group and gender was not significant. The average age of the sample as a whole was 4 years and 8 months, and the FR group was slightly older than the TD group overall ($t(186)=2.20$, $p=.029$). Across the whole sample, 86 children (46%) had not yet started school at the time of testing, and the mean number of months in school did not differ between the groups. The Block Design subtest from the *Wechsler Preschool & Primary Scale of Intelligence (WPSSI-III UK*; Wechsler 2004) was administered during the *t2* cognitive assessment as an index of non-verbal ability. The sample as a whole performed above published norms on this measure, with the TD group scoring significantly higher than the FR group.

Table 3.1
Sample characteristics of family-risk (FR) and typically developing (TD) groups at Wellcome t2

	Whole Sample	FR	TD	Group difference
N	188	116	72	
Gender (% boys)	56%	60%	50%	$\chi^2(1)=1.93$ (ns)
Age at *t2*[1]	56.54 (3.78)	57.01 (3.91)	55.78 (3.46)	$t(186)=2.20^{*}$
Months in school at *t2*	2.61 (3.35)	2.68 (3.30)	2.51 (3.46)	$t(186)=0.72$ (ns)
NVIQ at *t2*[2]	108.98 (18.32)	104.16 (17.05)	116.75 (17.30)	$t(186)=4.85^{***}$

Note: [1]in months; [2]WPPSI Block Design sub-test (standardised score); *$p<0.05$; ***$p<.001$, ns = non-significant

Of the 116 children at family-risk of dyslexia, 29 met the research criteria for language impairment at *t1*. Table 3.2 presents comparative group characteristics for FR children with language impairment (FR-SLI) as compared to those children with a family-risk of dyslexia only (FR-only). The proportion of boys in the FR-SLI group was somewhat higher than in the FR-only group, although this association was not significant. Mann-Whitney tests were used to compare these groups on demographic variables, due to the unequal group sizes. The groups did not differ in terms of age or months in school, but the mean non-verbal IQ score was significantly higher in the FR-only group than in the FR-SLI group.

Table 3.2
Sample characteristics of Family-risk only (FR-only) and Family-risk + Language Impairment (FR-SLI) groups

	FR-only	FR-SLI	Group difference
N	87	29	
Gender (% boys)	58.5%	65.5%	$\chi^2(1)=2.35$ (ns)
Age at *t2* (months)	57.05 (3.91)	56.90 (3.99)	U=1240.00 (ns)
Months in school at *t2*	2.68 (3.40)	2.69 (3.04)	U=1206.50 (ns)
NVIQ at *t2*[1]***	107.40 (16.63)	94.41 (14.60)	$U=735.00^{***}$

Note: [1]in months; [2]WPPSI Block Design sub-test (standardised score); ***$p<.001$, ns = non-significant

3.1.2 The Home Literacy Environment Interview

3.1.2.1 Design

Aspects of children's home literacy environment are typically tapped by parental report, using questionnaire or interview tools (Bus et al., 1995). At *t2* of the Wellcome project, a structured family interview was designed to be conducted with each child's primary caregiver. The interview included questions on home literacy practices, parental attitudes and modelling behaviours, children's interest in books, as well as demographics, child health and development. Questions were predominantly closed, using a likert scale response system, and parents were encouraged to give additional information where appropriate, which was recorded by the interviewer in note form.

Since the HLE items formed part of a broader interview schedule, it was necessary to select a small number of indicators for each HLE construct. Items were therefore selected on the basis of previous studies, and in particular the research by Sénéchal and colleagues reviewed in Chapter 1 (see Sénéchal et al., 1998), which provided the principal theoretical model for the current research. The key constructs of interest were interactional literacy-related practices, i.e. storybook exposure and direct literacy instruction, although additional questions were included to tap child- and parent-specific attitudes and behaviours. The interview items for each HLE construct of interest are displayed in Table 3.3. Questions designed to gauge storybook exposure concerned frequency of storybook reading, number of storybooks read at bedtime, child's age at onset of storybook reading, number of children's books in the home and frequency of library visits. Items concerning direct literacy instruction in the home required parents to rate the frequency with which they taught their children about letters, reading words and printing words. Questions tapping children's interest in books asked how often children initiated shared storybook reading, how often they looked at books independently and asked parents to rate their child's enjoyment of storybook reading. Finally items relating to parental beliefs and behaviours included questions on the importance of shared reading and direct instruction, the purpose of shared reading and self-rating of parents' own enjoyment of reading for pleasure.

3.1.2.2 Procedure

The HLE interview was conducted during home visits to the participating families at *t2* of the project, when children were 4 years old. At this testing point, two members of the research team visited each family's home, one of whom conducted a cognitive test battery with the child, while the other interviewed the primary caregiver. In very few cases, it was not possible to conduct interviews face-to-face, for example because the caregiver was occupied by caring for a younger sibling during the home visit. In these instances, interviews were conducted by telephone as soon as possible after the date of the home visit.

At the outset of the family interview, care was taken to ensure that parents understood that the questions asked about home literacy environment did not reflect 'best practice', but that the interview was simply designed to gauge the types of literacy-related activities that parents and children engaged in. In an attempt to reduce anxiety about literacy practices, particularly on the part of parents with dyslexia, a small number of filler questions were included, asking how often parents and children engaged in craft, building and physical activities. The interview questions and response categories were read out verbally, and clarification provided by the interviewer if necessary. Parents were encouraged to supplement their responses with additional relevant information if they wished, which was recorded in note form by the researchers.

3.1.2.3 Descriptive statistics

Table 3.3 presents descriptive statistics for the sample as a whole on the HLE interview items. Means and standard deviations are presented for interval scales, while medians and ranges are given for ordinal scales. Additionally, proportions of missing data are displayed.

Parents interviewed reported engaging in an average of 10 shared storybook interactions with their children each week, which is in line with the frequencies reported in the studies by Sénéchal and colleagues (Sénéchal et al., 1996; Sénéchal et al., 1998). Parents typically reported reading at least one storybook with their child at bedtime each night. The range in children's age when parents began reading storybooks with them was restricted, since a substantial majority reported reading books with their children since birth or very soon afterwards. This finding is discrepant with early HLE studies which found onset age of storybook reading to be a strong predictor of children's oral language skills (e.g. DeBaryshe, 1993). This inconsistency could be an artefact of inaccuracy of recall, since parents in the current study were interviewed when children were 4 years old. It is also possible that differences in sample SES are important for this variable; DeBaryshe's studies

Table 3.3

T2 HLE interview items: Descriptive statistics for the whole sample (N=188)

Item	% missing	Mean (s.d.)	Median (range)	Skewness	Kurtosis
Storybook Exposure					
Total frequency of shared reading per week (*Shared reading at bedtime + other times)*	0	9.96 (3.58)	-	-.08	.56
Typical number of bedtime stories	0	1.83 (.92)	-	.63	.04
Age of onset shared reading (*1 = 24+ months; 2=18-23 months; 3= 12-17 months; 4 = 6-11 months; 5 = 0-5 months)*	0.5	-	5 (1-5)	-1.58	1.62
Number of children's books in home (*1=0-20; 2=21-40; 3=41-60; 4=61-100; 5=100-150; 6=150-200; 7=200+)*	1.1	-	5 (1-7)	-.48	-.29
Frequency of library visits (*1=never; 2=occasionally; 3=at least once a month; 4=at least once a week*)	0.5	-	3 (1-4)	-.17	-.92
Direct Instruction					
Frequency of letter instruction (*1=never/occasionally; 2=at least once a month; 3= at least once a week; 4= several times a week; 5=daily)*	0	-	4 (1-5)	-.69	-.60
Frequency of reading instruction (*as previous item)*	0	-	3 (1-5)	-.29	-1.52
Frequency of writing instruction (*as previous item)*	0	-	3 (1-5)	-.20	-1.08
Child Interest					
Frequency of shared reading requests (*1=never/occasionally; 2=at least once a month; 3= at least once a week; 4= daily; 5=several times a day)*	0.5	-	4 (1-5)	-.39	-.57
Frequency of independent reading (*as previous item)*	0	-	4 (1-5)	-.42	-.47
Enjoyment of reading (*1=strongly dislikes; 2= dislikes; 3=neither likes nor dislikes; 4= likes; 5=strongly likes*)	3.7	-	5 (2-5)	-1.48	2.40
Adult Variables					
Enjoyment of reading (*1=strongly dislikes; 2= dislikes; 3=neither likes nor dislikes; 4= likes; 5=strongly likes*)	0	-	5(1-5)	-1.43	1.41

examined the HLE in low-income families, while the current sample includes a range of family SES. Finally, it may be the case that socio-political discourse around the value of reading storybooks with children from a young age has become more pervasive during the 20 intervening years between DeBaryshe's study and the current research. Most parents interviewed reported owning a substantial number of children's books, with the average estimate being 100-150 books, a higher figure than in many previous studies (e.g. Sénéchal et al., 1996; Sénéchal et al., 1998). Parents reported visiting libraries with their children on average at least once a month.

In terms of the interview items relating to direct instruction of literacy skills, parents reported teaching their children about letters several times a week on average. Inspection of the additional comments provided by parents suggested that they used a wide range of aids to boost their children's letter knowledge, including flash cards, foam bath letters, magnetic fridge letters and electronic phonics games. Teaching children to read words was reported to be slightly less common, with a median frequency of once a week. Again, a variety of materials and contexts were cited by parents, including storybooks, environmental print in the home and word games such as Scrabble. Finally, parents reported teaching their children to write words approximately once a week on average. Many respondents stated that they focused on helping their children to write their names, particularly in the context of signing cards and letters. In general, it was a common theme for parents to say that direct literacy instruction took place in an informal, contextualised and spontaneous manner in the home, often prompted by children's questions about environmental print.

Children's interest in books was rated as strong in the current sample. Parents estimated that children asked to be read stories, and looked at books independently, on a daily basis on average. The distribution of parental ratings of their children's enjoyment of storybooks was substantially negatively skewed; 96% of the sample stated that their child 'enjoyed' or 'strongly enjoyed' storybook reading. This restricted range is concordant with the questionnaire responses reported by Sénéchal et al. (1996). A similar pattern was found in parental self-reports of their own enjoyment of reading books for pleasure; 84% reported 'enjoying' or 'strongly enjoying' reading, while only 7% said that they did not enjoy reading. Of the 10 parents who reported not enjoying reading for pleasure, 7 also self-reported as dyslexic. In the additional comments associated with this question, many parents stated that they did not have as much time as they would like to devote to reading because of family life and/or work.

3.1.2.4 Missing data

No variable from the HLE interview contained more than 4% missing data. Little's MCAR test was computed for the interview dataset, which indicated that these data points were missing completely at random ($\chi^2(54)=55.68$, $p=.412$). On this basis, and in order to utilise data from all of the 188 participants in subsequent inferential analyses, the missing data points were imputed using an expectation maximisation (EM) technique on SPSS (v.20). Each imputation was made on the basis of the participant's scores on other items tapping the same construct as the missing data point. The analyses presented in the following two sections were conducted on the full data set including imputed missing values.

3.1.2.5 Group differences

3.1.2.5.1 Gender effects

Preliminary analyses of the interview items did not reveal gender differences in storybook exposure. However, parents reported teaching girls about letters and helping girls to write words more often than boys (Mann Whitney U=3179.00, p=.019; U=3193.50, p<.001 respectively). No gender differences were observed in the frequency with which parents taught children to read words. Moreover, parents tended to report that girls were more interested in storybooks than boys; significant differences were observed in the frequency of reading requests (U=3371, p=.006) and children's enjoyment of storybooks (U=3619.50, p=.023), and the higher frequency with which girls were reported to engage with print independently was marginally significant (U=3673.00, p=.059). Therefore, in the current data set, gender effects were found in direct instruction and children's interest in literacy, but not in storybook exposure. Nonetheless, data were collapsed across genders in the next step of analysis, in order to investigate the main effect of risk status on the individual interview items.

3.1.2.5.2 FR/TD group differences

Measures of central tendency and dispersion for the FR and TD groups on all HLE interview items are presented in Table 3.4, along with tests of difference (independent samples t-tests for the continuous measures and Mann-Whitney U tests for the ordinal scales). There was a non-significant trend for TD families to engage in shared reading more often, and to read more books at bedtime, than FR families. This group difference may in part be driven by the FR-SLI families (see section 3.1.2.5.3). No group differences emerged in the age of onset of shared reading, the number of children's books in the home, nor the frequency of library visits. Frequency of direct instruction of letters, reading and writing was comparable between the two groups. Likewise, parental reports of children's requests for storybook reading and independent looking at books did not differ between groups. However, even at this young age, parental reports of children's enjoyment of storybook reading were lower in the FR group and this difference reached statistical significance. In addition, FR parents reported enjoying reading for pleasure themselves significantly less than TD parents.

Overall then, there were few differences in literacy-related interactions in the home between FR and TD families, and those differences that did emerge had small effect sizes. Where FR/TD group differences were more evident was in the questions relating to enjoyment of reading. Parental reports of children's enjoyment showed a restricted variance in scores, making inferential analysis problematic. Nevertheless, the TD>FR difference on this item reached significance, and it is noteworthy that all children who were reported not to enjoy storybook reading came from the FR group. Similarly, and as expected given the dyslexic status of some of these participants, parents' self-reported enjoyment of reading was lower among FR than TD parents. These results imply that, while FR families may be cognisant of the cultural value placed in shared reading and therefore engage in as much storybook reading with children as TD families, these interactions may be less enjoyable for both children and parents.

3.1.2.5.3 FR-only/FR-SLI group differences

A further set of group comparisons was conducted within the FR group, in order to establish whether HLE experiences differed between children with and without language impairment. The two groups were matched for maternal education level; family SES is described in detail in Section 3.4 below. Measures of central tendency, dispersion and tests of difference for the FR-only and FR-SLI groups on the HLE interview items are presented in Table 3.5.

There was a non-significant trend for parents of FR-SLI children to report reading with their children less frequently, and having started reading with their children at a later age, than FR-only parents. Similarly, FR-SLI parents reported having fewer children's books available in the home than FR-only parents, although this difference did not reach significance. All of these differences represent small effect sizes. There were no differences between the two FR groups in the frequency of direct instruction in the home, nor in parental reports of children's interest in storybooks. However, parents in the FR-SLI group reported enjoying reading themselves less than parents in the FR-only group.

Overall, parental reports of HLE were comparable between FR-only and FR-SLI groups, although there was a tendency for the parents of FR-SLI children to report lower levels of storybook exposure than FR-only children. This difference may emerge more clearly if a larger group of FR-SLI children were recruited. The putative reduced storybook exposure for these language-impaired children may reflect gene-environment interplay. Previous research has indicated that LI children have difficulty in taking part in conversations during shared storybook reading (Barachetti & Lavelli, 2011; Crowe, 2000). Some children with language impairment may be resistant to participating in

Table 3.4
FR (n=116)/TD (n=72) group differences on HLE interview items

Item	FR mean (s.d.)	FR median (range)	TD mean (s.d.)	TD median (range)	Test of difference	*p*	Effect size *d*/ *r*
Storybook Exposure							
Total frequency of shared reading (*Shared reading at bedtime + other times)*	9.57(3.73)	-	10.58 (3.25)	-	*t*(186) =1.90	.059	*d*=.33
Typical number of bedtime stories	1.66 (.89)	-	2.11 (.92)	-	*t*(186)=3.35	.051	*d*=.28
Age of onset shared reading (*1 = 24+ months; 2=18-23 months; 3= 12-17 months; 4 = 6-11 months; 5 = 0-5 months)*	-	5(1-5)	-	5(1-5)	*U*=3531.50	.167	-
Number of children's books in home (*1=0-20; 2=21-40; 3=41-60; 4=61-100; 5=100-150; 6=150-200; 7=200+)*	-	5(1-7)	-	5(2-7)	*U*=3864.50	.379	-
Frequency of library visits (*1=never; 2=occasionally; 3=at least once a month; 4=at least once a week*)	-	3(1-4)	-	3(1-4)	*U*=3615.00	.106	-
Direct Instruction							
Frequency of letter instruction (*1=never/occasionally; 2=at least once a month; 3= at least once a week; 4= several times a week; 5=daily)*	-	4(1-5)	-	4(1-5)	*U*=3824.50	.310	-
Frequency of reading instruction (*as previous item)*	-	3(1-5)	-	3(1-5)	*U*=4142.00	.922	-
Frequency of writing instruction (*as previous item)*	-	3(1-5)	-	3(1-5)	*U*=4145.50	.931	-
Child Interest							
Frequency of shared reading requests (*1=never/occasionally; 2=at least once a month; 3= at least once a week; 4= daily; 5=several times a day)*	-	4(1-5)	-	3.5(1-5)	*U*=3836.50	.331	-
Frequency of independent reading (*as previous item)*	-	3.5(1-5)	-	4(1-5)	*U*=3740.50	.212	-
Enjoyment of reading (*1=strongly dislikes; 2= dislikes; 3=neither likes nor dislikes; 4= likes; 5=strongly likes*)	-	5(2-5)	-	5(3-5)	*U*=3333.00	.007	*r*=.20
Adult Variables							
Enjoyment of reading (*as previous item*)	-	4.5(1-5)	-	5(2-5)	*U*=3129.50	.001	*r*=.24

Table 3.5

FR-only (n=87)/FR-SLI (n=29) group differences on HLE interview items

Item	FR-only mean (s.d.)	FR-only median (range)	FR-SLI mean (s.d.)	FR-SLI median (range)	Test of difference	p	Effect size
Storybook Exposure							
Total frequency of shared reading *(Shared reading at bedtime + other times)*	9.93 (3.50)	-	8.48 (4.23)	-	$t(114) = 1.83$	.070	d=.37
Typical number of bedtime stories	1.69 (0.83)	-	1.57 (1.05)	-	$t(114)=0.63$	.528	-
Age of onset shared reading (*1 = 24+ months; 2=18-23 months; 3= 12-17 months; 4 = 6-11 months; 5 = 0-5 months)*	-	5 (1-5)	-	4 (1-5)	U=991.00	.056	r=.19
Number of children's books in home (*1=0-20; 2=21-40; 3=41-60; 4=61-100; 5=100-150; 6=150-200; 7=200+)*	-	5 (1-7)	-	4 (2-7)	U=978.50	.065	r=.18
Frequency of library visits (*1=never; 2=occasionally; 3=at least once a month; 4=at least once a week*)	-	3 (1-4)	-	2 (1-4)	U=1164.50	.519	-
Direct Instruction							
Frequency of letter instruction (*1=never/occasionally; 2=at least once a month; 3= at least once a week; 4= several times a week; 5=daily)*	-	4 (1-5)	-	3 (1-5)	U=1048.50	.151	-
Frequency of reading instruction (*as previous item)*	-	4 (1-5)	-	3 (1-5)	U=1196.50	.665	-
Frequency of writing instruction (*as previous item)*	-	3 (1-5)	-	3 (1-5)	U=1190.00	.639	-
Child Interest							
Frequency of shared reading requests (*1=never/occasionally; 2=at least once a month; 3= at least once a week; 4= daily; 5=several times a day)*	-	3 (1-5)	-	4 (1-5)	U=1254.00	.960	-
Frequency of independent reading (*as previous item)*	-	4 (1-5)	-	3 (1-5)	U=1118.50	.346	-
Enjoyment of reading (*1=strongly dislikes; 2= dislikes; 3=neither likes nor dislikes; 4= likes; 5=strongly likes*)	-	5 (2-5)	-	5 (3-5)	U=1203.50	.677	.
Adult Variables							
Enjoyment of reading (*as previous item*)	-	5 (1-5)	-	4 (1-5)	U=998.00	.069	r=.18

such language-heavy interactions. However, the fact that parents within this group also reported enjoying reading less than parents in the FR-only group may also reflect less orientation to books overall in the family environment of these children. These small group differences in items relating to storybook exposure and enjoyment of books suggest that the FR-SLI families contribute to the lower mean scores of the whole FR group compared to the TD group, as presented in the previous section.

3.1.2.6 Inter-item correlations

The inter-correlations for interview items are displayed in Tables 3.6 and 3.7. The coefficients above the diagonal in Table 3.6 represent correlations for the whole sample, while those below the line represent correlations in the TD group only. In Table 3.7, correlation coefficients above the diagonal represent the FR-only group, while those below the diagonal represent the FR-SLI group. Both parametric and non-parametric tests were run, and as the magnitude of correlations produced by both tests was very similar, the results of the parametric tests are presented (Pearson's product moment coefficient *r*). It should be noted that only those correlations that were significant at the $p<.001$ level (marked with three asterisks) survived Bonferroni's correction for multiple correlations.

The pattern of correlations is broadly as expected according to Sénéchal and LeFevre's (2002) Home Literacy Model. The five interview items tapping storybook exposure are weakly to moderately inter-correlated in the whole sample. Within the TD, FR-only and FR-SLI groups, these items remain positively associated, but the magnitude of correlation drops and in many cases is no longer statistically significant. The frequency of library visits is least reliably related to the other storybook exposure items.

The inter-correlations between the three items tapping direct instruction are moderate and significant, and similar in strength across the groups. In other words, parents who teach their children about letters also tend to teach reading and writing skills. These three items do not correlate with items designed to measure storybook exposure or children's interest in stories, providing a degree of discriminant validity. The sole exception is that parental teaching of letters correlates positively and significantly with the number of children's books in the home in the FR-SLI group only. This may be a chance finding, given the small number of participants in this group, or may possibly reflect a weaker dissociation between storybook exposure and direct instruction in this group.

The three interview items relating to children's interest in storybooks are also inter-correlated across both groups, such that children who ask to be read to more often also look at books by themselves more often, and are rated as enjoying storybooks more. These three items show no correlations with the direct instruction items, but relate to some storybook exposure items, in concordance with the findings of other authors (e.g. Baker et al., 1997). It is noteworthy that the child interest items are more strongly related to storybook exposure in the FR groups than in the TD group. This may reflect greater variability in children's interest in books within the at-risk groups, such that children who are resistant to engaging with printed material experience less literacy-related interaction in the home.

Overall then, the interview items cluster into three scales (storybook exposure, direct literacy instruction and child interest) in the sample as a whole, and within each group (TD, FR-only, FR-SLI). Storybook exposure shows higher correlations with child interest in the at-risk groups. The strength of the inter-

Table 3.6

Inter-correlations of HLE interview items: Whole sample (N=188) correlations shown above diagonal; TD group only (n=72) below diagonal

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Frequency shared reading		.27***	.25***	.25***	.15*	.07	-.10	.06	.37***	.13	.20**	.16*
2. No of. bedtime stories	.24*		.15*	.17*	.17*	.-.04	-.06	-.02	.12	-.07	.19**	.14†
3. Onset age	.30**	.07		.34***	.04	.00	-.05	-.03	.23**	.16*	.28***	.13†
4. No. of children's books	.22†	.23†	.21†		.00	.08	.00	-.07	.21**	.16*	.24***	.22**
5. Frequency library visits	.10	.06	.03	.02		-.04	-.03	-.03	.08	.07	.08	.15*
6. Frequency teaching letters	-.07	-.14	-.19	-.14	-.02		.27***	.44***	.12	.12	-.05	-.03
7. Frequency teaching reading	-.11	-.19	-.22†	-.07	-.11	.14		.31***	.03	.09	.05	-.06
8. Frequency teaching writing	-.10	-.14	-.26*	-.03	-.08	.46***	.30*		.02	.03	.01	-.08
9. Frequency reading requests	.40***	-.01	.06	.06	.00	.18	.12	.07		.32***	.31***	.21***
10. Frequency independent reading	.25*	-.17	.11	.03	.17	.13	.03	.11	.27*		.36***	.14†
11. Child enjoyment stories	.16	-.05	.28*	.06	.24*	-.02	.07	.05	.18	.43***		.25***
12. Adult enjoyment reading	.03	-.02	-.06	.16	.06	-.09	.01	-.05	.15	.10	.19	

Note: † *p*<.08; **p*<.05; ***p*<.01; ****p*<.001

Table 3.7

Inter-correlations of HLE interview items: FR-only group (n=87) shown above diagonal, FR-SLI group (n=29) below diagonal

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Frequency shared reading		.27*	.19†	.20†	.16	.10	-.17	.12	.31**	.06	.39***	.20†
2. No. bedtime stories	.21		.14	.16	.18	.01	.07	.00	.15	-.06	.23*	.15
3. Onset age	.16	.15		.31**	.00	.06	-.03	.07	.28**	.08	.35***	.15
4. No. children's books	.29	-.01	.43*		-.08	.07	-.06	-.16	.22*	.17	.44***	.20
5. Frequency library visits	.10	.23	.06	.12		-.11	.02	.01	.11	.01	.27*	.18
6. Frequency teaching letters	.19	.10	.07	.41*	.13		.22*	.41***	.06	.15	-.08	-.08
7. Frequency teaching reading	.06	-.05	.14	-.26	.05	.60***		.34***	-.04	.14	.00	-.14
8. Frequency teaching writing	.17	.12	.02	.10	-.06	.50***	.24		-.03	-.03	-.06	-.24*
9. Frequency reading requests	.47***	.22	.36†	.40*	-.14	.17	.02	.03		.35***	.50***	.24*
10. Frequency independent reading	-.01	-.12	.35†	.25	-.06	.01	.03	.02	.33†		.35***	.12
11. Child enjoyment stories	-.37*	.21	.02	-.19	-.17	.03	.19	.13	-.11	.21		.35***
12. Adult enjoyment reading	.00	.05	.04	.19	.04	.19	.14	.24	.18	-.04	-.17	

Note: †*p*<.08; **p*<.05; ***p*<.01; ****p*<.001

correlations between HLE items is often weak to moderate, in line with previous research using parental report measures of HLE (e.g. Sénéchal et al., 1996).

3.1.2.7 Internal consistency

Internal consistency was assessed using scores from the current sample before missing data points were imputed. Consistency for the five storybook exposure items from the HLE interview was low (Cronbach's α=.42) and did not differ between FR and TD groups. This finding is in line with some previous studies, which have found weak correlations between individual questionnaire items and limited predictive value of parental reports of shared storybook reading (e.g. Sénéchal et al., 1996). This may be at least partly attributable to social desirability bias, as parents are likely to attach a high value to reading with children. Indeed, nearly 100% of parents interviewed in the current study reported that they believed it was important to read storybooks with their children. In addition, it is plausible that not all of the five items included which were assumed to relate to storybook exposure in the home are robustly inter-correlated. For example, families who own more children's books may visit the library less frequently, since the resources necessary for shared storybook reading are readily accessible in the home. The use of such questionnaire measures in the early studies on home literacy environment reviewed by Scarborough and Dobrich (1994) calls into question the reliability of their conclusion that storybook reading was only weakly related to children's language and literacy skills. In anticipation of issues of reliability, the title and author checklists described below were included in the current HLE battery as an alternative metric of storybook exposure, and the five interview items are analysed here for descriptive purposes only.

Internal consistency for the interview items relating to direct instruction and child interest in books was also rather low (Cronbach's alpha .60 and .56 respectively) and the reliability statistics were comparable between FR and TD groups. The debate around 'acceptable' values of Cronbach's alpha is not settled, and Kline (2010) notes that different values may be appropriate for different types of measure. For example, while an *alpha* value of .80 may be expected in cognitive measurements such as IQ tests, questionnaires designed to tap psychological constructs may yield lower reliability scores. In addition, a subscale consisting of a small number of items may show reduced internal consistency values (Field, 2005). Both direct instruction and child interest in books were assessed using three items only in the current study, because the HLE scale was part of a larger battery contained within the parental interview. In the absence of a more reliable technique for tapping these two constructs (analogous to the checklists in relation to storybook exposure), the interview items are used in subsequent inferential analyses despite their modest levels of internal consistency.

3.1.2.8 Test-retest reliability

The HLE interview was administered to 15 parents of preschool children (mean age=3 years, 8 months, s.d.=7.24 months) who were not participating in the Wellcome project. These parents completed the measure twice, at an interval of approximately four weeks. Four-week test-retest reliability was .78 for the storybook exposure items; .70 for the direct instruction items; .66 for the child interest items; and 1.00 for the parental enjoyment item. Test-retest reliability was therefore somewhat higher than internal consistency for the HLE interview scales.

3.1.3 The Title/Author Checklists

3.1.3.1 Design

In addition the HLE interview items, two checklists were developed in which parents were required to recognise the titles and authors of popular children's picture books targeted at preschool children, from a list which contained a number of foils (*Children's Title Checklist* and *Children's Author Checklist*). These tools were conceived as a further proxy for children's exposure to storybooks in the home, since parents who engage in more reading with their children are likely to be more familiar with the titles and authors of popular children's books (Stanovich & West, 1989). Checklist instruments have been shown to have good reliability and criterion validity in many studies (e.g. Sénéchal et al., 2002). In addition, a third checklist was devised which comprised the titles of popular contemporary fiction from a range of genres, written in the English language (*Adult Author Checklist*). This additional measure was designed to assess parents' exposure to adult literature. All three checklist measures are included in the appendix.

Children's Title Checklist (CTC). Titles of children's picture books popular in the UK at the time of data collection were collated through interviews with parents and librarians, as well as surveys of bookshops and online bestseller lists. Titles that had been televised or made into a film were excluded (e.g. *Winnie the Pooh; Charlie and Lola*). Of the remaining titles, the 30 that were named most often by the various sources were selected for the checklist. 30 plausible foils were invented (e.g. *Letty Spaghetti; Bedtime Balloons*) and the catalogues of a public library and online booksellers checked in order to verify that these titles were not real, or similar to existing titles.

Children's Author Checklist (CAC). 40 authors associated with the titles elicited in research for the CTC were selected and intermixed with 40 foils, being the names of primary school classmates of the researcher. Care was taken to verify that the foils were not identical or similar to authors of published fiction.

Adult Author Checklist (*AAC*). Names of 40 authors of books for adults, spanning contemporary fiction from a range of genres, were collated from bestseller lists from the preceding five years. The 40 foils for this checklist were names of secondary school contemporaries of the researcher, which were dissimilar to the names of published authors.

Full copies of the three checklist tools are included in Appendix 1.

3.1.3.2 Procedure

After the HLE interview had been conducted during the *t2* home visit, the primary caregiver was given a number of paper questionnaires to fill out. These included the three checklist measures. The response sheet for each checklist included written instructions, asking respondents to check the box next to every title/author that they recognised, and making clear that they should not guess. These instructions were also emphasised verbally by the researcher, and if participants queried what to do when a given item 'sounded familiar', they were reminded to check only those items which they were confident that they recognised.

In scoring all three checklist measures, the number of foils checked (false alarms) was subtracted from the number of targets checked, in order to take into account possible individual differences in thresholds for guessing. This method takes its logic from signal detection theory, in that it uses a derived score which attempts to control for response biases, such as indiscriminately responding to targets and foils (Stanovich & West, 1989).

3.1.3.3 Descriptive statistics

Raw descriptive data for the three checklist measures are presented in Table 3.8. Parents in the current sample recognised an average of 14 titles and 13 authors of children's storybooks, while mean recognition of adult authors was slightly higher at 16. Examination of the false alarm rates revealed that guessing was rare; the median score was 0 and mean scores were less than 1 for all three measures. This was taken as evidence that the majority of participants followed the instruction to avoid guessing. However, the distributions of the false alarm rates were highly positively skewed, indicating that a small number of participants (who were evenly distributed across the FR and TD groups) had checked an unusually high number of foils. This was therefore corrected by computing a final score which constituted the number of foils checked subtracted from the number of targets checked.

3.1.3.4 Missing data

Five participating parents (2.7% of the sample) did not complete the checklist measures, due to time constraints during the parental test battery. Since the same participants did not complete all three checklists, it was not possible to conduct Little's MCAR test. However, the HLE interview responses for these three participants were reviewed and no systematic pattern was observed; in other words, the missing data for the checklist measures did not come from participants with extreme scores on other HLE measures. In order to maximise the sample size for inferential analysis therefore, the checklist corrected scores for these five participants was imputed using expectation maximisation, based on their scores on the HLE interview items relating to storybook exposure.

Table 3.8
Checklist measures: Descriptive statistics for the whole sample (N=188)

Item	% missing	Mean (s.d.)	Skewness	Kurtosis
CTC[1]	2.7			
Targets checked		13.87(6.72)	.03	-.54
False alarms		.96(2.24)	4.27	22.24
Corrected score (targets-false alarms)		12.70(6.91)	.10	-.56
CAC[2]	2.7			
Targets checked		13.13(8.42)	.37	-.94
False alarms		.50(1.70)	8.11	82.11
Corrected score (targets-false alarms)		11.99(8.91)	.17	-.46
AAC[2]	2.7			
Targets checked		15.68(10.17)	.42	-.96
False alarms		.32(.79)	3.26	12.27
Corrected score (targets-false alarms)		14.70(10.23)	.48	-.82

Note: [1]Max=30; [2]Max=40

3.1.3.5 Group differences

3.1.3.5.1 FR/TD group differences

Differences in corrected scores on the three checklist measures between the FR (pooling across FR-only and FR-SLI children) and TD groups are presented in Table 3.9. Statistically significant group differences emerge, with TD parents scoring more highly than FR parents on all three measures. These differences represent medium effect sizes. This is in contrast with the storybook exposure items from the HLE interview, in which group differences generally did not reach significance. This discrepancy could be accounted for in several ways. First, the checklists might be a more sensitive measure and therefore likely to pick up individual differences in storybook exposure better than the interview questions. Alternatively, it is possible that FR parents engage in as much storybook reading with their children as TD parents, but perhaps do not use as wide a range of reading materials, or else do not retain information about titles and authors to the same extent.

Table 3.9
Checklist measures: FR (n=116)/TD (n=72) group differences

Measure	FR mean (s.d.)	TD mean (s.d.)	*t (df)*	*p*	Effect size *d*
Children's Title Checklist	11.11 (6.53)	15.26 (6.77)	4.18 (186)	<.001	.62
Children's Author Checklist	10.03 (8.05)	15.15 (9.37)	3.99 (186)	<.001	.59
Adult Author Checklist	12.46 (9.85)	18.31 (9.86)	3.96 (186)	<.001	.59

3.1.3.5.2 FR-only/FR-SLI group differences

Again, FR scores were divided into groups according to whether or not the child was defined as having a language impairment at *t1* of the study. Table 3.10 presents FR-only/FR-SLI group differences on the checklist measures. Given the unequal group sizes (FR-only n=87; FR-SLI n=29), differences were analysed using Mann-Whitney tests.

Table 3.10
Checklist measures: FR-only (n=87)/FR-SLI (n=29) group differences

Measure	FR-only mean (s.d.)	FR-SLI mean (s.d.)	*U*	*p*	Effect size *r*
Children's Title Checklist	11.67 (6.82)	9.43 (5.33)	1012.50	.112	.15
Children's Author Checklist	11.39 (8.35)	5.93 (5.33)	779.50	.002	.29
Adult Author Checklist	13.96 (10.26)	7.98 (6.92)	820.50	.005	.26

Significant FR-only>FR-SLI group differences were observed on the CAC and AAC measures. This result suggests that children with a double 'risk' of reading difficulties, via family history and language impairment, may also experience limited exposure to storybooks compared to TD and FR-only peers.

3.1.3.6 Correlations of checklist scores with other HLE measures

In order to investigate the convergent and discriminant validity of the checklist measures, scores were correlated with items from the HLE interview. It was predicted that the checklist measures would relate to the items tapping storybook exposure and to a lesser extent child interest, but not to those tapping direct instruction. In order to reduce the number of variables included in this analysis, composite scores were calculated for the three constructs measured by the HLE interview; mean z-scores were calculated from contributing items. The frequency of library visits was omitted from the storybook exposure composite, as it correlated only weakly with the other items. The resulting correlations (Pearson's *r*) are displayed in Tables 3.11 and 3.12.

The pattern of correlations between the checklist measures and HLE composites was as predicted; each checklist measure showed moderate positive correlation with the storybook exposure composite, providing a measure of convergent validity. Furthermore, the correlation with the interview measure is stronger for the checklists relating to children's literature (CTC and CAC) than the one relating to adult literature (AAC). There is a significant, weak negative correlation between the child checklist measures and the direct instruction composite, and significant, small correlations between each checklist measure and children's interest in books. Despite the unequal group sizes, the direction and magnitude of inter-correlations between checklist and interview measures is strikingly consistent across the three groups.

In summary, the CTC and CAC appear to be valid tools with which to measure children's exposure to storybooks in the home.

Table 3.11

Correlations of checklist measures with HLE interview composites: Whole sample (N=188) shown above diagonal, TD group (n=72) below diagonal

	1.	2.	3.	4.	5.	6.
1. CTC		.79***	.55***	.48**	-.18*	.17*
2. CAC	.74***		.66***	.52***	-17*	.21**
3. AAC	.46***	.57***		.44***	-.11	.18*
4. Storybook exposure (interview measure)	.25*	.32**	.28*		-.03	.38***
5. Direct instruction	-.12	-.15	-.23	-.28*		.08
6. Child interest	.00	.09	.27**	.20	.16	

Note: **p*<.05; ***p*<.01; ****p*<.001

Table 3.12

Inter-correlations of checklist measures with HLE interview composites: FR-only group (n=87) shown above diagonal, FR-SLI group (n=29) below diagonal

	1.	2.	3.	4.	5.	6.
1. CTC		.81***	.54***	.59**	-.25*	.24*
2. CAC	.67***		.67***	.59***	-29**	.28**
3. AAC	.42*	.60***		.47***	-.12	.29**
4. Storybook exposure (interview measure)	.43*	.54**	.33†		.00	.45***
5. Direct instruction	-.21	-.08	.11	.25		.02
6. Child interest	-.09	-19	-.26	.30	.14	

Note: **p*<.05; ***p*<.01; ****p*<.001

3.1.3.7 Internal consistency

Each target item checked was coded as 1, each unchecked item as 0 and each checked foil as -1. Internal consistency was evaluated by calculating Cronbach's *alpha* for each checklist using data from the whole sample. The checklist measures were found to have high internal consistency: α=.85 for the CTC, α=.91 for the CAC and α=.93 for the AAC. Consistency estimates were similar when computed for the FR and TD groups separately.

3.1.3.8 Test-retest reliability

The three checklist measures were administered twice to 15 parents of preschool children (as described in section 3.1.2.8 above). Four-week test-retest reliability was .84 for the CTC, .98 for the CAC; and .97 for the AAC. Overall, the checklist measures show higher levels of internal consistency and test-retest reliability than the HLE interview scales.

3.1.4 Factor Structure of the HLE Measures

Structural equation modelling (SEM) techniques were utilised to analyse the factor structure of the HLE data described in the preceding sections. The measurement model presented here evaluated the hypothesis that storybook exposure and direct literacy instruction are separable aspects of the HLE, as in Sénéchal and LeFevre's (2002) Home Literacy Model. In addition, children's interest in books was included as a third factor, as previous authors have suggested that this construct ought to be considered separately from storybook exposure (e.g. Baker et al., 1997). On the basis of the research reviewed in Chapter 1, and the preliminary analyses presented in Sections 3.1 and 3.2, it was predicted that the checklist measures would load onto a 'storybook exposure' factor, while the interview items tapping teaching of letters and words would load onto a 'direct instruction' factor, and that these two latent factors would be uncorrelated. It was also hypothesised that a 'child interest' latent factor, indicated by the relevant interview items, would relate to storybook exposure, but not to direct instruction.

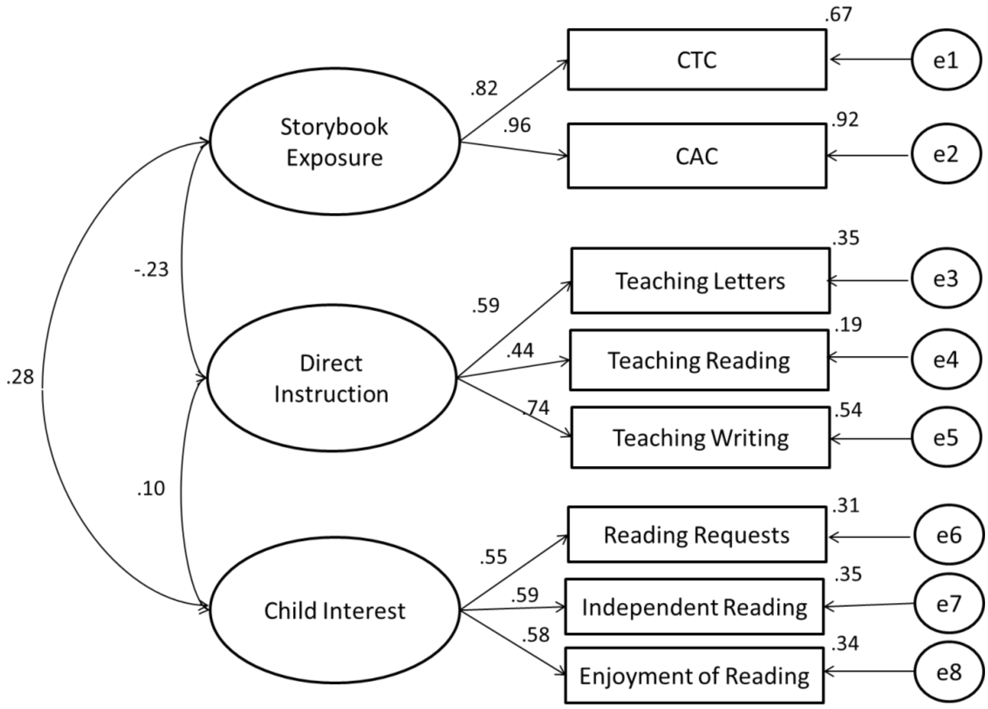
In order to test these hypotheses, a Confirmatory Factor Analysis (CFA) was run on SPSS AMOS, v.20 using maximum likelihood estimation. The resulting measurement model, using data from the whole sample (N=188) is shown in Figure 3.1.

Here, ellipses represent latent variables, which are defined by the observed variables shown in rectangular boxes. Factor loadings are indicated above each regression path from the latent variables to their respective observed variables. Finally, the proportion of variance in each observed variable which is accounted for by the relevant latent variable is shown at the top right-hand corner of each observed variable.

Examination of goodness of fit indices revealed good fit to the data: χ^2 (27) = 15.20, *p*=.58; χ^2/df ratio= .56; NFI=.95; CFI=1.00; RMSEA=.00 (90% confidence intervals: .00-.06; *p*=.901). Inspection of the modification indices did not suggest that altering the parameters would improve model fit. Table 3.13 reports the estimated loadings for all latent constructs on their respective indicator variables. All loadings are significant at the .001 level.

The two checklist measures show high loadings onto the storybook exposure latent construct. Adding relevant items from the HLE interview (e.g. frequency of storybook reading) attenuated model fit by adding extra parameters, but these items were only weakly loaded onto by the latent variable. For this reason, only the checklist measures were retained as indicators of storybook exposure.

The factor loadings of the direct instruction and child interest latent constructs are somewhat lower; this is likely due to the fact that indicators represent single items from the HLE interview and that internal consistency for these scales was modest. Teaching children to print letters and words was the most important indicator of direct instruction, while the three indicators of child interest showed equivalently modest



χ^2 (27) = 15.20, *p*=.58; CFA=1.0; RMSEA = .00 (90% CIs .00-.06), *p*=.90

***Figure 3.1*. One-group CFA model of *t2* HLE items**

Table 3.13

Factor loadings and covariances for one-group 3-factor CFA

Latent constructs and indicator variables	*b (SE b)*	*β*	Critical ratio	*p*
Storybook Exposure				
CTC	5.66 (.65)	.82	8.71	<.001
CAC	8.51 (.90)	.96	9.51	<.001
Direct Instruction				
Teaching Letters	.78 (.13)	.59	6.12	<.001
Teaching Reading	.72 (.15)	.44	4.91	<.001
Teaching Writing	1.02 (.15)	.74	6.95	<.001
Child Interest				
Reading Requests	.61 (.10)	.55	5.88	<.001
Independent Reading	.63 (.10)	.59	6.17	<.001
Enjoyment of Reading	.36 (.06)	.58	6.07	<.001
Covariances between factors				
Storybook Exposure – Direct Instruction	-.23 (.09)	-.23	-2.57	.010
Storybook Exposure – Child Interest	.28 (.10)	.28	2.97	.003
Direct Instruction – Child Interest	.10 (.12)	.10	.90	.367

loadings. Inspection of the modification indices revealed that allowing cross-loadings of indicators onto more than one factor would not improve the model fit.

There was a weak negative correlation between the storybook exposure and direct instruction factors supporting the predictions of the Home Literacy Model (Sénéchal & LeFevre, 2002). As expected, storybook exposure and children's interest in storybooks were positively correlated but there was no clear relationship between direct literacy instruction and children's interest in books.

Next, the invariance of the factor structure presented in Figure 3.1 across the FR and TD groups was tested. For the purposes of this analysis, FR-SLI families were included in the FR group. Although this sub-group of families showed lower scores on the HLE measures, the factor structure appeared comparable with the whole sample based on correlational analyses; furthermore removing these 29 families from the two-group CFA analysis yielded a very similar pattern of factor loadings to the full FR group model.

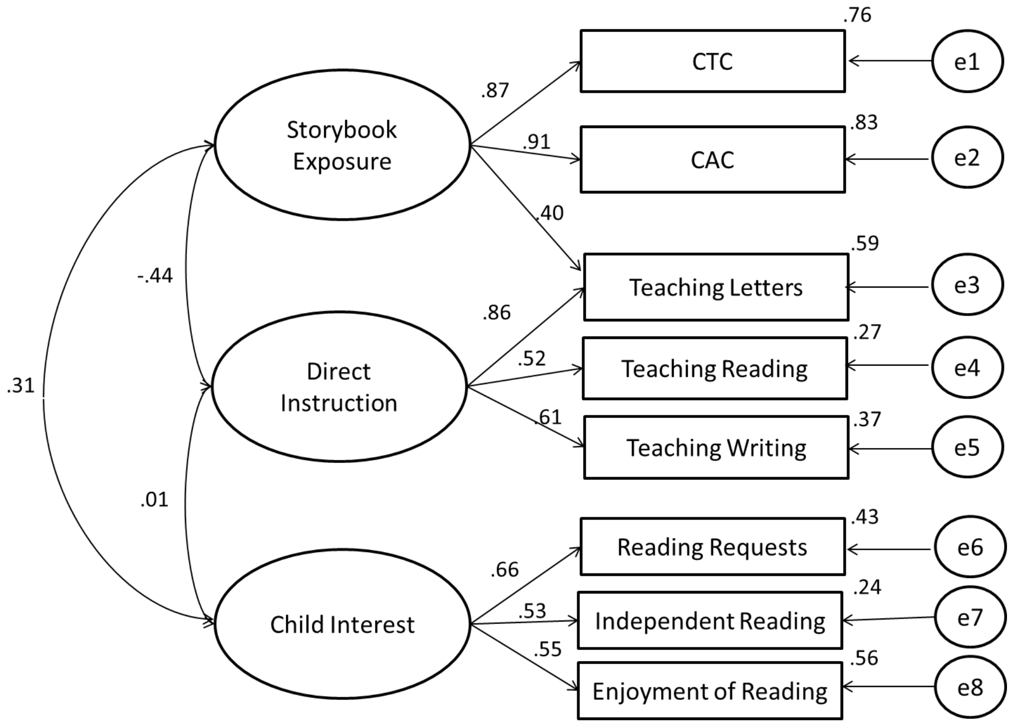
As a first step, baseline models were established for each group separately (Byrne, 2001). These baseline models are displayed in Figures 3.2(a) and (b). The factor structure set out in Figure 3.1 yielded good model fit for each group. For the FR group only, model fit was improved if the teaching letters indicator was allowed to cross-load onto the storybook exposure latent factor. This unique cross-loading meant that the following analyses tested the hypothesis of *partial* measurement invariance (Kline, 2005).

The second step in this multigroup analysis was to assess the model fit for both groups simultaneously. Chi-square values for the baseline FR and TD groups were summed, thus yielding goodness of fit indices for an unconstrained model. Then a second fully constrained model was created, in which equality constraints on all factor loadings, factor variances, factor covariances and error variances were imposed. Given the cross-loading of teaching letters in the FR group only, this parameter was fixed to zero in the TD group. If these constraints significantly reduced the model fit, variance across groups would be indicated. The results of this fully constrained model indicated a moderate fit to the data, and the difference between the baseline and fully constrained models was not significant (see Table 3.14). Thus, this model appears to be partially invariant across FR and TD groups.

Table 3.14
Multigroup CFA tests of measurement invariance across groups

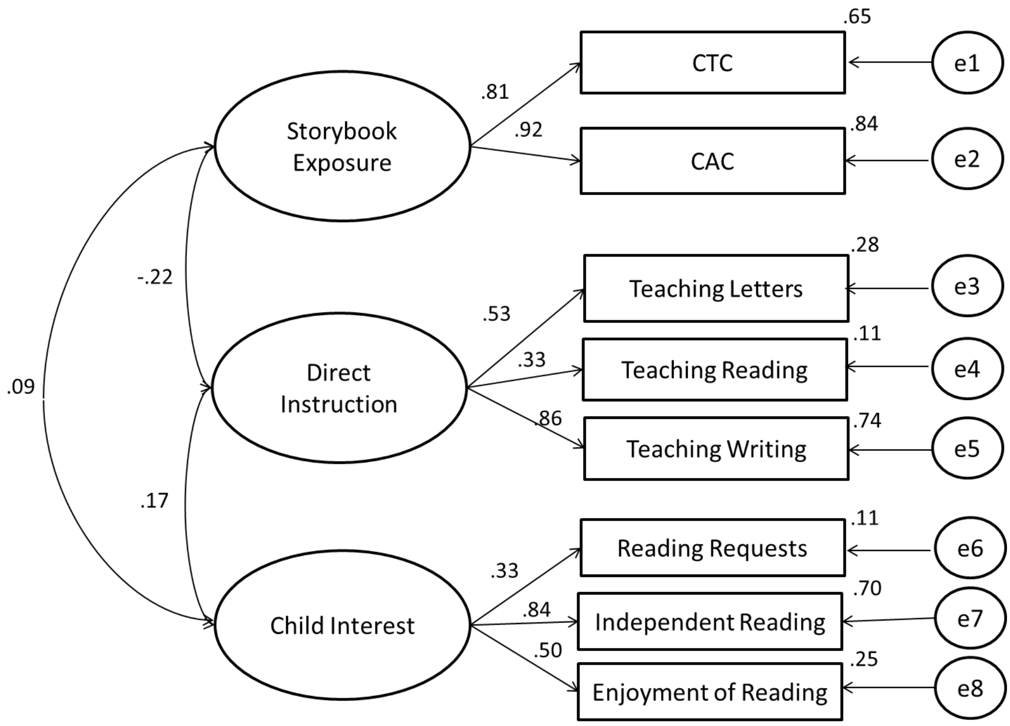
	χ^2	*df*	$\Delta\chi^2$	Δ *df*	*p*
Baseline model	25.90	33	-	-	-
Fully constrained model	59.51	52	33.61	19	.221

In summary, the confirmatory factor analyses indicated that storybook exposure, direct instruction of orthographic forms and children's interest in books are distinct factors in the FR and TD groups, although parental teaching of letter forms is also predicted by storybook exposure in the FR group only. These models provide the rationale for using the three factors as independent predictors of children's language and literacy development in subsequent chapters.



χ^2 (16) = 13.30, *p*=.65; CFA=1.0; RMSEA = .00 (90% CIs .00-.07), *p*=.861

***Figure 3.2(a)*. Baseline CFA model for FR group (n=116)**



χ^2 (17) = 12.60, *p*=.76; CFA=1.0; RMSEA = .00 (90% CIs .00-.08), *p*=.87

***Figure 3.2(b)*. Baseline CFA model for TD group (n=72)**

3.1.5 Group and Gender Effects on Aspects of the HLE

In the light of the gender and risk group differences at the item level (sections 3.1.2.5 and 3.1.3.5 above), potential interactions between these between-group factors were tested using 2x2 factorial ANOVAs. The dependent variables were composite measures of storybook exposure, direct instruction and child interest, formed on the basis of the CFA reported in the previous section. Composite scores were computed by calculating mean z-scores of all contributing items. It was of particular interest to test whether boys in the FR group experienced particularly low levels of HLE interactions compared with FR girls and TD children.

No main effect of gender was observed on children's storybook exposure ($f(1,184)=.04$, $p=.833$); however there was a main effect of risk group, with TD children having more exposure to storybooks than FR children ($f(1,184) = .10.47$, $p<.001$; partial $\eta^2=.05$). There was no significant interaction between gender and risk status ($f(1,184) = .23$, $p=.630$).

There was a main effect of gender on direct instruction of orthographic forms, such that parents reported engaging in these activities more often with girls than boys ($f(1,184) = 6.60$, $p=.011$, partial $\eta^2=.04$). No main effect of risk group was observed $f(1,184) = .55$, $p=.458$), nor was there a significant interaction between the gender and group ($f(1,184) = 1.82$, $p=.179$). In both the TD and FR groups, parents reported engaging in more direct literacy instruction activities with girls than boys.

Finally, a main effect of gender was also found on parental ratings of children's interest in books, with girls being rated as more interested than boys ($f(1,184) = 7.89$, $p=.4.77$, partial $\eta^2=.04$). There was also a significant main effect of risk group, such that children in the TD group were rated as more interested than those in the FR group ($f(1,184) = 4.77$, p=.030, partial η^2=.03). However, the interaction between gender and risk group was not significant ($f(1,184) = .23$, p=.636).

In conclusion, these analyses provide no evidence in support of the hypothesis that FR boys are particularly likely to experience impoverished home literacy interactions.

3.1.6 Family Composition and Socio-economic Status

Since the HLE literature reviewed in Chapter 1 suggests a strong link between SES and the types of literacy interaction that young children experience in the home, the relationships between the three HLE constructs and measures of family SES were investigated. In addition, some authors have found the number of siblings in the home to be negatively associated with HLE and language (Whitehurst, 1996; Yarosz & Bartlett, 2001). Therefore, indicators of family composition were also examined. It was expected that family SES would correlate positively with storybook exposure in the home; however, there were no directional hypotheses regarding the relationship of family SES with direct instruction or children’s interest in storybooks. Second, it was predicted that families with more children would show lower scores in variables tapping literacy-related interaction in the home (i.e. storybook exposure and direct instruction) due to pressure on time and financial resources.

3.1.6.1 Measures and descriptive statistics

At *t1* of the Wellcome Project, caregivers were asked to report their educational level and occupational status during a family interview. This information was updated at *t2*, so that any new qualification or change in occupation on the part of either parent was recorded. Education level was scored on a six-point scale, from 1 (no formal qualifications) to 6 (post-graduate qualification). Occupations were classified according to the Office for National Statistics Standard Occupational Classification (ONS, 2010), which is detailed in Appendix 2. In the current data set, these categories were coded from 1 (unemployed) to 10 (managers, directors and senior officials). Full-time parents and students were effectively coded as unemployed on economic grounds; however, since a substantial proportion of the parents in this sample were on parental leave from work at the time of data collection, respondents were asked to provide both their current and former occupational status. The data reported here represents the highest occupational status reached by each participant, since this was judged to be a more accurate metric of SES.

In addition, information was gathered on the number of children in the home, the birth order of the child participating in the Wellcome Project, and the number of parents living in the home. Descriptive statistics on all of these family-level variables are presented in Table 3.15.

The sample as a whole showed relatively high average SES, although the full range of education levels and occupational statuses was represented. Mothers in the sample were educated to degree level on average, while the median education level among fathers was a professional vocational qualification. The average 'best' occupation was at associate professional level among mothers and professional level among fathers. Families in this sample had an average of two children living in the home and the median birth order of Wellcome project children was first, suggesting that parents of first-born children were more likely to volunteer to participate. Finally, 11.5% of families had a single parent living at home, while the remainder had two (either biological or step-) parents within in the household

Table 3.15
Family variables: Descriptive statistics for whole sample (N=188)

Item	% missing	Median (range)	Skewness	Kurtosis
Maternal education level[1]	0.5	5(1-6)	-.47	-1.03
Paternal education level [1]	3.7	4(1-6)	-.17	-1.26
Maternal highest occupational status[2]	0.5	8(1-10)	-.79	-.46
Paternal highest occupational status[2]	3.7	9(1-10)	-1.10	.35
Number of children in home	0	2(1-6)	.99	2.49
Birth order of participating child[3]	0	1(1-4)	.86	-.21
Single parent families	0	*Percentage score* 11.7%	-	-

Note: [1]1 - no formal qualifications; 2 - GCSEs or equivalent; 3 - A'levels or equivalent; 4 - professional vocational qualification; 5 – degree; 6 – postgraduate degree
[2]1 – unemployed; 2 – elementary occupations; 3 – process, plant, machine operatives; 4 – sales and customer service; 5 – caring, leisure, service occupations; 6 – skilled trades; 7 – administrative and secretarial; 8 – associate professional and technical; 9 – professional; 10 – managers, directors, senior officials.
[3]1 – firstborn; 2 – second born; 3 – third born; 4 – fourth born or later

3.1.6.2 Group differences

3.1.6.2.1 FR/TD group differences

Differences between the FR and TD groups on these SES and family composition variables are shown in Table 3.16. As expected, FR parents reported significantly lower levels of education than TD parents. These group differences represented medium effect sizes. Occupational status was also ranked lower in both mothers and fathers in the FR group, representing medium effect sizes. FR families were more likely to have more children living at home and the child participating in the Wellcome project was less likely to be firstborn than in the TD group. This may signal an ascertainment issue, since several FR families were recruited to the project on the basis of an affected older sibling. Finally, the proportion of single parent families was slightly higher in the FR group, although this difference did not reach statistical significance.

Table 3.16

Family variables: FR (n=116)/TD (n=72) group differences

Measure	FR median (range)	TD median (range)	Test of difference/ association	p	Effect size r
Maternal education level	4(1-6)	5(1-6)	U=2235.00	<.001	.40
Paternal education level	3(1-6)	5(1-6)	U=2133.00	<.001	.38
Maternal occupational status	7(1-10)	8(1-10)	U=3042.50	.002	.23
Paternal occupational status	8(1-10)	9(1-10)	U=2632.50	<.001	.27
No of children in home	2(1-6)	2(1-5)	U=3359.00	.013	.18
Birth order	2(1-4)	1(1-3)	U=3240.00	.005	.21
Single parent family status	13.8%	8.3%	$\chi^2(1)$=.26	.352	-

3.1.6.2.2 FR-only/FR-SLI group differences

The FR group was again split according to whether the child had a language impairment or not. Comparisons of the family composition and SES variables between these two sub-groups are presented in Table 3.17.

Families in the FR-SLI group reported lower levels of parental education and occupation status than those in the FR-only group, and this difference was statistically significant, representing small to medium effect sizes, for paternal education level and both maternal and paternal occupational status. There were no differences between the groups in terms of family composition, although the proportion of single parent households was somewhat higher in the FR-SLI group.

Table 3.17

Family variables: FR-only/FR-SLI group differences

Measure	FR-only median (range)	FR-SLI median (range)	Test of difference/ association	*p*	Effect size *r*
Maternal education level	4(1-6)	4(1-6)	*U*=978.50	.109	-
Paternal education level	4(1-6)	2(1-6)	*U*=814.50	.038	.19
Maternal occupational status	7(1-10)	4(1-10)	*U*=963.00	.093	.16
Paternal occupational status	8(1-10)	6(1-10)	*U*=765.50	.010	.24
No of children in home	2(1-6)	2(1-5)	*U*=1252.00	.948	-
Birth order	2(1-4)	1(1-4)	*U*=1092.00	.246	-
Single parent family status	11.5%	20.7%	$\chi^2(1)$=.31	.216	-

3.1.6.3 Correlations with HLE measures

Correlations between these family background variables and the HLE measures are presented in Tables 3.18 and 3.19. In order to reduce the number of variables, the four variables measuring parental education level and occupational status were standardised and averaged to represent family SES. The composites of storybook exposure, direct instruction and child interest in storybooks derived from the interview were used (described in section 3.1.5 above). The mean standardised scores from the CTC and CAC were used as a further proxy of storybook exposure and the AAC is used as an indicator of caregivers' literate orientation.

Across the sample as a whole, family SES was negatively correlated with the number of children in the home; this relationship was driven by the TD group. Family SES was also weakly negatively correlated with single parent family status across all groups. Of the HLE variables, family SES was most clearly associated with those relating to storybook exposure and caregiver's literate orientation. The positive correlation between SES and the two storybook exposure composites was robust across all groups. Within the TD group, SES was weakly negatively correlated to direct instruction, but this relationship was not present in the FR groups. Family SES did not relate to children's interest in storybooks.

Overall, the number of children in the home did not relate to the HLE variables. TD parents with more children reported lower storybook exposure in the interview, but the same relationship was not present with the checklist composite measure. This may suggest that parents in larger families have less time to devote to storybook interactions with each individual child, but that their cumulative knowledge of children's literature is unaffected. The negative relationship between family size and storybook exposure was not present in the FR groups. Additionally, there was no evidence for an association between birth order and HLE in the current data. The sole exception was that parents in the FR-only group reported engaging in less direct instruction with later-born children.

Across the sample as a whole, a weak negative association emerged between single parent family status and several of the HLE variables, namely the two storybook exposure composites, child interest and the AAC. This pattern was observed across all groups, with slight variations in the magnitude of the relationship. It may be, therefore, that single parent family status constitutes a risk factor for reading development, operating via slightly impoverished HLE, presumably on account of pressures of time and resources. However, since the number of single-parent families in the current sample is relatively small, this possibility is not explored further.

Table 3.18

Correlations of family SES, family composition and HLE variables; whole sample (N=188) above diagonal, TD group only (n=72) below diagonal

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Family SES composite		-.15*	-.14	-22**	.54***	.49***	-.05	.12	.62***
2. Number of children	-.25*		.66***	-.13	-.03	-.10	-.02	.08	-.09
3. Birth order	-.22†	.37**		-.08	-.05	-.11	-13†	.03	-.05
4. Single parent family status	-.14	-.01	.03		-.17*	-.28***	-.03	-.20**	-.16*
5. Storybook exposure (CTC/CAC composite)	.41***	-.18	-.18	-.11					
6. Storybook exposure (interview composite)	.48***	-.36***	-.12	-.21†					
7. Direct instruction composite	-.20†	.25*	-.11	.01					
8. Child interest composite	.01	-.05	-.13	-.04					
9. AAC	.54***	-.08	-.11	-.11					

Note: †*p*<.08*; *p*<.05*; **p*<.01;***p*<.001

Table 3.19

Inter-correlations of family SES, family composition and HLE variables; FR-only group (n=87) above diagonal, FR-SLI group (n=29) below diagonal

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Family SES composite		.01	.01	-.25*	.52***	.41***	-.04	.05	.61***
2. Number of children	-.15		.76***	-.21†	.14	.08	-.26*	.19	.00
3. Birth order	-.09	.63***		-.11	.06	-.09	-.24*	.14	.01
4. Single parent family status	-.13	-.19	-21		-.16	-.30**	.05	-.25*	-.14
5. Storybook exposure (CTC/CAC composite)	.46*	.07	.25	-.12					
6. Storybook exposure (interview composite)	.34†	-.04	-.02	-.21					
7. Direct instruction composite	.09	.21	.02	-.23					
8. Child enjoyment composite	.04	.09	.13	-.25					
9. AAC	.49**	-.16	.16	-.17					

Note: †p<.08; *p<.05; **p<.01;***p<.001

In sum, family SES shows a clear relationship with storybook exposure in the current study, in concordance with many previous studies (for a review, see Phillips & Lonigan, 2005). However, family SES was not clearly related to the amount of direct instruction of orthographic forms provided by parents, nor to children's early interest in storybooks. The current data set did not support a negative relationship between the number of children in the home and the richness of the HLE; neither did later-born children appear to be at a disadvantage in terms of early literacy interactions. On the basis of these findings, family SES only is retained as a control variable in models predicting children's language and literacy development from early HLE (Chapters 4 and 5).

3.2 Study 2: Qualitative Description of Parental Beliefs about Literacy-related Activities in the Home

In addition to the key quantitative HLE variables described and analysed above, parents were questioned about their beliefs and values in relation to their children's literacy development during the HLE interview. It was the primary aim of the current research to measure HLE *behaviours* and analyse their relationships with children's language and reading development. However, it was acknowledged that a body of research in this area points to the influence of familial *beliefs* about reading on those behaviours (e.g. DeBaryshe et al., 2000; Martini & Sénéchal, 2012).

The sample for this study was identical to that described in section 3.1.1. As part of the Home Literacy Interview, parents were posed a number of open-ended questions about their literacy-related beliefs, in order to avoid 'leading' questions and to reduce the likelihood of prompting socially desirable answers. Parents' answers to these questions were written down in note form by interviewers and thematic analysis was performed on the resulting qualitative data. The central aim of this analysis was to provide a rich description of the beliefs of parents of young children within a specific cultural and temporal context, without seeking to produce results generalisable to other populations.

3.2.1 Beliefs about the Value of Shared Reading

Parents were asked whether they thought that it was important to read storybooks with their young children and encouraged to elaborate on the reasons for their response to each question. Nearly all parents said that they believed it was important to read storybooks with children. The one caregiver who dissented from the majority view responded that, although it was not necessarily important to share storybooks, she frequently engaged in shared reading with her children anyway as a calming activity at bedtime.

Parents were encouraged to supplement their answers by explaining why they believed shared storybook reading to be important, and were allowed to cite as many reasons as they wished. The reasons given were diverse and numerous. Responses were subsequently coded according to seven categories, reflecting commonly cited reasons for belief in the importance of shared storybook reading. These categories were: (a) emotional closeness/ calming; (b) for enjoyment/ to instil a love of reading; (c) to stimulate imagination; (d) language development; (e) literacy development; (f) to improve general knowledge; (g) development of attention and/or memory skills. Table 3.20 sets out the proportions of caregivers in the FR and TD groups who gave a reason falling within each of these seven categories. Percentages of caregivers who mentioned each of the seven reasons were similar between the FR and TD groups; although it is noteworthy that the only reason cited by a greater proportion of FR than TD parents was shared reading as a vehicle for literacy development.

Table 3.20
Parental beliefs about the importance of shared reading: Proportions of parents citing seven reasons

	(a) Bonding /Calming	(b) Enjoyment	(c) Imagination	(d) Language	(e) Literacy	(f) General Knowledge	(g) Memory/ Attention
FR	57%	50%	18%	38%	35%	29%	11%
TD	63%	53%	23%	42%	32%	32%	15%
Whole sample	60%	51%	20%	40%	33%	30%	13%

The most commonly cited reasons for a belief in the importance of shared reading were socio-emotional (60% of parents mentioned calming/ physical closeness with their child, while 51% said that shared reading was for fun or to help instil a love of reading in their child). Shared reading was also seen as an important vehicle for language development (mentioned by 40% of the sample). The potential to develop other skills through shared reading was mentioned slightly less frequently (literacy – 33%; general knowledge – 30%; memory and/or attention – 13%).

Overall, then, parents in the current sample were unanimous in the belief that storybook reading was of value for their children and, when asked to justify that belief, cited a range of reasons. In general, parents in the current sample oriented more strongly towards the 'storybook reading for fun' belief system identified by previous authors (Meagher et al., 2008; Sonnenschein & Munstermann, 2002), rather than 'storybook reading for skills', although many parents mentioned both socio-emotional and cognitive skills building in their responses.

3.2.2 Beliefs about the Value of Early Literacy Instruction

In addition, parents were asked whether they believed it was important to teach their young children about letter and word forms. There was not complete consensus on this question; 89% of parents responded "yes", while the remaining 11% responded "no". Of the caregivers who said that they did not believe it was important to teach children about orthographic forms, 7 were from FR families (representing 9% of the group) while 12 were from TD families (13% of the group). The reasons cited for responding "no" to this question were that teaching literacy skills should be left to schools (67%), that using different teaching methods to the school might confuse the child (17%), that 4-year-old children are too young to be taught about reading (33%), that imaginative play and social skills are more important at this age (42%) and that parents should only engage in didactic activities if children show an interest (33%).

A number of themes emerged in the responses of those parents who expressed the belief that teaching young children about letters and words is important. These themes are discussed below.

(a) Literacy skills for learning and for life

Fifty-eight parents (representing 32% of the "yes" respondents) gave answers which referred to literacy as the key to learning across the curriculum, and to success in later life. Typical responses allied to this theme included:

> It's important to give them the building blocks of reading; it opens up opportunities for school, imagination and personal interests.
>
> It's important for other subjects like maths, theatre, singing.
>
> It's a life skill. Learning to read is about getting ahead in life.

Respondents who explicitly stated this belief in the fundamental importance of literacy skills to progress in other areas often also expressed the view that literacy skills should be taught as early as possible. Forty-eight responses (26% of the "yes" group) made reference to the importance of a grounding in emerging literacy skills before school entry, for example:

> They need to know letters by the time they start school; it's best to start as young as possible.

> There’s such a lot to deal with when they start school; a bit of prior knowledge will ease the transition.

> Preschool don’t seem to be teaching them enough.

> I work in a school and I see the difference between children who do literacy activities [at home] and those who don’t.

Overall, the view that literacy holds a special status as a skill which is foundational to life progress, and should therefore be taught early on in children’s lives, was commonly expressed in the current dataset.

(b) The home-school partnership

A second commonly occurring theme in parents’ responses about the value of early direct literacy instruction in the home was the idea that teaching children to read should be a joint enterprise between school and the family. Of the “yes” responses, 18% (n=33) alluded to this theme. Most comments suggested a positive partnership between the two institutions, for instance:

> I’d rather it was teacher-led with the support of the family.

> He’s only at school for a certain time, it needs back-up.

On the other hand, one respondent expressed the opinion that family input was needed because of a poor standard of teaching at school:

> …because school doesn’t always do an adequate job of literacy instruction.

In a similar vein, a smaller number of parents (3% of “yes” respondents) made explicit reference to the belief that showing the child that a high value is placed on literacy activities by the family could be beneficial:

It’s good for the child to feel that parents think that reading is important.

It makes it more interesting if they think we do it too.

Thus, a substantial number of parents in the current sample expressed the belief that family members should play an active role in the early literacy instruction of children, both by consolidating the instruction received at school and by modelling a literate orientation.

(c) Literacy instruction should be fun and spontaneous

A further sub-set of responses reflected a child-led approach to early literacy activities in the home, typically expressing the view that instruction should only be undertaken within the family environment if the child expressed an interest in finding out about letters and words (n=38; 21% of “yes” respondents). Some examples of comments alluding to this belief included:

If he didn’t have the interest, I wouldn’t push it.

She is like a sponge at the moment, so I’m working with her natural interest.

Allied to this idea, several parents (n=18, 10% of “yes” respondents) expressed the view that overly didactic activities are inappropriate with young children, and that if letters and words are taught in the family environment, it should be through play and/or the use of environmental print.

If you’re out and about and they ask questions [then yes], but you don’t want to shove it in their face.

It’s important to make them aware that text is what you are reading in a story book, but not important to laboriously teach letters and words at the moment.

It is important to note that this ‘child-centred’ approach and the ‘literacy for learning and for life’ theme described above were not always mutually exclusive. For instance, one parent said:

> You shouldn't force them to learn, but if she's interested in doing it I go along with her interest. I would like her to learn the alphabet before she goes to school to get a foundation in reading.

(d) Awareness of developmental risk

A final important theme, which emerged from the responses of FR parents to this question, was that early literacy instruction in the home was particularly important given the known family history of dyslexia and/or the child’s speech and language difficulties. Of the FR families who answered “yes” to this question, 13 (15%) mentioned personal experience, or the experience of a close family member, of having difficulty with reading at school making them more aware of the importance of early instruction.

> His father struggled and I want to make sure that if T struggles, we’re on top of it.
>
> Because the older children have found it particularly difficult.
>
> I was bullied at school because I struggled with reading.

A further 6 participants (7% of FR group) reported using letters as a tool to help with their child’s speech or language difficulties. For example:

> It’s good for his speech.

To help his ability to express himself; his frustration has been reduced [by learning letters].

We're possibly emphasising it more because of his language problems, but he really enjoys it.

This evidence, albeit anecdotal, is suggestive that for some families of children at known developmental risk for reading difficulties, additional value may be placed on early instruction of letters and words in the home.

3.2.3 Beliefs about Teaching Children to Read

Parents were asked two questions about teaching their children to read. First, parents were asked what they believed is the most appropriate age to begin teaching children to read. Data on this question was available from 179 participants.

Of the respondents to this question. 28% gave an answer that suggested a child-led approach to reading instruction. Responses that fell into this bracket included:

It depends on individual skills and readiness.

It should be child-led, but you can encourage them through exposure to books. Perhaps we do too much too early.

A smaller group of parents (8%) expressed the opinion that the normative age for beginning to teach children to read in the UK (i.e. at primary school entry, aged 4) is too young, and that literacy instruction should be deferred until middle childhood. Answers expressing this view represented 6% of FR and 11% of TD responses. Comments aligning to this opinion included:

6 to 7 years old, especially for boys. They are more ready at this age. 4

> to 5 is too young, it pushes them.
>
> I went to school when I was 6 and don't remember learning to read being difficult. It's counterproductive to push too early; it should be enjoyable.
>
> It's more important to focus on social development earlier than 6.

The largest set of responses to this question aligned to the view that the current status quo is about right; in other words that 4 to 5 years old is a suitable age to begin literacy instruction (33% of respondents; 31% of FR, 36% of TD groups). Reasons for this belief included:

> [At age 4] they are able to understand and take information in properly.
>
> I hope he should be reading by 5, but all children are different.
>
> We read to her now and talk about letters. When she is 5 we will focus more on teaching.

Finally, a substantial proportion of responses expressed the view that reading instruction should begin as early as possible, and certainly before school entry (29% of respondents; 30% of FR, 27% of TD groups), for example:

> If they can read a bit before school it gives them a head start, if they can recognise a few words like "mummy" and "daddy".
>
> I taught phonics from 2 to 3 years old... it's important to influence their brain development at a very early age.
>
> I feel pressure [to start teaching literacy early] because I don't want him to be behind.

The last comment cited above was taken from an interview with a mother with dyslexia, who was highly aware of her son's elevated risk of reading difficulties and aligns with the view expressed by several parents in the FR group that teaching letters and words was particularly important for their children, discussed above. However, even within this group of parents who expressed the view that literacy instruction should start very early, there was a general acknowledgement that the key factor is the child's interest and willingness to learn, without which literacy instruction in the home could be counterproductive.

Second, parents were asked whether they felt able to teach their children to read. Data for this question were available from 180 participants, of whom the majority (n=160; 89%) asserted that they felt confident to teach reading to their child. Of the remaining 11% who reported that they did not feel able to teach their child to read, 13 were from FR families, while the remaining 7 were from the TD group. A commonly cited reason for not feeling confident in providing literacy instruction in the home was a lack of understanding of phonic methods:

> The way English and reading is taught is different from how it used to be.
>
> I don't know how to break down words; they change system of teaching all the time.
>
> I'm confident in my own reading ability, but I might confuse L by adopting a different approach to her teachers.

In addition, a number of the FR parents made specific reference to their own reading difficulties holding them back from teaching their children:

> I find it difficult because I'm not a good reader myself and I don't want to teach H bad habits.
>
> No – I struggle with reading because I'm dyslexic.

However, most parents in the current sample reported that they felt confident in supporting their children learn to read, often praising schools for including parents in phonics training sessions or sending home useful information for parents.

> The school is proactive in teaching us how to teach and his Speech and Language Therapist has helped.

3.2.4 Parental Beliefs: Conclusions

The analysis presented above reveals a number of over-arching themes, including points of consensus and division, in parents' beliefs about the value of literacy-related activities in the home. First, storybook reading with children is an activity universally valued by parents in this sample. In responses which were not shaped by a predetermined list of options, parents cited seven key reasons for the importance of reading storybooks with their children. Some of these were socio-emotional (such as spending calm, one-to-one time with their child, or having fun together), while others related to the scaffolding of cognitive skills (for instance, boosting general knowledge, language or literacy skills). While calming, bonding and entertainment were most commonly cited, it was noteworthy that many parents placed value in storybook reading for both the socio-emotional and cognitive development of their children.

Parents' beliefs about the value of explicitly code-based activities in the home were more diverse. While a clear majority of parents agreed that teaching children about letters and words was important, many added the proviso that code-based activities in the home should be child-led and informal, in the context of storybook reading, play or talking about environmental print. On the other hand, some parents viewed literacy as a 'special case' for early instruction, citing its value as a key skill which unlocks access to learning across the school curriculum and beyond. The desire to give children a head start in literacy skills, particularly knowledge of the alphabet, before starting school was commonly expressed in these responses.

Parents also offered a range of views as to the most appropriate time to begin to teach children to read. While some argued that the earlier children started to understand print function and forms the better, others believed that the commencement of formal literacy instruction at primary school entry in the UK represented too much, too soon for many children. Again, a majority of parents in the current sample made specific reference to individual differences in learning readiness among 4- to 5-year-old children, and some believed that the current educational system put those children who were less ready to learn to read at a disadvantage. A very commonly expressed idea was that parents should take their cues from children in deciding when and how to go about teaching reading in the home. Encouragingly, despite the sea change in literacy teaching methods that has taken place within the primary curriculum in the UK over the last 20 years (Snow & Juel, 2005), a substantial majority of parents reported feeling confident about helping to teach their children to read.

This qualitative analysis does not allow for robust inferences to be made about group differences in parental beliefs within FR and TD families. However, a number of salient points emerged about the attitudes of parents who are aware that their children are at family-risk of reading difficulties towards literacy activities in the home. First, both FR and TD parents were unanimous in the high value placed in storybook reading; however, a slightly higher proportion of FR parents made explicit reference to its importance as a vehicle for literacy development. This is consonant with the fact that several FR parents also cited awareness of family members' difficulty with reading at school as a motivator for engaging their children with letters and words in the home at an early age. Many of these same parents also expressed the view that starting to teach a child to read should ideally happen as early as possible. However, a small number of FR parents described themselves as feeling unable to teach their children to read, principally due to anxiety about 'doing it wrong' given their own dyslexia. Therefore, family-risk status may be associated with a variety of beliefs and attitudes towards reading development, the precise nature of which may depend on a host of factors, including whether the primary caregiver him- or herself has dyslexia. Beliefs about the importance of an early grasp of literacy concepts, coupled with anxiety about their own ability to teach reading to their children, may influence how these parents engage in literacy activities in the home with their children. For some families, this may mean an enhanced focus on early teaching of letters and early reading skills, while in others such literacy activities may be avoided altogether.

3.3 Conclusion: The Home Literacy Environment of Four-Year-Old Children at Family-Risk of Dyslexia

The design and scope of the Wellcome project allowed for a unique insight into children's early home literacy experiences, and consequently the analyses presented in this chapter constitute the most in-depth description of the early HLE of children at family-risk of dyslexia to date. A number of key points emerge from these analyses.

First, meaning-focused literacy interactions (here defined as exposure to storybooks) are not related to code-focused interactions (here defined as direct instruction of orthographic forms) in FR or TD families. This factor structure was invariant across groups in the current sample, with the exception that teaching of letters was partially explained by exposure to storybooks in the FR group only. This suggests that, among families with a history of reading difficulties, parents who read more stories with their children also teach them about letters more frequently. Martini and Sénéchal (2012) reported that many parents use storybook reading as a vehicle for pointing out letters and words, so it may be that this practice was more common in FR families in the current sample. However, overall, the factor structure presented in Section 3.1.4 is broadly consistent with Sénéchal and LeFevre's (2002) Home Literacy Model, in that storybook exposure and direct instruction of letters and words emerge as discrete components of the HLE.

Second, a common stepwise pattern (TD > FR-only > FR-SLI) was observed in several of the HLE and SES variables. Group differences were not statistically significant in the individual interview items relating to storybook exposure, but emerged more clearly in the checklist measures. As mentioned above, this could reflect the greater objectivity of the checklists, which were designed with the aim of controlling for social desirability bias. Alternatively, FR families may engage in storybook reading interactions as frequently as TD families, but the range of reading materials employed may be more limited, or parents with dyslexia may have difficulty retaining information about book titles and authors. Overall, however, these results suggest that FR children experience somewhat less exposure to storybooks in the preschool years than their TD peers, and that FR children who are language-impaired are least exposed to children's literature. While the frequency of direct literacy instruction in the home was equivalent across groups, a gender effect was observed, such that parents were more likely to report teaching girls about letters and words than boys. This effect held in both the FR and TD groups. It may be that parents view preschool girls as better able to concentrate during didactic interactions than boys. Alternatively, this gender difference could reflect parental perceptions that girls are more interested in reading than boys at this young age.

Third, there is some evidence that FR children are somewhat less interested in storybooks than TD children as early as 4 years old. It is unsurprising that self-reports of enjoyment of reading on the part of parents was lower in the FR group than the TD group, and this finding was supported by the significant group difference in scores on the Adult Author Checklist. However, parental ratings of *children's* enjoyment of books were also lower in the FR group. It is noteworthy that the correlation between the storybook exposure and child interest factors in the baseline CFA model for the FR group was markedly higher than in the TD group model. This indicates that greater variability in children's and adults' interest in books in FR families is reflected in the amount of storybook exposure that these children experience in the home.

The TD>FR-only>FR-SLI pattern was apparent in all SES indicators, suggesting that environmental risk factors are more prevalent in children at developmental risk of reading difficulties. In all groups, SES was positively correlated with storybook exposure, although no clear relationship emerged between

SES and direct instruction of letters and words, nor children's interest in books. This pattern is convergent with a substantial literature suggesting that the effects of SES on reading development are mediated by proximal environmental systems, including the HLE (Phillips & Lonigan, 2005).

There was no clear indication that either the number of children in the home or the birth order of the child was related to HLE experiences. One exception was that later-born FR children encountered less direct instruction of literacy in the home. Single-parent family status, on the other hand, was weakly negatively correlated with HLE and SES indicators. The issue of whether single-parent family status confers an environmental risk of reading difficulties in its own right, or whether the association is largely explained by socio-economic factors is unresolved (Ricciuti, 1999) and this issue is not explored further in the current thesis.

Finally, the qualitative analysis of parents' comments about their values and beliefs concerning literacy development revealed a number of interesting themes. Shared storybook reading is a universally valued activity, while more diversity of opinion exists on the value of teaching letters and words in the home. Although inferences drawn from this analysis must be tentative, it was notable that a number of parents in the FR group referred to a heightened awareness of their child's elevated risk of reading difficulties. This awareness often co-occurred with an expressed belief that literacy instruction should begin early in the home, or conversely with a reluctance to engage in code-related activities with their children for fear of 'doing it wrong'. These exploratory data suggest multiple, complex pathways through which parental belief systems may influence literacy-related behaviours in the home.

Chapter 4: The Home Literacy Environment as a Predictor of Children's Language and Emergent Literacy Skills

4.1 Introduction

The aim of this study was to test the predictions of Sénéchal & LeFevre's (2002) Home Literacy Model with regard to children's oral language, phonological awareness and knowledge of print forms, both concurrently at age 4;3 (*t2* of the Wellcome project) and one year later (Wellcome project *t3*). Phonological awareness and print knowledge were considered as separate components of emergent literacy since, although they are typically highly correlated (Blaiklock, 2004), the research literature suggests that the influence of environmental factors on phonological processing and orthographic knowledge may show different effect sizes (e.g. Byrne et al., 2005). Having found that storybook exposure and direct literacy instruction are distinct HLE factors in the current sample in concordance with previous research (Sénechal et al., 1998; Sénéchal, 2006), the next step was to assess the differential predictive value of these two factors in relation to the foundational skills of reading.

The differences in design between Sénéchal and LeFevre's (2002) longitudinal study of HLE and the Wellcome project meant that children were not assessed at exactly the same ages. Sénéchal and LeFevre measured the HLE when children were 4 years old, and related these variables to foundational literacy skills in kindergarten (age 5) or at the beginning of Grade 1 (age 6). However, children in Canada do not commence formal literacy instruction at school until the age of 6, whereas phonics instruction begins in Britain when children enter reception class at 4 to 5 years old. The possibility that the relationship between HLE experiences and emergent literacy might change as children progress through the early years of primary education could not be discounted. For this reason, the HLE data collected in the Wellcome project was analysed in relation both to their concurrent skills at around the time of school entry (Study 1), and to the same set of skills one year later at age 5 (Study 2). In both sets of analyses, the number of months children had spent in school at the time of testing is controlled.

For the TD group in the current sample, it was predicted that storybook exposure would predict meaning-based skills, operationalised here as performance on a number of receptive and expressive language tests, while direct instruction would predict code-based skills, operationalised as performance on tests of letter-sound knowledge and letter writing at *t2*, and as performance on tests of word reading at *t3*. In line with the Home Literacy Model, it was predicted that the relationship between the two HLE factors and phonological awareness would be indirect, mediated by receptive language and emergent decoding (Figure 4.1).

Given the small body of research on the influence of the HLE in the literacy development of children at developmental risk of reading difficulties, there were no directional hypotheses about group differences in the predictive value of storybook exposure and direct instruction within the FR and TD groups. Findings from the Jyväskylä Longitudinal Study of Dyslexia suggest that the relationships between HLE and reading outcomes are stronger in children at family-risk of dyslexia (Torppa et al., 2007). However, this study did not differentiate between meaning-focused and code-focused activities in the home. The studies presented in this chapter therefore employ regression models and mediation analyses to compare the influences of the HLE on oral language and emergent literacy between children with and without a developmental risk of reading difficulties.

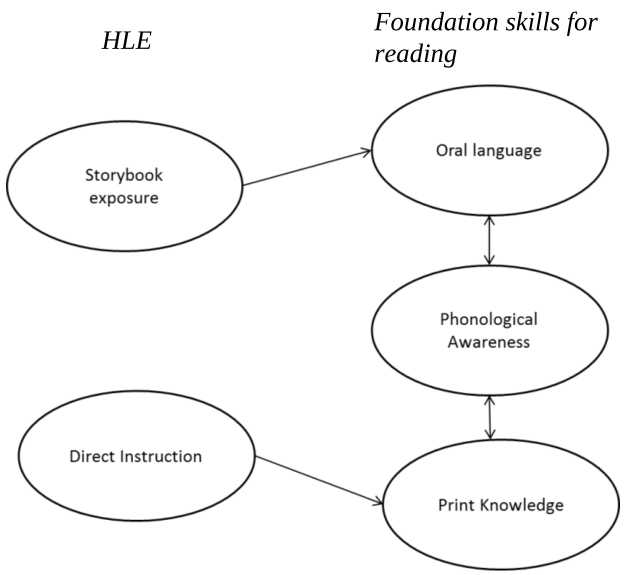


***Figure 4.1*. Predictions of the Home Literacy Model (Sénéchal & LeFevre, 2002) in relation to children's language and emergent literacy skills**

4.2 Study 1: The HLE and Children's Concurrent Language and Emergent Literacy

4.2.1 Method

4.2.1.1 Participants

The sample was identical to that described in section 3.1. A total of 188 children were included in these analyses, comprising 116 FR and 72 TD children. Of the FR group, 87 children had language scores within the normal range at

Wellcome project *t1*, while 29 were classified as language impaired. The mean age of the children at this testing point was 4 years and 8.5 months (s.d. = 3.78 months).

4.2.1.2 Measures

In addition to the HLE measures described in Chapter 3, nine tests from the Wellcome project *t2* assessment battery were selected as outcome variables in the current study. Internal reliability, as reported in the manuals of standardised measures or computed using the full Wellcome project sample for bespoke measures, is displayed in Table 4.1.

Three tests were chosen as measures of children's receptive language:

(a) *Receptive One-Word Picture Vocabulary Test* (*ROWPVT-3)* (Brownell, 2000). In this test, children were shown an array of four pictures and heard a single word read aloud by the examiner. They were instructed to point to the picture that matched the word. Testing was discontinued when a child gave four incorrect responses within a sequence of six consecutive items.

(b) *Clinical Evaluation of Language Fundamentals: Preschool Second Edition UK (CELF-P II UK)* (Wiig, Secord, & Semel, 2006): *Sentence Structure* sub-test was used to assess understanding of grammatical sentences. Children were required to select the picture, from a choice of four, which matched a sentence read aloud by the examiner.

(c) *Semantic Picture Matching* was a bespoke task for the Wellcome project, in which children saw an array of three pictures and were given a card displaying a fourth picture. They were asked to place their card with the

picture from the array which it best matched, without hearing a verbal cue or producing a verbal output. The relationships between the objects were either functional (e.g. bucket and spade) or categorical (e.g. banana and apple). The aim of this task was to assess children's conceptual knowledge, while removing the verbal load of the previous two tasks. As such, it is not a test of receptive *language*, but was included in initial analyses as a potential indicator of conceptual knowledge.

Three tasks were selected as indicators of children's phonological awareness ability:

(a) *Syllable Matching* (Carroll & Snowling, 2001). In this task, children were shown a picture, which the examiner named, and asked to judge which of a choice of two other words, presented with corresponding pictures, sounded the same at the beginning (e.g. fireman – firework) or at the end (e.g. ladder – spider) of the word. The test comprised six first-syllable items and six second-syllable items.

(b) *Alliteration Matching* (Carroll & Snowling, 2001). This task followed the same format as Syllable Matching, except that children were asked to match words (presented with accompanying pictures) that started with the same sound (e.g. hit – hose). Two practice items preceded 10 test items.

(c) *Phoneme Isolation* (Carroll & Snowling, 2001). In this task, the examiner said a simple non-word aloud (e.g. zik, dal) and asked the child to repeat the word, in order to ensure that s/he was able to articulate all constituent sounds. The examiner then asked the child which sound the non-word began with

(e.g. dal - /d/) or ended with (e.g. hos - /s/). After four practice items, the test comprised eight word-initial items and eight word-final items.

Three tasks related to children's knowledge of print forms at age 4:

(a) *York Assessment of Reading Comprehension (YARC), Primary Edition: Letter-sound Knowledge* sub-test (Hulme et al., 2010). Children were shown a series of 32 letters and digraphs and asked to provide the sound that each one makes.

(b) *YARC: Early Word Reading* sub-test. Children were shown a list of 30 words (15 of which were regular, 15 irregular) and asked to read them aloud.

(c) *Letter Writing* was a bespoke task for the Wellcome project. Examiners read out a series of 10 letter sounds, some of which were consistent (e.g. /m/, /t/) while others were inconsistent, in that several orthographic representations exist for the sound (e.g. /k/ - *c* or *k*). Children were asked to write down the letter that made each sound on a piece of paper. For the inconsistent sounds, any letter or digraph that could represent the sound was accepted as correct.

In addition to these key outcome measures, a test of non-verbal ability was included in the inferential analyses as a control variable:

Wechsler Preschool and Primary Scales of Intelligence (WPPSI-III UK) (Wechsler, 2003)*: Block Design* sub-test. In this task, children were required to recreate a series of two-tone geometric patterns displayed in a book, using nine cuboid blocks. Testing was discontinued after errors on three consecutive items.

4.2.1.3 Procedure

The 10 tasks described above were administered as part of a longer assessment battery at *t2* of the Wellcome project. Testing sessions almost always took place in the child's home, but a small number took place in the child's nursery or reception setting for practical reasons (for example, both parents working full-time out of the home). This assessment was divided into two sessions, which were usually administered during two separate home visits, separated by approximately one week. In a few exceptional cases, where the family lived a significant distance from the research centre, both testing sessions took place on the same day, but with a lengthy break in between the two.

Table 4.1
Published and computed reliability coefficients for t2 *cognitive tests*

Test	Reliability (Cronbach's α)	Age range	Published or computed
Receptive One-Word Vocabulary Test	.96	4 years	published
CELF Sentence Structure	.81	4;6-4;11	published
Semantic Picture Matching	.73	4-5 years	computed
Syllable Matching	.53	4-5 years	computed
Alliteration Matching	.67	4-5 years	computed
Phoneme Isolation	.91	4-5 years	computed
YARC Letter-sound Knowledge	.98	3;0 – 8;4	published
YARC Early Word Reading	.98	3;0-8;4	published
Letter Writing	.79	4-5 years	computed
WPPSI Block Design	.84	4;6-4;11	published

For the first home-based testing session, two researchers were present, one of whom worked with the child, while the other conducted the Home Literacy Environment Interview, title/author checklist measures and other questionnaires with the primary caregiver. Only the researcher who was working with the child returned for the second visit. There was a standard running order for the battery of tests; however flexibility was allowed in order to allow for individual differences in the young children's sustained attention and language level. For example, where a child displayed difficulty in tests of receptive language, an effort was made to ensure that these tests were interspersed with non-verbal or computer-based tasks in order to maximise children's comfort and engagement.

4.2.2 Results

4.2.2.1 T2 cognitive variables: Descriptive statistics

Descriptive statistics for the whole sample's raw scores on the nine outcome variables of interest are presented in Table 4.2. Distributions for most variables were acceptable, however a slight negative skew was observed in semantic picture matching, sentence structure, syllable matching and alliteration matching. Conversely, the distribution of the early word reading scores was highly positively skewed, suggesting floor effects. Indeed, 44.7% of the sample scored zero on this test, reflecting the fact that many children had not yet started school at the time of testing.

Those variables displaying skewness greater than +/-1 were subjected to square-root transformation, rendering the distributions suitable for the parametric statistical techniques reported below. Where there was a negative skew, distributions were reflected before square-root transformation was applied.

4.2.2.2 Group differences in t2 cognitive variables

Independent t-tests were run on the nine cognitive variables, in order to examine differences between the FR and TD groups. In Table 4.3, group means for the raw data are presented; however the transformed variables were used in the inferential analyses.

Table 4.2
T2 *outcome measures: Descriptive statistics for the whole sample (N=188)*

Measure	Percentage missing	Mean (s.d.)	Range	Skewness	Kurtosis
Receptive Language					
Semantic Picture Matching[1]	0%	21.00 (2.52)	10-24	-1.33	2.12
Receptive Vocabulary[2]	0.5%	62.59 (9.97)	29-89	.14	.62
Sentence Structure[3]	0%	17.29 (2.84)	4-22	-1.19	2.57
Phonological Awareness					
Syllable Matching[4]	1.6%	9.61 (1.85)	0-12	-1.35	3.64
Alliteration Matching[5]	2.7%	7.51 (2.40)	0-10	-.1.10	1.06
Phoneme Isolation[6]	2.7%	7.18 (5.71)	0-16	.14	-1.43
Print Knowledge					
Letter-sound Knowledge[7]	0%	17.52 (9.85)	0-32	-.24	-1.21
Early Word Reading[8]	0%	4.03 (6.61)	0-30	2.20	4.66
Letter Writing[9]	0.5%	4.13 (3.05)	0-10	.24	-1.12

Note: [1]max=24; [2]max=170; [3]max=22; [4]max=12; [5]max=10; [6]max=16; [7]max=32; [8]max=30; [9]max=10

Table 4.3
Differences between FR (n=116) and TD (n=72) groups on t2 outcome measures

Measure	FR mean (s.d.)	TD mean (s.d.)	*t*(df)	*p*	*Effect size d*
Receptive Language					
Semantic Picture Matching	20.75 (2.74)	21.46 (2.11)	1.82 (186)	.071	.29
Receptive Vocabulary	61.31 (11.05)	65.34 (7.58)	3.01 (185)	.003	.43
Sentence Structure	16.78 (2.07)	18.03 (2.29)	3.02 (186)	.003	.57
Phonological Awareness					
Syllable Matching	9.32 (2.07)	10.06 (1.34)	2.77 (183)	.006	.42
Alliteration Matching	7.11 (2.41)	8.27 (2.16)	4.07 (180)	<.001	.51
Phoneme Isolation	6.31 (5.67)	8.70 (5.42)	3.24 (183)	.001	.43
Print Knowledge					
Letter-sound Knowledge	16.76 (9.88)	19.62 (9.36)	2.53 (186)	.012	.30
Early Word Reading	3.28 (5.79)	5.35 (7.33)	2.78 (186)	.006	.31
Letter Writing	3.93 (3.01)	4.66 (3.03)	2.11 (185)	.037	.24

Note: [1]max=24; [2]max=170; [3]max=22; [4]max=12; [5]max=10; [6]max=16; [7]max=32; [8]max=30; [9]max=10

The mean scores were higher in the TD group than in the FR group for all variables, although the difference was not statistically significant in the case of semantic picture matching. The group differences generally represented small effects; effect sizes were small to moderate in the measures of phoneme awareness.

In a second set of group comparisons, the FR-SLI children were removed from the analysis, in order to compare group means for children with a family-risk of dyslexia only with TD controls. These analyses are presented in Table 4.4. Group differences in the three receptive language measures were no longer significant, but the TD>FR pattern persisted in measures of phoneme awareness and word reading with attenuated effect sizes. These results suggest that the poorer performance of FR children on measures of receptive language is largely driven by the sub-group of FR-SLI children.

Table 4.4
Differences between FR-only (n=87) and TD (n=72) groups on t2 outcome measures

Measure	FR-only mean (s.d.)	TD mean (s.d.)	*t*(df)	*p*	*Effect size d*
Receptive Language					
Semantic Picture Matching[1]	20.99 (2.66)	21.46 (2.11)	.95 (157)	.346	-
Receptive Vocabulary[2]	64.18 (9.95)	65.34 (7.58)	.94 (156)	.350	-
Sentence Structure[3]	17.57 (2.40)	18.03 (2.29)	1.32 (157)	.190	-
Phonological Awareness					
Syllable Matching[4]	9.68 (2.01)	10.06 (1.34)	1.30 (155)	.195	-
Alliteration Matching[5]	7.59 (2.15)	8.27 (2.16)	2.71 (154)	.007	.32
Phoneme Isolation[6]	7.49 (5.62)	8.70 (5.42)	1.71 (155)	.089	.22
Print Knowledge					
Letter-sound Knowledge[7]	17.78 (9.48)	19.62 (9.36)	1.55 (157)	.124	-
Early Word Reading[8]	3.66 (5.69)	5.35 (7.33)	1.96 (157)	.052	.26
Letter Writing[9]	4.27 (3.01)	4.66 (3.03)	1.17 (157)	.245	-

Note: [1]max=24; [2]max=170; [3]max=22; [4]max=12; [5]max=10; [6]max=16; [7]max=32; [8]max=30; [9]max=10

4.2.2.3 Correlations among t2 cognitive variables

Table 4.5 displays partial correlations between the nine cognitive variables, controlling for children’s age in months. Correlations within the FR group are presented above the diagonal while correlations within the TD group are shown below the diagonal. (Correlations relating to the whole sample, and to the FR-only and FR-SLI subgroups are included in Appendix 3.)

In both groups, the nine cognitive variables are significantly positively inter-correlated, with a few exceptions. In the TD group, the predicted factor structure emerges clearly in the correlation matrix. In other words, measures tapping the same construct (oral language, phonological awareness and print knowledge) are inter-correlated, while correlations between measures tapping different constructs are generally not significant, with the exception of phonological awareness and print knowledge. It is noteworthy that the measures of oral language are more strongly correlated with tests of phonological awareness and print knowledge in the FR group. This may be attributable to the wider distribution of language scores in this group.

4.2.2.4 Confirmatory Factor Analysis of t2 cognitive variables

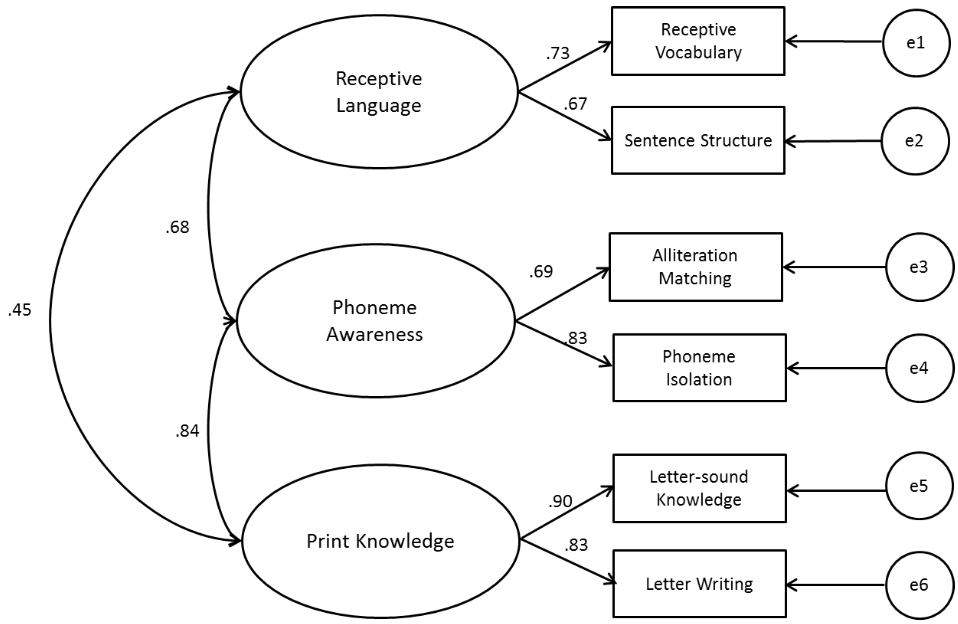
A measurement model was constructed in order to evaluate the statistical basis for forming three composite variables from the *t2* cognitive measures in advance of the regression and mediation analyses reported below. In this model, a receptive language latent construct was defined by the three semantic measures (semantic picture matching, receptive vocabulary and sentence structure), phonological awareness by syllable matching, alliteration matching and phoneme isolation, and print knowledge by letter-sound knowledge and letter writing. Early word reading was not included in the model as an indicator of print knowledge, due to the floor effect noted in Section 4.3.1. All cognitive variables were residualised for children's age (in months) before entry into the model.

Table 4.5
Partial correlations among t2 cognitive measures, controlling for child age; FR group (n=116) above diagonal, TD group (n=72) below diagonal

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1.Semantic Picture Match		.28**	.22*	.17†	.26**	.19†	.26**	.14	.28**
2.Receptive Vocabulary	.31**		.47***	.35***	.36***	.41***	.34***	.18†	.26**
3.Sentence Structure	.29*	.43***		.32***	.40***	.42***	.28**	.17†	.27**
4.Syllable Matching	.20	.35***	.30*		.24*	.38***	.29**	.27**	.19*
5.Alliteration Matching	.18	.22	.15	.44***		.57***	.52***	.36***	.52***
6.Phoneme Isolation	.12	.20	.10	.35**	.48***		.61***	.46***	.58***
7.Letter-sound Knowledge	.02	.06	.11	.23	.38***	.61***		.51***	.77***
8.Early Word Reading	-.19	.12	-.02	.06	.13	.48***	.61***		.58***
9.Letter Writing	-.02	.09	.11	.12	.23*	.60***	.68***	.49***	

Note: †p<.08; *p<.05; **p<.01; ***p<.001

Fit indices for this model indicated good fit to the data ($\chi^2(17)=21.98$, p=.185; CFI=.99; RMSEA=.04 (.00-.08), p=.609). However, model fit was improved when syllable matching was allowed to cross-load onto the receptive language factor ($\chi^2(16)=11.03$, p=.808; CFI=1.00; RMSEA=.00 (.00-.04), p=.970). In this second model, the factor loading of syllable matching on receptive language was significant at the .001 level; however, its loading onto the phonological awareness factor was no longer significant. Given the ambiguous loading of this measure, therefore, syllable matching was dropped from the model. In addition, the residual associated with semantic picture matching was high, and its loading onto the receptive language latent factor was relatively low. Therefore, this indicator was also removed from the model. The resulting CFA, including three latent constructs defined by six observed measures, is displayed in Figure 4.2.



χ^2 (6) = 3.67, *p*=.721; CFI=1.00, RMSEA=.00

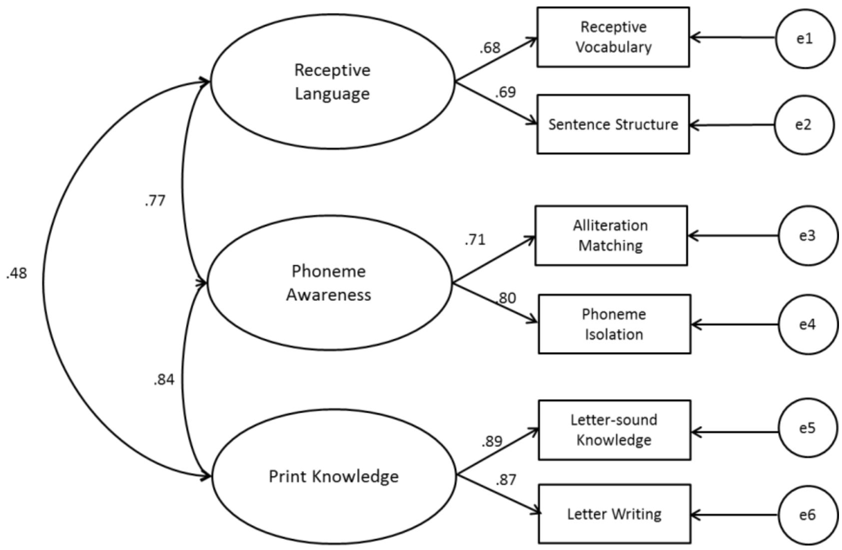
***Figure 4.2*. One-group CFA measurement model of t2 cognitive measures**

For the sample as a whole, the model was a good fit to the data (χ^2 (6) = 3.67, *p*=.721; NFI=.99; CFI=1.00; RMSEA=.00 (90% CIs .00-.07), *p*=.881). All factor loadings were significant at the .001 level. Covariances between the three latent constructs were also highly significant.

The invariance of this factor structure across the groups was tested, using the procedure outlined in Section 3.5.1. Model fit and factor loadings were similar when the model was computed for the FR-only group and the FR(all) group. On this basis, the 29 FR-SLI children were retained in the two-group analysis. The baseline models for the TD and FR groups are presented in Figures 4.3 (a) and (b).

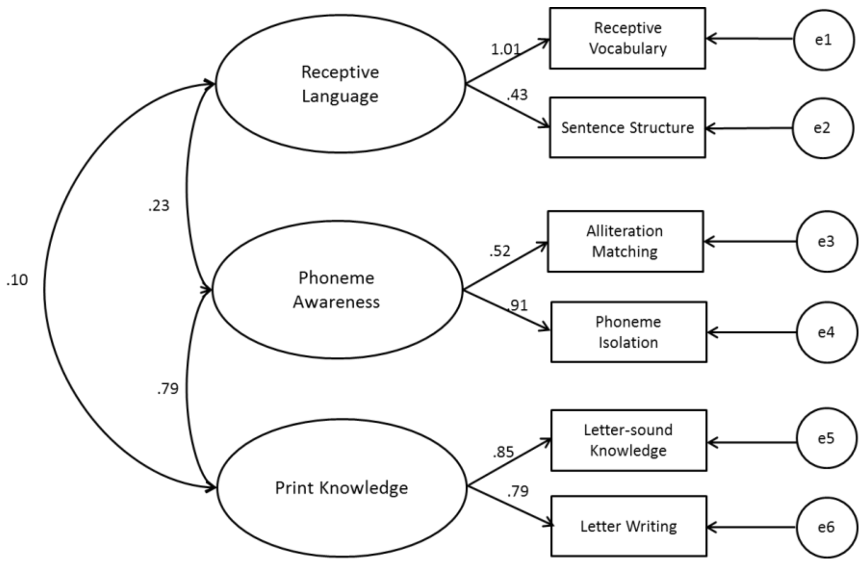
Covariance between receptive language and phoneme awareness was higher in the FR group. In addition, the receptive language and phoneme awareness factors were more strongly defined by one indicator in the TD group, whereas factor loadings across indicators were more similar in the FR group. However, both baseline models yielded a good fit to the data; the combined chi-square value for this unconstrained model was 7.53 (*df*=12). Next, a two-group model was tested, in which factor loadings, variances and covariances and error variances were constrained to be equivalent across the groups. While model fit was reduced in this fully constrained model (χ^2 (27) = 34.86, p=.142), the change in chi-square, given the change in degrees of freedom, between the two models was not significant. Therefore, the factor structure was assumed to be invariant across the groups.

These CFA models provided statistical support for the theoretical rationale to form composites for use as cognitive outcomes in subsequent analyses. The phoneme awareness and print knowledge factors are highly correlated; however, there is a theoretical rationale for retaining these as separate factors, since environmental influences have been shown to exert stronger effects on print knowledge than phoneme awareness (e.g. Samuelsson et al., 2005). Since the factor structure was invariant across the FR and TD groups, composites were produced by



χ^2 (6) = 2.43, *p*=.877; CFI=1.00, RMSEA=.00

***Figure 4.3(a).* Baseline CFA model of t2 cognitive variables for FR group (n=116)**



χ^2 (6) = 5.10, *p*=.529; CFI=1.00, RMSEA=.00

***Figure 4.3(b).* Baseline CFA model of t2 cognitive variables for TD group (n=72)**

calculating the mean of the standardised, age-residualised indicator variables for each construct (receptive language, phoneme awareness and print knowledge).

4.2.2.5 Correlations between SES, HLE and t2 cognitive variables

These three composite measures were next analysed in relation to concurrent measures of home environment. Tables 4.6 presents correlations between SES, HLE and the three cognitive constructs measured at age 4 in the FR and TD groups. (The same set of correlations across the whole sample, as well as in the FR-only and FR-SLI sub-groups, are included in Appendix 3). The creation of composite variables for the SES and HLE constructs is described in Chapter 3.

Family SES is moderately correlated with receptive language in both groups, and weakly correlated with phoneme awareness and print knowledge in the FR group only. Storybook exposure shows a moderate positive association with receptive language in both groups. Storybook exposure is also positively correlated with concurrent phoneme awareness and print knowledge in the TD group; by contrast, in the FR group, the correlation with phoneme awareness is weaker, and there is no association between storybook exposure and print knowledge. Direct instruction is moderately correlated with print knowledge and weakly correlated with phoneme awareness in the FR group; these relationships are weaker in the TD group. Direct instruction shows no relationship with receptive language. Parental report of children's interest in storybooks is unrelated to any of the cognitive variables. Overall, this pattern is broadly consistent with the predictions of Sénéchal and LeFevre's (2002) Home Literacy Model. However, within the TD group, storybook exposure is related to all three outcome measures; in particular, the relationship between storybook exposure and print knowledge is not predicted by the model. This result suggests that TD children may derive some information about letter forms and sounds implicitly through early exposure to storybooks, although the direction of causality cannot be assumed on the basis of these concurrent correlational analyses.

Table 4.6
Zero order correlations between SES, HLE and t2 cognitive composites; FR group (n=116) above diagonal, TD group (n=72) below diagonal

	1.	2.	3.	4.	5.	6.	7.
1. Family SES		.52***	.04	.07	.30***	.19*	.19*
2. Storybook Exposure	.41***		-.20*	.22*	.36***	.20*	.05
3. Direct Instruction	-.20	-.15		.06	.10	.20*	.33***
4. Child Interest	.01	.05	.16		.12	.02	-.04
5. Receptive Language	.38***	.36**	-.20	.10		.52***	.36***
6. Phoneme Awareness	.11	.36**	.14	.00	.23*		.66***
7. Print Knowledge	.03	.23*	.27*	-.14	.13	.58***	

Note: *p<.05; **p<.01; ***p<.001

It is noteworthy there is a lack of correlation between any SES or HLE variable and children's receptive language, phoneme awareness and print knowledge in the FR-SLI sub-group (see Appendix 3). It is striking that the semantic skills of these children are neither associated with family socio-economic status nor with the amount of storybook exposure that they experience in the home, in contrast to both the TD and FR-only groups. Likewise, explicit instruction of letters and word reading is unrelated to these children's print knowledge and phoneme awareness. Although the lack of relationship between cognitive and home environment variables in this subgroup is likely to be partly attributable to the small number of children, it is also possible that the effects of the HLE are dependent on the developmental level of the child. Thus, children with depressed oral language and/or phonological skills may derive less benefit than their typically developing peers from exposure to literacy interactions in the home.

4.2.2.6 Hierarchical regression analyses

The relationships between SES, HLE and children's concurrent cognitive skills were examined further in a series of hierarchical regression analyses. Family SES, children's non-verbal ability, the number of months that the child had spent in school at the time of testing and primary caregiver scores on the Adult Author Checklist were entered as control measures in the first step. The Adult Author Checklist was included as an attempt to control for possible passive genetic-environmental correlations affecting the HLE. Two HLE variables (storybook exposure and direct instruction) were entered as a second step. Finally, dummy variables representing FR and LI status were entered as a third step. Three models, regressing receptive language, phoneme awareness and print knowledge on this set of predictor variables, are presented in Table 4.7.

The first model accounts for 40% of the variance in children's receptive language ability at age 4. Family SES is a significant predictor, and children's non-verbal ability a marginal predictor, together accounting for 23% of the variance. Neither the number of months in school at the time of testing nor the primary caregiver's orientation to reading (as tapped by the Adult Author Checklist) is predictive of receptive language. Storybook exposure contributes a unique 4% of variance in children's receptive language after accounting for the control variables, but direct instruction is not related to language skills. Unsurprisingly LI status is significantly negatively predictive of receptive language, but FR status is not a unique predictor.

Table 4.7

Hierarchical regression models, predicting receptive language, phoneme awareness and print knowledge at age 4

Predictor	ΔR^2	B (SE B)	β	*p*
		Outcome Variable: Receptive Language		
Step 1				
Family SES	.23	.20 (.09)	.19	.021
Non-verbal ability		.01 (.00)	.12	.062
Months in school		.01 (.02)	.05	.421
AAC		-.01 (.01)	-.14	.100
Step 2				
Storybook exposure	.04	.25 (.07)	.27	.001
Direct instruction		.00 (.07)	.00	.974
Step 3				
FR status	.13	.02 (.12)	.01	.857
LI status		-.98 (.16)	-.41	<.001
		Total R^2=.40; F (8,178) =7.00, p<.001		
		Outcome Variable: Phoneme Awareness		
Step 1				
Family SES	.26	.01 (.09)	.01	.909
Non-verbal ability		.01 (.00)	.22	.001
Months in school		.04 (.02)	.15	.017
AAC		.00 (.01)	-.02	.835
Step 2				
Storybook exposure	.05	.22 (.08)	.23	.005
Direct instruction		.17 (.07)	.14	.022
Step 3				
FR status	.07	-.22 (.13)	-.12	.079
LI status		-.63 (.17)	-.25	<.001
		Total R^2=.38; F (8,178) =13.33, p<.001		
		Outcome Variable: Print Knowledge		
Step 1				
Family SES	.27	.13 (.10)	.11	.175
Non-verbal ability		.01 (.00)	.26	<.001
Months in school		.07 (.02)	.25	<.001
AAC		-.01 (.01)	-.11	.190
Step 2				
Storybook exposure	.06	.15 (.08)	.15	.072
Direct instruction		.30 (.08)	.24	<.001
Step 3				
FR status	.02	-.15 (.13)	-.08	.257
LI status		-.31 (.18)	-.12	.083
		Total R^2=35; F (7,180) =12.17, p<.001		

Family SES does not contribute to the model relating to phoneme awareness, but children's non-verbal ability and number of months in school are significant predictors. Again, parental literate orientation does not predict this outcome. However, both interactive HLE constructs are significantly predictive of phoneme awareness, together accounting for 5% of unique variance after entry of the control variables. The Home Literacy Model (Sénéchal & Lefevre, 2002) predicts that the relationship between HLE and phonological awareness is mediated by oral language print knowledge; these putative indirect relationships are tested in Section 4.2.2.7 below. Children's phoneme awareness at age 4 is negatively predicted by both FR and LI status, but the relationship with FR status does not reach significance. Overall, 38% of variance in children's phoneme awareness ability is accounted for by this model.

Finally, the third model accounts for 35% of the variance in children's print knowledge at age 4. Neither family SES nor parental literate orientation contributes variance to the model, but children's non-verbal ability and months spent in school are both highly predictive of their print knowledge. Storybook exposure is a marginal predictor of this outcome measure, while direct instruction of letters and words in the home is a highly significant predictor. Together these two HLE constructs explain 6% of unique variance. The negative associations of FR and LI status with print knowledge do not reach statistical significance in this model,

Overall, then, family SES emerges as a significant unique predictor of children's oral language, but not emergent literacy skills at age 4. However, the HLE constructs measured concurrently predict unique variance in receptive language, phoneme awareness and print knowledge at this age, after controlling for non-verbal ability, months of schooling at the time of testing and caregivers' orientation to reading. Specifically, storybook exposure is a unique predictor of receptive language and phoneme awareness, while direct instruction predicts phoneme awareness and print knowledge. The fact that the predictive power of the two HLE constructs persists after controlling the parents' literate orientation, a measure that is highly correlated with children's storybook exposure, suggests that it is the literacy interactions with adults that children experience which are important in the development of these skills, rather than the passive observation of parents reading for pleasure in the home.

4.2.2.7 Mediation analyses

The HLE literature suggests that a number of the relationships identified in Section 4.2.2.6 are likely to represent indirect effects, through processes of mediation and moderation (Baron & Kenny, 1986). Three putative indirect relationships are tested here. First, it is hypothesised that the predictive value of family SES in children's receptive language is partially mediated by storybook exposure in the home (Forget-Dubois et al., 2009). Second, the Home Literacy Model (Sénéchal & LeFevre, 2002) predicts that the relationship between storybook exposure and phonological awareness is completely mediated by oral language (here operationalised as performance on two receptive language tasks which draw on semantic knowledge). The above regression analyses suggest that risk status may moderate the nature of this relationship. Finally, Sénéchal and LeFevre's (2002) model also predicts that the relationship between direct instruction of literacy skills in the home and phonological awareness is completely mediated by print knowledge.

4.2.2.7.1 The mediating role of storybook exposure in the relationship between SES and receptive language

As a first step, a simple mediation analysis was conducted using data from the whole sample, in order to test the hypothesised mediated effect displayed in Figure 4.4. Mediation occurs when all or part of the effect of a causal variable upon an outcome variable is carried by a third, mediating variable. In models of this kind, path *c* represents the total effect of the causal variable upon the outcome. Path *a* is the effect of the causal variable on the mediator, while path *b* is the effect of the mediator on the outcome. Finally, path *c'* denotes the direct effect of the causal variable on the outcome, after controlling for the effect of the mediator. In complete mediation, *c'* does not differ significantly from zero, i.e. all of the effect of the causal variable on the outcome is carried by the mediator. In partial mediation, on the other hand, path *c'* is of smaller magnitude than the total effect (*c*), but is still significantly different from zero. In other words, partial mediation reflects cases in which both a direct effect of the causal variable on the outcome and an indirect effect, via the mediator, are found to exist.

Using the steps set out by Baron and Kenny (1986), path *a* was found to be significantly different from zero, as was path *b* when family SES was controlled. The total effect (path *c*, without taking account of the mediator) was reduced in strength when the mediating variable (storybook exposure) was controlled (path *c'*), suggesting partial mediation. All path weights and associated significance levels are reported in Table 4.8. Sobel's test was employed in order to estimate the size and significance of the mediated effect (Preacher & Hayes, 2004; Sobel, 1982). The results indicated that the indirect pathway from SES to receptive language via storybook exposure was significantly different from zero (Sobel's t=3.40, p<.001).

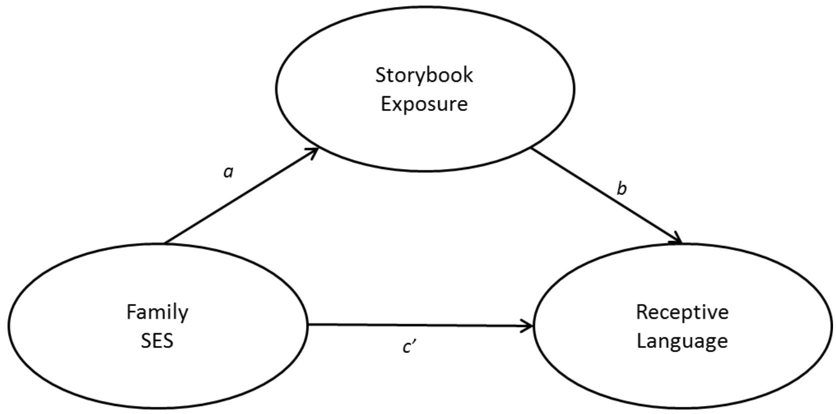


***Figure 4.4*: Proposed mediated effect from SES to receptive language**

The proportion of the effect of SES on receptive language that can be accounted for by mediation through storybook exposure was calculated by dividing the product of the weights of paths *a* and *b* by the path weight of the total effect *c* (Baron & Kenny, 1986).

ab / c = (.64 x .25) / .43 = .37

This suggests that 37% of the effect of family SES on children's receptive language is accounted for by mediation through storybook exposure in the home. On this basis, it can be concluded that, in the sample as a whole, storybook exposure plays a partial mediating role in the relationship between SES and receptive language.

Table 4.8
Path weights associated with the mediated relationship between SES and receptive language via storybook exposure

Path	Whole Sample b (SE)	β	FR b (SE)	β	TD b (SE)	β
c (total effect: SES → receptive language)	.43 (.07)	.25***	.35 (.11)	.30***	.40 (12)	.38***
a (SES → storybook exposure)	.64 (.07)	.54***	.59 (.06)	.52***	.60 (.16)	.41***
b (storybook exposure → receptive language)	.25 (.07)	.27***	.29 (.11)	.28**	.17 (.08)	.25*
c' (direct effect: SES → receptive language)	.27 (.08)	.25***	.18 (.12)	.15	.29 (.12)	.28*

Note: *p<.05; **p<.01; ***p<.001

The mediation analysis was repeated within the FR and TD groups separately. The path weights and associated significance levels were highly similar when the FR-SLI children were removed from the FR group analysis, therefore the reported coefficients represent effects in the full FR group. However, given the lack of significant correlation between environmental variables and receptive language in this group, it is plausible that the nature of this mediated relationship is different in language-impaired children.

The partial mediation effect identified within the whole sample held within the FR group. The model suggested that 48% of the effect of family SES on receptive language was carried by storybook exposure, and this indirect pathway was significantly different from zero (Sobel's t=2.55, p=.010). In the TD group, the same pattern was observed, but the indirect effect was weaker: 26% of the effect of family SES on receptive language was mediated by storybook exposure. Sobel's test did not reach significance in this group (Sobel's t=1.85, p=.064). The pathway parameters for both groups are reported in Table 4.8.

Overall, these mediation analyses converge with the broader HLE literature in suggesting that the relationship between family SES and children's receptive language skills at the outset of formal education is partially mediated by storybook exposure in the home.

4.2.2.7.2 The mediating role of receptive language in the relationship between storybook exposure and phoneme awareness

A second mediation analysis was conducted in order to examine the mediating effect represented in Figure 4.5. Path *a* was found to be significantly different from zero, as was path *b* when storybook exposure was controlled. The total effect (path *c*, without taking account of the mediator) was reduced in strength when the mediating variable (receptive language) was controlled (path *c'*), suggesting partial mediation. All path weights and associated significance levels are displayed in Table 4.9.

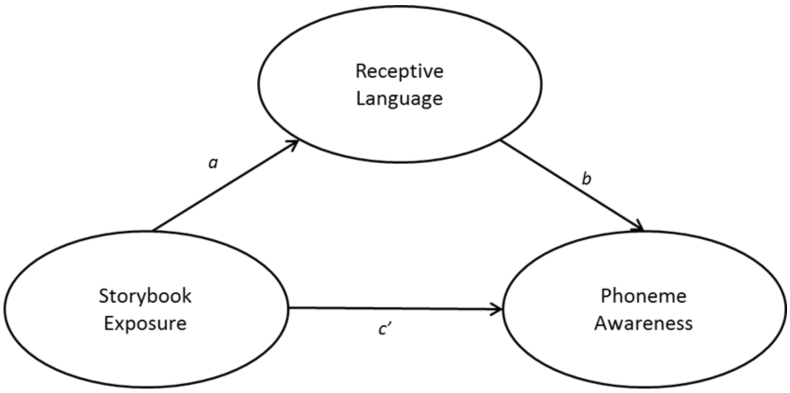


Figure 4.5: **Proposed mediated effect from storybook exposure to phoneme awareness**

Sobel's test indicated that the indirect pathway from storybook exposure to phoneme awareness via receptive language was significantly different from zero

(Sobel's t=3.74, p<.001). The proportion of the effect of storybook exposure on phoneme awareness that can be accounted for by mediation through receptive language was calculated using the equation given in Section 4.2.2.7.1. Results indicated that 50% of the effect of storybook exposure on children's phoneme awareness is accounted for by mediation through receptive language. Receptive language therefore acts as a partial mediator of the relationship between storybook exposure and phoneme awareness.

Table 4.9
Path weights associated with the mediated relationship between storybook exposure and phoneme awareness via receptive language

	Whole Sample		FR		TD	
Path	b (SE)	β	b(SE)	B	b (SE)	β
c (total effect: storybook exposure → phoneme awareness)	32(.07)	34***	20 (.09)	20*	.30 (.09)	.36**
a (storybook exposure → receptive language)	37 (.06)	41***	37 (.09)	36***	.25 (.08)	.36**
b (receptive language → phoneme awareness)	43 (.07)	42***	48 (.08)	51***	.13 (.14)	.11
c' (direct effect: storybook exposure → phoneme awareness)	16 (.07)	17*	02 (.09)	.02	.27 (.10)	.32**

Note: *p<.05; **p<.01; ***p<.001

However, when data from the two groups were analysed separately, different patterns emerged. For the FR children, the effect of storybook exposure on phoneme awareness was completely mediated by receptive language, in line with the Home Literacy Model. The indirect pathway via receptive language accounted for 89% of the effect of storybook reading on phoneme awareness, and Sobel's test indicated that this indirect pathway was highly significant (Sobel's t=3.39, p<.001). Conversely, there was no indirect effect in the TD group. The direct pathway from storybook exposure to phoneme awareness was statistically significant, and only 12% of this effect was mediated by receptive language. Sobel's test indicated that the indirect pathway was not significantly different from zero (Sobel's t=0.89, p=.373).

These analyses suggest that the relationship between storybook exposure in the home and children's concurrent phoneme awareness skills differs between 4-year-old FR and TD children. This difference may be driven between group differences in the developmental trajectory of phoneme awareness (see Section 4.2.2.2). Given that the current analyses are correlational, this difference is analysed further longitudinally in Study 2.

4.2.2.7.3 The mediating role of print knowledge in the relationship between direct instruction and phoneme awareness

The mediated relationship represented in Figure 4.6 was tested using the same procedure. Path *a* was found to be significantly different from zero, as was path *b* when direct instruction was controlled. The total effect (path *c*, without taking account of the mediator) was reduced to zero when the mediating variable (print knowledge) was controlled (path *c'*), suggesting complete mediation. All path weights and associated significance levels are displayed in Table 4.10.

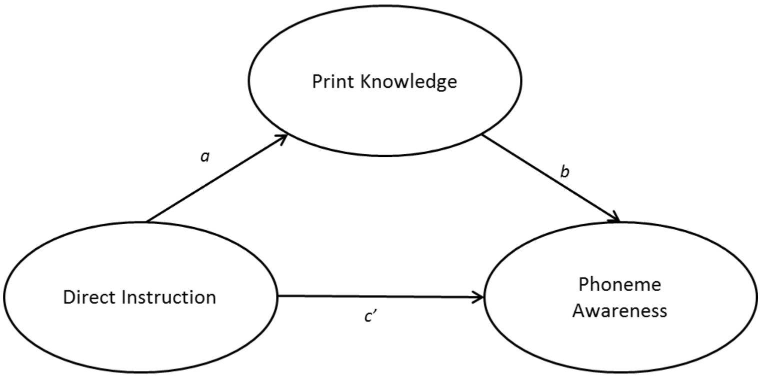


Figure 4.6: ***Proposed mediated effect from direct instruction to phoneme awareness***

Sobel's test indicated that the indirect pathway from direct instruction to phoneme awareness via print knowledge was significantly different from zero (Sobel's t=3.75, p<.001). All of the effect of direct instruction of literacy skills in the home on children's phoneme awareness was explained by the mediating influence of print knowledge, indicating complete mediation in line with the predictions of the Home Literacy Model.

Table 4.10

Path weights associated with the mediated relationship between direct instruction and phoneme awareness via print knowledge

	Whole Sample		FR		TD	
Path	b (SE)	β	b (SE)	β	b (SE)	β
c (total effect: direct instruction → phoneme awareness)	.19 (.09)	.16*	.23 (.10)	.20*	.15 (.13)	.14
a (direct instruction → print knowledge)	.36 (.09)	.29***	.39 (.10)	.33***	.34 (.15)	.27*
b (print knowledge → phoneme awareness)	.64 (.06)	.67***	.64 (.07)	.67***	.50 (.09)	.58***
c' (direct effect: direct instruction → phoneme awareness)	-.04 (.07)	-.03	-.02 (.08)	-.01	-.02 (.11)	-.02

Note: *p<.05; **p<.01; ***p<.001

The pattern of complete mediation of the effect of direct instruction on phoneme awareness by print knowledge held in both FR and TD groups. However, it was notable that pathway (*c*) between direct instruction and phoneme awareness was non-significant in the TD group, meaning that there was no direct effect to explain. Sobel's test suggested that the mediated pathway was highly significant in the FR group (Sobel's t = 3.49, p<.001).

4.2.3 Discussion

This study aimed to investigate the predictions of Sénéchal and LeFevre's (2002) Home Literacy Model in a sample of children at family-risk of dyslexia. The HLE was measured concurrently with children's receptive language, phoneme awareness and print knowledge around the time of school entry at 4 years old. Previous longitudinal and intervention research has suggested a causal link between home literacy input and the foundational skills of literacy, and it was considered important to assess this relationship at the time of school entry. However, this necessitated a concurrent design due to the earlier age of entry into primary education in the UK.

The current study replicated many others (e.g. Foster et al., 2005; Forget-Dubois et al., 2009) in finding that the effects of family SES on young children's oral language is partially mediated by the HLE, in particular children's early exposure to storybooks in the home. Moreover, this mediated relationship was not driven by parents' own orientation to reading; rather it was the interactions in which parents engaged their children with storybooks that predicted oral language skills. This study therefore provides confirmatory evidence that the HLE is a proximal mechanism by which distal socio-economic factors operate on language development.

In addition, the predictions of the Home Literacy Model were broadly upheld. Storybook exposure in the home, operationalised as parent's recognition of titles and authors of children's storybooks, predicted unique variance in children's receptive language skills, after accounting for family SES, children's non-verbal ability, the number of months in school and caregivers' orientation to reading. However, contrary to the predictions of the model, storybook exposure also predicted phoneme awareness. In FR children, this relationship was almost completely mediated by receptive language, as the model predicts. In TD children on the other hand, there was a direct effect of storybook exposure on phoneme awareness that could not be explained by broader language skills. The direction of causality of this relationship is not clear, since both constructs were measured concurrently. However, it is tentatively concluded that TD children in this sample may derive information about the constituent sounds of words implicitly through reading of storybooks with parents in the home. Conversely, the FR children, who already show impaired phonemic awareness skills, may not derive the same benefit.

In accordance with the Home Literacy Model, direct teaching of literacy skills in the home predicted children's knowledge of orthographic forms. Further, the predictive value of direct instruction on phoneme awareness was completely mediated by print knowledge in the FR group. No direct effect of direct instruction on phoneme awareness was observed in the TD group. This finding indicates that children at developmental risk of reading difficulties may derive particular benefit from early explicit teaching of letter and word forms, in that two key foundational skills of reading are enhanced through parental teaching of orthographic forms. However, the possibility that parents engage in more of this type of activity with children who show better early phonemic and letter identification skills cannot be discounted. The directionality of the effects described in this study is explored longitudinally in Study 2.

This study provides some evidence that the effects of storybook exposure on children's cognitive skills may depend on the individual child's developmental level. It is to be assumed that most learning that occurs in the context of storybook reading interactions is implicit, in that parents give explicit definitions of words or instruction on the component sounds of words relatively rarely (Hammett et al., 2003). In the main, children extrapolate meanings of unfamiliar lexical items from contextual cues, both verbal and visual. The data analysed in this study suggest that the relationship between storybook exposure and receptive language in children with impaired language skills is weaker than in those with language scores in the normal range. However, the small number of language-impaired children in this study does not allow for more in-depth analysis of the direct and indirect effects of HLE on language in this population.

In addition, the direct relationship that exists for TD children between storybook exposure and phoneme awareness is not present in FR children, who show relatively poor phoneme awareness skills at this age. It is plausible that, in order to extrapolate linguistic and/or phonological information within the rich context of storybook reading, children must have adequate pre-existing skills onto which to map this new information.

Finally, it is noteworthy that parental reports of children's interest in books did not relate to their concurrent foundational skills for reading. Several authors have suggested that children's interest in books may be a key driver of the relationship between the HLE and emergent literacy (e.g. Frijters et al., 2000). The lack of relationship in the present data may be partly caused by social desirability effects leading to limited variance in this construct. Alternatively, it may be that an early interest in books predicts the extent to which children engage with books independently in middle childhood, and thus effects on reading come online later in development.

4.3 *Study 2: The HLE as a Predictor of Children's Language and Emergent Literacy at Age Five*

4.3.1 Method

4.3.1.1 Participants

Attrition from *t2* to *t3* of the Wellcome project within the current sample was 1.1% (N=2). Both of these children were from the FR group and had family SES scores below the sample mean. The analyses reported in this study were therefore conducted with a sample of 186 participants (114 FR; 72 TD). Within the FR group, 85 children had language scores within the normal range (FR-only), while 29 were classified as language impaired at *t2* (FR-SLI). The mean age of the children at Wellcome project *t3* was 5 years and 8 months (s.d. = 3.45 months). The mean ages of the FR and TD groups did not differ significantly at this time point (FR mean = 68.60, s.d. = 3.64 months; TD mean = 67.81, s.d. = 3.08 months).

4.3.1.2 Measures

The battery of cognitive tests at *t3* of the Wellcome project had some overlap with the *t2* measures, but it was not possible to use exactly the same measures as those reported in Study 1 for a number of reasons. First, the *t3* assessment was conducted during one visit only, and consequently the battery was reduced in length. Second, some tests reported in Study 1, for example syllable matching and letter writing, were designed for use with younger children. Seven tests from the Wellcome project *t3* assessment battery were selected as outcome variables in the current study. Since receptive vocabulary was not assessed at this time point, a standardised measure of expressive vocabulary is substituted in this study. Phoneme deletion replaces alliteration matching as a more age-appropriate test of phonemic awareness. Finally, two tests of word reading are included as indicators of children's emerging decoding skills, since it was anticipated that letter-sound knowledge would approach ceiling when children had spent a year in full-time primary education. All measures are described in more detail below and internal reliability, as reported in the manuals of all standardised measures, is displayed in Table 4.11.

At this time point, two measures of oral language were administered:

(a) *Clinical Evaluation of Language Fundamentals: Fourth Edition UK (CELF IV UK)* (Wiig, Secord, & Semel, 2006): *Sentence Structure* sub-test was used to assess understanding of grammatical sentences. The procedure was identical to that described in relation to the test of Sentence Structure in Section 4.2.1.2.

(b) *CELF IV UK: Expressive Vocabulary* sub-test. In this test, children were shown a series of pictures of objects and actions of increasing difficulty, and asked to name them.

Two tasks at Wellcome project *t3* tapped children's phoneme awareness ability:

(a) *Phoneme Isolation* – as described in Section 4.2.1.2.

(b) *YARC: Phoneme Deletion sub-test.* In this test, children were shown a series of pictures and heard the corresponding word read aloud by the tester. They were first asked if they could repeat the word (e.g. 'plant') and then

instructed to say the word again, without either the initial, final or a medial phoneme (e.g. ‘Can you say ‘plant’ without the /n/?’ – /plat/).

Three tasks measured children’s decoding ability at age 5:

(a) *YARC Letter-sound Knowledge* sub-test – as described in Section 4.2.1.2.

(b) *YARC: Early Word Reading* sub-test – as described in Section 4.2.1.2.

(c) *YARC: Single Word Reading* sub-test. Children were asked to read aloud a list of 60 words, which included regular and irregular items of increasing difficulty. The test was discontinued after five consecutive errors or refusals.

Table 4.11
Published reliability coefficients for new cognitive tests at t3

Test	Reliability (Cronbach’s α)	Age range
CELF IV Sentence Structure	.66	5;6-5;11
CELF IV Expressive Vocabulary	.84	5;6-5;11
YARC Phoneme Deletion	.93	3;0-8;4
YARC Single Word Reading	.98	3;0-8;4

4.3.1.3 Procedure

Children were tested approximately one year after Wellcome project *t2* on a somewhat shorter battery of cognitive tests. The interval between testing points 2 and 3 ranged from 8 to 17 months. The majority of assessments at Wellcome project *t3* took place in the child’s school and, where possible, a quiet room was requested in order to minimise distractions. In cases where an assessment fell due during school holidays, testing was conducted in the child’s home. In all, the test battery lasted for approximately two hours. Children were given a break of 15 minutes during this time, and further short breaks if needed.

4.3.2 Results

4.3.2.1 T3 cognitive variables: Descriptive statistics

Descriptive statistics for the seven outcome measures described in Section 4.3.1.2 across the whole sample are presented in Table 4.12. There were very few missing data points at this assessment; only the single word reading measure had cases missing. Distributions were acceptable for most variables, but since sentence structure and phoneme isolation displayed a slight negative skew, these variables were reflected and then subjected to square root transformation in advance of parametric inferential tests. As expected, letter-sound knowledge showed ceiling effects and was therefore also transformed before parametric analysis.

4.3.2.2 Group differences in t3 cognitive variables

Independent t-tests were run on the seven cognitive variables, in order to examine differences between the FR and TD groups. In Table 4.13, group means for the raw data are presented; however the transformed variables were used in the inferential analyses.

Table 4.12
T3 *outcome measures: Descriptive statistics for the whole sample (N=186)*

Measure	Percentage missing	Mean (s.d.)	Range	Skewness	Kurtosis
Oral Language					
Expressive Vocabulary[1]	0%	28.13 (9.10)	2-47	-.73	.61
Sentence Structure[2]	0%	20.97 (3.50)	9-26	-1.01	.74
Phoneme Awareness					
Phoneme Isolation[3]	0%	13.06 (3.90)	0-16	-1.61	1.86
Phoneme Deletion[4]	0%	6.92 (2.54)	0-12	-.17	-.21
Emergent Decoding					
Letter-sound Knowledge[5]	0%	29.42 (4.20)	8-32	-2.89	.18
Early Word Reading[6]	0%	17.06(8.92)	0-30	-.08	-1.09
Single Word Reading[7]	1.1%	11.09 (10.14)	0-44	.90	.05

Note: [1]max=40; [2]max=26; [3]max=16; [4]max=12; [5]max=32; [6]max=30; [7]max=60

As at *t2*, TD group means are higher than FR group means on all variables, and these differences are all statistically significant, with the exception of letter-sound knowledge which approaches ceiling in both groups. The group differences in expressive vocabulary, phoneme deletion and both measures of word reading represent moderate effect sizes, while those in sentence structure, phoneme isolation, and letter-sound knowledge represent small effect sizes. It is noteworthy that the deficit in emergent decoding in the FR group is larger in magnitude at age 5 than at age 4.

Table 4.13
Differences between FR (n=114) and TD (n=72) groups on t3 cognitive measures

Measure	FR mean (s.d.)	TD mean (s.d.)	*t*(df)	*p*	*Effect size d*
Oral Language					
Expressive Vocabulary	25.76 (9.94)	31.88 (5.95)	4.71 (184)	<.001	.75
Sentence Structure	20.49 (3.80)	21.74 (2.84)	2.39 (184)	.018	.37
Phoneme Awareness					
Phoneme Isolation	12.47 (4.22)	14.00 (3.13)	2.66 (184)	.009	.41
Phoneme Deletion	6.41 (2.59)	7.74 (2.26)	3.57 (184)	<.001	.55
Decoding					
Letter-sound Knowledge	28.95 (4.23)	30.18 (4.06)	1.98 (184)	.051	.30
Early Word Reading	14.97 (8.85)	20.36 (9.75)	4.19 (184)	<.001	.58
Single Word Reading	8.81 (9.76)	14.34 (9.75)	3.96 (182)	<.001	.57

The FR-SLI children were removed from the analysis, in order to compare group means for children with a family-risk of dyslexia only with TD controls (Table 4.14). At this time point, significant group differences remain between FR-only and TD children in all measures except sentence structure and letter-sound knowledge. Exclusion of the language impaired children from the analysis attenuates effect sizes somewhat, but at this time point children in the FR-only group show deficits in vocabulary, phoneme awareness and word reading compared with the TD group.

Table 4.14
Differences between FR-only (n=85) and TD (n=72) groups on t3 cognitive measures

Measure	FR-only mean (s.d.)	TD mean (s.d.)	*t*(df)	*p*	*Effect size d*
Oral Language					
Expressive Vocabulary	28.45 (8.74)	31.88 (5.95)	2.82 (155)	.005	.46
Sentence Structure	21.48 (2.87)	21.74 (2.84)	.56 (155)	.580	-
Phoneme Awareness					
Phoneme Isolation	13.06 (3.47)	14.00 (3.13)	1.77 (155)	.079	.28
Phoneme Deletion	6.68 (2.54)	7.74 (2.26)	2.72 (155)	.007	.44
Emergent Decoding					
Letter-sound Knowledge	29.76 (2.76)	30.18 (4.06)	0.76 (155)	.449	-
Early Word Reading	16.61 (8.80)	20.36 (9.75)	2.77 (155)	.006	.40
Single Word Reading	10.18 (9.72)	14.34 (9.75)	2.85 (154)	.005	.43

4.3.2.3 Correlations among t3 cognitive variables

Table 4.15 displays partial inter-correlations among six cognitive variables, controlling for children's age at *t3*. The measure of letter-sound knowledge is omitted from this analysis, on the basis of the ceiling effects described above. As at *t2*, the predicted factor structure is seen most clearly in the TD group correlation matrix; in particular, there is a clear dissociation between measures of oral language and phoneme awareness. In the FR group, on the other hand, the two oral language measures are significantly correlated with phoneme isolation and the two measures of word reading. These associations are markedly stronger than those in the TD group, and may reflect bootstrapping of weak phonological skills onto stronger oral language skills in the FR group.

Table 4.15
Partial correlations among t3 cognitive measures, controlling for child age; FR (n=114) above diagonal, TD group (n=72) below diagonal

	1.	2.	3.	4.	5.	6.
1. Expressive Vocabulary		.41***	.28**	.14	.35***	.35***
2. Sentence Structure	.46***		.40***	.24*	.42***	.35***
3. Phoneme Isolation	.09	.11		.53***	.57***	.43***
4. Phoneme Deletion	.08	.10	.39***		.67***	.66***
5. Early Word Reading	.20	.19	.52***	.62***		.89***
6. Single Word Reading	.21	.17	.37**	.54***	.88***	

Note: *p<.05; **p<.01; ***p<.001

Confirmatory factor analysis indicated that the proposed factor structure was robust in the TD group; in other words, an oral language factor was defined by expressive vocabulary and sentence structure, a phoneme awareness factor by phoneme isolation and phoneme deletion, and an emergent decoding factor by early word reading and single word reading. Model fit was excellent in the TD group, but poor in the FR group, chiefly because of poor loadings onto the oral language factor. Full details of these CFA models are provided in the appendices. In order to maintain consistency with the analyses presented in Study 1, in addition to the theoretical rationale for the three constructs, composite scores were formed by computing means of standardised, age-regressed raw scores.

4.3.2.4 Correlations between SES, HLE and t3 cognitive variables

Table 4.16 displays correlations between family SES, *t2* HLE composites and the three *t3* cognitive constructs. As at *t2*, family SES shows a positive association with oral language only in the TD group, but correlates with all three cognitive composites in the FR group. Storybook exposure is positively correlated with oral language in both groups, although the magnitude of the correlation is attenuated in the TD group. A significant, positive correlation also emerges between storybook exposure and phoneme awareness in the FR group only. Direct instruction at age 4 correlates significantly with phoneme awareness in the TD group, and emergent decoding in the FR group.

Table 4.16
Correlations between SES, HLE and t3 cognitive constructs; FR group (n=114) above diagonal, TD group (n=72) below diagonal

	1.	2.	3.	4.	5.	6.
1. Family SES				.31***	.27**	.23*
2. Storybook exposure *t2*				.36***	.25**	.16
3. Direct instruction *t2*				.02	.09	.19*
4. Oral language *t3*	.38***	.27*	-.01		.37***	.45***
5. Phoneme awareness *t3*	-.17	.06	.30*	.13		.69***
6. Decoding *t3*	.04	.22†	.06	.23*	.63***	

*Note: †p<.08; *p<.05; **p<.01; ***p<.001*

4.3.2.5 Hierarchical regression analyses

As in Study 1, the relationships between HLE at age 4 and children's emergent literacy skills one year later were examined further in a series of hierarchical regression models. Family SES, children's non-verbal ability, the number of months that the child had spent in full-time school at the *t3* assessment and caregiver's orientation to reading (Adult Author Checklist) were entered as a first step. The two HLE constructs were entered at the second step, and the dummy variables representing FR and LI status at the third step. Models predicting oral language, phoneme awareness and emergent decoding at age five are presented in Table 4.17.

The model accounts for 42% of the variance in children's oral language skills at *t3*. Language skills are significantly predicted by family SES, non-verbal ability, storybook exposure and, negatively, by language impaired status. The proportion of variance accounted for by storybook exposure has reduced slightly to 3% at this time point. This may be partly due to the combination of receptive and expressive measures at this time point; there is some evidence for stronger effects of storybook exposure on receptive language (DeBaryshe, 1993). Phoneme awareness at age 5 is significantly predicted by non-verbal ability, storybook exposure and direct instruction of orthographic forms in the home a year previously. FR status is also marginal negative predictor of this construct. Overall, this model accounts for 25% of the variance in children's phoneme awareness, of which early HLE interactions contribute a unique 4%. Finally, decoding skills are predicted by non-verbal ability, the number of months in school and FR status. Family SES, storybook exposure and direct instruction of orthographic forms are marginally significant predictors. 31% of the variance in children's decoding ability is explained by this model.

Table 4.17
Hierarchical regression models, predicting oral language, phoneme awareness and decoding at age 5

Predictor	ΔR^2	B (SE B)	β	*p*
		Outcome Variable: Oral Language		
Step 1				
Family SES	.29	.20 (09)	.18	.025
Non-verbal ability		.01 (.00)	.07	.010
Months in school at *t3*		.01 (.01)	.07	.276
AAC		.00 (.01)	-.02	.834
Step 2				
Storybook exposure	.02	.15 (.07)	.17	.035
Direct instruction		.00 (.07)	.00	.964
Step 3				
FR status	.11	-.07 (.12)	-.04	.553
LI status		-.88 (.16)	-.37	<.001
		Total R^2=.42; F (8,175) =15.53, p<.001		
		Outcome Variable: Phoneme Awareness		
Step 1				
Family SES	.18	.14 (.10)	.13	.157
Non-verbal ability		.01 (.00)	.22	.004
Months in school at *t3*		.02 (.01)	.11	.117
AAC		-.01 (.01)	-.11	.247
Step 2				
Storybook exposure	.04	.17 (.08)	.18	.047
Direct instruction		.18 (.08)	.15	.029
Step 3				
FR status	.03	-.26 (.14)	-.15	.053
LI status		-.25 (.18)	-.11	.166
		Total R^2=.25; F (8,175) =7.21, p<.001		
		Outcome Variable: Emergent Decoding		
Step 1				
Family SES	.25	.19 (.11)	.16	.075
Non-verbal ability		.02 (.00)	.29	<.001
Months in school at *t3*		.03 (.01)	.14	.035
AAC		-.01 (.01)	-.11	.219
Step 2				
Storybook exposure	.03	.17 (.09)	.16	.059
Direct instruction		.16 (.09)	.13	.055
Step 3				
FR status	.03	-.30 (.15)	-.15	.040
LI status		-.26 (.20)	-.10	.179
		Total R^2=31; F (8,175) =9.80, p<.001		

4.3.2.6 Mediation analyses

The indirect relationships described in Section 4.2.2.7 were tested longitudinally. In the whole sample, the effect of family SES on oral language skill continued to be partially mediated by storybook exposure, and the indirect effect was significant (Sobel's t=2.92, p<.001) accounting for 31% of the total effect. This relationship also held in the FR group, in which 45% of the effect of SES on oral language was carried through storybook exposure (Sobel's t=2.44, p=.007). However, the pathway between storybook exposure and oral language was weak in the TD group in this longitudinal analysis, and therefore the indirect effect was non-significant (Sobel's t=1.09, p=.137). All path coefficients are presented in Table 4.18.

Table 4.18
Path coefficients for mediated relationship between family SES and oral language ability at t3 via storybook exposure

	Whole Sample		FR		TD	
Path	b (SE)	β	b (SE)	β	b (SE)	β
c (total effect: SES → oral language)	.45 (.07)	.42***	.37 (.11)	.31***	.37 (.11)	.38***
a (SES → storybook exposure)	.63 (.08)	.53***	.58 (.09)	.51***	.60 (.13)	.41***
b (storybook exposure → oral language)	.22 (.07)	.24**	.29 (.11)	.28**	.09 (.08)	.14
c' (direct effect: SES → oral language)	.32 (.08)	.29***	.20 (.12)	.17	.31 (.12)	.32**

Note: *p<.05; **p<.01; ***p<.001

Turning to the indirect effects of early HLE on the development of phoneme awareness, the partial mediation of the effect of storybook exposure on phoneme awareness by oral language continues to be statistically significant in the whole sample (Sobel's t=3.37, p<.001) and in the FR group (Sobel's t=2.53, p=.006), accounting for 50% of the total effect (46% in the FR group). However, the direct and indirect pathways from storybook exposure to phoneme awareness are weak and non-significant in the TD group (Sobel's t=0.91, p=.180). Coefficients are displayed in Table 4.19. This pattern of results is the reverse of that found in Study 1, in that the concurrent analyses showed a direct effect of storybook exposure on phoneme awareness in the TD but not the FR group.

Table 4.19
Path coefficients for mediated relationship between storybook exposure and phoneme awareness at t3 via oral language

	Whole Sample		FR		TD	
Path	b (SE)	β	b (SE)	β	b (SE)	β
c (total effect: storybook exposure → phoneme awareness)	.23 (.07)	.25***	.26 (.10)	.25**	.05 (.09)	.06
a (storybook exposure → oral language)	.35 (.06)	.39***	.37 (.09)	.36***	.18 (.08)	.27*
b (oral language → phoneme awareness)	.33 (.08)	.33***	.32 (.10)	.32***	.14 (.14)	.13
c' (direct effect: storybook exposure → phoneme awareness)	.12 (.07)	.12	.14 (.10)	.13	.02 (.09)	.03

Note: *p<.05; **p<.01; ***p<.001

The indirect pathway from direct instruction of letters and words in the home to phoneme awareness via emergent decoding also shows differential weights between the groups. Across the sample as a whole, the effect of direct instruction on phoneme awareness is relatively weak, and 64% of this effect is mediated by emergent decoding (Sobel's t= 1.68, p=.046). In the FR group the modest effect of direct instruction on phoneme awareness skills a year later is completely mediated by emergent decoding (Sobel's t=2.04, p=.020). In the TD group, on the other hand, no mediating effect exists (Sobel's t=0.53, p=.297) since the pathway from direct instruction to emergent decoding is non-significant. However, the main effect of early direct instruction on phoneme awareness a year later is significant in the TD group (see table 4.20).

Table 4.20
Path coefficients for mediated relationship between direct instruction and phoneme awareness at t3 via emergent decoding

	Whole Sample		FR		TD	
Path	b (SE)	β	b (SE)	β	b (SE)	β
c (total effect: direct instruction → phoneme awareness)	.16 (.09)	.14*	.10 (.11)	.09	.29 (.11)	.30**
a (direct instruction →emergent decoding)	.17 (.10)	.13	.23 (.11)	.19*	.08 (.15)	.06
b (emergent decoding → phoneme awareness)	.62 (.05)	.69***	.68 (.07)	.69***	.47 (.07)	.62***
c' (direct effect: direct instruction → phoneme awareness)	.06 (.06)	.05	-.05 (.08)	-.04	.26 (.09)	.26**

Note: *p<.05; **p<.01; ***p<.001

4.3.3 Discussion

This study examined the predictive value of the HLE, measured around the time of school entry, on three foundational skills for reading measured one year later (oral language, phoneme awareness and emergent decoding). In combination with the results of Study 1, different patterns of relationships between home environment, oral language and emergent literacy variables were found for FR and TD children.

4.3.3.1 The role of the HLE in the emergent literacy development of typically developing children

For the 72 TD children included in the current study, exposure to storybooks in the home was predictive of receptive language skills concurrently, and this relationship accounted for a significant portion of the total effect of family SES on receptive language. The proportion of variance in children's language skills accounted for by the storybook exposure measure at both time points was modest, in line with previous studies (Scarbrough & Dobrich, 1994), and the effect of storybook exposure on oral language skills measured one year later was non-significant in this group. This may be accounted for by the inclusion of a test of expressive vocabulary at *t3*, but may also indicate that when these children have settled into primary education, other environmental influences on language development supersede the effects of home environment.

Counter to the predictions of the Home Literacy Model (Sénéchal & LeFevre, 2002), storybook exposure predicted TD children's concurrent phoneme awareness ability independently of receptive language. This relationship was no longer significant when measured longitudinally. It is suggested that this unexpected pathway is driven by the already relatively advanced phonological skills of the TD children in the current sample at age 4. Since the introduction of the Early Years curriculum in the UK, many children receive early exposure to phonics training in preschool and nursery settings (Rose, 2005). It is hypothesised that, when children with no genetic susceptibility to phonological impairment begin to grasp the concept of breaking words into their constituent sounds, the development of these skills may be driven forward by exposure to children's literature, which is characteristically rich in rhyming and alliterative material.

Direct instruction of orthographic forms in the home predicted TD children's early print knowledge, which completely mediated the pathway between direct instruction and concurrent phoneme awareness. This pattern is in line with the predictions of the Home Literacy Model. The effects of early instruction in the home on word reading at age 5 were not significant in the TD group. It is important to note that the measures of decoding at *t2* took knowledge of letter forms as the key unit of interest, while the allied construct at *t3* measured word reading. It is plausible that early direct instruction has effects which are specific to letter knowledge, and do not necessarily transfer to the blending skills necessary for word decoding. However, early direct instruction predicted phoneme awareness skills measured one year later, independently of orthographic decoding. The longitudinal effect of direct instruction on phoneme awareness may reflect the close relationship between early letter knowledge and developing phonological awareness skills (Blaiklock, 2004).

Overall, then, for typically developing children, the effects of the HLE are most pronounced around the time of school entry at age 4. Thereafter, other environmental effects, particularly of the classroom environment, are likely to become increasingly important in the development of these children's emergent literacy.

4.3.3.2 The role of the HLE in the emergent literacy development of children at family-risk of dyslexia

A somewhat different picture emerges from analysis of data within the FR group. For these children, storybook exposure in the home is a stronger mediator of the effects of SES on language, both concurrently and longitudinally, than in the TD group. Given that the parental education and occupation levels are lower overall in the FR group than the TD group, this finding may reflect the protective role of a rich exposure to print in the early years against risk associated with lower family SES.

There is no effect of storybook exposure on FR children's phoneme awareness ability at age 4, in contrast to the TD group; however, a relationship emerges a year later at age 5. It is likely that any implicit learning about the constituent sounds of words that takes place in the linguistically rich context of storybook reading depends on the developmental level of the child. For at-risk children whose phonological awareness development is slow (Pennington & LeFly, 2001), it may be more difficult to extrapolate phonological information about words implicitly. However, the fact that this effect emerges longitudinally in the FR group highlights the importance of a rich early HLE in the early literacy development of these at-risk children.

As in the TD group, direct instruction of orthographic forms in the home predicts print knowledge directly and phoneme awareness indirectly. In this population of children, it is possible that weak phonological skills are bootstrapped by knowledge of the orthographic forms explicitly taught by parents. The relationship between direct instruction and word reading at age 5 is unique in the FR group, and again may be contingent upon the developmental level of the child. Early support in the home which principally scaffolds letter knowledge may exert effects in the earliest stages of learning to decode, and so this longitudinal relationship may be driven by poorer word reading skills in the FR group.

In summary, the studies described above provide broad support for Sénéchal and LeFevre's (2002) Home Literacy Model, with a number of provisos. First, the effects of early storybook exposure and direct instruction of orthographic forms appear to come online earlier in the development of this sample of British children.

This is likely due to the earlier onset of formal literacy instruction at school in the UK than Canada. In the UK, where phonics instruction is emphasised in reception year and often in preschool environments, the current analyses indicate that rich exposure to literature may also promote phoneme awareness. The concurrent design of Study 1 precludes firm causal interpretation, but the weight of literature suggests that early literacy-related interaction in the home does causally predict children's emergent literacy.

Second, the trajectory of HLE effects in early literacy development is not the same across all children. For those at developmental risk of reading difficulties, the impact of the HLE on phoneme awareness and word reading appears to emerge later than in TD controls. The benefit to be derived from early exposure to books and letter forms in the home may be universal, but may show differential time courses depending on children's developmental level.

Chapter 5: The HLE as a Longitudinal Predictor of Early Reading Development

5.1 Introduction

The aim of this study was to test the second part of Sénéchal and LeFevre's (2002) Home Literacy Model, by evaluating the predictive value of the early home literacy environment for children's reading skills (Figure 5.1). In Sénéchal and LeFevre's longitudinal analysis, reading at the end of Grade 1 (age 7) was operationalised as a composite of performance on the word reading, reading vocabulary and reading comprehension subtests of the MacGinitie Reading Tests. It was decided to analyse decoding and reading comprehension as separate outcomes in the current study.

This chapter presents two longitudinal observed variables path models, delineating the direct and indirect pathways from HLE measured at age 4 (*t2* of the Wellcome project) via foundational skills for literacy at age 5 (Wellcome project *t3*) to reading outcomes at age 6 (Wellcome project *t4*). In line with the Home Literacy Model, it was predicted that the HLE would predict decoding and comprehension at age 6 via a number of indirect pathways. First, it was expected that early parental instruction of orthographic forms would predict emergent decoding skills, which would in turn predict later decoding and comprehension skills. Second, on the basis of the analyses presented in Chapter 4, it was predicted that the relationship between family SES and oral language ability would be mediated by early storybook exposure in the home, and that this pathway would relate to children's reading comprehension skills. Finally, on the basis of the mediation analyses presented in section 4.3.2.6, it was expected that the indirect pathway from HLE at age 4 to reading skills at age 6 via phoneme awareness at age 5 would be significant in the FR group only.

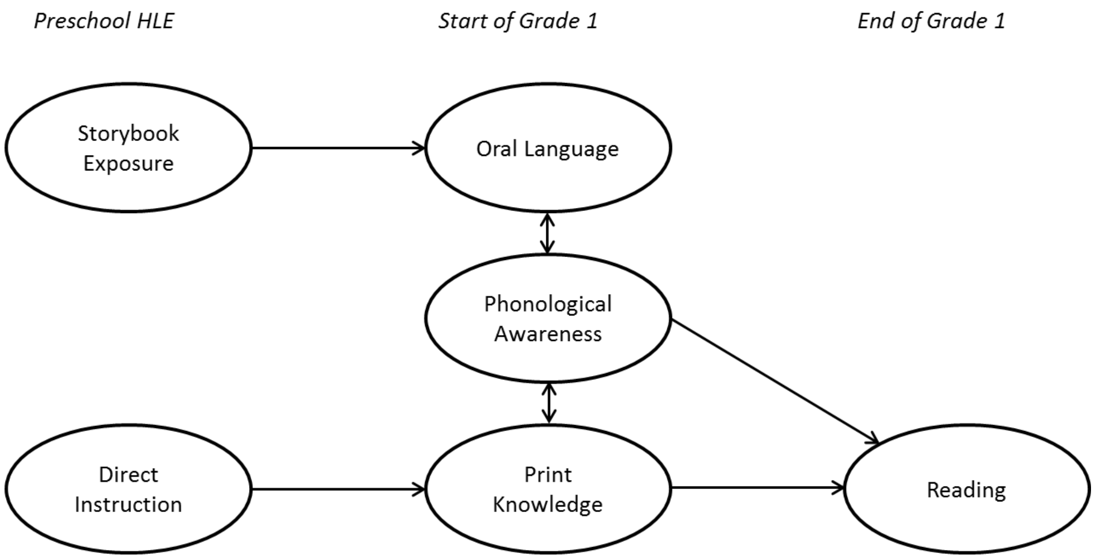


Figure 5.1: **Longitudinal predictions of the Home Literacy Model (Sénéchal & LeFevre, 2002)**

5.2 Method

5.2.1 Participants

The sample at *t4* was identical to that described in Section 4.3.1.1, since there was no attrition from *t3* of the Wellcome project within the current sample. Of the 186 children tested at this time point, 116 were FR and 72 TD. The average age at testing was 6 years and 7 months (mean=78.99; s.d.=4.33 months), and mean ages were comparable in the FR group (79.14; s.d.=3.83) and TD group (78.89; s.d.=4.63).

5.2.2 Measures

Measures of HLE and SES are described in Chapter 3; indicators of oral language, phoneme awareness and emergent decoding at *t3* are described in Section 4.3.1.2. At Wellcome project *t4*, four measures were used to assess decoding ability. These were:

(a) *YARC: Early Word Reading* sub-test – as described in Section 4.3.1.2.

(b) *YARC: Single Word Reading* sub-test – as described in Section 4.3.1.2.

(c) *Graded Nonword Reading Test (GNWRT)* (Snowling, Stothard, & McLean, 1996). In this test, children were presented with 20 phonotactically legal nonsense words of increasing complexity (e.g. *tegwop*). Testing was discontinued after six consecutive errors.

(d) *Spelling*: This was a bespoke task for the Wellcome project. Children were read aloud a series of 10 words and asked to write them down on a piece of paper, which presented picture representations of the target items.

At this time point, there was one measure of reading comprehension:

YARC Primary Passage Reading Comprehension (Snowling et al., 2010). In this test, children were presented with three short passages of increasing difficulty, and asked to read them aloud. Reading errors were corrected by the examiner; if a child made 16 or more reading errors on a given passage, testing was discontinued. After reading each passage, a series of comprehension questions was posed verbally by the examiner, which tested vocabulary comprehension, comprehension of literal meaning and inference.

Mean reliability for children between the ages of 4;6 and 8;4 on these three passages is .68, as published in the test manual.

Finally, non-verbal ability was assessed again at this time point, using a task analogous to the non-verbal measure employed at *t2*:

Weschsler Intelligence Scale for Children (WISC IV UK) (Wechsler, 2004): *Block Design* sub-test. Children were required to reproduce a series of geometric designs presented in a booklet, using nine two-tone blocks. Testing was discontinued after three consecutive errors. Published internal reliability for this test is .77.

5.2.3 Procedure

The measures described in the current analyses were assessed as part of a longer cognitive battery. Testing in Wellcome project *t4* took place over two visits, almost always in the child's school setting. One researcher visited each child on both occasions, and testing sessions were separated by approximately one week. As at previous time points, children were given a break of 15 to 20 minutes during each testing session, and further short breaks were offered if needed.

These longitudinal data were examined with path models for observed variables using MPlus (Muthén & Muthén, 2010). In the current analyses, these observed variables were the composites described in Chapters 3 and 4. Essentially, path analyses represent the structural, regression-based models of SEM, without the measurement models. In this case, measurement models were computed to test the underlying factor structures of the HLE and cognitive variables separately (see sections 3.1.4 and 4.2.2.4), and the structural models were simplified by using the relevant composites. The longitudinal path models focus on possible causal pathways between variables, both in terms of direct and indirect (mediated) effects.

5.3 Results

5.3.1 *T4* cognitive variables: Descriptive statistics

Descriptive statistics for the *t4* literacy outcome measures are presented in Table 5.1. Datasets were complete for all variables with the exception of reading comprehension, where there was one missing data point. Distributions were acceptable for most variables, but a slight negative skew was observed in early word reading at this time point, as TD children approached ceiling on this measure.

Table 5.1
T4 *literacy outcome measures: Descriptive statistics for the whole sample (N=186)*

Measure	Percentage missing	Mean (s.d.)	Range	Skewness	Kurtosis
Decoding					
Early Word Reading[1]	0%	24.16 (7.68)	1-30	-1.37	.85
Single Word Reading[2]	0%	22.33 (12.85)	0-55	.08	-.89
Nonword Reading[3]	0%	10.01 (6.24)	0-20	-.13	-1.25
Spelling[4]	0%	5.26 (2.87)	0-10	.29	-1.03
Reading Comprehension					
Passage Comprehension[5]	0.5%	13.19 (6.87)	0-23	.38	-1.17

Note: [1]max=30; [2]max=60; [3]max=20; [4]max=10; [5]max=24

5.3.2 Group differences

Independent t-tests examined differences between the FR and TD groups on the five literacy measures; these are presented in Table 5.2. The TD group means were significantly higher than the FR group means on all literacy measures; these group differences represent medium to large effect sizes. Effect sizes were attenuated somewhat when the FR-SLI sub-group was removed from the sample (see Appendix 4); however, the pattern of group differences remained the same.

Table 5.2
Differences between FR (n=114) and TD (n=72) groups on t4 cognitive variables

Measure	FR mean (s.d.)	TD mean (s.d.)	*t*(df)	*p*	*Effect size d*
Decoding					
Early Word Reading	22.01 (8.35)	27.56 (4.86)	5.11 (184)	<.001	.81
Single Word Reading	18.84 (13.11)	27.86 (10.29)	4.95 (184)	<.001	.77
Nonword Reading	8.22 (6.42)	12.85 (4.76)	5.27 (184)	<.001	.82
Spelling	4.67 (2.79)	6.19 (2.77)	3.65 (184)	<.001	.55
Reading Comprehension					
Passage Comprehension	11.04 (6.99)	16.57 (5.14)	5.79 (183)	<.001	.90

5.3.3 Correlations among *t4* literacy variables

Partial correlations among the five literacy measures, controlling for children's age at *t4*, are presented in Table 5.3. In both the FR and TD groups, all five literacy measures are strongly and significantly correlated. (The same analyses within the FR-only and FR-SLI subgroups show similar magnitudes of correlation, and are included in the appendices). The correlation coefficients between reading comprehension and the measures of decoding are extremely high, as expected at this early stage of children's reading development before fluency has typically been achieved. These coefficients provide a statistical rationale for forming a literacy composite using all five measures. However, since it was predicted that early exposure to storybooks may play a greater role in children's comprehension than decoding skills, it was decided to analyse reading comprehension as an independent outcome variable, despite its high correlations with the other measures.

Table 5.3
Correlations among t4 literacy variables; FR group (n=114) above diagonal; TD group (n=72) below diagonal

	1.	2.	3.	4.	5.
1. Early Word Reading		.81***	.71***	.72***	.76***
2. Single Word Reading	.78***		.86***	.83***	.85***
3. Nonword Reading	.55***	.77***		.70***	.77***
4. Spelling	.54***	.71***	.62***		.74***
5. Reading comprehension	.81***	.71***	.52***	.44***	

Note: ****p*<.001; shaded cells represent measures of decoding

5.3.4 Correlations between SES, HLE and *t4* literacy variables

Each of the five literacy variables was residualised for children's age in months at the time of testing. A decoding composite score was calculated as the mean of the standardised, age-residualised scores on early word reading, single word reading, nonword reading and spelling. Reading comprehension was analysed as a single measure.

The correlations between the resultant two *t4* literacy outcome scores and the composites of SES and HLE described in Chapters 3 and 4 are displayed in Table 5.4. In the TD group, reading comprehension is moderately correlated with family

SES and storybook exposure, but the relationships between HLE, SES and decoding are weak and non-significant. In the FR group, decoding at *t4* is weakly and significantly correlated with family SES and early storybook exposure, and there is a moderate positive correlation between reading comprehension and storybook exposure. Early direct instruction of orthographic forms does not relate significantly to reading outcomes at age 6. (Correlation matrices relating to the FR-only and FR-SLI sub-groups are included in the Appendix 4.)

Table 5.4
Correlations between SES, HLE and t4 *literacy composites; FR group (n=114) above diagonal; TD group (n=72) below diagonal*

	1.	2.	3.	4.	5.	6.
1. Family SES					.23*	.29**
2. Storybook Exposure					.24**	.41***
3. Direct Instruction					.15	.12.
4. Child Interest					.03	.10
5. Decoding *t4*	.20	.19	.08	-.04		
6. Reading Comprehension *t4*	.24*	.27*	.08	-.01		

Note: *p<.05; **p<.01; ***p<.001

5.3.5 Hierarchical regression analyses

In order to examine the predictive value of early literacy-related interactions in the home for outcomes at age 6, two hierarchical regression models were constructed with decoding and reading comprehension at *t4* as the outcome measures. As a first step, the family SES composite, children's non-verbal ability (tested at *t4*) and adults' orientation to reading were entered as control variables. The number of months that children had spent in school was omitted from this model, as at this testing point children were generally in their third year of formal education. The two HLE composite variables were entered as a second step, and the dummy variables representing FR and LI status as a third step. All coefficients and model fit statistics are presented in Table 5.5.

Decoding ability at age 6 was significantly predicted by family SES, non-verbal ability, direct instruction and, negatively, by FR and LI status. Neither parents' orientation to reading nor storybook exposure was a significant predictor of this construct. The model accounted for 28% of the variance in decoding ability, of which a unique 3% was explained by the HLE constructs.

Table 5.5

Hierarchical regression models, predicting t4 literacy outcomes

Predictor	ΔR^2	B (SE B)	β	*p*
Outcome Variable: Decoding (t4)				
Step 1				
Family SES	.20	.25 (.10)	.19	.031
Non-verbal ability		.26 (.06)	.29	<.001
AAC		.01 (.01)	.01	.920
Step 2				
Storybook exposure	.03	.10 (.09)	.11	.226
Direct instruction		.19 (.08)	.15	.022
Step 2				
FR status	.05	-.33 (.14)	-.18	.016
LI status		-.38 (.18)	-.15	.038
Total R^2=.28; F (7, 176) =9.95, p<.001				
Outcome Variable: Reading Comprehension (t4)				
Step 1				
Family SES	.26	.08 (.10)	.06	.430
Non-verbal ability		.21 (.06)	.21	.001
AAC		.00 (.01)	.01	.898
Step 2				
Storybook exposure	.05	.23 (.09)	.21	.008
Direct instruction		.18 (.08)	.14	.023
Step 3				
FR status	.11	-.30 (.14)	-.15	.029
LI status		-.82 (.18)	-.30	<.001
Total R^2=.42; F (7,175) =18.30, p<.001				

The regression model relating to children's reading comprehension at age 6 accounted for 42% of the variance, of which 5% was accounted for by the HLE constructs. Non-verbal ability, early storybook exposure and direct instruction of orthographic forms were all significant predictors of reading comprehension. As comprehension at this age was highly dependent on word reading, FR status negatively predicted children's performance and, as expected, LI status was a highly significant negative predictor in this model. Family SES and caregivers' orientation to reading did not predict children's reading comprehension.

In a second set of analyses, autoregressive hierarchical regression models were built, in order to evaluate whether early HLE interactions continued to predict literacy skills at age 6, when emergent literacy skills assessed a year previously were controlled. To reduce the number of predictor variables, the Adult Author Checklist was removed from the models, since it did not contribute variance either to decoding or reading comprehension. In these models, therefore, family SES and children's non-verbal ability were entered as the first step, and the *t3* composite measures of oral language, phoneme awareness and emergent decoding as a second step. The two HLE composites were entered as a third step, and FR and LI status as a fourth step. All coefficients relating to these autoregressive models are reported in Table 5.6.

The model for decoding at *t4* accounted for 77% of the variance, most of which was explained by phoneme awareness and emergent decoding skills at *t3*. Once these autoregressive measures had been entered, the HLE variables did not account for any further unique variance. However, in the model relating to reading comprehension, early storybook exposure remained a significant predictor after accounting for the effects of oral language, phoneme awareness and emergent decoding at age. In this highly conservative model, storybook exposure accounted for 1% of unique variance. In addition, language impaired status was negatively predictive of reading comprehension, even after controlling for the effects of language ability at *t3*.

Table 5.6
Autoregressive hierarchical regression models, predicting t4 literacy outcomes

Predictor	ΔR^2	B (SE B)	β	*p*
		Outcome Variable: Decoding (t4)		
Step 1				
Family SES	.19	.08 (.05)	.07	.164
Non-verbal ability		.02 (.04)	.02	.682
Step 2				
Oral language (*t3*)	.58	.01 (.05)	.01	.878
Phoneme awareness (*t3*)		.24 (.05)	.23	<.001
Emergent decoding (*t3*)		.60 (.05)	.64	<.001
Step 3				
Storybook exposure	.00	.02 (.04)	.02	.618
Direct instruction		.00 (.05)	.00	.996
Step 4				
FR status	.00	-.10 (.08)	-.05	.230
LI status		.00 (.11)	.00	.970
		Total R^2=.77; F (9,175) =64.12, p<.001		
		Outcome Variable: Reading Comprehension (t4)		
Step 1				
Family SES	.25	.11 (.07)	.01	.887
Non-verbal ability		.04 (.05)	.04	.433
Step 2				
Oral language (*t3*)	.45	.26 (.06)	.22	<.001
Phoneme awareness (*t3*)		.15 (.07)	.13	.027
Emergent decoding (*t3*)		.48 (.06)	.47	<.001
Step 3				
Storybook exposure	.01	.13 (.05)	.12	.015
Direct instruction		.04 (.06)	.03	.455
Step 4				
FR status	.01	-.11 (.10)	-.06	.245
LI status		-.29 (.14)	-.10	.037
		Total R^2=.70; F (9,174) =49.22, p<.001		

Overall, these two sets of models suggest that early effects of the HLE on literacy skills at age 6 operate predominantly indirectly, via foundational skills for literacy earlier in development. However, there is some evidence that early storybook exposure is uniquely predictive of reading comprehension skills, even after accounting for these earlier skills. These putative relationships are evaluated further using path analysis.

5.3.6 Direct and indirect pathways from early HLE to literacy at age six: Path analyses

Longitudinal path analyses were conducted, in order to synthesise the results presented in Chapters 4 and 5 into two models. The models predict decoding and reading comprehension at age 6 respectively. Given the complexity of the hypothesised pathways from early HLE to literacy skills at age 6, composites of observed variables were used in preference to latent variable structural regressions. Since the FR children showed deficits on all emergent literacy variables measured at *t3*, all literacy outcomes measured at *t4* and several of the HLE and SES variables, it was concluded that the FR and TD groups of children represented different populations. For this reason, all composite scores were standardised within groups before entry into the path models. The models presented in this section are therefore longitudinal, two-group observed variable path models.

In accordance with the results of the regression and mediation analyses reported thus far, it was predicted that family SES would predict storybook reading in the home, and that both of these environmental factors would predict oral language skills at *t3*. Given the significant correlations between storybook exposure and a range of emergent literacy skills, pathways from storybook exposure to phoneme awareness and emergent decoding at *t3* were also included. Direct instruction was entered as a predictor of phoneme awareness and emergent decoding. These pathways were identical for both the decoding and the reading comprehension models.

5.3.6.1 Path model predicting decoding ability at age six

In the first path model, pathways from phoneme awareness and emergent decoding at *t3* to decoding skills at *t4* were predicted. No additional direct pathways from the HLE or SES composites to the literacy outcomes were included in the initial models; the relationships were expected to be mediated by emergent literacy at *t3*.

The path model predicting decoding ability at age 6 in the FR and TD groups is presented in Figures 5.2 (a) and (b); path weights in these diagrams represent standardised beta weights and correlation coefficients. All unstandardized path weights were initially constrained to be equivalent across groups; however, modification indices suggested that model fit would be improved if the pathways from storybook exposure (*t2*) to phoneme awareness (*t3*) and from emergent decoding (*t3*) to decoding (*t4*) were allowed to vary between the groups. Overall, the model represented a good fit to the data ($\chi 2$ (25) = 33.29, p=.124; CFI = .98; RMSEA = .06 (.00-.11)). Inspection of the modification indices suggested that there were no other pathways whose addition would improve the fit of the model.

Unstandardised path weights, covariances and their associated critical values and significance levels are included in Appendix 4. All pathways were statistically significant, with the exception of storybook exposure to phoneme awareness at *t3* in the TD group.

As a further step, the indirect pathways from SES and early HLE to decoding at age 6 were investigated. The unstandardised estimates for each indirect effect, along with associated confidence intervals, critical ratio values and significance levels, are reported in Table 5.7. Unstandardised and standardised beta weights are identical, because the data entered into this model were composite variables based on z-scores. As recommended by Preacher and Hayes (2004), bias-corrected bootstrapped confidence intervals were computed for all direct and indirect effects.

Indirect effects from family SES to decoding at age 6 vary between the FR and TD groups. Within the FR group, there is a significant indirect pathway from SES, via storybook exposure and phoneme awareness, to decoding; but this effect is not observed in the TD group. An indirect pathway from SES, via storybook exposure and emergent decoding, to decoding at age 6 is statistically significant in both groups.

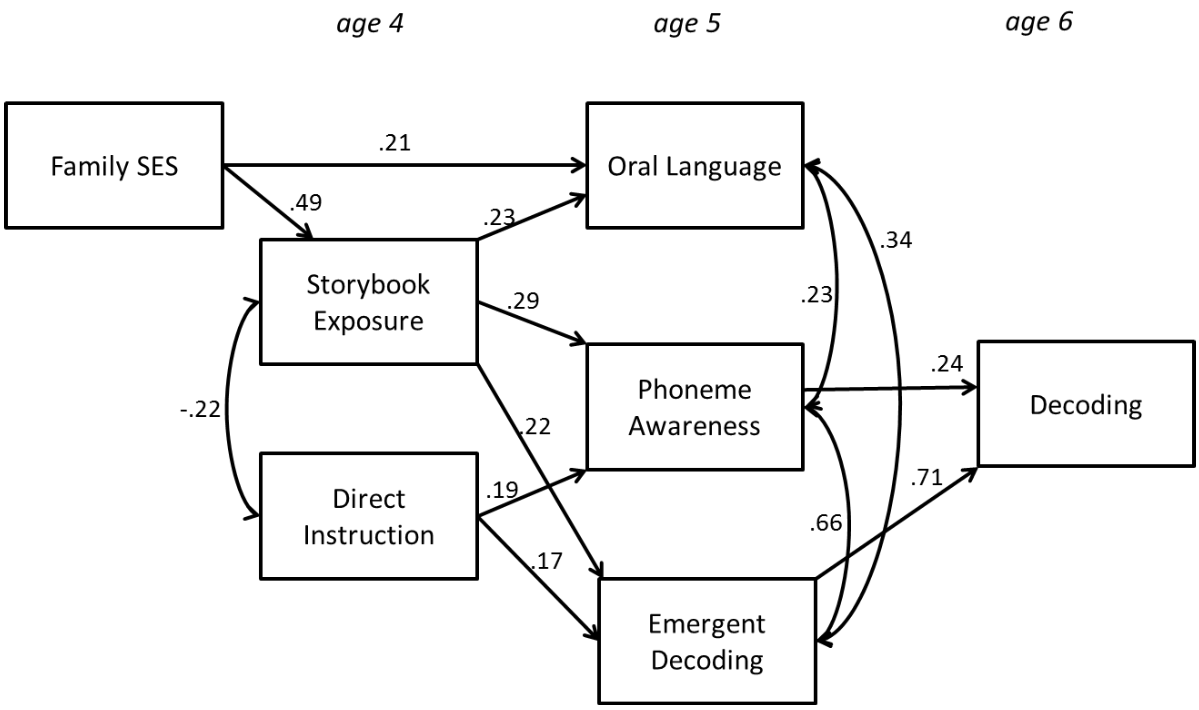
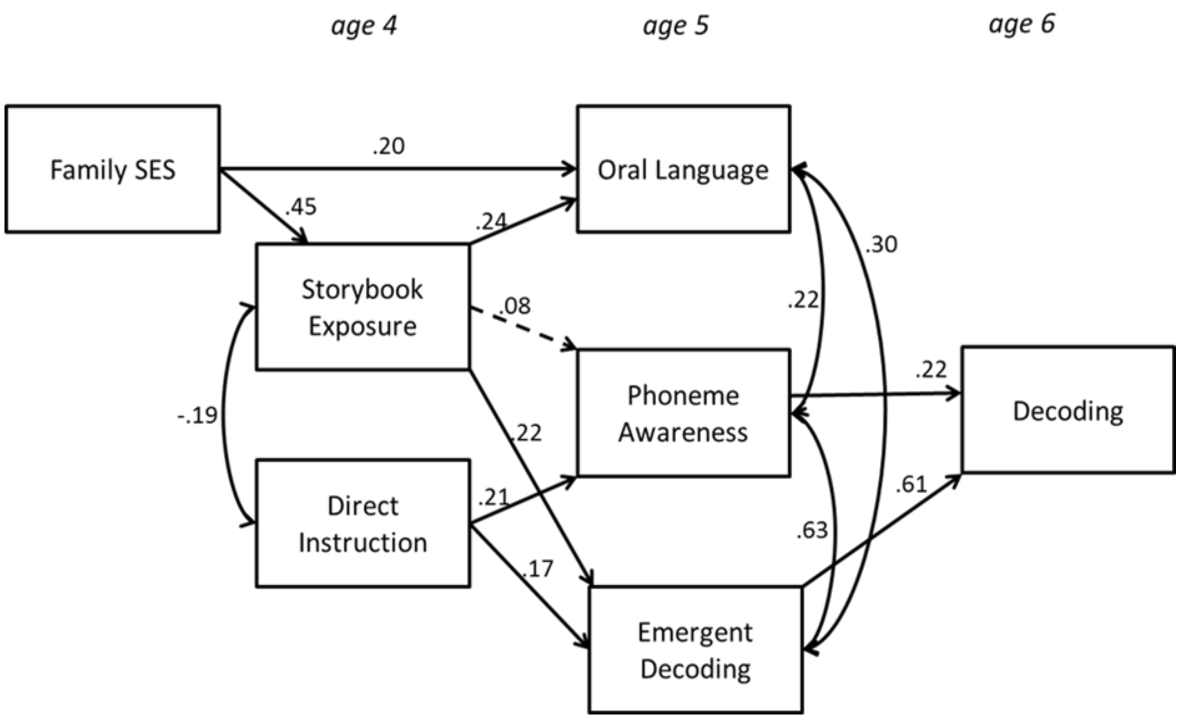


Figure 5.2(a): **Two-group path model predicting decoding skills at age 6 from SES, HLE and emergent literacy: FR group coefficients**



$\chi 2$ (25) = 33.29, p=.124; CFI = .98; RMSEA = .06 (.00-.11)

Figure 5.2(b): **Two-group path model predicting decoding skills at age 6 from SES, HLE and emergent literacy: TD group coefficients**

Additional indirect pathways were observed from storybook exposure, measured at age 4, to decoding ability at age 6. The indirect pathway from storybook exposure via emergent decoding was statistically significant in both groups. However, a second pathway from storybook exposure via phoneme awareness was significant in the FR group only.

Finally, two indirect pathways from early direct instruction of orthographic forms to decoding at age 6 were observed, operating via phoneme awareness and emergent decoding respectively. These indirect pathways were significant in both groups.

In summary, multiple direct pathways from early HLE to the foundational skills of literacy, and indirect pathways from early HLE to decoding ability at age 6 via these foundational skills, were revealed in the path model. It was notable that indirect pathways from SES and storybook exposure to the decoding outcome via phoneme awareness were observed in the FR group, but not the TD group.

Table 5.7
Indirect path weights (unstandardised regression coefficients) for two-group observed variables path model, predicting decoding at age 6

	FR				*TD*			
Indirect Path Weight	B (SE)	95% CIs	C.R.	*p*	B (SE)	95% CIs	C.R	*p*
1. SES $\rightarrow$ Storybook exposure $\rightarrow$ Phoneme awareness $\rightarrow$ Decoding *t4*	.03 (.01)	.01-.06	2.44	.015	.01 (.01)	-.01- .03	0.72	.473
2. SES $\rightarrow$ Storybook exposure $\rightarrow$ Emergent decoding *t3* $\rightarrow$ Decoding *t4*	.07 (.03)	.03-.11	2.41	.016	.06 (.03)	.02-.11	2.37	.018
3. Storybook exposure $\rightarrow$ Phoneme awareness (*t3*) $\rightarrow$ Decoding *t4*	.07 (.03)	.02-.12	2.68	.007	.02 (.02)	-.02- -.06	0.72	.469
4. Storybook exposure $\rightarrow$ Emergent decoding *t3* $\rightarrow$ Decoding *t4*	.16 (.06)	.06-.25	2.71	.007	.13 (.05)	.05-.21	2.62	.009
5. Direct instruction $\rightarrow$ Phoneme awareness *t3* $\rightarrow$ Decoding *t4*	.05 (.02)	.01-.08	2.23	.026	.05 (.02)	.01-.08	2.23	.026
6. Direct instruction $\rightarrow$ Emergent decoding *t3* $\rightarrow$ Decoding *t4*	.12 (.06)	.03-.22	2.10	.036	.10 (.05)	.02-.18	2.11	.035

Note: 95% CIs = bootstrapped 95% confidence intervals; CR= critical ratio

5.3.6.2 Path model predicting reading comprehension at age six

A second path model was designed, using the same set of predictor variables, but substituting reading comprehension as the *t4* outcome variable. In this model, all three emergent literacy constructs (oral language, phoneme awareness and emergent decoding) were expected to predict reading comprehension. In the initial model, no additional direct pathways from SES/HLE to reading comprehension were included.

The model yielded a satisfactory fit to the data ($\chi^2(21) = 29.89$, p=.094; CFI = .98; RMSEA = .07 (.00-.12)). However, inspection of the modification indices revealed that the addition of a direct pathway from storybook exposure to reading comprehension would improve the fit of the model. In addition, the pathway from phoneme awareness to reading comprehension was not significant (*p*=.083). This pathway was therefore removed from the analysis, and the resulting model yielded a better fit ($\chi^2(21) = 26.07$, p=.204; CFI = .99; RMSEA = .05 (.00-.11)). This model is presented in Figures 5.3(a) and (b) for the FR and TD groups respectively. Path weights displayed in the diagram represent standardised regression and covariance coefficients. Unstandardised coefficients, critical ratios and associated significance levels of all direct pathways in the model are included in Appendix 4.

Reading comprehension at *t4* was significantly predicted by oral language, and emergent decoding at *t3* in both groups. The direct pathway from early storybook exposure to reading comprehension at *t4* was significant in the FR group only.

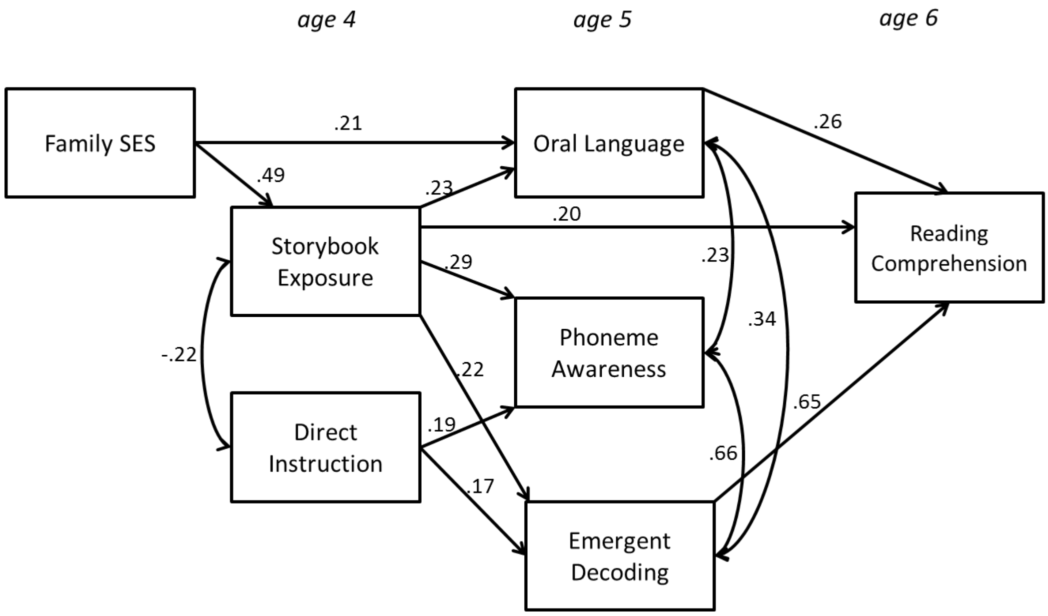
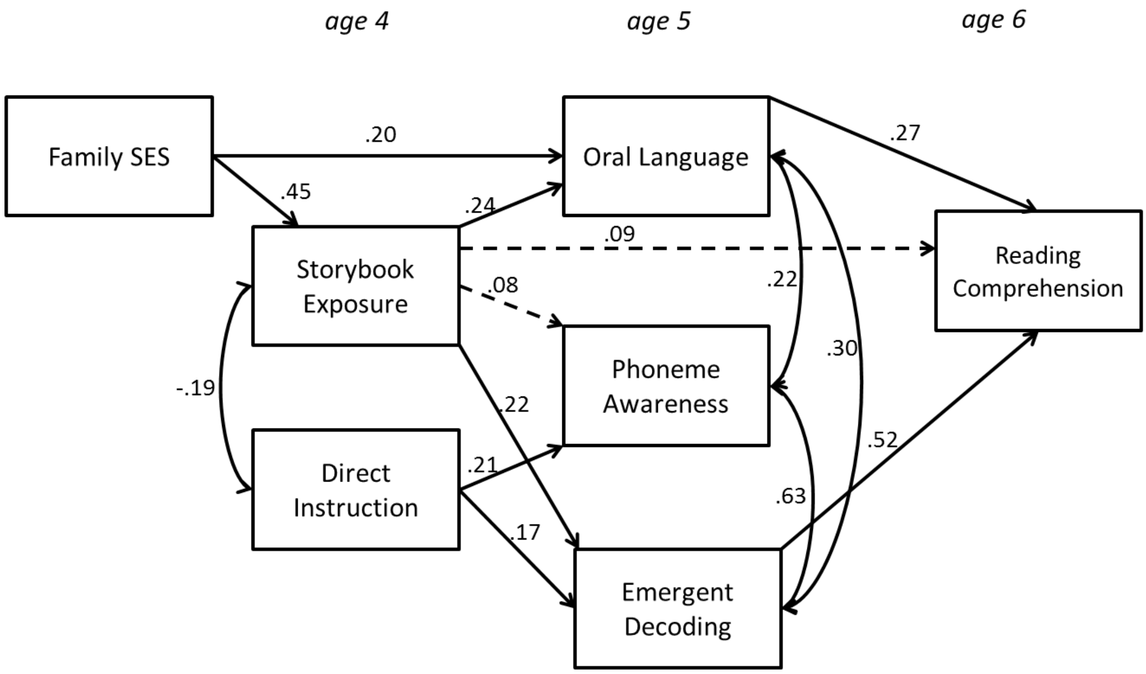


Figure 5.3(a): **Path model predicting reading comprehension at age 6 from SES, HLE and emergent literacy: FR group**



χ^2 (21) = 26.07, *p*=.204; CFI = .99; RMSEA = .05 (.00-.11)

Figure 5.3(b): **Path model predicting reading comprehension at age 6 from SES, HLE and emergent literacy: TD group**

As with the decoding path model, indirect effects from SES and HLE constructs to reading comprehension were also examined. Unstandardised beta coefficients, bootstrapped 95% confidence intervals, critical ratios and significance levels for all indirect pathways to reading comprehension are displayed in Table 5.8.

Table 5.8
Indirect path weights (unstandardised and standardised regression coefficients) for two-group observed variables path model, predicting reading comprehension at age 6

	FR				*TD*			
Indirect Path	B(SE)	95% CIs	C.R.	*p*	B(SE)	95% CIs	C.R	*p*
1. SES → storybook exposure→ reading comprehension *t4*	.09 (.03)	.01-16	3.98	<.001	.04 (.05)	-.02-.11	.85	.395
2. SES → oral language *t3* → reading comprehension *t4*	.05 (.02)	.01-.09	2.32	.020	.05 (.02)	.01-.09	2.32	.020
3. SES → storybook exposure → oral language *t3* → reading comprehension *t4*	.03 (.01)	-.01-.07	2.32	.021	.03 (.01)	-.01-.07	2.32	.021
4. SES → storybook exposure → emergent decoding *t3* → reading comprehension *t4*	.07 (.03)	.03-.12	2.56	.011	.05 (.03)	.00-.10	2.10	.036
5. Storybook exposure → oral language *t3* → reading	.06 (.03)	.02-.11	2.37	.018	.06 (.03)	.02-.11	2.37	.018
comprehension *t4*	.14 (.05)	.06-.22	2.91	.004	.11 (.05)	.03-.19	2.27	.023
6. Storybook exposure → emergent decoding *t3* → reading								
comprehension *t4*	.20 (.04)	.12-.28	4.47	<.001	.09 (.10)	-.03-.20	.89	.373
7. Storybook exposure → reading								
comprehension *t4* (direct pathway)	.11 (.06)	.02-.20	2.00	.046	.09 (.05)	.00-.18	1.84	.066
8. Direct instruction → emergent decoding *t3* → reading comprehension *t4*								

Note: 95% CIs = bootstrapped 95% confidence intervals; CR= critical ratio

Indirect pathways from family SES to reading comprehension ability were multiple and complex. The first of these, via storybook exposure, was highly significant in the FR group, but non-significant in the TD group. A second indirect pathway from SES via oral language was significant in both groups. Third, a significant indirect pathway from SES, via storybook exposure and oral language, to reading comprehension was also observed in both groups. Finally, the indirect effect of SES on reading comprehension via storybook exposure and emergent decoding at *t3* was significant in both groups.

Additional indirect pathways from storybook exposure to reading comprehension were observed, in addition to the direct pathway in the FR group described above. Two indirect effects of storybook exposure on reading comprehension, via oral language and emergent decoding respectively, were significant in both groups. Finally, an indirect pathway from direct instruction via emergent decoding at *t3* was significant in the FR group but did not reach significance in the TD group.

The path model predicting reading comprehension at age 6 showed more complex direct and indirect relationships with early SES and HLE than did the decoding model. Of particular note was the direct effect of early storybook exposure on reading comprehension two years later for FR children. Storybook exposure was also predictive of reading comprehension via a number of indirect pathways, both mediating the effects of SES on reading comprehension, and adding independent predictive value through the effects of oral language and emergent decoding.

5.4 Discussion

This study aimed to evaluate the predictive value of early home literacy experiences for children's decoding and reading comprehension skills two years later. It was predicted that the effects of HLE on these literacy outcomes would be primarily indirect, mediated by the foundational skills for reading (i.e. oral language, phoneme awareness and emergent decoding) measured at *t3*. There were no specific hypotheses about the relative predictive value of the HLE in the family-risk and typically developing groups; however, based on the analyses presented in Chapter 4, it was anticipated that a relationship between early storybook exposure and phoneme awareness at age 5 would be found in the FR group only.

Hierarchical regression analyses revealed that direct instruction of orthographic forms in the home was significantly predictive of children's decoding skills two years later, after controlling for family SES and children's non-verbal ability. Storybook exposure was not a significant predictor of decoding at age 6. However, the predictive value of the HLE construct was eliminated when phoneme awareness and emergent decoding at age 5 were entered into the model, suggesting an indirect relationship.

Both storybook exposure and direct instruction of orthographic forms were significantly predictive of children's reading comprehension at age 6. The effect of direct instruction disappeared when oral language, phoneme awareness and emergent decoding at age 5 were entered into the model. However, storybook exposure remained a significant predictor of reading comprehension in this conservative autoregressive model.

The nature of these direct and indirect relationships was investigated further in a pair of two-group, longitudinal path models. Models predicting decoding and reading comprehension at age 6 were a good fit to the data, and suggested slightly different patterns of prediction in the FR and TD groups. One key implication of these models is that the effects of family SES on reading outcomes are fully explained by variation in HLE and children's oral language at age 5; no direct pathways between SES and reading were found in either the FR or TD group.

For typically developing children, early direct instruction of letter and word forms appears to boost the development of phonemic and orthographic skills during the first year of formal schooling. TD children also derive knowledge about orthographic forms from a rich exposure to print during the preschool period, as indicated by the significant relationship between storybook exposure and emergent decoding at age 5. Whether this relationship is driven by parents' use of shared storybook reading as a setting in which to teach children about orthographic forms, or by children's implicit learning through frequent exposure to print, is unclear. The effects of early HLE on decoding ability at age 6 are completely accounted for by phoneme awareness and emergent decoding measured one year previously.

Multiple indirect pathways were found between family SES, storybook exposure and TD children's reading comprehension, via oral language and emergent decoding at age 5. For these children, the indirect effects of early direct instruction on reading comprehension were no longer significant. This finding is likely to reflect the fact that reading comprehension is less dependent on decoding at age 6 for TD than FR children; in general, word reading ability in this group was at an adequate level to facilitate comprehension of simple passages.

For the FR children, early HLE showed more numerous direct and indirect effects on reading outcomes at age 6. In addition to the indirect pathways to decoding outlined in relation to the TD group, at-risk children who had experienced richer exposure to storybooks in the preschool period showed enhanced phoneme awareness at age 5, which in turn predicted decoding ability a year later. Moreover, a direct pathway between storybook exposure and reading comprehension was observed in the FR group only. It is plausible that exposure to storybooks may boost narrative comprehension skills, such as inference making and maintaining textual cohesion and coherence, which are not tapped by the measures of oral language included in the current study. For FR children, enhanced narrative skills might be drawn upon as a compensatory mechanism to infer meaning from text, when word reading ability is relatively impoverished.

In conclusion, the models presented in this chapter suggest that the effects of HLE on reading outcomes at age 6 are stronger and more numerous for children at developmental risk of reading difficulties than for TD children. In convergence with the wider literature, the effects of HLE seem to come on-line early in children's literacy development and are particularly influential in individual differences in oral language and print knowledge during the first years of primary education. However, the current analyses also provide preliminary evidence that for children with impaired phonemic awareness and letter-sound mapping skills, the effects of early interactions with print in the home may play a protective role in reading development.

Chapter 6: The Quality of the Home Literacy Environment: Mother-Child Shared Reading Interactions

6.1 Introduction

The analyses reported in Chapters 3, 4 and 5 indicate that the frequency with which young children participate in literacy-related interactions in the home predicts the development of a range of language and literacy skills in both at-risk and typically developing groups. However, the observational literature reviewed in Chapter 1 indicates that there is also considerable variation in the quality of interaction when parents read storybooks with their children. This chapter presents an observational study, involving a sub-sample of mother-child dyads from the Wellcome project, in which extra-textual talk during shared storybook reading and the affective quality of the interactions were analysed.

Parent-child dyads differ along a number of dimensions when reading storybooks together. First, variation exists in the amount of extra-textual talk contributed by parents (e.g. Hammett et al., 2003). Second, the content of parental extra-textual talk around stories has been analysed, often in terms of the level of language used during discussion around stories (e.g. Danis et al., 2000; Hindman et al., 2008) or, less commonly, in terms of focus on print function and forms (e.g. Hindman et al. 2013; Yaden et al., 1989). Third, a smaller number of studies have focused on differences in children's extra-textual contributions during storybook reading (e.g. DeTemple & Snow, 1996; Hammett et al., 2009). Finally, a further body of research has evaluated the affective quality of adult-child reading interactions, focusing on variables including parental sensitivity to children's contributions and the extent to which parents make stories fun and engaging for young children (e.g. Baker et al., 2001; Sonnenschein & Munsterman, 2002).

Intervention studies targeting parental shared reading techniques have shown promising results in terms of language and reading outcomes for children. These intervention studies broadly fall into two categories. Training parents in dialogic reading techniques has repeatedly been shown to have lasting effects on children's vocabulary and other oral language skills (Lever & Sénéchal, 2011; Whitehurst et al., 1988). Interventions that have trained parents in introducing verbal and non-verbal print-referencing techniques during shared reading, on the other hand, have demonstrated robust and lasting effects on young children's orthographic knowledge and word reading (Justice et al., 2009; Piasta et al., 2012). These two shared reading training programmes align with the distinction between informal and formal literacy activities made by Sénéchal and LeFevre (2002) in their Home Literacy Model. Dialogic reading may be viewed as a best practice technique in scaffolding meaning-based skills, such as comprehension at the word, syntactic and narrative levels, while print-referencing enhances knowledge of orthographic forms. That both types of skill can be fostered during storybook reading also highlights the artificiality of dichotomising shared reading and teaching of letters as two separate classes of literacy activity, corresponding to 'formal' and 'informal'. As is evident in the beliefs about early literacy expressed by parents in the current sample and analysed in section 3.5, families use a wide variety of settings and tools to introduce their children to letter forms, many of which do not resemble 'formal' teaching interactions.

Studies which focus on affective aspects of shared storybook reading have suggested that parental warmth and sensitivity to children's contributions during early interactions predict children's motivation to engage with print independently as they become fluent readers (Baker et al., 2001). Independent reading is likely to have a reciprocal relationship with reading development, and it is therefore plausible that early experience of book reading that is positive and engaging has an indirect effect on reading development through building children's motivation to engage with print.

There has been relatively little research conducted on storybook reading interactions in children at developmental risk of reading difficulties. An observational study conducted as part of the Jyväskylä study found no differences in the frequency of maternal interactions nor children's interest in storybooks between FR and TD children at 14 months (Laakso et al., 1999). Furthermore, children's early rated interest in books predicted their language skills at 18 months. However, early interest was only predictive of later letter knowledge in the TD group (Laakso et al., 2004). The two studies reported in this chapter use data from video observations of 31 mothers reading with their 4-year-old children. Study 1 investigates the quality of maternal and child extra-textual talk around storybooks and its relationship with language and literacy skills. Study 2 focuses on the affective quality of the shared reading interactions and links to children's print motivation. In both studies, a key question was whether systematic differences would be observed between TD and FR dyads.

6.2 *Study 1: Extra-textual Talk during Shared Storybook Reading*

6.2.1 Aims

This study aimed to describe in detail the nature of extra-textual talk engaged in by parents and children during two shared storybook reading interactions. A recently published study reported that extra-textual talk in a sample of 700 parent-child dyads, observed reading together when the children were 4 years old, was dominated by utterances related to the meaning of the story, while references to print forms were rare (Hindman et al., 2013). This pattern of findings converges with a number of smaller-scale observational studies (Hindman et al., 2008; Yaden et al., 1989) and eye-tracking studies (Evans & Saint-Aubin, 2005; Evans et al., 2009) which have reported that parental and child focus on print is uncommon during shared storybook reading. It was therefore hypothesised that more meaning-related than print-related utterances would be observed in the current study.

A second aim was to compare the extra-textual utterances made by FR dyads where the adult reader had dyslexia (FR-D), FR dyads where the adult did not have dyslexia (FR-ND) and TD dyads. Laakso et al. (1999) reported equivalent maternal-child interactions between very young FR and TD dyads during shared storybook reading, but to the best of the author's knowledge, there have been no published studies reporting specific types of extra-textual talk in this population. There were therefore no directional hypotheses regarding group differences in the nature of extra-textual talk during storybook reading.

Finally, evidence from behavioural genetics suggests that vocabulary and print knowledge are two aspects of pre-reading ability that are strongly influenced by shared environment (e.g. Petrill et al., 2006; Samuelsson et al., 2005). A number of shared reading observation studies have reported links between the use of decontextualised language during storybook reading (i.e. language without an immediate referent on the page, such as predictions, explanations and inference) and aspects of children's vocabulary and own use of decontextualised language (Dickinson & Tabor, 2001; Hindman et al., 2008; van Kleeck et al, 1997). It was therefore predicted that the amount of decontextualised meaning-related talk observed during a shared reading interaction at age 4 would show a positive relationship with children's oral language skills at age 5. Links between references to print during storybook reading and children's print knowledge and decoding skills have been demonstrated in intervention programmes (e.g. Piasta et al., 2012) but not robustly in naturalistic observations of shared reading (Hindman et al., 2008). This relationship was therefore also investigated in the current study.

6.2.2 Method

6.2.2.1 Participants

The Wellcome project subsample described in the present study was self-selecting; letters were sent to parents whose children fell within the target age bracket (3 to 4 years old) and those who gave consent to be observed reading with their children were included in the study. Although it was made clear that either biological parent could take part as long as they regularly read books with their child, all of the caregivers who consented were mothers.

Table 6.1 displays subsample characteristics. The children were 4 years old at the time of the observation; differences in children's age between the groups were not statistically significant. In line with the full sample, there was a slightly higher proportion of boys in the FR groups than the TD group, and children in the TD group showed higher non-verbal IQ score than those in the FR groups. When children were pooled across the FR-D and FR-ND groups, the difference in non-verbal ability approached significance (U=62.00; p=.066).

All participating mothers were of white British origin. Mean maternal age at the time of observation was 37 years old, and this did not differ between the groups. As in the full sample, maternal education was higher in the TD group than the FR groups, but the difference was not significant in the current subsample.

Table 6.1
Subsample Characteristics

	FR-D	FR-ND	TD
N	9	12	10
Child age at observation (mean, s.d.)[1]	54.33 (4.39)	51.75 (4.29)	51.00 (3.43)
Gender (% boys)	55.6%	50%	40%
Nonverbal IQ (mean, s.d.)[2]	109.33 (20.59)	107.00 (13.97)	120.40 (16.05)
Maternal age at observation (mean, s.d.)[3]	36.00 (5.05)	38.00 (3.49)	37.30 (3.74)
Maternal education (median)	Vocational qualification	Vocational qualification	Degree

Note: [1] in months; [2]WPPSI Block Design (standard score); [3] in years

6.2.2.2 Design

This study was exploratory in nature, given the paucity of research evidence on the nature of extra-textual talk during shared reading interactions with children at developmental risk of reading difficulty. The design was therefore descriptive, with the primary purpose of providing a detailed picture of the amount and type of extra-textual talk contributed by FR children and their parents with and without dyslexia. The study also investigated longitudinal relationships between the type of extra-textual talk contributed by mothers and 4-year-old children during reading interactions and children's oral language and word reading skills approximately one year later, at Wellcome project *t3*. Specifically, the predictive value of decontextualized meaning-related talk during shared reading in children's oral language ability and the predictive value of print-related talk in emergent decoding were tested.

6.2.2.3 Measures and procedures

6.2.2.3.1 Cognitive tests

The outcome measures were composite scores of oral language and emergent decoding assessed at Wellcome project *t3* when children were 5 years old. The formation of these composites is described in detail in Chapter 4, along with reliability coefficients and administration information. Briefly, oral language was operationalised as children's composite score on two standardised tests: CELF Expressive Vocabulary and CELF Sentence Structure. The emergent decoding composite consisted of scores on two tests of word reading: YARC Early Word Reading and Single Word Reading. All cognitive tests were regressed for children's age in months before composites were formed.

In predicting children's language and emergent decoding skills at age 5, three control variables were included. These were maternal education level, children's non-verbal ability (WPPSI Block Design), and two autoregressive variables corresponding to children's existing levels of oral language and letter knowledge at the time of the observation (Wellcome project *t2*). Since it is likely that parents adjust the level of their discussion around storybooks in line with their child's developmental level (e.g. Sénéchal et al., 1995), it was considered important to control for children's existing language and pre-literacy skills at the time of observation. As described in Chapter 4, the oral language composite at *t2* consisted of age-regressed scores on the Receptive One-Word Picture Vocabulary Test and CELF Sentence Structure sub-test. Print knowledge was a composite of age-regressed scores on the YARC Letter-sound Knowledge sub-test, and a bespoke test of letter writing.

6.2.2.3.2 Observation measures

For the observation of shared storybook reading, each mother selected a picture book that she and her child knew well and enjoyed reading together. In addition, each was asked to read an unfamiliar storybook provided by the researcher (*The Cow that Laid an Egg* (Cutbill, 2008)). This picture book was newly published in paperback at the time of data collection, and was not known to mothers in the study. It was selected for its attractive illustrations, salience of text and narrative structure, which was thought likely to elicit extra-textual discussion. Two of the children reported recognising the pictures from a televised reading of the book, but the story was unfamiliar to all participating parents. The order of reading of the familiar and unfamiliar books was counterbalanced among the dyads.

Mother-child pairs were videotaped on one occasion in their own home, within five months of the Wellcome project *t2* cognitive assessment. Mothers were asked to behave as they would during a typical storybook reading with their child and, where possible, the researcher left the room during the reading interactions, or else remained unobtrusively in the background.

6.2.2.3.3 Extra-textual talk: Preparation and coding

All reading interactions, including exchanges occurring immediately before and after the book readings, were transcribed and the extra-textual talk coded. Direct repetitions of preceding utterances were excluded from categorisation, as were yes/no responses to closed questions. No differentiation was made between the syntactic form of the utterances (e.g. statement or question); rather, the focus was on the content of the utterances. Mothers' extra-textual utterances were coded according to five broad categories, using an adapted version of the system devised by Hammett et al. (2003). The first three categories were of primary theoretical interest.

(1) Print-related utterances were divided into two sub-categories:

Print forms: references to letters or words (for example, attempts to elicit letter names or sounds from children; asking "what does that word say?")

Print functions: utterances relating to storybook reading procedure (e.g. "Shall we start here?"), page turning (e.g. "Are you going to turn the page for me?"), title, author or illustrator (e.g. "Do you remember who the author is?").

(2) *Contextualised meaning-related* utterances referred to discussion of aspects of the story perceptible in the illustrations on the page. Two sub-categories within this broad category correspond to the first two levels of linguistic abstraction described by Blank, Rose and Berlin (1978a; 1978b), a system which differentiates how far an utterance demands that the listener draw on mental representations without an immediately perceptible referent (see Table 6.2 for full description of these categories).

(a) *Matching perception* (e.g. "There are one, two, three, four, five, six, seven, eight chickens!"; "What do think that is?" [*pointing to picture*])

(b) *Selective analysis/integration of perception* (e.g. "She's got a very big mouth, look." "She's carrying it in a wheelbarrow.")

(3) *Decontextualised meaning-related* utterances represented a combination of Blank et al.'s (1978) third and fourth levels of abstraction. Utterances at this level require the listener to go beyond what is immediately present on the page, and include predictions, explanations and judgements (see Table 6.2).

(a) *Reordering/inferring about perception* (e.g. "How's she feeling today?" "Who do you think laid the egg?")

(b) *Reasoning about perception* (e.g. "Eight eggs would make a good pan of scrambled eggs, wouldn't it?" "What's going to come out [of the egg]?" "Why's she rung the newspaper?")

Table 6.2
Levels of abstraction in content-related utterances

Contextualised		*Decontextualised*	
Level 1: Matching Perception	Level 2: Selective analysis/ integration of perception	Level 3: Reordering/ inferring about perception	Level 4: Reasoning about perception
Label: Name an object or person (or stated as question, e.g. "What's that?") including negative label ("It's not an X"). **Locate**: Describe the location of an objects or character; ask a question regarding location. **Notice:** Direct attention to a pictured object. **Rote counting**	**Describe characteristics**: focus on perceptual properties (size, shape, colour) or parts of objects or characters. This includes colours or numbers if there is a referent. Specify the type of object, quantity of something, or possession. **Describe/ notice scene:** Describe or notice actions that are immediately perceptual in text or pictures. **Complete cloze task:** mother leaves pause to allow child to complete sentence, or child completes sentence.	**Infer:** Based on pictures/ text and not explicitly stated/ shown in pictures. **Recall Information:** Focus on prior information presented in book during current or previous reading; summarise/ synthesise information from series of pictures. **Judgment/ evaluation:** (about characters, objects or ideas) included nonperceptual qualities and internal states (sad, hungry); sometimes introduced by epistemic verb (I think); judgments (beautiful, funny); providing point of view; interpretation of what character is thinking or feeling. **Identify similarities:** Compare or contrast between things in book.	**Predict:** Offer or request what will happen next in the story (in unfamiliar storybook only, otherwise it is Level 3 recall). **Factual knowledge/ information:** Provide general information that is not directly given in the story. Includes defining word meanings or distinguishing between fantasy and reality. **Explain:** Going beyond story or actions to provide an explanation, often indicated with words like "because", "so that" and "since" or by asking "why" questions.

Note: Based on Hammett et al.'s (2003) adaptation of Blank, Rose and Berlin (1978a, 1978b)

(4) *Behaviour management/feedback* included mothers' attempts to (re-)direct children's attention to the storybook, as well as praise, agreement and correction in response to children's utterances.

(5) *Unrelated* utterances were those with no clear relevance to the storybook reading.

Children's extra-textual utterances were coded according to the same system, with the exclusion of category (4), behaviour management/feedback.

6.2.2.3.4 Inter-rater reliability

The observational data were transcribed and coded by a researcher who was blind to the group status of the dyads. The author coded a randomly selected sub-sample of reading interactions from the three participant groups, corresponding to 39% of the total sample. Inter-rater reliability, calculated using Cohen's *kappa* statistic, was high for maternal and child extra-textual utterances, ranging from .82 to .90. On the basis of these reliability coefficients, the ratings of the first coder were used for all subsequent analyses.

6.2.3 Results

6.2.3.1 Children's cognitive skills

Children's scores on composites of oral language and emergent decoding at *t2* and *t3* are presented in Table 6.5. There were no missing values for any of these measures. Although there was a trend for FR children to perform more poorly than TD children on composites of letter knowledge and emergent decoding, and for children in the FR-D group to achieve the poorest scores on oral language composites at both time points, these differences were not statistically significant in this small subsample.

Table 6.3
Means and standard deviations for language and emergent literacy measures at t2 and t3

	FR-D (n=9)	FR-ND (n=12)	TD (n=10)
t2			
Child age[1]	55.33 (2.45)	55.00 (3.22)	53.80 (2.04)
Oral language composite[2]	-.34 (.84)	.36 (.56)	.25 (.69)
Letter knowledge composite[2]	-.54 (.86)	.16 (.73)	.33 (.94)
t3			
Child age[1]	67.22 (3.03)	66.58 (2.91)	66.30 (2.50)
Oral language composite[2]	-.31 (.84)	.11 (.65)	.15 (.85)
Emergent decoding composite[2]	-.54 (.59)	.07 (.93)	.40 (1.18)

Note: [1]in months; [2]z-scores (grand mean = 0)

6.2.3.2 Extra-textual talk around storybooks

6.2.3.2.1 The nature of extra-textual talk contributed by mothers and children during readings of a familiar and an unfamiliar storybook

The mean duration of reading interactions with the unfamiliar storybook was 6 minutes and 16 seconds (s.d. 2 minutes, 45 seconds). A one-way ANOVA comparing time spent on reading the unfamiliar storybook between groups revealed a marginally significant difference ($f(2,28) = 3.17$, $p=.058$), driven by the FR-ND group spending less time reading the book than the other two groups. However, post hoc analyses did not reveal significant group differences. Mothers contributed an average of 44 extra-textual utterances during this interaction, and the number of contributions varied widely (s.d = 32.36). Children made fewer extra-textual comments than adults (mean = 15.06, s.d.=11.42). There were no group differences in the number of extra-textual utterances made by mothers or children during the reading of the unfamiliar storybook.

Since the familiar storybooks chosen by the dyads varied considerably in length, it was not possible to make a direct comparison of the reading duration. Therefore, the duration of each familiar storybook interaction was divided by the number of words in the book being read. An average of 1.04 seconds per word (s.d. = .84) was recorded, and this measure did not differ between groups. Mothers contributed an average of 42.77 extra-textual comments during readings of the familiar storybooks, equating to .11 utterance per word of the book being read (s.d. = .12). Children tended to contribute more extra-textual utterances during readings of familiar than unfamiliar storybooks (mean = 25.81; mean utterances per word = .07 (s.d.=.07)). No group differences were observed in the number of extra-textual comments made by mothers or children during familiar storybook interactions.

For each storybook reading, the number of extra-textual utterances made by each participant which fell into each coding category was divided by the total number of extra-textual utterances that they made. The resulting proportion scores are presented in Table 6.4 and 6.5. As predicted, content-related utterances were observed more frequently than print-related utterances by both adults and children. References to print forms were very rare. Although references to print function were somewhat more common, taken together, print-related utterances accounted for only 15-23% of the total utterances made by mothers and children.

Contextualised content-related utterances made up 41% of maternal extra-textual utterances during readings of the unfamiliar storybook, and 23% during familiar storybook readings. In general, parents tended to label pictures, or attempt to elicit labels from their children, more frequently in the context of a book which the child had not seen before. Contextualised content-related talk constituted more than 50% of children's extra-textual utterances in readings of both the unfamiliar and familiar storybooks. Decontextualised talk was less common than contextualised meaning-related talk, making up 22-23% of all maternal talk and 28-33% of all child talk.

Maternal utterances containing feedback to children were somewhat more frequent during readings of the familiar storybook (34%) compared with the unfamiliar storybooks (22%), corresponding to the observation that children tended to contribute more extra-textual talk overall when they knew the storybook well. Finally, utterances that were unrelated to the storybook interaction were very uncommon from mothers and children.

6.2.3.2.2 Effects of risk status and familiarity of storybook on maternal and child extra-textual talk

As a next step, the effects of group status and familiarity of storybook on the three types of extra-textual talk of theoretical interest (i.e. print-related, contextualised content-related and decontextualised content-related) were investigated. The familiar storybooks selected by each dyad varied considerably in length and narrative complexity, although this variation was not systematic between the groups. Therefore, in order to standardise the data for inferential analyses, new proportion scores were calculated by dividing the frequency count of extra-textual utterances in each category by the number of sentences in the book being read. Finally, each observation variable was subjected to square root transformation, in order to account for differences in scale and to normalise distributions.

Table 6.4

Proportion of maternal extra-textual utterances in each category

Type of extra-textual utterance	Whole Sample	FR-DR	FR-NDR	TD
	Unfamiliar Storybook			
1a: Print forms	4%	4%	2.5%	5%
1b: Print function	11%	10%	13%	10%
Print-related utterances (1a+1b)	15%	14%	15.5%	15%
2a: Matching perception	8%	10%	6%	8.5%
2b: Integrating perception	33%	33%	31.5%	35%
Contextualised content-related utterances (2a+2b)	41%	43%	37.5%	43.5%
3a: Inferring about perception	11%	11%	11%	10%
3b: Reasoning about perception	11%	7%	12%	12.5%
Decontextualised content-related utterances (3a+3b)	22%	18%	23%	22.5%
4: Feedback/behaviour management	22%	24%	24%	19%
5: Unrelated utterances	0%	1%	0%	0%
	Familiar Storybook			
1a: Print forms	2%	2%	1%	3%
1b: Print function	16.5%	14%	19%	16%
Print-related utterances (1a+1b)	18.5%	16%	20%	19%
2a: Matching perception	8%	12%	5%	9%
2b: Integrating perception	14.5%	20.5%	10.5%	14%
Contextualised content-related utterances (2a+2b)	22.5%	32.5%	15.5%	23%
3a: Inferring about perception	19%	17.5%	23.5%	18%
3b: Reasoning about perception	4%	2%	4%	5%
Decontextualised content-related utterances (3a+3b)	23%	19.5%	27.5%	23%
4: Feedback/behaviour management	34%	30%	36%	33%
5: Unrelated utterances	2%	2%	2%	2%

Table 6.5

Proportion of child extra-textual utterances in each category

Type of extra-textual utterance	Whole Sample	FR-DR	FR-NDR	TD
	Unfamiliar Storybook			
1a: Print forms	4%	3%	2%	8%
1b: Print function	9.5%	4.5%	10%	13.5%
Print-related utterances (1a+1b)	13.5%	7.5%	12%	21.5%
2a: Matching perception	27%	36%	23%	23%
2b: Integrating perception	25%	20%	24%	32%
Contextualised content-related utterances (2a+2b)	52%	56%	47%	55%
3a: Inferring about perception	19%	24%	23%	8.5%
3b: Reasoning about perception	13.5%	9%	17%	13%
Decontextualised content-related utterances (3a+3b)	32.5%	33%	40%	21.5%
4: Unrelated utterances	2%	3.5%	1%	2%
	Familiar Storybook			
1a: Print forms	3%	1%	0%	7%
1b: Print function	9%	7%	13%	8%
Print-related utterances (1a+1b)	12%	8%	13%	15%
2a: Matching perception	18%	24%	14.5%	16%
2b: Integrating perception	37%	35%	36.5%	40%
Contextualised content-related utterances (2a+2b)	55%	59%	51%	56%
3a: Inferring about perception	24%	27%	28%	16%
3b: Reasoning about perception	4%	1%	7%	5%
Decontextualised content-related utterances (3a+3b)	28%	28%	35%	21%
4: Unrelated utterances	5%	6%	1%	8%

Mixed 2x3 ANOVAs were conducted using the square root transformed data, with familiarity of storybook (familiar, unfamiliar) as a within-subjects factor, and reading status group (FR-D, FR-ND, TD) as a between-subjects factor. One main effect of group was observed, namely mothers in the FR-ND group produced fewer contextualised content-related utterances than mothers in the other groups ($f(2,28)=5.04$, $p=.014$, partial $\eta^2=.27$). Further, the main effect of group on maternal print-related utterances was significant ($f(2,28)=2.75$, $p=.035$, partial $\eta^2=.21$); however, post-hoc tests did not reveal significant differences between the groups. No group differences in maternal decontextualised content-related utterances, nor any type of utterance contributed by children, were observed. A main effect of familiarity of storybook was observed in relation to mothers' contextualised content-related utterances, such that more were observed during readings of the unfamiliar storybook ($f(2,28)=15.49$, $p<.001$, partial $\eta^2=.36$). No other effects of familiarity on maternal or child extra-textual talk were observed. Finally, there were no significant interactions between risk status and familiarity of storybook.

In addressing the second aim of the study, therefore, the data set provided little evidence that the types of extra-textual talk around storybooks which have been related to child language and literacy outcomes, namely print-related talk and content-related talk, differ between FR and TD families. Both parents with dyslexia and children at family-risk of dyslexia contributed comparable levels of all types of extra-textual talk to typically developing mother-child dyads.

6.2.3.3 Relationship of extra-textual talk at age four with child cognitive skills one year later

In order to address the third aim of the study, the relationships between decontextualised content-related talk during storybook reading and children's oral language skills, and between print-related talk and children's decoding skills, were examined. Extra-textual talk scores for each dyad's reading interactions (familiar and unfamiliar storybook) were summed to increase the robustness of the analysis. Zero-order inter-correlations among observation and cognitive variables were compared between the groups, using Fischer's method of transforming r statistics to r', computing the associated standard errors and testing group difference (Fischer, 1921). Given that more than 95% of the resultant z statistics fell within 1.96 of the transformed mean $z_{0.025}$, the null hypothesis was not rejected. Consequently the correlations reported below reflect data combined from the FR-D, FR-ND and TD groups (N=31) (Howell, 2002).

Table 6.6 shows zero-order correlations between the four observation variables of primary interest (i.e. print-related and decontextualised content-related talk by both mothers and children) and language and literacy composites measured approximately a year after the storybook reading sessions. It was predicted that adults' and children's use of decontextualised language during storybook reading would relate to children's oral language skills. Although weak positive correlations between decontextualised talk and children's language at *t3* were observed (r=.30 and r=.22 for maternal and child decontextualised utterances respectively), these correlations were not statistically significant. It may be that the small sample provided insufficient power to capture the effect, leading to a Type II error. However, on the basis of these data, it cannot be concluded that use of decontextualised language during storybook reading is related to children's oral language skills.

Although maternal and child print-related utterances were well correlated (r=.60), a relationship with children's decoding skills was observed only in the case of children's print-related talk. This positive correlation was moderate in strength, and statistically significant, after implementing Bonferroni's correction for multiple correlations.

Table 6.6
Zero-order correlations between extra-textual talk at age 4 and children's language and emergent literacy skills at age 5

	1.	2.	3.	4.	5.	6.
1. Maternal print utterances						
2. Maternal decontextualised utterances	.58***					
3. Child print utterances	.60***	.49**				
4. Child decontextualised utterances	.60***	.83***	.54**			
5. Oral language *t3*	-.05	.30	.17	.22		
6. Emergent decoding *t3*	.11	.10	.46**	.12	.36*	

Note: *p<.05; **p<.01; ***p<.001

These relationships were investigated further in a pair of hierarchical regression models, respectively predicting oral language and decoding at *t3*. In each model, a number of control variables were entered at the first step, namely maternal education, children's non-verbal ability and the relevant autoregressive composite variable (i.e. oral language at *t2* in the language model, and letter knowledge at *t2* in the decoding model). Autoregressors were included in order to take account of children's existing language and literacy skills at the time of observation. In light of the small sample, however, only those covariates making a marginal contribution (i.e. a beta weight with associated alpha level of <.10) were retained in the final models (see Hindman et al., 2008). At the second step, the two theoretically related observation variables were entered, i.e. maternal and child decontextualised meaning-related utterances in the oral language model, and maternal and child print-related utterances in the decoding model). The B statistics, with associated standard errors, standardised betas and R^2 change statistics for the two models are presented in Table 6.7.

Table 6.7

Hierarchical regression analyses predicting oral language and emergent decoding skills at age 5

Predictor Variable	ΔR^2	*B (SE B)*	β	*p*
Outcome measure = Oral Language				
Step 1				
Maternal education level	.50	.21 (.09)	.39	.029
Oral language at *t2*		.54 (.15)	.51	.002
Step 2				
Maternal decontextualised talk	.01	-.45 (.78)	-.15	.556
Child decontextualised talk		.60 (.80)	.18	.460
Total R^2 = .51; F(2,28)=6.68, p=.001				
Outcome measure = Emergent Decoding				
Step 1				
Letter knowledge at *t2*	.50	.72 (.14)	.65	<.001
Step 2				
Maternal print-related talk	.08	-.78 (.71)	-.16	.283
Child print-related talk		2.27 (.97)	.35	.027
Total R^2=.58; F(2,28)=12.57, p<.001				

Maternal education level and children's existing language level at the time of observation were strong predictors of oral language at *t3*, together accounting for 50% of the variance. The amount of decontextualised meaning-related talk contributed by mothers and children during shared reading did not predict additional variance in children's oral language at age 5. Since there is debate as to whether autoregressive models are overly conservative (Stoolmiller & Bank, 1995), oral language at *t2* was removed from the model; however, decontextualised language did not predict additional variance after controlling for maternal education level. It is possible, therefore, that individual differences in high-level talk around storybooks between mother-child dyads are largely accounted for by maternal education.

Children's letter knowledge at *t2* was the only covariate that significantly predicted emergent decoding at *t3*, accounting for 50% of the variance. Maternal education level and children's non-verbal ability did not contribute additional variance, and were therefore removed from the model. However, the print-related talk contributed by children during shared storybook reading at age 4 explained a further 8% of unique variance in decoding, after accounting for their existing level of letter knowledge. Maternal print-related utterances were not significantly predictive of decoding ability. Although maternal and child utterances were highly correlated, such that extra-textual utterances often occurred in contingent pairs (e.g. maternal print-related question – child print-related response), it was only children's focus on print forms and function during shared storybook reading that predicted their progress in word reading one year later.

6.2.4 Discussion

In this study, data obtained during observation of mother-child dyads whilst storybook reading were analysed. The aim was to compare the linguistic quality of storybook interactions between mothers and children at family-risk of dyslexia with families with no such history. The primary focus was on types of extra-textual talk contributed by mothers and 4-year-old children in the context of a familiar and an unfamiliar storybook reading. In addition, the study aimed to investigate the role of such talk as a predictor of early language and literacy outcomes one year later, when children were 5 years old.

Children tended to contribute more extra-textual talk in the context of a book which they knew well compared with an unfamiliar book. In both storybook contexts, contextualised meaning-related talk was observed most frequently, followed by decontextualised meaning-related talk. The least common type of extra-textual utterance contributed by children was print-related, and within this category, talk about print function was more common than talk about print forms. This finding corroborates eye-tracking evidence suggesting that young children focus on text rarely when reading storybooks with adults (Evans & Saint-Aubin, 2005).

Maternal extra-textual talk was highly related to children's extra-textual talk, since mothers often elicited contributions from their children by asking questions. The familiarity of the storybook being read affected the amount of contextualised meaning-related talk provided by mothers; labelling and description of pictures were more common when reading a storybook which children did not know well. Previous observational studies have suggested that parents are generally sensitive to their children's existing level of knowledge during shared reading (Sénéchal et al., 1995; van Kleeck et al., 1997). The increased focus on labelling when reading a new book observed in the current data indicates a scaffolding approach, whereby mothers consolidate children's basic understanding of new material while also stimulating higher-level abstract representations by encouraging children to make inferences and judgements based on the text (Danis et al., 2000). However, the level of decontextualised meaning-related talk contributed by mothers was equivalent across readings of the unfamiliar and familiar storybooks, suggesting that adults attempt to scaffold children's understanding regardless of how well children know the storybook. Mothers also frequently gave positive feedback to children's extra-textual contributions, especially in the context of reading familiar book, when children tended to contribute more often.

The mothers in this sample very rarely drew children's attention to print forms during storybook reading. The gains in orthographic skills associated with print referencing during storybook reading (Piasta et al., 2012) are likely to depend on tailored training for parents; it seems that parents of pre-school children rarely focus on print spontaneously during shared reading.

Overall, then, the majority of extra-textual discussion observed in this study related to the meaning of the stories, and mothers often supported children's contributions with positive feedback. This behavioural pattern is consonant with the interview responses reported in Chapter 3, in which parents were most likely to cite engendering a love of reading, emotional closeness and boosting children's language as reasons for valuing shared storybook reading.

The present study did not provide evidence to suggest that the quality of extra-textual talk contributed by FR and TD mother-child dyads during storybook reading differs. FR-ND dyads spent somewhat less time in reading the unfamiliar storybook than TD dyads, and adults in this group contributed less contextualised meaning-related talk than those in the FR-D and TD groups. However, the nine mothers with dyslexia observed reading with their young children contributed similar amounts and types of extra-textual talk to parents in TD dyads. The two types of extra-textual talk that have previously been linked to positive language and literacy outcomes in children, namely print-related talk and use of decontextualised language, were equivalent across the three groups. Moreover, the extra-textual contributions of FR children, whether reading with a parent with or without dyslexia, were very similar to those of TD children. In sum, the current study provides no support for the idea that linguistically impoverished early interactions around storybooks act as an additional risk factor in the reading development of children at family-risk of dyslexia.

The use of decontextualised content-related talk by adults and children during shared reading was not uniquely predictive of children's oral language at age 5, after maternal education had been controlled. It may be that individual differences in the use of higher-level language during shared reading are almost entirely dependent upon parents' level of education, and so the two variables account for the same portion of variance in language outcomes. Alternatively, the use of decontextualised language may relate to aspects of language ability not tapped by the composite used in the current study, which comprised vocabulary and sentence comprehension. Encouraging children to think beyond aspects of the story immediately perceptible through illustrations on the page may show a stronger effect on children's narrative comprehension skills, including inference generation and maintaining textual coherence (Oakhill & Cain, 2007). In this case, a mediated relationship between maternal education and comprehension skills, via decontextualised language use, might be hypothesised. However, it is beyond the scope of this study to investigate this possibility further.

Children who made more references to print forms and function at age 4 showed better word reading skills a year later. Moreover, this relationship was not accounted for by maternal education level or children's letter-sound knowledge a year earlier. Although references to print often occurred in contingent pairs (e.g. maternal question – child answer) it was only children's, not mothers', print-related utterances which related to word reading skills. This finding indicates that children who learn to decode quickly during the first year at primary school may already show an orientation to the mechanistic aspects of reading before starting to learn to read at school. It is important to note that causality cannot be assumed, however. Young children's interest in print forms and function may be an early behavioural manifestation of favourable genes for reading. However, it seems that an early motivation to engage with the mechanistic aspects of reading may be a predictor of reading independently of concurrent letter knowledge.

To conclude, the findings of this observation study add to the body of literature on the role of the home literacy environment in reading development, emphasising the importance of the quality as well as the frequency of shared reading interactions. What children and parents say, and how they interact, during storybook reading varies widely, and it is of theoretical and applied interest to pinpoint which behaviours foster emergent literacy skills in children. However, the current analyses do not support the idea that early differences in emergent literacy between children with and without family-risk of dyslexia could be explained by differences in the linguistic quality of their early experiences of storybook reading.

6.3 Study 2: The Affective Quality of Shared Storybook Reading

6.3.1 Aims

Shared reading offers an opportunity for parents to interact positively with their young children, and several authors have highlighted the potential for enjoyable early reading experiences to foster children's motivation to engage with print as they develop (Baker et al., 1997; Bus, 2001). Moreover, affective interaction processes within families have been demonstrated to be stable over time (Leseman & de Jong, 1998). In this study, affective quality was defined as interactional behaviours reflecting enjoyment of, and engagement in, the shared reading process. Both parent and child interactional behaviours were measured in the same shared reading interactions described in Study 1, with a focus on maternal reading expression, engagement and sensitivity to the child's contributions, children's engagement, and physical closeness in the mother-child dyads.

This study aimed to describe the affective quality of shared reading interactions between mothers and their 4-year-old children, and its relationship to extra-textual talk around storybooks. While the linguistic and socio-emotional quality of shared reading interactions might predict different aspects of reading development, it is likely that the two factors are inter-related. Several authors have reported an association between positive affect and decontextualised language use during shared reading (Baker et al., 2001; Sonnenschein & Munsterman, 2002), while one study found a negative correlation between affective quality of a shared reading interaction and print-related extra-textual talk (Baker et al., 2001). It was therefore predicted that observer-rated affective quality during shared reading would be positively associated with decontextualised meaning-related talk, and negatively associated with print-related talk.

A second aim of this study was to compare the affective quality of shared reading interactions between mother-child dyads with and without a family history of dyslexia. As in Study 1, FR dyads were grouped according to whether the adult reader did or did not have dyslexia, and compared with TD dyads. Laakso et al. (2004) reported no differences between young FR and TD children's interactional behaviours during shared reading. However, no studies to date have focused on the affective quality of parent-child interactions during shared reading in an FR sample. Therefore, there were no directional hypotheses regarding group differences in affective quality.

The final aim of this study was to assess the relationship of affective quality with children's language, decoding and independent engagement with print one year later. Since previous studies have generally not found an association between the affective quality of early reading interactions and later attainment measures (but see De Jong & Leseman, 2001), no correlation with language or decoding skill was predicted. However, affective quality has been repeatedly linked to children's motivation to engage with print, and particularly with more complex texts such as chapter books (Baker et al., 2001; Sonnenschein & Munsterman, 2002). Although the children in the current sample were not fluent readers a year after the observation at *t3*, it was hypothesised that positive affective ratings during shared reading at age 4 would predict parental reports of children's independent engagement with print at age 5.

6.3.2 Method

The sample, design and procedure were identical to those described in Study 1.

6.3.2.1 Measures

6.3.2.1.1 Outcome measures

The composite scores of children's oral language and decoding skills at *t3* were those described in Study 1. In addition, children's print engagement was measured using a single item from the family questionnaire at *t3*, which asked how often children read or looked at printed materials independently. Response categories were: 1 (never/occasionally), 2 (once or twice a month), 3 (about once a week), 4 (several times a week), 5 (daily).

6.3.2.1.2 Observation measures of affective quality

Ratings of the affective quality of each reading interaction were made, based on the coding system developed by Sonnenschein and Munsterman (2002). Five variables were rated on a three-point scale, ranging from 1(low) to 3(high); these were maternal reading expression, contact with child, reader appearance of involvement, child appearance of involvement and reader's sensitivity to child's engagement. Descriptors for the three rating levels of each of these three affective variables coded in the current study are provided in Table 6.8.

Table 6.8
Affective quality rating scale (Sonnenschein & Munsterman, 2002)

Rating	Descriptor
Reading expression	
1	Monotonous, flat reading, little attention to punctuation.
2	Some tonal change, no imitation of voices; moderate expression.
3	Expressive, multi-tonal reading; imitation of character voices, expression suggests suspense, etc.
Contact with child	
1	No or very little contact.
2	Occasional or little contact, less than 50% of time.
3	Contact greater than 50% of time – arm around child, sitting on lap.
Reader appearance of involvement	
1	Distracted behaviour, little smiling or laughing related to story, irrelevant questions.
2	Looks at book 25-75% of time, some appropriate smiling, laughing, asking questions.
3	Attends to story most of time, appears to enjoy story most of time, asks questions, smiling, laughing.
Child appearance of involvement	
1	Distracted behaviour, little smiling or laughing related to story, irrelevant questions.
2	Looks at book 25-75% of time, some appropriate smiling, laughing, asking questions.
3	Attends to story most of time, appears to enjoy story most of time, asks questions, smiling, laughing.
Reader sensitivity to child's engagement	
1	Displays none of behaviours listed below.
2	Displays 1 or 2 of following behaviours: asks child if enjoying story, acknowledges child's feelings, periodic eye contact to gauge child's interest, attempts to recapture child's attention if waning.
3	Displays 3 or more of the listed behaviours.

Each of the 62 shared reading interactions (31 with the unfamiliar storybook, 31 with a familiar storybook) was divided into three time intervals of equal duration, and affective ratings in each of the five categories were made at the end of each interval. Means for each affective variable were calculated across the three time points, yielding a final score in each affective category for each shared reading interaction.

6.3.2.1.3 Inter-rater reliability

The affective ratings were made by a researcher who was blind to the risk status of the dyads. A randomly selected subsample of reading interactions from each of the three groups, corresponding to 39% of the total reading interactions, were coded by the author. Inter-rater reliability was somewhat lower for the affective ratings than for coding of extra-textual talk (average Cohen's *kappa* .73); this was likely due to the more subjective judgements necessary for this scale. However, since agreement was above 70%, the coding of the first rater was used in analyses.

6.3.3 Results

6.3.3.1 Children's independent engagement with print at t3

On average, parents reported that their children looked at books independently several times a week. There were no differences between FR and TD children on this item.

6.3.3.2 Affective quality of shared reading interactions

Total affective ratings did not differ between readings of the unfamiliar and unfamiliar storybooks. However, physical closeness and maternal sensitivity to children's engagement was rated as higher when reading the familiar storybook (Wilcoxon Z=2.31, *p*=.05; Z=2.05, *p*=.04 respectively). Nonetheless, it was decided to sum affective rating scores across the two storybook interactions, creating a scale with a minimum of 1 and a maximum of 6. Since these variables were derived from ordinal scales, non-parametric statistics were used in all inferential analyses.

Descriptive statistics and tests of group difference for each of the affective quality scales are presented in Table 6.9. There was a non-significant trend for dyslexic readers and their children to be rated as less physically close during shared reading than TD dyads, and a non-significant trend for maternal sensitivity to children's engagement to be rated lower for mothers in the FR-ND group than those in the FR-D group. However, since these patterns did not reach statistical significance, it can be concluded that no differences in the affective quality of shared reading were observed between FR and TD dyads were observed.

Table 6.9

Descriptive statistics and non-parametric tests of group difference for affective quality variables

	All		FR-DR		FR-NDR		TD		Kruskal-Wallis H	*p*
	Median	Range	Median	Range	Median	Range	Median	Range		
Reading expression	4.00	2.00-6.00	4.33	2.00-5.67	4.17	2.67-6.00	4.00	3.00-5.67	.10	.952
Physical closeness	5.33	3.67-6.00	4.33	3.67-6.00	5.17	4.00-6.00	5.50	4.67-6.00	5.15	.076
Reader involvement	4.33	2.66-6.00	4.33	3.67-6.00	4.50	2.66-5.00	4.33	3.00-6.00	.34	.848
Child involvement	4.00	2.66-6.00	4.67	2.66-5.67	4.17	3.00-5.00	4.00	3.00-6.00	.62	.732
Maternal sensitivity	5.00	2.33-6.00	5.33	4.00-6.00	4.50	2.33-6.00	5.00	3.66-6.00	5.53	.063

6.3.3.3 Relationships between affective quality and extra-textual talk

A total affective rating score was calculated, being the sum of scores on reading expression, physical closeness, maternal involvement, child involvement and maternal sensitivity. Zero-order correlations between affective quality, maternal education level and the four extra-textual talk variables discussed in section 6.2.3.3

are presented in Table 6.10. Affective quality was moderately and significantly positively correlated with maternal education level. There was also a significant relationship between positive affect and both maternal and child use of decontextualised meaning-related talk during shared reading. The hypothesised negative relationship between print-related talk and affective quality was not observed; in fact children's print-related talk was moderately positively correlated with affective quality, although this correlation did not reach statistical significance.

Table 6.10
Zero-order correlations (Speaman's r)between affective quality and extra-textual talk at age 4

	Maternal education	Adult print-related talk	Adult de-contextualised talk	Child print-related talk	Child de-contextualised talk
Affective quality	.37*	.14	.44*	.35†	.41*

†*p<.07; ** p<.01*

6.3.3.4 Relationships between affective quality and children's language, emergent decoding and independent engagement with print at age 5

Zero-order correlations and partial correlations, controlling for maternal education level, between affective quality during the storybook interactions at age 4 and measures of receptive language, emergent decoding and independent engagement with print at *t3* are displayed in Table 6.11. Affective quality during shared reading was significantly positively correlated with children's language scores at age 5, and this relationship remained significant when maternal education level was partialled out. A marginally significant relationship between affective quality and emergent decoding was largely accounted for by maternal education level. No relationship between affective quality during shared reading and parental reports of children's independent print at age 5 was observed.

Table 6.11
Zero-order correlations and partial correlations (controlling for maternal education) of affective quality with language, emergent decoding and print engagement at t3

	Language *t3*	Emergent decoding *t3*	Print engagement *t3*
Zero-order			
Affective quality	.55***	.35†	.01
Partial			
Affective quality	.43*	.13	-.05

†*p<.06; * p<.05; ***p<.001.*

A hierarchical regression model was run, predicting children's receptive language at age 5, using maternal education, an autoregressor (being the children's oral language scores at *t2*, as in the model reported in Table 6.2.3.3) and affective quality of shared reading as predictors. The B statistics, with associated standard errors, standardised betas and R^2 change statistics for the three models are presented in Table 6.12. Affective quality accounts for an additional 4% of variance in receptive language after controlling for maternal education and oral language at *t2*, however the associated beta weight was not significant in this small sample.

Table 6.12
Hierarchical regression analysis predicting oral language at age 5

Predictor variable	ΔR^2	*B (SE B)*	β	*p*
	Outcome measure = Oral language			
Step 1				
Maternal education level	.50	.14 (.08)	.27	.023
Oral language *t2*		.45 (.15)	.43	.006
Step 2				
Affective quality	.04	.09 (.05)	.26	.105
Total R^2 = .54; F(2,28)=10.72, p<.001				

6.3.4 Discussion

In the current study, affective dyadic quality was defined as a combination of reading expression, physical closeness, mothers' and children's appearance of involvement and maternal sensitivity. Observer rated affective quality was broadly equivalent across FR-D, FR-ND and TD dyads. Trends for FR-D dyads to be rated as less physically close and maternal sensitivity to be rated lower in the FR-ND group did not reach statistical significance. Therefore the current study provides no evidence that the affective quality of shared reading interactions with young children differs between FR and TD families.

A positive relationship between affective quality and maternal and children's use of decontextualised language during shared reading emerged, which replicates the findings of other observational studies of shared reading (Baker et al., 2001, Sonnenschein & Munsterman, 2002). However, the predicted negative relationship between print-related talk and affective quality, which was reported by Baker et al. (2001), was not observed. In fact, the amount of print-related talk contributed by children was marginally positively related with affective quality. Parents in the current study referred to print forms and function relatively rarely, and when they did occur, these interactions were not didactic in nature, and were often initiated by the child. It seems likely that a warm and engaging interaction is more likely to elicit higher level extra-textual contributions from children during shared storybook reading, relating both to story content and to print.

The predicted relationship between affective quality and children's independent engagement with print did not emerge in these data. This is likely to be due to the fact that the measure of print engagement was taken before children were fluent readers. Baker et al. (2001) reported that affective quality was a predictor of children's engagement with more complex texts, such as chapter books. However, the children in the current study were not yet at an age when they commonly read books of this complexity. It may be that the affective quality of these early reading interactions will predict children's print engagement measured at a later stage of the Wellcome project.

Affective quality was robustly correlated with children's oral language skills at age 5, and this relationship was not accounted for by maternal education level. This finding gives an indication that it is not only the content of linguistic exchanges that take place between parent and child, but also the socio-emotional context of those exchanges, which foster children's language development. It is plausible that the benefits for young children of engaging with the linguistic demands of storybooks, and extra-textual talk around them, may be magnified if these interactions are warm and enjoyable.

The observational studies presented in this chapter were exploratory and need to be replicated in larger samples to increase confidence. However, taken together, the findings indicate that the linguistic and socio-emotional quality of early shared reading interactions is comparable across FR and TD mother-child dyads. Furthermore, these findings point to two mechanisms by which the effects of parental education may operate on children's developing language skills, namely the use of decontextualised language during, and the affective quality of, shared reading interactions. Finally, the results indicate that children who are motivated to engage in print-related talk during storybook reading go on to have better early reading skills a year later, and this effect is not accounted for by their concurrent ability in letter and word identification. It may be social processes such as those described in these observation studies that underlie the effects of storybook exposure on children's language, emergent literacy and reading described in Chapters 4 and 5.

Chapter 7: General Discussion: The Home Literacy Environment of Children at Family-Risk of Dyslexia

7.1 Summary of Key Findings

The research reported in this thesis aimed to investigate the role of early literacy activities in the home in the language and literacy development of a sample of young children at increased risk of reading difficulties due to a family history of dyslexia. The research formed part of the Wellcome Language and Reading Project. Several research questions were addressed, primarily using interviews and observational methods. First, the nature of the home literacy environment was investigated, with a view to ascertaining whether children at family-risk experienced early encounters with print material that differed systematically in frequency or quality in comparison with those of typically developing children. Second, the relationship of the HLE with family SES, and particularly parental education level and occupation status, was analysed. Third, the nature of parental beliefs about literacy-based interactions with their children were described in an exploratory qualitative analysis. Fourth, the predictive value of home literacy activities in children's oral language and emergent literacy skills during the first two years of primary school education was examined, with a particular focus on whether early storybook exposure and parental instruction of orthographic forms related to children's pre-reading skills in a similar manner for FR and TD children. Fifth, the measures of early HLE were related to reading outcomes at age 6, and path analysis was employed in order to identify significant direct and indirect pathways from early environmental input to later reading attainment. Finally, the storybook reading interactions of a small sub-sample of mother-child dyads were analysed, in terms of the observed linguistic exchanges and socio-emotional quality.

7.1.1 The Nature of the Preschool HLE in FR and TD Families

The predicted distinct HLE factors, namely storybook exposure and direct instruction of orthographic forms in the home, emerged in the current dataset, in support of Sénéchal and LeFevre's (2002) Home Literacy Model. The independence of these factors was observed in both the FR and TD groups, such that parents who frequently read storybooks with their children did not necessarily also teach them about letter and word forms.

There was some limited evidence to suggest that children in the FR group experienced less exposure to storybooks in the preschool years than TD children. Data from the HLE interviews revealed a trend for less frequent shared storybook reading reported by parents in the FR group, and FR parents also scored significantly more poorly than TD parents on an alternative measure of storybook exposure, the Children's Title and Author Checklists. Caution should be taken in interpreting these group differences, however, because the checklist tools contain a memory load which could disadvantage dyslexic respondents. It may be that parents with dyslexia read as widely with their young children as other parents, but tend to retain less information about titles and authorship than non-dyslexic parents.

Already by age 4, parents in the FR group reported that their children were slightly less interested in reading than TD children. Since storybook exposure and children's interest in storybooks are likely to have a reciprocal influence, it is possible that reduced early interest in storybooks could lead to less storybook reading in the home, although the reverse interpretation is also plausible. In combination with the group effects in measures of storybook exposure, it is tentatively concluded that FR children's exposure to, and interest in, storybooks is somewhat less than that of TD children, although this difference represents a small effect (see also Scarborough et al., 1991). However, the current research cannot address the issue of whether the effect is driven by child or parent characteristics.

No differences in the frequency with which parents teach their children about orthographic forms emerged between the FR and TD groups, but in the sample as a whole parents tended to engage in more direct instruction of this sort with girls than boys. However, no interaction between risk-group and gender was observed; in other words FR boys did not experience particularly low levels of direct instruction in the home.

Finally, the observation study did not reveal any clear differences in the linguistic or socio-emotional quality of shared reading interactions between FR and TD mother-child dyads. Therefore, on the basis of the research reported here, the HLE experienced by preschool FR and TD children can be characterised as broadly equivalent, as has been observed in other family-risk studies (e.g. Torppa et al., 2007). The TD>FR pattern in measures of storybook exposure could be indicative of a small group difference in this construct; however, other interpretations of this result are also possible.

7.1.2 The Relationship of HLE with family SES

In concordance with previous research (e.g. Foster et al., 2005; Kiernan & Huerta, 2008), children's exposure to storybooks in the preschool years was found to be moderately associated with family SES, and in particular parents' education level and occupational status. The strength of this relationship was somewhat stronger in the FR group than the TD group in the current dataset, perhaps reflecting wider variation in parental educational level and occupational status in this group. Furthermore, the effect of family SES on children's oral language ability was partially mediated by storybook exposure in both groups. This indirect effect has been reported by several other authors (e.g. Forget-Dubois et al., 2009; van Steensel, 2006). It is likely that more educated parents engage their children in higher-level verbal exchange in a range of everyday settings, thereby scaffolding children's developing receptive and expressive language skills. Storybook reading provides a particularly facilitative setting for scaffolding language, since both parents and children produce more linguistically complex utterances in this setting (Dunn et al., 1977; Hoff, 2005) and discussion around storybooks allows children to engage with concepts outside the scope of their everyday lives. Storybook reading in the home, then, appears to be a key mechanism by which family-level socioeconomic factors operate on children's language development, accounting for 31-37% of the effect of family SES on children's language skills at ages 4 and 5 in the current dataset.

On the other hand, family SES showed no reliable relationship with parental teaching of orthographic forms or parental ratings of children's interest in storybooks. There was variation in the beliefs parents expressed about the importance of teaching children about letters and words at a young age. Although these data were qualitative and cannot be linked systematically to the behavioural data, it is suggested that the variation in the frequency with which parents teach their children about orthographic forms is driven more strongly by parental beliefs than by family SES. For example, some parents emphasised socio-emotional development in the early years and advocated delaying formal reading instruction until later childhood. Other parents expressed the belief that helping children to recognise and write letters and words should begin as early as possible, in order to prepare their children for primary school and acquiring the 'special skill' of reading.

The current data provided no evidence that the HLE is impoverished in families with more children. Survey studies using large, nationally representative samples have suggested that having more siblings is a risk factor for reduced storybook reading in the home (e.g. Yarosz & Bartlett, 2001). While a wide range of socio-economic backgrounds was represented in the Wellcome project sample, in general parental education and occupation status were higher than national norms (Office for National Statistics, 2010). It may be, therefore, that the risk associated with a larger number of children in the home is specific to lower SES families, and is an indicator of increased competition for material and financial, rather than time, resources.

There was some evidence of reduced literacy activities in the home in single-parent families in the current sample. Specifically, levels of storybook exposure and children's interest in books were lower in single-parent than two-parent households. However, it is not clear that single-parent family status in itself constitutes a risk factor for impoverished early literacy interactions in the home. It is equally possible that higher levels of deprivation or lack of social support in this population drive the negative association between single-parent status and HLE.

7.1.3 Parental Beliefs about Literacy-related Interactions with Children

Previous research has indicated that parental beliefs about literacy may be an important predictor of the interactions in which they engage their young children (DeBaryshe, 1995; Martini & Sénéchal, 2012). The conceptualisation of the HLE in this thesis focused primarily on measurable parent-child behaviours, but it was acknowledged that parental belief systems could influence the frequency and quality of these interactions. Parents were therefore asked about their beliefs in the context of an informal interview, and their responses recorded in note form. While analyses of these data are necessarily exploratory and descriptive, they give an indication of the range of beliefs that parents of young children in the UK hold about their role in supporting children's literacy development.

A number of interesting themes emerged from these analyses. Reading storybooks with young children was a universally valued activity. When expressing their reasons for believing shared storybook reading to be important, parents tended to foreground socio-emotional aspects, such as spending quiet, one-to-one time with their children, or encouraging an independent love of reading. However, storybook reading was also seen to be important in scaffolding a range of cognitive abilities in young children, including language, general knowledge, sustained attention and emergent literacy. Overall, both the "storybook reading for fun" and "storybook reading for skills" orientations (Sonnenschein et al., 1997) were represented in parents' responses, and the two were not mutually exclusive.

A greater variety of attitudes towards teaching young children about orthographic forms was observed in parents' responses. While a clear majority of parents expressed the opinion that it was important to teach young children about letters and words, this position was not universal. Among those parents who did not value more formal literacy-related activities in the home, some cited the inappropriateness of engaging preschool children in didactic activities while others expressed concern about confusing children by using different teaching methods from school. These responses suggest that parents who engage in little direct literacy instruction in the home may do so for a number of reasons. A very commonly cited theme in response to this question, both among parents who did and did not believe teaching letters and words to young children to be important, was that these interactions should be child-led, i.e. only attempted if the child showed a clear interest in print. Again, these responses indicate that children's experiences in their home environments may not be independent of genetic factors; children who show an early orientation to print are more likely to be taught about letters and words by their parents.

Finally, a small number of responses from parents in the FR group pointed to a range of effects that awareness of a child's elevated risk of reading difficulties may have on parents' beliefs and behaviours in relation to early literacy. Some parents in this group stated that the knowledge that other family members had struggled to learn to read at school motivated them to engage in a wide range of literacy activities with their preschool children in order to give them a head start before school entry. Other parents stated that they did not feel confident in helping their child learn to read, because of their own reading difficulties. Within this population, then, awareness of children's risk status for reading difficulties might prompt parents to engage in either more or less frequent literacy-related interactions in the home.

7.1.4 The HLE and the Development of Language and Emergent Literacy

The predictions of Sénéchal and LeFevre's (2002) Home Literacy Model were tested with regard to children's oral language and emergent literacy skills. In general, the model was validated, in that early exposure to storybooks was found to predict children's oral language, both concurrently and longitudinally. Direct instruction of orthographic forms, on the other hand, predicted letter knowledge concurrently, and early word reading longitudinally. However, a number of deviations from the Home Literacy Model were observed in the current dataset.

First, storybook exposure was found to relate to a wider range of skills than the Home Literacy Model predicts. Significant positive correlations were observed between storybook exposure at age 4 and concurrent oral language, phonological awareness and print knowledge skills. Moreover, a series of hierarchical regression models showed storybook exposure to be a unique predictor of oral language and phonological awareness, and a marginally significant predictor of print knowledge, after controlling family SES, children's non-verbal ability and parents' own orientation to reading. Mediation models revealed a different pattern of relationships in the FR and TD groups. For FR children, the effect of storybook exposure on concurrent phonological awareness was completely mediated by oral language. In contrast, a partial mediation effect was observed in the TD group, such that a direct effect remained after controlling for the indirect pathway via oral language. It is possible that this divergence from the predictions of the Home Literacy Model may be accounted for by the earlier onset of phonics instruction in school and nursery settings in the UK compared with Canada. For the generally high-ability TD group in the current study, some of whom had been attending school for a number of months at Wellcome project *t2*, it is hypothesised that once the foundations of the alphabetic principle were in place, through parental instruction of letter sounds and forms and/or phonics activities in school and nursery, an increased exposure to printed material in the form of storybooks acted to accelerate the development of phoneme awareness skills. Storybooks aimed at 4- to 5-year old children are typically rich in rhyming and alliterative material, and it is plausible that children build on their existing knowledge of the constituent sounds of words both implicitly, through exposure to storybooks, and explicitly, if parents point out sound patterns in the text when reading stories.

However, for children whose phonological processing skills are impaired, implicit learning of phonological components of words may not take place during storybook reading. Interestingly, a direct effect of storybook exposure was observed longitudinally in the FR group; storybook exposure at age 4 predicted FR children's phoneme awareness skills at age 5; an effect that was partially mediated by oral language. In other words, the same pattern of direct and indirect pathways between storybook exposure and phoneme awareness was found in both groups, but the effect came online a year later in the FR group compared with the TD group. These findings suggest that storybook exposure can play a role in boosting the development of phoneme awareness skills, but the effect is likely to depend upon children's current ability level. Where children have begun to understand that words can be divided into constituent sounds, exposure to linguistically rich storybook texts may facilitate phonological processing. For FR children, however, this influence may not come online until they have received a certain amount of formal phonics instruction at school.

Direct instruction of orthographic forms in the home at age 4 was related to children's concurrent letter knowledge and phoneme awareness. In line with the Home Literacy Model, the effect of direct instruction on concurrent phoneme awareness was completely mediated by letter knowledge. Longitudinally, an indirect effect of direct instruction on phoneme awareness, via emergent decoding, persisted in the FR group. However, while a direct effect of direct instruction on phoneme awareness at age 5 was found in the TD group, no relationship emerged between direct instruction and emergent decoding for these children. These group differences are once again argued to be a product of the differential developmental levels of emergent literacy in FR and TD children. For FR children, phoneme awareness skills develop slowly in the early primary years and the developmental shift from letter knowledge to phoneme awareness as the primary predictor of reading attainment happens later in this population than in typically developing children (Pennington & LeFly, 2001). It is plausible that the main effect of early instruction by parents is on children's letter knowledge. Thus, while a concurrent effect of direct instruction on letter knowledge was observed in the TD group, no link between direct instruction and word reading a year later emerged. By this stage, children in the TD group had generally reached ceiling in a measure of letter-sound knowledge, and many were using orthographic strategies to read words. Therefore, classroom effects may have superseded HLE influences on the word reading of TD children. In contrast, the slower growth of phoneme awareness, letter knowledge and word reading in the FR group means that early direct instruction of letter forms in the home continues to exert an influence on these skills into the second year of primary education (see also Torppa et al., 2006).

In all regression models predicting aspects of children's language and emergent literacy at ages 4 and 5, the two key HLE constructs – storybook exposure and direct instruction- predicted unique, significant variance independently of family SES. Nonetheless, there were clear effects of SES on children's oral language skills, and family SES was also a significant predictor of phoneme awareness at age 4 and word reading at age 5. However, although important, SES effects did not eradicate the effects of storybook reading and direct instruction on emergent literacy; both of these factors showed additional, independent effects on phoneme awareness and emergent decoding, contrary to the conclusions of earlier work in this area (Scarborough and Dobrich, 1994). Furthermore, it is clear that there is intra-SES class variation in home literacy activities, and so a rich HLE may act as a protective factor against socio-economic risk of poor emergent literacy.

In addition, it is worth noting that primary caregiver scores on the Adult Author Checklist, a proxy for parental orientation to reading, did not predict variance in any emergent literacy outcome. This finding supports previous research (e.g.

Burgess et al., 2002; Storch-Bracken & Fischel, 2008) in suggesting that children do not learn pre-reading skills simply by observing their parents engaging in literate activities. Rather, it is the literacy-related *interactions* between adults and children that influence the development of language and emergent literacy skills. The inclusion of the Adult Author Checklist in the hierarchical regression models was an attempt to control for passive gene-environment correlations -in other words, the possibility that both parents and children who share favourable genes for reading are likely to read for pleasure frequently- in interpreting HLE effects on emergent literacy. The fact that parents' orientation to reading was not a significant predictor of any outcome measure suggests that early environmental influences on children's pre-reading skills are not entirely explained by parents' own reading ability.

7.1.5 The HLE and Reading Outcomes

As predicted, the effects of early HLE experiences on children's decoding and reading comprehension ability at age 6 were primarily indirect, via emergent literacy skills at age 5. Significant pathways from early direct instruction of orthographic forms to decoding, via phoneme awareness and emergent decoding were observed in both the FR and TD groups, in accordance with the Home Literacy Model (Sénéchal & LeFevre, 2002). In addition, the effects of SES on decoding at age 6 were completely explained by an indirect pathway via storybook exposure and emergent decoding in both groups. The effect of storybook exposure on emergent decoding is not predicted by the Home Literacy Model, and suggests that children are able to pick up information about letter and word forms implicitly from incidental exposure to printed material, and/or that some parents use storybook reading as an opportunity to teach their children about letters and words.

Two significant indirect pathways to decoding at age 6 via phoneme awareness were observed in the FR group only. This finding is interesting, because it suggests that rich early literacy experiences in the home- both storybook reading and direct instruction- can play a protective role in the development of phoneme awareness, which is typically impaired in at-risk children whether or not they go on to have reading difficulties themselves (Snowling et al., 2003).

The effects of early home literacy experiences were more pronounced in the model predicting children's reading comprehension. Although comprehension was still highly dependent on decoding skills at age 6, oral language, in addition to phoneme awareness and emergent decoding, was predictive of reading comprehension. This pattern is consonant with the Simple View of Reading (Hoover & Gough, 1990), in which reading is seen to be the product of decoding and comprehension. Due to the early age at which reading comprehension was assessed in this study, direct instruction of orthographic forms in the home predicted comprehension indirectly via emergent decoding. Additionally, multiple indirect pathways were observed from family SES and storybook exposure to reading comprehension, via oral language and emergent decoding, in both groups.

Importantly, a direct pathway from early storybook exposure to reading comprehension at age 6 was significant in the FR group only. This finding is intriguing, because it suggests that at-risk children may derive particular long-term benefit from early shared reading with family members. It has been suggested that some children at family-risk of dyslexia use strong oral language skills as a compensatory mechanism when reading, using contextual cues to read unfamiliar words (Snowling et al., 2003). Part of the effect of early storybook exposure on FR children's reading comprehension was mediated by oral language at age 5 in the current study. However, this oral language composite comprised measures of expressive vocabulary and receptive grammar only. It may be that exposure to storybooks also fosters the development of other language skills relevant to text comprehension, such as inference generation, anaphoric resolution and understanding of text structure (Oakhill & Cain, 2007). These skills may be particularly important in reading comprehension when phonological decoding ability is impaired.

A final issue raised by these models of reading development is that the effects of family SES on emergent literacy, decoding and reading comprehension are completely explained by family-level differences in early home literacy environment. In other words, the addition of a direct pathway from family SES to any of the reading-related outcomes did not improve model fit. It seems, then, that the HLE provides a powerful explanatory mechanism for SES effects on reading.

7.1.6 The Quality of Mother-Child Shared Reading Interactions

While the majority of the analyses reported in this thesis used frequency measures of HLE, an attempt was made to consider the quality of home literacy interactions, thereby adding depth to the picture of how family environment may influence children's developing language and literacy skills. In a small-scale observation of mothers reading with their 4-year-old children, extra-textual talk was found to be predominantly related to the content of the storybooks being read. The majority of these contributions by both mothers and children were contextualised, i.e. linked to a perceptible referent on the page. In addition, both partners used decontextualised language to discuss storybook content, for instance by making predictions about what might happen next, linking the story to the child's own experience, and making inferences beyond the information contained in the text. References to print forms were very rare during storybook reading, although a small number of children focused on letters and words markedly more often than the majority. The finding that parents rarely use shared storybook reading as a vehicle for teaching children about print forms has been reported in several other studies (e.g. Hammett et al., 2003; Hindman et al., 2008).

No systematic differences in the quality of extra-textual talk contributed by mothers with and without dyslexia were observed, suggesting that adults with dyslexia engage their children in discussion around books in a comparable way to typical readers. Similarly, FR and TD children contributed extra-textual talk that did not differ in quantity or quality. The affective quality of the dyadic interactions was also rated equivalent between the groups. Therefore, this study indicates that shared storybook reading with adults is a valuable context for scaffolding the language development of children at risk of reading difficulties, as it is for typically developing children.

The use of decontextualised content-related talk by mothers and children was expected to relate to children's oral language skills, as has been reported by other researchers (e.g. Hindman et al., 2013; van Kleeck et al., 1997). However, while mothers' use of decontextualised language during shared storybook reading was positively correlated with children's oral language a year later, this association was explained by maternal education level. Use of decontextualised language was moderately correlated with affective quality of the dyadic interaction, and this latter variable predicted a small but significant amount of unique variance (4%) in children's oral language skills at age 5 after controlling maternal education and autoregressing children's oral language skills at the time of observation. Parental education level, linguistic and socio-emotional quality of shared reading are inter-related constructs (see also Sonnenschein & Munsterman, 2002), and it is hypothesised that the interaction of linguistic and socio-emotional quality during shared reading might mediate the effects of maternal education level on children's language skills.

Finally, although references to print forms and functions were rare, the extent to which children did refer to print during these shared reading interactions predicted their emergent decoding skills at age 5, even after controlling for concurrent letter knowledge. Although children's use of print-related utterances was highly contingent upon parents', adults' print-related talk did not relate to the emergent literacy outcome measure. This finding was unexpected. It is possible that, for some children in the sample, discussion around print was outside their zone of proximal development, and so parental attempts to encourage them to focus on print, albeit rare, did not elicit print-related talk from children. Other children were already showing interest in textual features and were able to respond appropriately to parents' print-related comments and/or initiate print-related linguistic interactions themselves. This interest in print was predictive of word reading above and beyond the effects of concurrent print knowledge, suggesting that individual differences in children's early orientation to print may be an important precursor of reading achievement.

7.2 Implications of the Findings

7.2.1 Implications for Typically Developing Children

Taken as a whole, the findings reported in this thesis converge with the broader HLE literature in suggesting that children's early literacy-related experiences in the home are influential in the early stages of reading development. For children at low risk of reading difficulties, the effects of the preschool HLE operate primarily on two key precursors of reading: oral language and print knowledge. These content-based skills appear to be more amenable to environmental influences than process-based predictors of reading ability (e.g. phonological memory). However, the data analysed in Chapter 4 suggest that the development of phonological awareness may also be influenced by home literacy activities. The effect of direct instruction of orthographic forms by parents on phonological awareness is indirect, via children's early letter knowledge. However, data from the Wellcome project sample indicate that storybook exposure can also exert an influence on phonological awareness skills, once children have begun to understand that words can be decomposed into constituent sounds. The performance of the TD group on measures of rhyme awareness and alliteration matching suggests that many had begun to identify and manipulate speech sounds at age 4. While it is clear that phonological awareness is strongly genetically influenced (e.g. Byrne et al., 2007), it is plausible that exposure to children's literature, the text of which is often rich in phonological patterns, affects the rate of development of phonological awareness (Petrill et al., 2010).

Parent-child interactions within the home literacy environment, then, are directly predictive of a number of key pre-reading skills in typically developing children. The influence of the HLE is clearest around school entry; by the time children in the current sample had been in primary school for two years, HLE effects on reading attainment were wholly indirect, mediated by oral language, phonological awareness and emergent decoding at age 5. Reading becomes more strongly heritable in middle childhood (e.g. Byrne et al., 2009) and, for children whose emergent literacy skills develop typically, school and classroom effects may supersede early HLE in accounting for remaining environmental influences through development. In summary, engagement in a range of literacy-related activities with parents in the preschool years can explain variance additional to descriptive family variables, such as parental education level, in typically developing children's pre-reading skills. Meaning-based and code-based literacy activities show differential effects. Given that individual differences at the outset of primary school have been demonstrated to be largely stable over the course of reading development (e.g. Wagner et al., 1997), early parent-child literacy interactions appear to be a valuable way of preparing children to learn to read.

7.2.2 Implications for Children at Family-risk of Dyslexia

Early home literacy experiences may be particularly important in the early literacy development of children at high risk of reading difficulties. The data presented in this thesis indicate that pathways between preschool HLE and reading attainment at age 6 are more numerous, and in some cases stronger, in the FR group than the TD group. Two particularly salient findings are (a) that shared storybook reading in the home has a longitudinal effect on the development of phonological awareness in FR children, and (b) that a direct pathway exists between early storybook exposure and reading comprehension ability at age 6.

Slow growth of phonological awareness skills has been frequently noted in young children who go on to have reading difficulties (Pennington & LeFly, 2001; Snowling et al., 2003). Since dyslexia is strongly heritable (Harlaar et al., 2005) it is likely that the core phonological deficit is primarily influenced by genetic factors (Byrne et al., 2007). However, recent behavioural genetic research indicates that shared environmental factors may be particularly influential in the developmental slope, rather than the intercept, of a number of component skills (Petrill et al., 2010). A combination of exposure to salient phonological patterns through storybook reading and direct instruction of letter and word forms in the home may plausibly affect the rate of development of phonological awareness in these children. While parent-child literacy interactions cannot eliminate the genetic risk of dyslexia, it is plausible that they can play a role in boosting weak phonological skills as children begin to learn to read at school. Multiple, significant, indirect pathways from early

HLE to word reading via phonological awareness were identified in the Wellcome project family-risk group.

Early storybook exposure also showed multiple direct and indirect pathways to reading comprehension in the FR group. As discussed above, children with impaired phonological processing ability may rely on relatively strong oral language skills as a compensatory strategy when learning to read. The longitudinal data and observation study reported here converge with many other studies in suggesting that shared storybook reading is a prime context for parental scaffolding of children's language skills (e.g. Hindman et al., 2008; Sénéchal, 2006). This activity may be particularly beneficial for FR children, then, as the semantic, structural and pragmatic aspects of language scaffolded during book reading provide these children with additional strategies to use when attempting to read for meaning.

Finally, the Wellcome project FR sample included 29 children who were also classified as language-impaired at the outset of the study. Within this small sub-group, storybook exposure at age 4 was not reliably correlated with concurrent oral language; however, a positive and significant relationship emerged when language was assessed a year later at age 5. Learning takes place within the zone of proximal development (Vygotsky, 1978). For children with impaired language skills, deriving benefit from the rich language encountered during shared storybook reading may be beyond their current developmental level. However, it is interesting to note that, within this small group of FR-SLI children, those whose language skills were strongest at age 5 had also experienced more shared storybook reading in the preschool period. While the small subgroup of FR-SLI children in these studies precludes firm conclusions about the role of early home literacy interactions in the development of language and emergent literacy in this population, the analyses reported in Chapter 4 relating to these children are suggestive that the benefit derived from early literacy interactions may be dependent on children's developmental level (see also Carlson et al., 2012).

In summary, the analyses reported in this thesis provide a positive message for parents of children at elevated risk of reading difficulties. While neither storybook reading nor teaching of orthographic forms in the home can eradicate genetically-influenced deficits in phonological processing and other component reading skills, this research suggests that what parents do with their young children matters. Especially for those FR children with intact oral language skills, parent-child literacy-related interactions can play a protective role in early literacy development operating via a host of direct and indirect pathways.

7.3 Limitations and Future Directions

A number of limitations to this research should be noted. First, these studies did not employ a genetically sensitive design, and therefore the extent to which home literacy environmental factors are independent of genetic influences cannot be determined. An attempt was made to account for parental factors by including the Adult Author Checklist, a measure of parental orientation to reading, in regression models, and this measure was not found to be a predictor of children's oral language or emergent literacy. Parent-child literacy interactions, on the other hand, were predictive of a range of pre-reading skills. Thus it can be concluded that parents' orientation to reading is a different construct from shared reading interactions with children, and it is only the latter which are influential in early literacy development. There was some, limited evidence for passive gene-environment correlation, since FR children experienced slightly less exposure to storybooks than TD children. However, as discussed previously, this group difference may be confounded by the memory load inherent to the checklist measures. Additionally, the TD group displayed higher mean non-verbal ability and family SES scores, so these factors, rather than risk-status per se, may have influenced the observed group difference in storybook exposure.

Petrill et al.'s (2006) report of HLE effects in a sample of adopted siblings indicates that the home environment is not completely explained by genetic factors. However, it is acknowledged that individual differences in children's interest in books, language ability and parental literacy skills, all of which are genetically influenced, may exert effects upon the quality of the home literacy environment experienced by young children. It is also possible that the reported HLE effects on literacy outcomes in the FR group represent gene x environment interactions, such that children at genetic risk of reading difficulties are more sensitive to environmental inputs than other children. However, the current design cannot address this issue.

Second, the measures of direct instruction of orthographic forms and children's interest in reading were low in internal consistency. Few questions tapping each construct were included in the Home Literacy Environment Interview for practical reasons. However, it would have been preferable to have included more interview items relating to direct instruction to provide a more sensitive measure. Nonetheless, this construct showed criterion validity in that it predicted children's print knowledge and phoneme awareness both concurrently and independently.

The results of the observation study reported in Chapter 6 indicate individual differences in young children's orientation to orthographic forms. The interview measure of child interest focused on orientation to storybooks only; in future studies, it would be useful to differentiate between interest in storybooks and interest in print. In these studies, child interest was well correlated with storybook exposure, but did not predict additional variance in child outcomes. This finding fails to replicate other studies, which have found children's early interest in reading to be a good predictor of language and print knowledge (e.g. Frijters et al., 2000). Furthermore, some parental report items of children's interest in books had restricted variance; it may be that observation methods provide a more sensitive measure of children's interest.

Third, the design of the Wellcome project did not allow control of school and classroom variables. The children involved in the project attended many different schools, spread over a wide geographical area. In order to isolate the effects of home environmental influences, it would be preferable to account for extraneous variables, such as nursery and school classroom effects.

Despite these limitations, the longitudinal nature of the current research allows for detailed analysis of how differences in early HLE may influence children's language and literacy development over time. Previous research has indicated robust effects of relatively small magnitude of HLE on language and reading (e.g. Bus et al., 1995). The nature of these effects can only be properly understood through longitudinal research, which focuses on direct and indirect pathways from early home experiences to later cognitive outcomes.

As data continues to be collected in the latter phases of the Wellcome project, a next step in analysis of HLE influences will be to compare the early literacy-related experiences of those FR children who go on to exhibit reading difficulties with those who do not. Previous family-risk studies have produced conflicting results as to HLE differences between FR-dyslexic and FR-not dyslexic groups (e.g. Scarborough et al., 1991; van Bergen et al., 2011). It is of considerable interest to discover to what extent early literacy experiences in the home can play a protective role in mitigating genetic risk for dyslexia.

As children in the Wellcome project sample enter middle childhood, it will be possible to gain more sensitive measures of their independent engagement with print, for example by administering an adapted Child Title Checklist to children themselves. Since previous studies have pointed to a strong link between early HLE and later print motivation (e.g. Sénéchal & LeFevre, 2002; Sonnenschein & Munsterman, 2001), it will be useful to gauge whether children's independent engagement with print constitutes another indirect pathway by which early HLE operates on reading development.

In addition, the role of the HLE in the early literacy development of language-impaired children warrants further attention. Observation studies of shared reading interactions between parents and children with SLI have suggested qualitative differences in interactional style compared with typically developing dyads (e.g. Barachetti & Lavelli, 2011). Furthermore, there is some evidence to suggest that children with more profound disabilities do not derive benefit from early home literacy interactions, despite experiencing a similar quantity of shared reading to children with milder disabilities (Carlson et al., 2012). Analysis of the HLE data relating to the LI group within the Wellcome project will address the extent to which children with speech and language impairments of varying severity benefit from rich early literacy-related interactions in the home.

7.4 Conclusion

The research reported in this thesis adds to a growing body of research suggesting that early parent-child literacy activities in the home influence reading acquisition, primarily indirectly via oral language and emergent literacy. The predictive relationships identified in the Wellcome project dataset are summarised in Figure 7.1. Further, this research adds to the knowledge base by indicating that the role of the HLE may be particularly important in the early literacy development of children at family-risk of dyslexia. It is hoped that the findings of the studies reported here will inform home- and school-based intervention programmes for children at elevated risk of reading failure.

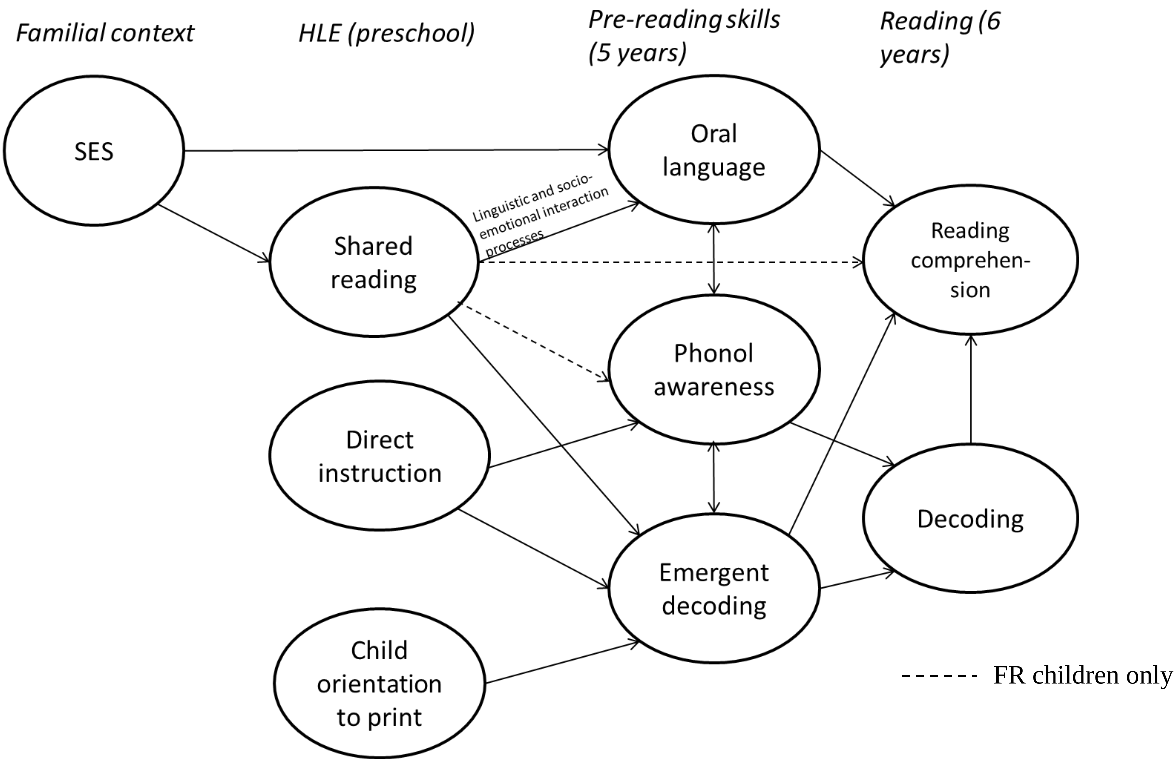


***Figure 7.1*. Relationships between early HLE and reading outcomes identified in the Wellcome Language and Reading project sample**

Appendix 1: Title/Author Checklist Measures

Children's Title Checklist

*This list contains some names of children's storybooks and some unrelated titles. Put a tick in the box beside the name of any children's book that you **recognise** - you do not have to have read the book - but please do not guess!*

No Matter What		Dogger		Rodney and the Big Blue Bubble	
One Snowy Night		Polly's Pink Pyjamas		Peace at Last	
Green Greta		Pumpkin Soup		The Kiss that Missed	
Six Dinner Sid		Goodnight Moon		Kabam Kaboom!	
Owl Babies		There's Treasure in the Attic		Splish Splosh Sunday	
Marmalade Muffins for Breakfast		Letty Spaghetti		Little Grey Duckling and the Egg	
The Very Quiet Cricket		The Jolly Postman		Hairy Maclary from Donaldson's Dairy	
How do you Climb a Rainbow?		Crackers and Fluff		My Mum Knows	
Daisy's Magic Day		Handa's Surprise		The Tiger who Came to Tea	
Bedtime Balloons		Is it Bedtime, Wibbly Pig?		Chimney Pot Cha Cha	
The Snail and the Whale		Ding Dong Doodle Doo		The Great Toy Hunt	
A Flute, A Trumpet and a Big Bass Drum		The Lazy Koala		Say Hello Clemmie	
Nr Gumpy's Outing		Each Peach, Pear, Plum		Mr Wolf's Pancakes	
Giraffes Can't Dance		The Owl who was Afraid of the Dark		Reindeer's Recipe	
Dear Zoo		Fox and Mr Boot		Watch Out, Octopus!	
The Little Lifeboat		Spring in the Meadow		The Lighthouse Keeper's Lunch	
We're Going on a Bear Hunt		The Floppy Broomstick		The Lion Rider	
Round and Round the Windmill		Guess How Much I Love You		Stop that Steamroller!	
Rosie's Walk		Where's My Teddy?		Meg and Mog	
Billy's Fantastic Book		Mog the Forgetful Cat		Not Now, Bernard	

Children's Author Checklist

This list contains some names of authors of children's storybooks and some unrelated names. Put a tick in the box beside the name of any author that you ***recognise*** *- you do not have to have read his or her books - but please do not guess!*

Rod Campbell		Emma Mulligan		Rachel Smale	
Neil Greenfield		Luke Pitman		Spencer Davis	
Janet Ahlberg		John Burningham		Tracey Pratt	
Margaret Mayo		Nathalie Peacey		Lynley Dodd	
Pat Hutchins		Jez Aldborough		Sandra Boynton	
Angus Cook		Raymond Briggs		Mick Inkpen	
Ashley Fruin		Judith Kerr		Hayley Clutterbuck	
Maurice Sendak		Lorna Pockett		Sarah Easdown	
Dav Pilkey		Beatrix Potter		Jan Fearnley	
Christopher Holpin		Steve Leadbetter		Eric Hill	
Lynsey Bull		Joanne Birch		Ian Falconer	
Julia Donaldson		A.A. Milne		Lee O'Connor	
Emma Williams		Jenny Gleed		Shirley Hughes	
Martin Waddell		Debi Gliori		Annette Howe	
Charlie Coulbourn		Sam Meyrick		Rosslyn Elliott	
Graham Cramp		Ian Whybrow		Cressida Cowell	
Laura Dalley		Nick Butterworth		Sean Mowatt	
Lauren Child		Michelle Tilling		Juliet Morefield	
Katherine Holabird		Dr Seuss		Georgina Tudor	
Russell Hide		Giles Andreae		Michael Bond	
Jill Tomlinson		A.J. Bodenham		Lucy Cousins	
David McKee		Eric Carle		Alison Pack	
Miranda Cullen		Denise Ireland		Roger Hargreaves	
Michael Rosen		Helen Nicoll		Sam McBratney	
Alan Hazlewood		Hilary Mitton		Martin Dalton	
Robert Wathan		Louisa Dimmock		Rev W Awdry	
Fiona Milne		Helen Cooper			

Adults' Author Checklist

*This list contains some names of authors of fiction for adults and some unrelated names. Put a tick in the box beside the name of any author that you **recognise** - you do not have to have read his or her books - but please do not guess!*

Ian McEwan		Jemma Read		Duncan Normington	
Mark Bentley		Sophie Kinsella		Martina Cole	
Madeline Whitaker		James Patterson		Joanne Harris	
Louis de Bernières		Adrian Fendall		Vicki Williams	
Sebastien Lauzier		Salman Rushdie		Sophie Zadeh	
Monica Ali		Joseph Roberts		John Le Carré	
Matthew Brindley		Bernard Cornwell		Alice Sebold	
Dean Koontz		Jessica Rushton		Mark Haddon	
Philippa Gregory		Caroline Tee		Martin Amis	
Caroline Crockett		Cecilia Ahern		Robin Herringshaw	
Nicola Wellfair		Margaret Drabble		Pat Barker	
Stephen King		Rose Tremain		Lynette Webster	
Andrew Voss		George Savidge		Monica Crowther	
Matthew Dyke		Ian Rankin		Jackie Collins	
James Gambold		Georgina Holmes		Richard Murphy	
Maeve Binchy		Eleanor Talbot		Maggie O'Farrell	
Val McDermid		Katherine Tucker		Nick Hornby	
Julian Barnes		Sarah Waters		Tracy Payton	
Guy Warner		Khaled Hosseini		Colin Stokes	
Iain Banks		Edward Burcher		John Grisham	
Gemma Hymas		Hadrian Briggs		Kate Atkinson	
Beth Motley		Tom Guy		Stuart Baugh	
Dan Brown		Florence Chamberlain		Doris Lessing	
Dan Marcal		Sebastian Faulks		Alexander McCall Smith	
Zadie Smith		Andy McNab		Richard Dade	
David Abott		Piers Brazier		P.D. James	
Barnaby Pitts		Jodi Picoult			

Appendix 2: Adapted Version of *Standard Occupational Classification* (ONS, 2010)

General Nature of Qualifications, Training and Experience for Occupations in SOC10 Major Groups

Rank	Group	General nature of qualifications, training and experience for occupations in the major group
10	Managers, directors and senior officials	A significant amount of knowledge and experience of the production processes and service requirements associated with the efficient functioning of organisations and businesses.
9	Professional occupations	A degree or equivalent qualification, with some occupations requiring postgraduate qualifications and/or a formal period of experience-related training.
8	Associate professional and technical occupations	An associated high-level vocational qualification, often involving a substantial period of full-time training or further study. Some additional task-related training is usually provided through a formal period of induction.
7	Administrative and secretarial occupations	A good standard of general education. Certain occupations will require further additional vocational training to a well-defined standard (e.g. office skills).
6	Skilled trades occupations	A substantial period of training, often provided by means of a work based training programme.
5	Caring, leisure, and other service occupations	A good standard of general education. Certain occupations will require further additional vocational training, often provided by means of a work-based training programme.
4	Sales and customer service occupations	A general education and a programme of work-based training related to Sales procedures. Some occupations require additional specific technical knowledge but are included in this major group because the primary task involves selling.
3	Process, plant and machine operatives	The knowledge and experience necessary to operate vehicles and other mobile and stationary machinery, to operate and monitor industrial plant and equipment, to assemble products from component parts according to strict rules and procedures and subject assembled parts to routine tests. Most occupations in this major group will specify a minimum standard of competence for associated tasks and will have a related period of formal training.
2	Elementary occupations	Occupations classified at this level will usually require a minimum general level of education (that is, that which is acquired by the end of the period of compulsory education). Some occupations at this level will also have short periods of work-related training in areas such as health and safety, food hygiene, and customer service requirements.
1	Unemployed, full-time student, full-time parent	Unrelated to qualifications, training and experience

Note: Class 1 added to ONS(2010) classification for Wellcome Project classification of parental occupational status

Appendix 3: Additional statistical analyses (Chapter 4)

Section 4.2.2.3

Partial inter-correlations among t2 cognitive measures, controlling for child age; whole sample (N=188)

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Semantic Picture Matching		.32***	.27***	.22**	.28***	.20**	.22**	.05	.21**
2. Receptive Vocabulary			.49***	.40***	.38***	.39***	.30***	.20**	.24***
3. Sentence Structure				.36***	.37***	.36***	.27***	.15*	.25***
4. Syllable Matching					.35***	.40***	.32***	.23**	.21**
5. Alliteration Matching						.58***	.51***	.31***	.45***
6. Phoneme Isolation							.64***	.50***	.60***
7. Letter-sound Knowledge								.58***	.75***
8. Early Word Reading									.55***
9. Letter Writing									

Note: *p<.05; **p<.01; ***p<.001

Section 4.2.2.3

Partial inter-correlations among t2 cognitive measures, controlling for child age; FR-only group (n=87) above diagonal, FR-SLI group (n=29) below diagonal

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Semantic Picture Matching		.24*	.27*	.11	.13	.16	.18	.09	.19
2. Receptive Vocabulary	.06		.30**	.27*	.25*	.31**	.25*	.12	.18
3. Sentence Structure	-.10	.36		.18	.33**	.29**	.21	.09	.22
4. Syllable Matching	.15	.05	.28		.06	.32**	.16	.18	.14
5. Alliteration Matching	.38*	.07	.18	.42*		.60***	.48***	.37***	.51***
6. Phoneme Isolation	.01	.11	.37	.10	.18		.60***	.56***	.60***
7. Letter-sound Knowledge	.32	.22	.15	.45*	.42*	.56**		.54***	.79***
8. Early Word Reading	.19	.17	.19	.42*	.33	.01	.41*		.63***
9. Letter Writing	.44*	.04	.10	.02	.29	.29	.64*	.41*	

Note: **p*<.05; ***p*<.01; ****p*<.001

Section 4.2.2.4

Factor loadings and latent construct covariances for one-group CFA

Latent factors and indicator variables	*b (SE b)*	Critical ratio	*p*
Receptive Language			
Receptive Vocabulary	.73 (.09)	8.47	<.001
Sentence Structure	.67 (.09)	7.99	<.001
Phoneme Awareness			
Alliteration Matching	.69 (.07)	9.98	<.001
Phoneme Isolation	.83 (.07)	12.29	<.001
Print Knowledge			
Letter-sound Knowledge	.89 (.06)	14.27	<.001
Letter Writing	.83 (.06)	12.95	<.001
Covariances between Factors			
Receptive Language-Phoneme Awareness	.68 (.08)	8.88	<.001
Phoneme Awareness – Print Knowledge	.84 (.05)	18.06	<.001
Receptive Language – Print Knowledge	.45 (.08)	5.34	<.001

Section 4.2.2.5

Zero order correlations among SES, HLE and t2 cognitive composites; whole sample (N=188)

	1.	2.	3.	4.	5.	6.	7.
1. Family SES		.54***	-.04	.12	.40***	.28***	.22**
2. Storybook Exposure			-.18*	.20**	.41***	.34***	.19**
3. Direct Instruction				.08	.01	.16*	.29***
4. Child Interest					.16*	.08	-.02
5. Receptive Language						.49***	.34***
6. Phoneme Awareness							.66***
7. Print Knowledge							

Note: *p<.05; **p<.01; ***p<.001

Zero order correlations among SES, HLE and t2 cognitive composites; FRO group (n=87) above diagonal, FR-SLI group (n=29) below diagonal

	1.	2.	3.	4.	5.	6.	7.
1. Family SES		.52***	-.03	.05	.25*	.18	.13
2. Storybook Exposure	.46*		-.27*	.27**	.31**	.12	-.02
3. Direct Instruction	.10	-.15		.02	.05	.28**	.46***
4. Child Interest	.04	-.15	.14		.20	.02	-.07
5. Receptive Language	.04	.20	.06	-.18		.40***	.28**
6. Phoneme Awareness	-.24	.07	-.17	-.12	.31		.63***
7. Print Knowledge	.10	-.01	-.09	-.02	.18	.60***	

Note: *p<.05; **p<.01; ***p<.001

Section 4.23

Partial inter-correlations among t3 cognitive measures, controlling for child age; whole sample (N=186)

	1.	2.	3.	4.	5.	6.
1. Expressive Vocabulary		.46***	.30***	.21**	.39***	.38***
2. Sentence Structure			.36***	.24***	.39***	.33***
3. Phoneme Isolation				.52***	.59***	.45***
4. Phoneme Deletion					.67***	.64***
5. Early Word Reading						.90***
6. Single Word Reading						

Note: *p<.05; **p<.01; ***p<.001

Partial inter-correlations among t3 cognitive measures, controlling for child age; FR-only group (n=85) above diagonal, FR-SLI group (n=29) below diagonal

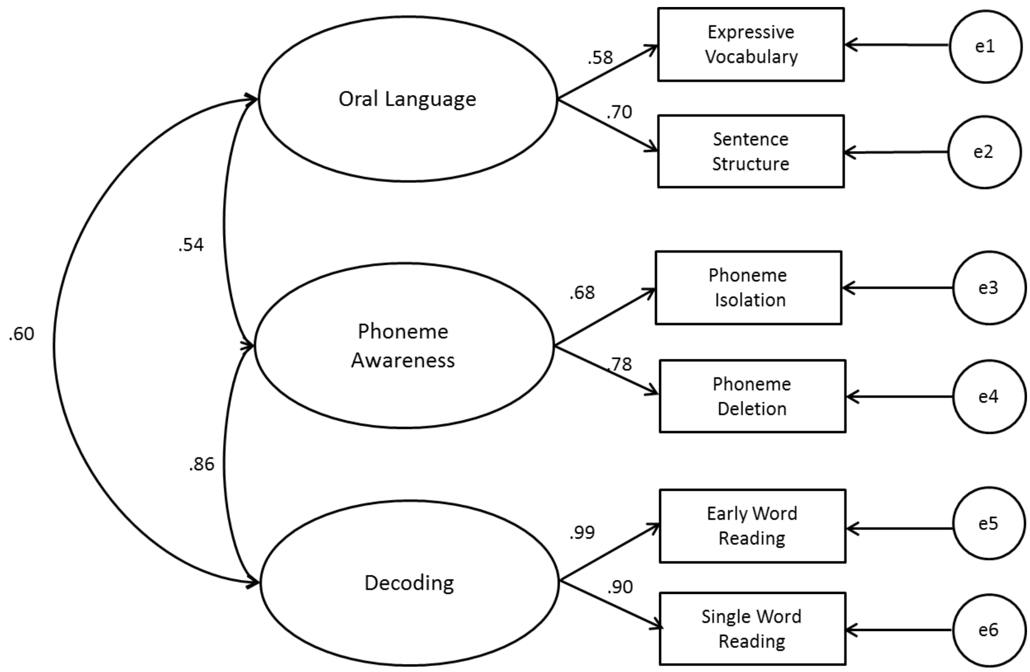
	1.	2.	3.	4.	5.	6.
1. Expressive Vocabulary		.24*	.18	.04	.20	.26*
2. Sentence Structure	.25		.26*	.27*	.34**	.31**
3. Phoneme Isolation	.24	.44*		.51***	.53***	.45***
4. Phoneme Deletion	.15	.03	.53**		.65***	.67***
5. Early Word Reading	.39*	.34	.67***	.68***		.91***
6. Single Word Reading	.31	.25	.32	.58**	.77***	

Note: **p*<.05; ***p*<.01; ****p*<.001

Section 4.3.2.3

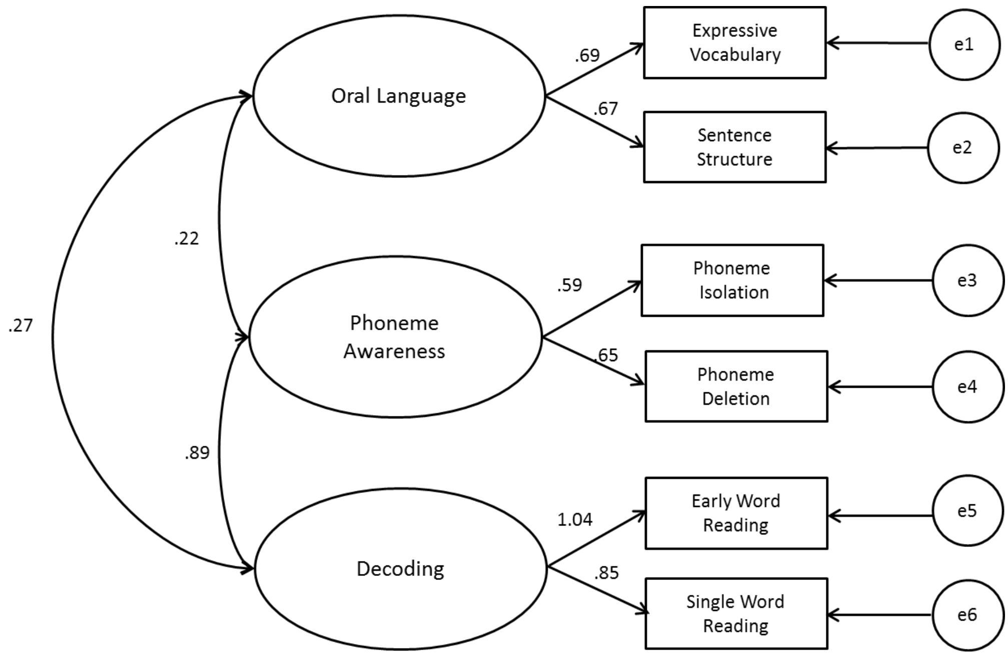
Baseline CFA models of *t3* cognitive variables

(a) FR group



χ^2 (6) = 25.08, *p*<.001; CFI=.95, RMSEA=.17

(b) TD group



χ^2 (6) = 3.65, *p*=.723; CFI=1.00, RMSEA=.00

Section 4.3.2.4

Correlations between SES, HLE and t3 cognitive constructs; whole sample (N=186)

	1.	2.	3.	4.	5.	6.
1. Family SES				.42***	.25***	.27***
2. Storybook exposure *t2*				.39***	.25***	.27***
3. Direct instruction *t2*				.01	.14†	.13†
4. Oral language *t3*					.38***	.45***
5. Phoneme awareness *t3*						.70***
6. Decoding *t3*						

*Note: †p<.08; *p<.05; **p<.01; ***p<.001*

Correlations between SES, HLE and t3 cognitive constructs; FR-only (n=85) group above diagonal, FR-SLI group (n=29) below diagonal

	1.	2.	3.	4.	5.	6.
1. Family SES				.06	.16	.11
2. Storybook exposure *t2*				.26*	.19†	.10
3. Direct instruction *t2*				-.01	.19†	.32**
4. Oral language *t3*	.43*	.38*	-.11		.26*	.35***
5. Phoneme awareness *t3*	.32†	.24	-.19	.34†		.68***
6. Decoding *t3*	.30	.08	-.33†	.43*	.66***	

*Note: †p<.08; *p<.05; **p<.01; ***p<.001*

Appendix 4: Additional statistical analyses (Chapter 5)

Section 5.3.2

Differences between FRO (n=85) and TD (n=72) groups on t2 cognitive measures

Measure	FR mean (s.d.)	TD mean (s.d.)	*t*(df)	*p*	*Effect size d*
Decoding					
Early Word Reading	23.09 (8.10)	27.56 (4.86)	4.09 (155)	<.001	.67
Single Word Reading	20.87 (13.35)	27.86 (10.29)	3.62 (155)	<.001	.59
Nonword Reading	9.04 (6.60)	12.85 (4.76)	4.08 (155)	<.001	.66
Spelling	5.12 (2.82)	6.19 (2.77)	2.40 (155)	.017	.38
Reading Comprehension					
Passage Comprehension	12.88 (6.80)	16.57 (5.14)	3.77 (154)	<.001	.61

Section 5.3.3

Correlations among t4 literacy measures; whole sample (N=186)

	1.	2.	3.	4.	5.
1. Early Word Reading		.83***	.72***	.68***	.80***
2. Single Word Reading			.86***	.80***	.83***
3. Nonword Reading				.70***	.75***
4. Spelling					.67***
5. Reading comprehension					

Note: ****p*<.001

Correlations among t4 literacy measures; FR-only group (n=85) above diagonal; FR-SLI group (n=29) below diagonal

	1.	2.	3.	4.	5.
1. Early Word Reading		.81***	.69***	.71***	.79***
2. Single Word Reading	.79***		.85***	.81***	.87***
3. Nonword Reading	.74***	.83***		.68***	.82***
4. Spelling	.69***	.81***	.69***		.72***
5. Reading Comprehension	.70***	.70***	.51**	.66***	

Note: ***p*< .01 ****p*<.001

Section 5.3.4

Correlations between SES, HLE and t4 literacy composites; whole sample (N=186)

	1.	2.	3.	4.	5.	6.
1. Family SES					.34***	.40***
2. Storybook Exposure					.31***	.43***
3. Direct Instruction					.11	.09
4. Child Interest					.07	.14
5. Decoding *t4*						
6. Reading Comprehension *t4*						

Note: ****p*<.001

Correlations between SES, HLE and t4 literacy composites; FR-only group (n=85) above diagonal; FR-SLI group only (n=29) below diagonal

	1.	2.	3.	4.	5.	6.
1. Family SES					.15	.20
2. Storybook Exposure					.17	.33***
3. Direct Instruction					.25*	.13
4. Child Interest					.00	.13
5. Decoding *t4*	.21	.27	-.24	.06		
6. Reading Comprehension *t4*	.17	.46*	-.12	-.16		

Note: **p*<.05; ****p*<.001

Section 5.3.6.1

Direct path weights (unstandardised regression and covariance coefficients) for two-group observed variables path model, predicting decoding at age 6

	FR				*TD*			
Regression path weight	B(SE)	95% CIs	CR	*p*	B(SE)	95% CIs	CR	*p*
SES → storybook exposure	.47 (.06)	.37-.57	7.78	<.001	.47 (.06)	.37-.57	7.78	<.001
SES → oral language *t3*	.20 (.08)	.07-.34	2.51	.012	.20 (.08)	.07-.34	2.51	.012
Storybook exposure → oral language *t3*	.23 (.08)	.10-.37	2.85	.004	.23 (.08)	.10-.37	2.85	.004
Storybook exposure → phoneme awareness *t3*	.30 (.09)	.16-.44	3.29	<.001	.07 (.10)	-.09-.23	0.75	.455
Storybook exposure → emergent decoding *t3*	.22 (.07)	.10-.34	2.95	.003	.22 (.07)	.10-.34	2.95	.003
Direct instruction → phoneme awareness *t3*	.20 (.08)	.07-.33	2.60	.009	.20 (.08)	.07-.33	2.60	.009
Direct instruction → emergent decoding *t3*	.17 (.08)	.04-.30	2.20	.028	.17 (.08)	.04-.30	2.20	.028
Phoneme awareness *t3* → decoding *t4*	.23 (.05)	.15-.31	4.83	<.001	.23 (.05)	.15-.31	4.83	<.001
Emergent decoding *t3* → decoding *t4*	.72 (.06)	.62-.81	12.71	<.001	.60 (.08)	.48.73	7.79	<.001
Covariances								
Storybook exposure ↔ direct instruction	-.18 (.07)	-.29- -.07	-2.68	.007	-.18 (.07)	-.29- .07	-2.68	.007
Oral language *t3* ↔ phoneme awareness *t3*	.20 (.07)	.09-.31	2.99	.003	.20 (.07)	.09-.31	2.99	.003
Oral language *t3* ↔ emergent decoding *t3*	.29 (.06)	.19-.39	4.70	<.001	.29 (.06)	.19-.39	4.70	<.001
Phoneme awareness *t3* ↔ emergent decoding *t3*	.59 (.08)	.45-.73	7.06	<.001	.59 (.08)	.45-.73	7.06	<.001

Note: 95% CIs – bootstrapped 95% confidence intervals; CR – critical ratio

Section 5.3.6.2

Direct path weights (unstandardised regression and covariance coefficients) for two-group observed variables path model, predicting reading comprehension at age 6

	FR				*TD*			
	B(SE)	95% CIs	CR	*p*	B(SE)	95% CIs	CR	*p*
Regression path								
SES → storybook exposure	.47 (.06)	.37-.57	8.04	<.001	.47 (.06)	.37-.57	8.04	<.001
SES → oral language *t3*	.20 (.09)	.07-.34	2.40	.016	.20 (.09)	07-.34	2.40	.016
Storybook exposure → oral language *t3*	.23 (.08)	.10-.37	2.93	.003	.23 (.08)	.10-.37	2.93	.003
Storybook exposure → phoneme awareness *t3*	.30 (.08)	.16-.44	3.66	<.001	.07 (.10)	-.09-.23	0.74	.457
Storybook exposure → emergent decoding *t3*	.22 (.07)	.10-.34	3.01	.003	.22 (.07)	.10-.34	3.01	.003
Storybook exposure → reading comprehension *t4*	.20 (.04)	.12-.28	3.88	<.001	.09 (.10)	-.03-.20	0.92	.360
Direct instruction → phoneme awareness *t3*	.20 (.08)	.07-.33	2.59	.010	.20 (.08)	.07-.33	2.59	.010
Direct instruction → emergent decoding *t3*	.17 (.08)	.04-.30	2.13	.033	.17 (.08)	.04-.30	2.13	.033
Oral language *t3* → reading comprehension *t4*	.26 (.05)	.17-.33	4.25	<.001	.26 (.05)	.17-.33	5.64	<.001
Emergent decoding *t3* → reading comprehension *t4*	.64 (.06)	.52-.76	8.06	<.001	.51 (.12)	.52-.76	4.26	<.001
Covariance								
Storybook exposure ↔ direct instruction	-.18 (.06)	-.29- -.07	- 2.77	.006	-.18 (.06)	-.29- -.07	-2.77	.006
Oral language *t3* ↔ phoneme awareness *t3*	.20 (.07)	.09-.31	3.01	.003	.20 (.07)	.09-.31	3.01	.003
Oral language *t3* ↔ emergent decoding *t3*	.29 (.06)	.19-.39	4.90	<.001	.29 (.06)	.19-.39	4.90	<.001
Phoneme awareness *t3* ↔ emergent decoding *t3*	.59 (.08)	.45-.73	7.26	<.001	.59 (.08)	.45-.73	7.26	<.001

Note: 95% CIs – bootstrapped 95% confidence intervals; CR – critical ratio

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