EARLY LANGUAGE DELAY: A STUDY OF THE EVOLVING LANGUAGE ENVIRONMENTS OF PRESCHOOL CHILDREN

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Abstract

Primary language impairment (PLI) affects approximately one in 20 young children, who may have difficulties with language in later life. The importance of parent-child interaction (PCI) for language development has been well established. Many early speech and language therapy interventions have focused on modifying characteristics of PCI to enhance opportunities for language learning. However, the success of such programmes is mixed. Furthermore, there is a dearth of literature examining the developmental nature of the relationship between parent and child language with children who have PLI. Using a case study methodology, the present study aimed to understand the dynamics of the relationship between PCI and the trajectories of vocabulary growth of children with PLI.

Four case studies were developed using data from preschool children and their families. Following baseline assessments, data were collected at four time points across 9-10 months. Vocabulary development was examined using MacArthur-Bates Communicative Development Inventories. Children wore a LENA (Language ENvironment Analysis) recorder at home, which collected naturalistic all-day audio, used to sample PCI for transcription and analysis. The LENA audio was coded to examine how talk varied across everyday activities. In addition, mother-child dyads were video-recorded looking at a picture-book to examine parent teaching behaviours. Semi-structured interviews were carried out with parents to get their perspectives on having a child with PLI.

The findings demonstrated cross-case differences in the trajectories of children's vocabulary growth, which were consistent with differences in maternal talk. Across cases, mothers were generally found to dominate interactions. There was no clear pattern in maternal responsiveness that suggested change over time. However, there was a trend for increased responsiveness during picture-book sharing compared to the naturalistic PCI samples. Mother-child play was infrequent during the LENA recordings. These findings challenge previous research that observed PCI in single, researcher-defined settings such as toy play and its representativeness for understanding PCI more broadly. Further research is discussed, including evaluation of PCI interventions in naturalistic settings to assess integration of strategies. The interviews with parents identified factors to improve engagement and satisfaction with interventions. Understanding individual differences in response to interventions is essential for improving the effectiveness of support for children.

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List of abbreviations

PLI	primary language impairment
PCI	parent-child interaction
SLT	speech and language therapy
LENA	Language ENvironment Analysis
TD	typically developing
CDI	communicative development inventory
SES	socioeconomic status
MLU	mean length of utterance
MLUm	mean length of utterance (in morphemes)
TTR	type token ratio
MDI	Mental Development Index
BSID-II	Bayley Scales of Infant Development, Second Edition
AWC	adult word count
CVC	child vocalisation count
CTC	conversational turn count
BCRP	Better Communication Research Programme
NHS	National Health Service
NRES	National Research Ethics Service
R&D	Research and Development
UWE	University of the West of England
REC	Research Ethics Committee
PLS-3	Preschool Language Scale-3
SD	standard deviation
TIM	Thorpe Interaction Measure
ALSPAC	the Avon Longitudinal Study of Parents and Children
SALT	Systematic Analysis of Language Transcripts

Chapter 1 Introduction

1.1 Introduction to the study

There is wide variation in children's early language development (Bates, Dale and Thal, 1995, Lieven, Pine and Barnes, 1992) and while the majority of toddlers develop language without any apparent difficulties, some children start talking later than expected. Children with primary language impairment (PLI) may go on to have persistent problems with language at school and even into adulthood that impact on their chances for success. Understanding the factors that facilitate language development is crucial for informing effective language interventions. There is a wealth of research that has demonstrated a positive relationship between characteristics of parent talk and parent-child interaction (PCI) and typical language development (Girolametto *et al*, 1999, Hart and Risley, 1995, Huttenlocher *et al*, 1991, Rowe, 2008, Tamis-LeMonda and Bornstein, 2002). Furthermore, the nature of PCI and its relationship with children's language has been shown to change throughout early development (Nelson *et al*, 1984, Rowe, 2012, Tamis-LeMonda and Bornstein, 2002). However, many studies of PCI measure both parent and child language at the same time point (e.g., Conti-Ramsden 1990, Paul and Elwood, 1991, Rescorla *et al*, 2001), which makes it difficult to determine the direction of the relationship between them. In particular, there is a dearth of literature examining the developmental nature of the relationship between PCI and the language development of children with early language difficulties.

Characteristics of PCI that have been found to facilitate child language development have been utilised in speech and language therapy (SLT) interventions to support preschool children with PLI. A common intervention involves working with parents to modify children's home language environments (e.g., Baxendale and Hesketh, 2003, Fey, Cleave and Long, 1997, Girolametto, Pearce and Weitzman, 1996). However, intervention studies do not always measure parent language, and the exact nature by which such interventions bring about change is not always clear. An additional problem with PCI research relates to the nature of the sampling context. Studies often measure parent and child language during brief, dyadic interactions, usually involving toy play. Regular play is not reported by all families (Brocklebank, Bedford and Griffiths, 2014), which questions the representativeness of observations during play for understanding typical PCI that occurs in children's natural environments (Marchman and Weisleder, 2011).

The present study aimed to examine the dynamics of the relationship between PCI and the vocabulary development of children with PLI to address the currently limited developmental perspective. Examination of PCI during everyday activities in children's home environments aimed to understand interactions without prescribing the level of control used in dyadic play observations and add to the current understanding of the interaction experiences involved in family life. In addition, parents' perspectives of having a child with PLI were captured. The findings from the present study intended to inform intervention approaches that involve parent training to take an individualised approach that is acceptable to families.

1.2 Vocabulary development

Language difficulties can present within a single aspect of the language structure or a number of different levels. Crystal and Varley (1998) outlined the following three different areas that form the structure of language in which children may demonstrate difficulties:

1. Semantics - meaning of language
    - Vocabulary
    - Other aspects
2. Grammar - structure of language
    - Morphology
    - Syntax
3. Phonology - sound system of languages
    - Phonetics
    - Segmental
    - Non-segmental

Early language delay is identified when children talk later than expected and have a limited vocabulary size. Children can also have problems with phonology, which refers to the organisation of the speech sounds used in a particular language. As language develops, children may demonstrate grammatical deficits, which could include problems with morphology (word structure and formation), such as not using appropriate verb agreement, or syntactic problems when constructing sentences. Children can also present with pragmatic difficulties that result in problems using or understanding language within the context of social interactions.

The current study focused on preschool children with early language delay, with small vocabulary sizes and no word combinations. Limited vocabulary size is an early clinical marker

for later language difficulties (Ellis and Thal, 2008, Paul, 1996, Rescorla, 1989). Speech and language therapy goals to modify PCI are a particularly relevant intervention target for young children aged 2;0-3;0 (years; months) (Roulstone *et al*, 2012b). Children demonstrating language difficulties in this age range are likely to be using only small vocabularies and single-word utterances; therefore, the focus of the literature review for the current study was on examining the research into the vocabulary development of young preschool children[1].

1.3 Children with primary language impairment (PLI)

Broadly, language difficulties can be considered as either primary, when language is the predominant area of concern, or secondary problems to another developmental, sensory or neurological disorder, such as hearing impairment or autism. Children with primary language difficulties appear to have a particular problem with the acquisition of language, despite otherwise typical development, although the absence of other deficits may not always be clear during early development due to variation in developmental milestones. The prevalence of PLI for young children up to age 7;0 is approximately 6% (Law *et al*, 2000) and it is associated with poor literacy skills and later academic, social and behavioural problems (Aram, Ekelman and Nation, 1984, Beitchman *et al*, 2008, Conti-Ramsden *et al*, 2013, Mok *et al*, 2014, Rescorla, 2009, St Clair *et al*, 2011, Stothard *et al*, 1998, Whitehouse, Robinson and Zubrick, 2011). Children with very early language delays that include limited vocabularies have been described using a range of terminology, including 'language-delayed' (Cunningham *et al*, 1985) and 'late-talking' (Rescorla and Fechnay, 1996). The more formal term 'specific language impairment (SLI)' (Fey *et al*, 1999) has been used widely to describe older children, 3;0 and over, who may demonstrate problems beyond late emergence of talking, including deficits in grammar, phonology or pragmatics (Tager-Flusberg and Cooper, 1999). A recent review of the term 'specific language impairment' was published recently (Reilly *et al*, 2014), which examined the evidence regarding the common criteria for a discrepancy in language and cognitive performance. The reviewers proposed that the current criteria could not be defended based

[1] During the course of the study the children developed early grammatical skills and began to combine words. Measures of early language complexity, particularly mean length of utterance (MLU), were collected; however, they have not been reported at present. The MLU data did not provide additional insight into the understanding of children's language delay, development over time or the relationship between parent and child language. The inclusion of MLU data was considered to distract from the main focus of the study to understand children's vocabulary development and the extent to which characteristics of PCI were related to children's developing skills.

on the available research and suggested that the 'specific' label should be dropped and that the term 'language impairment' be used instead (Reilly *et al*, 2014).

For the purpose of the present study, the term primary language impairment (PLI) was used to cover all of the descriptions outlined previously. This term has been used because it offers a more inclusive expression for language difficulties that are not related to another known disorder (Bishop, 2014). It is important that this term is not confused with pragmatic language impairment, or taken to mean primary school age (Bishop, 2014). It should also be noted that the word 'impairment' is used only as an umbrella term to cover the range of descriptions. For some children this term could be considered an inappropriate label as their language difficulties may be a transient delay (Bates, Dale and Thal, 1995). Researchers may distinguish between 'late talkers' who are later shown to be either 'truly delayed', demonstrating persistent problems, or 'late bloomers', catching up to within normal limits (e.g., Henrichs *et al*, 2011, Thal and Tobias, 1992, Thal, Tobias and Morrison, 1991). However, it is difficult to predict later language performance in the early preschool years and Olswang, Rodriguez and Timler (1998) recommended intervention decisions should be made on the basis of children's profiles of predictors (expressive and receptive language, phonology, imitation abilities, play, gesture use and social skills) and risk factors (ear infections, family history and parent needs).

1.4 The Child Talk programme grant

This PhD study was funded as part of a large programme grant, Child Talk (Roulstone *et al*, 2015), which was funded by the National Institute of Health Research (NIHR), under its Programme Grant for Applied Research Programme (RP-PG-0109-10073). Child Talk aimed to understand the types of interventions being used by SLT services with preschool children with speech and language difficulties, the critical elements of these approaches and how they are modified for different children. The programme incorporated the perspectives of parents, early years staff and children. Child Talk identified nine themes that characterised SLT approaches, the assessments and interventions that mapped onto these areas and the quality of evidence available to support their use.

The present study was funded as part of the Child Talk programme grant and was designed and researched independently but aimed to complement the programme goals. The PhD study intended to inform interventions that modify PCI in order to optimise the language learning environment of children, which related to two themes identified by Child Talk: adult

understanding and adult-child interaction. The importance of the role of social interactions for early child development was developed by Soviet psychologist Lev Vygotsky (1896-1934). Vygotsky proposed that children develop within a social context, which provides important opportunities for encouragement and feedback. Children are proposed to learn within their 'zone of proximal development' which was described as:

> *…the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers*
> (Vygotsky, 1978, p.86)

A more capable partner provides the necessary components of the task-specific skills that the child has not yet acquired. Through this process of 'scaffolding' children are able to focus on elements of the task that are within their own ability and achieve successful completion of the task with the support of more skilled partners (Wood, Bruner and Ross, 1976). The interaction partner, who in the early preschool stages is often the parent, can provide linguistic scaffolding appropriate to their child's abilities, which stimulates language growth. This may include imitating the words or phrases children use or repeating their utterances back to them in a more complete grammatical form, or with additional semantic information. The social-interactionist approach to understanding language learning has informed SLT interventions. Practitioners use contingent responses to children's behaviour or utterances to place these within a communicative context, modelling more advanced linguistic skills (Paul, 1995). This practice has been extended in the development of interventions that train parents, which intend to modify PCI to optimise children's language learning environments.

1.5 Overview of the thesis

Chapter 2 explores the current literature regarding the vocabulary development of children with typical and delayed language, the relationship between PCI and language development and the inclusion of PCI strategies in SLT interventions. The review identifies limited research into the relationship between parent language and the language of children with PLI from a developmental perspective. There is also limited PCI research across a broad range of activities in children's natural environments. The literature review considers how PCI varies across different contexts. The chapter also covers research into parents' perspectives on language development and interventions.

Chapter 3 outlines the aims and objectives of the study and the research questions used to guide the methodological decisions. Chapter 4 describes the multiple case study design and its suitability to the present research. The recruitment and selection of cases is then outlined followed by the methods used to collect data, including an innovative new technology to collect language data from children's natural environment over a whole day: the LENA (Language ENvironment Analysis) system. LENA uses an audio recorder worn by the child and accompanying software provides automated analysis of the audio environment. A pilot study used to assess the feasibility of the proposed methods is first described, followed by the procedure and analysis plan for the full-scale case studies.

Chapter 5 presents each case study in turn, reporting on the trajectories of children's vocabulary growth, the context of the high-level interaction samples as well as the different activities children are involved in more broadly, and variation in parent and child talk and interactions across these contexts from everyday family lives. The chapter highlights the value of capturing individual variation and also draws comparisons across cases. Then the chapter reviews parents' experiences of being involved in the study, which provides useful insight for other researchers intending to use the LENA system or other methods of observation.

Despite differences across cases relating to age, language level and family context, a number of similarities emerged regarding PCI with the four children over the study period, which have been reported in Chapter 6 for clarity. Chapter 6 discusses the extent to which characteristics of PCI changed as children's vocabulary developed. The chapter draws distinctions between PCI in children's homes sampled using LENA, without researcher presence, and during video-recorded picture-book sharing sessions. The discussion considers the potential impact of the sampling context on study findings and the representativeness of a single context for understanding PCI more broadly. Chapter 7 examines parents' perspectives on having a child with PLI and discusses factors that could support individualised SLT approaches that are acceptable to families.

Finally, Chapter 8 summarises the findings and considers the strengths and limitations of the study. Implications for future research and practice are outlined including further investigation into the impact of the PCI sampling contexts and how to empower parents who are concerned about their children's language development and engage them in the SLT process.

Chapter 2 Early vocabulary development and the role of children's language learning environments

2.1 Introduction

The literature review in this chapter identifies the wide variation in early vocabulary that is reported for both typically developing (TD) children and those with primary language impairment (PLI). The review focuses on vocabulary development to reflect the fact the early vocabulary delays are used as initial markers of a later language problem and children referred for interventions that target PCI are likely to be in the early, presyntactic stages of language development (before the onset of expressive grammar). Studies have shown that it is difficult to determine which children are likely to have persistent difficulties (Dale *et al*, 2003) and require intervention. The rate, and associated composition, of vocabulary growth has been shown to be a more useful predictor of children's subsequent language skills compared to measures of vocabulary at a single time point (2.2). Furthermore, there is a wealth of literature that has demonstrated a relationship between parent talk and parent-child interaction (PCI) and children's language development, particularly in TD populations (2.3). A systematic review of the literature explores the differences in PCI for children with PLI compared to their TD peers (2.3.3). Understanding the characteristics of PCI that facilitate TD language development have been used in speech and language therapy (SLT) interventions that aim to modify PCI to help optimise the opportunities for language learning present in children's environments (2.3.4). After presenting the literature, the review highlights issues regarding how to measure parent and child language and the extent to which study observations of PCI represent interactions that occur most often in the home (2.4). Finally, the chapter outlines the value of incorporating parents' perspectives when planning interventions (2.5).

2.2 Vocabulary development of preschool children

There is large variation in the onset of early word production, and vocabulary size at age 2;0 (years; months) has been used as an initial indicator of PLI. This section identifies the difficulty predicting later language performance reliably using a single measurement of vocabulary production. Research into vocabulary development has demonstrated large variation in the rate of growth, associated with vocabulary composition, for both TD children and children with PLI. The rate of growth has been found to be a more useful indicator of later language.

There is wide variation in early vocabulary size within a TD population, which increases from the time children use their first words around their first birthday. Heterogeneity in early vocabulary was demonstrated in the norming study for the MacArthur-Bates Communicative Development Inventories (CDI; a parent checklist of children's word use) (Fenson *et al,* 2007), which collected cross sectional vocabulary data from 1803 infants aged 0;8-2;6, using the parent report tool (Bates *et al,* 1994). The cross sectional study showed that variation began around age 1;0, which for many children was the time of initial word use (Bates *et al,* 1994). A year later at age 2;0, variation increased with children at the ninetieth percentile and above using over 500 words. In contrast, children at or below the tenth percentile were using less than 60 words. It is important to note that although Bates *et al* (1994) used a large population of children in the US whose families ranged in their socioeconomic backgrounds, over half of the adults involved had achieved a college diploma compared to less than 20% of adults in the general US population, according to census data from 1990 (Bates *et al,* 1994, Fenson *et al,* 1994). Parent education is used as an indicator of socioeconomic status (SES) and overrepresentation of higher SES families in the CDI norming study challenge the representativeness of the norming sample for understanding typical variation in vocabulary size (see section 2.3.1 for discussion of SES differences). However, other studies have also identified the discrepancy in vocabulary size between TD children and those with PLI at age 2;0. Thal *et al* (1999) found that at age 2;2, children with PLI were using 17 words on average and Ellis Weismer, Murray-Branch and Miller (1994) found that at age 2;1-2;2, four children with PLI had limited vocabulary sizes of 25-87 words based on parent report and exhibited no overlap in vocabulary size with 19 TD children. A small vocabulary size below 50 words at age 2;0 has been used as an important indicator of delay (Paul, 1996, Rescorla and Schwartz, 1990).

Children can be separated into typical or delayed groups around age 2;0 depending on their vocabulary production. Measuring vocabulary at one time point is not always a clear predictor of later language performance at an individual level. The four children with PLI in Ellis Weismer, Murray-Branch and Miller's (1994) study were followed up to age 2;10-2;11, at which point three of the children had reported vocabularies of over 500 words, which the study authors proposed as support for the idea that children with early delay can 'catch up' in expressive vocabulary by 3;0. However, when they examined the individual trajectories of children's vocabulary growth, the child with the largest number of words (87) at 2;1 had the smallest number at 2;11 (369). In another study, Thal *et al* (1997) examined the stability of

language development in a subsample of children included in the CDI norming study who were followed longitudinally. Twenty-four of the 185 children in the sample (aged 1;4-2;1) scored at or below the tenth percentile and were classed as the PLI group. Six months later, 17 of the children were identified as having PLI, overall 71% of children with PLI at Time 2 had been previously identified as delayed. Using age, SES and language variables, individual children could only be correctly classified as having PLI at Time 2 in 69% of cases (Thal *et al,* 1997). Difficulties predicting later language skills are problematic for professionals in identifying which children require additional support or intervention.

Vocabulary studies have identified different trajectories of growth amongst preschool children and found that the rate of growth may be a more successful predictor of later language. In an eight-month longitudinal study of TD children aged 1;2 to 1;10, Goldfield and Reznick (1990) found that 13 out of 18 children exhibited a sudden increased rate of vocabulary development, which they labelled a vocabulary spurt, learning approximately 64 new words per two-month period. The other five children in the study demonstrated more gradual development, learning approximately 40 new words in the same time. Bauer, Goldfield and Reznick (2002) later used the CDIs to examine monthly rate of lexical growth in 26 younger TD children from ages 0;8-0;10 up to 1;2. Two distinct trajectories of either fast or slow acceleration were found among these younger children and their group membership (fast or slow) was predictive of vocabulary size at 1;9 (466 and 86 words respectively).

Rescorla, Mirak and Singh (2000) found similar differences in the trajectories of older children, aged 2;0 to 3;0, with PLI. Bimonthly vocabulary data was collected from 28 children, who had an average vocabulary delay of approximately a year, using the Language Development Survey (LDS) (Rescorla, 1989), a parent checklist of 310 words. Rescorla, Mirak and Singh (2000) differentiated children into two groups according to whether or not they had a vocabulary size of 100 words or more at age 2;6. Group 1 had a mean vocabulary size of 184 at 2;6 and showed accelerated vocabulary growth, with 70-83 new words reported every two-months between ages 2;2 and 2;8. In contrast, group 2 had a mean vocabulary size of 28 words at 2;6 and demonstrated a slower rate of overall growth, which peaked at a later age showing a mean increase of 58 words in the two-month period aged 2;8-2;10. There was a larger proportion of children with PLI who did not show a spurt (61%) than there were in the Goldfield and Reznick's (1990) TD study (28%). The rate of children's vocabulary growth at age 2;6 was predictive of expressive vocabulary as well as syntax use and mean length of utterance

(MLU) at age 3;0 based on language samples during mother-child play (Rescorla, Mirak and Singh, 2000). The rate of growth could be useful for professionals to determine who may benefit from early language intervention.

The proportion of different word types in children's early vocabularies has been linked to variation in the rate of growth. In particular, high proportions of nouns in the early stages of vocabulary learning have been linked to faster rates of growth. Differences in the composition of vocabularies of TD children compared to children with PLI suggest that it could be a useful addition for identifying which children may require extra support. Bates *et al* (1994) examined the composition of children's early vocabularies in relation to their vocabulary size, irrespective of age, and found that initial language production concentrated on reference (nouns). The preference for nouns was most evident in early vocabularies up to 50 words, peaking at a vocabulary size of around 100-200 words. Next there was a move to an emphasis on predication (action verbs and adjectives), with wide variation in closed-class use (e.g. pronouns, prepositions, question words, connectives) in vocabularies of up to 400 words followed by a steadier linear increase after 400 words. Bates *et al* (1994) compared the proportions of word types in children's vocabularies to the proportion of common nouns, predicates, and closed class words represented on the CDIs. If children showed no preference towards different word classes then they would be expected to draw evenly from the different word classes; however, as outlined above, the proportion of different word types in children's vocabularies was found to change over time. The differences found in Bates *et al*'s (1994) study provide useful information about overall changes at the group level. The study did not demonstrate differences at the individual level.

Smaller studies capable of tracking children's individual trajectories have found that differences in the composition of early vocabularies were related to the rate of vocabulary growth. In Goldfield and Reznick's (1990) study of rate of language growth, outlined above, the composition of individual children's developing vocabularies was related to the presence of their proposed vocabulary spurt. Goldfield and Reznick (1990) suggested that the associated period of rapid learning could be described as a naming explosion, as nouns accounted for a greater proportion of children's vocabularies during this period. The children who showed more gradual development demonstrated little change in the proportion of nouns being added to their lexicon.

The proportion of nouns may also be related to the rate of growth for children with PLI. Rescorla, Mirak and Singh's (2000) study, outlined previously, demonstrated that the proportion of nouns could differentiate the rate of vocabulary development of children with PLI (aged 2;0 to 3;0). The proportion of nouns was plotted for the two groups of children with either fast or slow vocabulary growth. Group 1 had a faster rate of development and had approximately 60% nouns in their vocabularies, which was consistent with the proportion represented on the parent report tool used in the study. In contrast, group 2 demonstrated slower rates of growth and their proportion of nouns was approximately 50% across the study to age 2;8. An increase in nouns was found for Group 2 after 2;8 in line with an increase in their rate of growth.

The importance of the rate of early vocabulary development as a predictor of later language skills was upheld in a more recent longitudinal study. Rowe, Raudenbush and Goldin-Meadow, (2012) examined the vocabulary development of 62 preschool children from age 1;2 to 3;10, with follow-up receptive vocabulary assessment at age 4;6. The rate and acceleration of children's vocabulary growth was a significant predictor of later receptive vocabulary, whereas vocabulary use at five single time points between ages 1;2 and 2;6 did not predict later performance. Rate of growth was a greater predictor for children from lower SES backgrounds. When assessing children's need for early intervention, it is not necessarily feasible to measure language over a large number of time points; however, Rowe, Raudenbush and Goldin-Meadow (2012) suggested that assessing change in vocabulary size from two or three points during the toddler years could be beneficial for identifying children who would benefit from additional support.

Difficulties predicting later language are consistent with evidence that the rate of children's vocabulary development is not linear; children have been shown to fluctuate in their broader profile of language skills across the preschool period and can move between typical and impaired levels. In a large, population-based study of 1113 children in Australia, Ukoumunne *et al* (2012) collected language data longitudinally, using parent report of children's early speech and social skills at ages 0;8 and 1;0, and vocabulary and grammatical complexity on CDIs at ages 2;0 and 3;0, followed by standardised assessment of language at age 4;0. The study used latent class analysis to identify different profiles of development, based on whether children's language skills were classed as 'typical', 'precocious' or 'impaired' at each assessment point; using a five class model to categorise children according to average paths of language

development. Approximately two thirds of children were in the typical class, demonstrating stable language performance over the 40-month study period. The remaining children were categorised in the other four classes that included acceleration or deceleration of language development over time. Precocious (late) or precocious (early) classes included children with typical language that was followed by accelerated performance above the mean, or initially accelerated levels of language developed that later decelerated to typical levels. In contrast, impaired (late) or impaired (early) classes included children with typical language that preceded or followed delayed performance across the preschool stage. Ukoumunne *et al* (2012) suggested that heterogeneity within groups makes it difficult to use the profiles to screen children. Interestingly, using a six class model identified a class of children that maintained delayed performance throughout the study period; however, the five-class model was identified to be the best fit and an overall impaired class was not included. Ukoumunne *et al* (2012) suggested that the absence of an overall impaired class could have been related to the lack of receptive language measures, or the exclusion of children with incomplete data records for each time point, shown to have been more likely to have lower language scores. Ukoumunne *et al* (2012) found that children with improving trajectories had indicators of higher SES and suggested that intervention may need to be targeted at children with disadvantaged backgrounds.

The research outlined in this section highlights the need to track individual development over time in order to understand the trajectories of vocabulary growth for children with PLI. Using single measures of early vocabulary can be problematic for predicting later language performance because children's abilities fluctuate over time. The instability of language development during the preschool years highlights the importance of taking multiple measures to improve accuracy of diagnoses (Reilly *et al*, 2014). Differences in the rate and composition of children's vocabularies could provide important information for professionals working with children with PLI to make decisions regarding whether children might require additional support or intervention. It is also necessary to identify the factors that influence individual differences in early vocabulary development in order to inform SLT intervention planning effectively. The next section examines research into the relationship between children's language exposure and their subsequent language skills.

2.3 Parent child interaction

A number of influential studies in the 1990s initiated a wealth of research into the role of adult language input in children's developing language skills and its contribution to individual differences in early language proficiency. The following section reviews evidence for the relationship between the characteristics of parent talk (2.3.1) and the characteristics of parent language used during PCI (2.3.2), including parental responsiveness (utterances related to the child's preceding utterance or behaviour) or directive language (to control the child's behaviour or focus of attention). A systematic review of the literature, which examined studies of PCI with TD children compared to children with PLI, is then reported (2.3.3). Finally, the effectiveness of SLT intervention studies that aimed to modify PCI is reviewed (2.2.4).

2.3.1 Quantity and complexity of parental talk

Research into the relationship between parent and child language found that characteristics of parent talk, including parent talkativeness (the amount of parent talk based on number of words produced), diversity (the number of different words or type/token ratio) and complexity (often measured using MLU) were related to aspects children's language development. Differences in parent talk across families from a range of SES backgrounds have been associated with differences in children's early language achievements within the preschool period. Examination of children's language is resource intensive and there is often a trade-off in studies that relates to the procedures used to collect data. Studies using small samples can observe PCI for longer periods of time across a range of settings that more accurately represent children's everyday interactions; whereas, larger samples of children often result in the implementation of brief samples of PCI in more artificial settings. Methodological issues are discussed in detail in section 2.4.

Greater parental talkativeness has been associated with increased vocabulary development for preschool children, which suggested that increased exposure to words provides more opportunities for learning and faster vocabulary growth. In a longitudinal sample of 22 children from age 1;2 to 2;2 from middle-class families, Huttenlocher *et al* (1991) demonstrated that the talkativeness of mothers was related to children's variation in vocabulary growth. Talkativeness was based on the number of words mothers directed at their children during three-hour video- or audio-recorded observations at home. Furthermore, they found that the frequency of different word use was related to the order in which words were learnt, which was explained as a result of the increased exposure to words that were used most frequently

providing more opportunities for learning. The importance of exposure for learning can be used as a strategy for improving vocabulary learning of children with PLI through repeated presentation of words (e.g., interactive focused stimulation, Girolametto *et al*, 1996).

Variation in parental talk has explained differences in children's vocabulary development across different SES backgrounds. The seminal study by Hart and Risley (1995) found marked variation in parent talkativeness between families with different SES backgrounds, using monthly, one-hour observations of recorded language in the homes of 42 families during the first three years of children's lives (from ages 0;7-0;9). Differences were found in children's vocabulary sizes according to SES; children from higher SES families had larger vocabularies at age 3;0. These SES differences in children's language skills were mediated by the amount of parent talk and the number of words parents used per hour was related to children's language ability. On average, children aged 1;1-3;0 from professional families heard 2153 words/hour compared to 616 words/hour in families on welfare support. Children in the low SES families heard considerably fewer words during everyday home interactions compared to children from high SES families. Parents from higher SES groups were also found to provide their children with more praise and fewer directives than those from lower SES backgrounds. A linear extrapolation was carried out to estimate the cumulative differences in children's experience over the first four years. This estimated that there was a 30 million word gap between the highest and lowest SES families and highlighted the significant challenge interventions had to redress these differences in children's early experiences (Hart and Risley, 2003).

Other characteristics of parent talk, including diversity and complexity have been found to mediate the relationship between SES and child vocabulary development (Hoff, 2003, Rowe, 2008). In addition to being more talkative, parents from higher SES backgrounds have been found to use a more diverse vocabulary and have a higher MLU. The use of longer utterances in parent speech has been related to faster rates of child vocabulary growth, which could reflect parents' use of more diverse words, providing children with more opportunities to learn a diverse vocabulary (Hoff, 2003). In a study of 108 low SES families, with children aged 1;0 to 3;0, Pan *et al* (2005) found that parent talkativeness itself did not have an independent effect on children's vocabulary growth, which was unexpected in light of the previous studies (Hart and Risley, 1995, Huttenlocher *et al*, 1991). Maternal language diversity was a stronger predictor of child vocabulary growth in Pan *et al*'s (2005) sample of children. Maternal

language diversity was based on the number of different words mothers used during 10 minute play sessions in the children's homes, with books and toys provided by the research team, when children were aged approximately 1;2, 2;0 and 3;0. The child language measure was the number of words used during these same interactions; therefore, the relationship found between maternal and child language was based on children's actual vocabulary use rather their overall vocabulary knowledge that is often measured using parent reports. Pan *et al (*2005) found that maternal use of pointing during interactions was positively related to child language growth and, although the effect was not maintained after accounting for maternal language diversity, the effect was stronger than the amount of maternal talk. Maternal language and literacy skills were also found to be predictors of child vocabulary growth, and had a greater influence on children's language than maternal education. Pan *et al (*2005) highlighted the importance of understanding the complex nature of the relationship between maternal and child language and the individual variation in the characteristics of PCI that extended beyond the characteristics of parent talk.

Mothers' use of a diverse vocabulary has also been shown to be important for children with PLI. In their longitudinal study of 20 children with PLI, aged 2;0-3;3 at the start, Domsch and Camarata (2008) found the number of different words mothers used during 15-minute play sessions was positively related to children's receptive, but not expressive, vocabulary. The families received between five and seven visits over the eight-month study. Maternal education, often used as an indicator of SES, was also related to children's MLU but not their vocabulary size or rate of development. Domsch and Camarata (2008) suggested that children with PLI might require increased exposure to words compared to TD children for adequate learning and successful word use. The relationship with receptive vocabulary does suggest that parents should still be encouraged to use a range of words with their children. Differences in the characteristics of parent talk that have been related to children's vocabulary growth highlight the need to understand the range of factors that could inform strategies to facilitate growth.

There is considerable evidence supporting a relationship between measures of parent talk and later child language, which have been found to mediate the relationship between children's vocabulary differences across SES backgrounds. Furthermore, Rowe (2008) found that differences in parent talk to their children across SES backgrounds were mediated by parent knowledge of child development; parents whose understanding reflected that of experts were

more likely to use language that was positively related to child vocabulary growth. However, the amount, complexity and diversity of parent talk are not the only features of parent language that have been associated with children's language development. There have also been differences found in the purpose and responsiveness of parent utterances during interactions with their children. Differences in characteristics of PCI have been found across SES groups, in addition to the differences in parent talk outlined above. In particular, parents from higher SES backgrounds have been found to use less directives (Rowe, 2008), talk more for the purpose of conversation (Hoff, Laursen and Tardif, 2002), and use more praise with their children (Hart and Risley, 1995). In a longitudinal study of 275 families with children 0;2-4;0, the effects of the amount of adult talk on child language development were mediated by adult-child conversations (Zimmerman *et al,* 2009), which highlighted the importance of actually engaging children in conversation. Examining the influence of parent language within the context of communicative interactions is necessary for a more complete understanding of the relationship between parent and child language.

2.3.2 Responsiveness during parent-child interactions

Parental responsiveness during interactions with their children has been shown to be facilitative of child language development (Girolametto *et al,* 1999, Landry, Smith and Swank, 2006, Masur, Flynn and Eichorst, 2005, Tamis-LeMonda, Bornstein and Baumwell, 2001, Tamis-LeMonda and Bornstein, 2002). Responsiveness has been defined as parental replies to the child that are prompt (within five seconds of the child's utterance), contingent (dependent on the child's language/behaviour) and appropriate (positively related to the child's behaviour), and responsiveness has been shown to be a greater predictor of child language development compared to parent talkativeness (Tamis-Lemonda and Bornstein, 2002). On the other hand, research into parental use of directive language has identified negative associations with child language development.

Specific characteristics of parental responsiveness have been shown to influence child language differentially across development, emphasising the multidimensional nature of responsiveness (Tamis-LeMonda, Bornstein and Baumwell, 2001). A study of 40 high SES mother-child dyads explored the relationship between maternal responsiveness and child language development. Maternal responsiveness was assessed during 10 minutes of mother-child free play, with experimenter provided toys, at participants' homes when children were aged 0;9 and 1;1. Information about children's language development from ages 0;9 to 1;9 was

collected from biweekly interviews with parents regarding their child's most recent language use. Overall responsiveness when children were aged 1;1 was found to be predictive of children's language milestones, including the onset of combinatorial speech and talk about the past. These linguistic achievements emerged sooner for children with more responsive mothers (Tamis-LeMonda *et al,* 1998). These findings were extended to examine the nature of what mothers responded to (e.g., children's verbal or exploratory behaviours) and the type of response given (e.g., praise or verbal elaboration of children's behaviours) and the specific influence of these features of maternal responsiveness on children's language development (Tamis-LeMonda and Bornstein, 2002, Tamis-LeMonda, Bornstein and Baumwell, 2001). The predictive nature of maternal responsiveness was specific and maternal responses to children's vocalisations and play were consistently important for influencing child language development when measured at ages 0;9 and 1;1. In particular, maternal descriptions at 0;9 were predictive of children's first imitations, and affirmations, descriptions and play prompts at 0;9 were predictive of children's timing of first word use. Maternal play prompts at age 0;9 and imitations and expansions at age 1;1 were predictive of children achieving a 50 word vocabulary. Play prompts at ages 0;9 and 1;1 as well as imitations and expansions at 1;1 predicted the onset of combinatorial speech. Finally, imitations and expansions and questions at 1;1 predicted children starting to talk about the past. These maternal behaviours were of greater importance for children's language development than children's own vocalisations, which demonstrated the importance of children's social interactions for learning language (Tamis-LeMonda, Bornstein and Baumwell, 2001). In a comparison of parents at the extremes on the scale of responsiveness, children's onset of language milestones varied by up to six months. The ability to account for variation within this TD sample of dyads from similar SES backgrounds can help explain why single measures of child vocabulary have been insufficient predictors of later language performance (discussed in section 2.2).

The research by Tamis-LeMonda and colleagues suggested that variation in the predictive value of parental responsiveness reflected the changing needs of the children as their linguistic and cognitive skills became increasingly more sophisticated (Tamis-LeMonda *et al,* 1998, Tamis-LeMonda and Bornstein, 2002, Tamis-LeMonda, Bornstein and Baumwell, 2001). The studies suggested that children in the very early stages of language may benefit most from parental descriptions of their environment while they are engaged in exploratory behaviour. On the other hand, as children's language develops, feedback and expansion of their early language attempts becomes more important (Tamis-LeMonda, Bornstein and Baumwell,

2001). Furthermore, in line with these changing relationships, parental use of descriptions were found to decrease, as imitations, expansions and questioning increased, and parents' responses moved to focus on children's play behaviour, suggesting an awareness of children's changing abilities (Bornstein *et al,* 2008). These findings highlight the importance of taking a developmental perspective to understanding the role of PCI in child language development.

In contrast to responsive utterances, parental directives aim to control children's behaviour, which may require children to shift their focus. The use of directives has been shown to be negatively associated with children's language development (Harris *et al,* 1986, Masur, Flynn and Eichorst, 2005, Tomasello and Farrar, 1986, Tomasello, Mannle and Kruger 1986, Tomasello and Todd, 1983). However, there have been inconsistencies in the literature regarding the role of directives and other studies have found either positive associations (Barnes *et al,* 1983) or no relationship (Hoff and Naigles, 2002) with later language development. In an early study, Tomasello and Todd (1983) found that the amount of time parent-child dyads spent sharing joint attentional focus related to children's subsequent vocabulary development. The attention regulation hypothesis proposed that interactions that occur during episodes of joint attention facilitate language learning through the provision of clear pragmatic cues, which require limited effort for children to match objects or actions to labels, and encourage further involvement in such interactions. When directive utterances change children's focus of attention, they have to establish the intention of the interaction partner. This process is demanding and requires greater cognitive capacity to associate labels with referents, which reduces the resources available for learning words and makes it more difficult for children to maintain interactions. Tomasello and Farrar (1986) extended the previous research to explore the nature of the language used inside and outside of episodes of joint attention. They found that mothers and children talked more and had longer conversations, and mothers used shorter sentences and more commenting when interacting within periods of joint attention. Furthermore, significant positive associations were found between references to objects during these periods that followed children's focus of attention and their subsequent vocabulary skills. Associations between references that redirected children's attention and their later vocabulary skills were generally negative, although did not often reach significance. No significant relationships were found between references that followed or directed children's focus when they occurred outside episodes of joint attention.

A subsequent study (Akhtar, Dunham and Dunham, 1991) reinforced the distinction between parental directives that either follow or lead children's attention, given the potential for directives that follow children's current focus to encourage their verbal or exploratory behaviours. The study found that directives that followed children's focus during interactions at age 1;1 were positively associated with their vocabulary at 1;10. A negative relationship was found between directives that required children to change their focus of attention. The relationship was not significant; however, a significant negative relationship was found between attention devices (demanding an attentional shift) and children's vocabulary development. The positive relationship between directive utterances that followed children's attention was maintained after controlling for attention devices and the amount of parent talk, highlighting their unique role in facilitating vocabulary development. Masur, Flynn and Eichorst (2005) also found that directives that follow the child's attention, in addition to responsive utterances, were positive predictors of vocabulary development; whereas, intrusive directives that required a shift in focus were negative predictors of child vocabulary skills. Differences in the definition of directives may explain apparent discrepancies across studies (see section 2.4.1). Directives that follow children's interest may facilitate learning by enabling children to understand the request being made and support them to respond appropriately (Akhtar, Dunham and Dunham, 1991). These findings highlight the importance of understanding the characteristics of PCI in context. How directives are used within social interactions, rather than structural or pragmatic features of the utterances, determine their value for supporting word learning (Akhtar, Dunham and Dunham, 1991).

Research into the facilitative role of parent talk and PCI for language development in TD children has been utilised in SLT interventions that aim to optimise the language learning opportunities children have at home. However, the reciprocal nature of the relationship between parent and child language may have consequences for parental responsiveness with children with PLI, who by their nature have language levels lower than their TD peers. Parents may have fewer opportunities to respond to their children's language when production is limited; therefore, reducing children's chances for language learning. There is a need for a better understanding of the differences in parent and child characteristics during interactions and the extent to which these vary for interactions involving children with PLI compared to their TD peers.

2.3.3 Children with PLI compared to their typically developing peers

A review of the effectiveness of SLT interventions found that including parents could have beneficial effects (Law, Garrett and Nye, 2003). The review found that parental response to PCI interventions was varied, and such approaches may be more appropriate for certain families compared to others (Gibbard, 1994). Parent-child interaction strategies that support TD language skills may not be appropriate, or may require enhancement, to support children with delayed language development. A systematic review of the literature was carried out as part of the development of the present study to examine the available literature using observations of PCI with children with PLI and their TD peers. The extent of PCI differences between these groups has implications for the use of PCI interventions and for research into the relationship between children's environment and their language development. The systematic review was published recently (Blackwell *et al,* 2015) and the abstract can be found in Appendix A. The details below outline the method, findings and methodological limitations of studies that were reported. The characteristics of PCI that were identified in the review were used to structure the data collection and analysis for the present study.

The review included a search of 10 electronic databases (April 2012) with no date limits: MEDLINE; EMBASE; CINAHL Plus; PsycINFO; SocINDEX; PsycARTICLES; Cochrane Database of Systematic Reviews; CENTRAL; Cochrane Methodology Register; ERIC. The MEDLINE search strategy was comprised of subject headings and textwords, which described the elements of the population (preschool children with PLI and a TD comparison group, aged 0;0-5;11) and variables measured (observations of dyadic PCI during play) as well as exclusionary criteria. Electronic searches were supplemented by checking references of relevant publications and included journal articles, book chapters and doctoral dissertations (≤ 5 years old). After removing duplicates, 17824 papers were identified. Papers published in languages other than English were excluded due to time and resource constraints (n=89). Case-control studies only were included in the review. Irrelevant papers were excluded by screening titles and abstracts and then full text articles were then retrieved and further considered against inclusion criteria. Papers were subjected to quality assessment using the Critical Appraisal Skills Programme (CASP, 2012) case-control checklist to determine study quality, reliability and application of findings. The process for selecting papers and extracting data can be found in the data collection section of the full article. A narrative synthesis was used which summarised findings descriptively.

Nine studies were retained for inclusion in the review. In four studies the TD group included chronological age matched children, while in five studies language-matched children were included. Most studies used cross-sectional case-control designs although two collected data longitudinally. Broadly, the measures of PCI fell into five main categories:

1. Quantity of language e.g. number and rate of verbal/nonverbal acts
2. Complexity of language e.g. MLU
3. Dialogue participation – Proportion of conversational turns and initiations
4. Purpose of communicative act e.g. share meaning, demonstrate intentions, maintain conversation
5. Responsiveness – Type and appropriateness of conversational reply in relation to previous turn, e.g., elaboration and recasts

The four studies that used age-matched controls examined quantity and complexity of language used by mother-child dyads, and found some differences between PLI and TD dyads. Rescorla *et al* (2001) collected language data from 10 minutes of PCI samples during play when children were aged 3;0. The study found that mothers in PLI dyads talked more than controls. There was no difference in the number of utterances produced by children in the two groups; however, children with PLI used shorter and less complex utterances. The group difference in the amount of maternal talk was not found in Paul and Elwood's (1991) study, which also observed PCI during 10 minutes of dyadic play. Furthermore, the two groups of children produced fewer utterances overall and a group difference was found. Children with PLI produced 17 interpretable utterances on average, compared to 63 in the TD group. In Rescorla *et al*'s (2001) study children produced 114 utterances on average in both groups; however, utterances were defined to include sentences, phrases, words and sounds, which were not specified to be interpretable. The children in Paul and Elwood's (1991) study were also younger, ranging in age from 1;8 to 2;9 and differences in language could have been more pronounced during this early stage of language development when the children with PLI had vocabulary sizes smaller than 50 words or were using no word combinations. A greater discrepancy between mother and child MLU was also found for PLI dyads compared to controls (Paul and Elwood, 1991). Cunningham *et al* (1985) found that the discrepancy in language complexity between mother and child increased with greater language delay and as children interacted less.

The review found that the most notable difference between children with PLI and their TD peers regarding dialogue participation was related to their levels of initiation. In a study using age-matched TD controls, Cunningham *et al* (1985) found that children with PLI initiated less following maternal non-interaction, and younger children with PLI engaged less in interaction compared to older children with PLI and TD peers. Three language-matched control studies also found that children with PLI initiated less conversation than peers (Conti-Ramsden and Friel-Patti, 1983, Conti-Ramsden and Friel-Patti, 1984), while mothers in the PLI group initiated more compared to controls (Conti-Ramsden, 1990). Despite similar numbers of conversational turns between groups there was a greater discrepancy in participation between partners in PLI dyads compared to control dyads. Fewer child initiations in PLI dyads may result in parents appearing more controlling. However, children in both groups were found to introduce more topics than parents suggesting that they are allowed to guide the content (Conti-Ramsden and Friel-Patti, 1984, Rescorla *et al*, 2001).

The evidence for group differences in responsiveness was mixed. Mothers in PLI dyads were found to use some responsive utterances less often than mothers of TD children (Conti-Ramsden and Friel-Patti, 1983), specifically mothers in PLI dyads used complex recasts less frequently (Conti-Ramsden, 1990). Subsequent studies have failed to replicate these findings, and demonstrated evidence for no differences in simple or complex recasts, over an eight-month period (Fey *et al,* 1999, Proctor-Williams *et al*, 2001). Paul and Elwood (1991) highlighted the need for caution when interpreting parental responsiveness that was contingent on children's preceding utterances. They found that group differences in the proportion of expansions and extensions in maternal utterances were no longer significant when examined in relation to the proportion of child utterances. Mothers of children with PLI have fewer opportunities to provide contingent replies to their children as a result of their limited language production and differences in PCI may play a role in maintaining delay. However, group differences in PCI were generally considered to be child driven. It is important to recognise that that seven papers (Conti-Ramsden, 1990, Conti-Ramsden and Friel-Patti, 1983, Conti-Ramsaden and Friel-Patti, 1984, Fey *et al*, 1999, Proctor-Williams, Fey and Loeb, 2001, Rescorla *et al*, 2001, Rescorla and Fechnay, 1996) presented data that was included in the other studies reviewed. The systematic review consisted of only five completely separate samples of fewer than 250 children across the two groups; therefore, the representativeness of the findings should be interpreted with caution.

Overall, the review suggested that there were limited differences in the characteristics of PCI with children with PLI compared to TD peers. Where differences were found they were often attributed to group differences in the children. The difficulty for children with PLI to learn from their language environment was highlighted. The current understanding of PCI with children with PLI is often based on the analysis of single snap shots of brief (5-30 minutes), focused, dyadic play, either at home with toys provided by the research team, or in a laboratory-based room. Two studies in the review examined PCI three times over eight months; however, they did not consider how parents' language changed in relation to children's developing language skills. Tager-Flusberg (2005) suggested that examining the relationship between parent and child language behaviour over time could be used to analyse the factors that influence children's developmental trajectories. Specific characteristics of PCI might change as children's language develops (Nelson *et al,* 1984, Rowe, 2012) and understanding children's individual trajectories would permit a closer analysis of these developmental differences that could be lost when analysing PCI at the group level.

2.3.4 Speech and language therapy interventions that target parent-child interaction

The naturalistic study of PCI does not lend itself to experimental manipulation and research into the relationship between parent and child language has predominantly used observational studies with either correlational or case-control designs. Evidence for the relationship between parent and child language in clinical populations has also been found from SLT interventions. Corroborating findings from the different study types helps to improve understanding of the facilitative characteristics of PCI and the nature of the relationship between parent and child language.

Previous research has shown that engaging parents in interventions, to optimise children's language learning opportunities, is an important intervention target, particularly during the earlier preschool stage. In a UK survey of over 500 speech and language therapists, 73% reported PCI as an outcome target of therapy with children aged 2;0-3;0, whereas targets for older school-age children focused on child related factors such as attention and listening skills (Roulstone *et al,* 2012b). The features of SLT interventions that use parent-training have been derived from an understanding of typical language development, teaching PCI strategies that are positively related to language development in order to drive child language changes through intervention (Pickstone *et al,* 2009). Intervention studies examine the effect of children's involvement in intervention on their language performance. Positive results from

interventions that modify PCI provide support for the idea that parent language can facilitate child language growth. Study methodologies need to be examined carefully to identify the active ingredients of the intervention, and parent language is not always measured. Intervention studies do not provide a clear explanation of the relationship between natural PCI differences and child language. Evidence from PCI intervention research that demonstrates a facilitative effect of parent talk and interactions over time, can be used to aid understanding of the systematic review findings where some differences in characteristics of PCI were found between groups, as well as adding to the TD literature on the relationship between PCI and child language.

There is evidence to support the positive effect of SLT parent-training programmes that teach specific interactive techniques to promote child language development. These have been shown to have comparable effects to the more traditional one-to-one SLT in the clinic, although not all children make equivalent gains and the suitability of approach may vary according to their profile of delay (Baxendale and Hesketh, 2003, Gibbard, 1994). Two studies that carried out follow-up assessments found that around three quarters of children in intervention groups made continued language gains after a year, in one study these children had caught up with TD levels (Baxendale and Hesketh, 2003, Buschmann *et al,* 2009). It is important to note that a quarter of children had persisting language difficulties and it is challenging to determine which children will benefit from intervention.

It is difficult to determine the features of the interventions necessary for bringing about change in children's language, particularly as not all studies assess changes in parent language. Studies that have assessed parent outcomes demonstrated that interventions were successful in achieving their goal of modifying parent language behaviour. For example, Baxendale and Hesketh (2003) demonstrated that following intervention, the dynamics of PCI changed in line with child language improvements. Parents were found to use fewer utterances compared to the number the child produced, which meant that they participated in interactions more equally. Following focused stimulation intervention, Girolametto, Pearce and Weitzman (1996) found that mothers in the experimental group used less words per minute, shorter utterances compared to controls, and an increased number of target words. Concurrent with these changes was an increase in the vocabulary of children in this group.

In addition to changes in parent talkativeness, studies have found changes in parental responsiveness, including use of expansions, imitations and recasts following intervention. Baxendale and Hesketh (2003) found increased expansion and imitation use by parents following intervention. When these features were low, children were less likely to show improvements in their expressive language. In a study examining a focused stimulation intervention, Fey *et al* (1993) found that children with delayed grammatical development showed linguistic improvements following four and a half months of either clinician or parent-based therapy. They found that parents used more recasts after training but they found no evidence that parental recast rate was related to child language gains. A subsequent follow-up (Fey, Cleave and Long, 1997) with some of the participants was successful at helping increase parent recasting. The children exposed to higher frequency recasts scored higher on tests of language. However, recasting was found to decrease when children progressed to more complex grammar and the intervention was not successful at helping parents use recasts beyond this language stage. Findings such as these highlight the importance of taking a dynamic approach to supporting children's developing language, which is consistent with findings outlined in section 2.3.2 that the relationship between characteristics of PCI and child language change over the course of development.

The characteristics of parental responsiveness targeted and found to change as a result of intervention have been found to be predictive of children's later language. Girolametto *et al* (1999) found that responsive input was a significant predictor of child language development, with imitations and expansions being particularly robust indicators of later language. Further support for the facilitative role of these PCI characteristics was provided by a population based study of 251 children with delayed language (scoring ≤ 20th percentile on a 100 word expressive vocabulary checklist at age 1;6) (Levickis *et al,* 2014). Expansions were the strongest predictor and also predicted improvement in child language between 2;0 and 3;0. The findings from this population based study support the use of SLT interventions that involve parent training. Levickis *et al* (2014) suggested that identifying the relative rate of expansion use during PCI could support interventions planning, screening for families who would benefit most from being taught these facilitative behaviours.

Continued assessment over time would also be beneficial for establishing the fidelity of interventions. It is important to ascertain the extent to which intervention techniques have been implemented by parents. Consistent implementation is necessary to establish the

internal validity of the study as well as identifying potentially important individual differences that may have important clinical implications for individualising SLT. Gibbard (1994) found that not all children in an intervention group made equal language gains and suggested that some families may be better suited to parent-training interventions than others.

The research outlined above demonstrated a number of characteristics of PCI that facilitate child language development and can be utilised in SLT interventions to optimise the language learning opportunities for children with PLI. During the course of the review, a number of common methodological issues emerged including how best to measure language, how to account for the reciprocal nature of the relationship between parent and child language and the importance of understanding PCI from a developmental perspective. These issues are discussed in the section below.

2.4 Methodological issues

2.4.1 Child and parent language measures

Methodological differences across studies, regarding study design and how language was measured, have important implications for the validity of findings and the ability to compare findings. Child and parent language measures vary across studies and notable distinctions include whether parent report (e.g., Akhtar, Dunham and Dunham, 1991, Tamis-LeMonda, Bornstein and Baumwell, 2001) or observational assessment was used (e.g., Harris *et al,* 1986, Hoff and Naigles, 2002). There is also wide variation in the outcome measures used in intervention studies, which makes it difficult to evaluate the effectiveness of different study approaches. Some studies use standardised language measures (e.g., Buschmann *et al,* 2009, Gibbard, 1994), which can be useful in comparing language gains relative to a normative population, i.e., whether a child's language scores improve to within typical language limits. Others use language sampling (e.g., Baxendale and Hesketh, 2003, Girolametto *et al*, 1996), sometimes combined with standardised measures, which can capture differences in language abilities that could be missed when standardised assessments are used in isolation. Standardised assessment tools and language sampling are common methods used to collect language data, which both have strengths and limitations, in particular, the latter is time consuming and not always feasible in larger studies. Parent report tools, such as the Communicative Development Inventories (CDIs; Fenson *et al*, 2007), utilise parents' expert knowledge of their children to collect data on vocabulary use and early grammatical skills. However, parent checklists use a finite list of words, which do not necessarily reflect the full

extent of children's vocabulary knowledge. Studies have also found parents both overestimating (Bloom, Tinker and Margulis, 1993) and underestimating (Furey, 2011) their children's language use (see section 4.4.2.1 for further details).

In child language research, it is difficult to define word production accurately in terms of functional use and this information cannot be ascertained from parent report data (Lieven, Pine and Barnes, 1992). Bates *et al*, (1994) stated that their distinctions between different word types reflected what children were learning from their language input and not functional differences in word use. Although CDIs and similar tools can provide useful information about the rate and trends in language development, parent reports do not provide information about how often different words are used or whether children use them appropriately (Hick *et al*, 2002). Observations of children interacting with others are often used as an alternative method to collect and analyse samples of child language in context. For example, in a study of 45 TD children, Nelson, Hampson and Shaw (1993) found that that there was a much higher proportion of nouns reported (70%) on checklists than there were produced in observational language sampling (38%) at age 1;8. The potential bias towards nouns on parent report measures challenges the apparent preference for noun learning in the early stages of development. Bloom, Tinker and Margulis (1993) questioned the proposed link between nouns and accelerated growth and the use of classifying words in children's early, presyntactic vocabularies according to adult part-of-speech membership, e.g., noun, verb and adjective. Bloom, Tinker and Margulis (1993) proposed that understanding early language development should focus on how children use the words. Rather than examining individual words, Tomasello (2000) proposed that the child's utterance was a more appropriate unit of analysis because utterances "express complete and coherent communicative intentions" (Tomasello, 2000, p.65). Although a child may produce only single-word utterances, these might function as a more complete utterance, e.g., 'Cup!' can function as 'I want my cup!' or 'Look at the cup', which have been labelled holophrases (Barrett, 1982, Tomasello, 2000).

Observational studies can collect data that more accurately reflects language used within the context of social interactions; however, these may result in variation in the type of interactions sampled. Rather than using parent report like the many other larger scale studies of language, Rowe, Raudenbush and Goldin-Meadow (2012) collected language data from nine 90-minute video-recorded home observations at four-month intervals. The extent to which children's vocabulary knowledge is represented in language samples could vary across individuals, and

the activities families chose to engage in during the observations could influence the representativeness of language measured. However, Rowe, Raudenbush and Goldin-Meadow (2012) highlighted the possibility that the activities families engaged in could themselves be related to differences in children's early language experiences rather than a product of the study procedure (see section 2.4.4).

In order to make meaningful comparisons between observational studies it is important to account for any variation in the definitions used of child and parent language measures. Differences in the definition of PCI characteristics or inconsistencies in the variables selected across studies may account, at least in part, for apparent contradictions in study findings (Masur, Flynn and Eichorst, 2005, Tamis-LeMonda, Bornstein and Baumwell, 2001). For example, the research discussed in section 2.3.2 demonstrated that distinguishing between directives that follow or lead the child's focus of attention had a substantial impact on whether studies found that there was a positive or negative relationship between directives and child language development. The analysis of variables may also differ, for example, Tamis-LeMonda, Bornstein and Baumwell (2001) coded maternal responses to any child act whether it was behavioural or verbal, whereas Hoff and Naigles (2002) coded only replies to children's speech. The latter approach may be confounded by the child's level of productivity (Masur, Flynn and Eichorst, 2005).

Using multiple measures of language can strengthen studies and language sampling can complement parent report data. For example, Ellis Weismer, Murray-Branch and Miller (1994) used 15-minute samples of parent- and examiner-child interactions in order to support their parent report data. The observational data showed consistent differences between the four children with PLI and the TD children in expressive language, which validated the parent report findings. Observational data can provide information about how children actually use words during interactions with others, which can help to identify the impact of differences in vocabulary development for children. Understanding parent and child language use within the context of social interactions can help speech and language therapists make decisions about the best strategies to use and the expected outcomes for families.

2.4.2 The reciprocal relationship between parent and child

In addition to decisions about the measures of language used, it is necessary to consider when these measures are taken, given the reciprocal nature of the relationship between parent and

child language. Although observational studies provide information regarding language use during interactions, taking measures of parent and child language from the same interaction can be problematic. The level of talkativeness of the parent or child, both in general and within the specific context of the observed interaction, could influence the amount of talk elicited from the other interaction partner. For example, the absence of an independent measure of vocabulary size questions the findings of research into the role of parent talk such as Hart and Risley's (1995) study (Nation, 2015). To address this issue, Huttenlocher *et al* (1991) analysed the influence of parent talk on parameters of children's vocabulary growth over time. Pan *et al* (2004) also demonstrated that children's vocabulary use during brief PCI samples were consistent with parent report measures of vocabulary.

It is important to recognise that the studies outlined in section 2.3 do not show definitive evidence for a causal link between parental speech and child language development. There are other possible explanations for the association found between variables. It is possible that the relationship could reflect biological hereditary similarity between parent and child. A longitudinal study of children and their adoptive and biological parents found that children's cognitive skills were similar to their adoptive parents during early childhood but became more like their biological parents later in life, suggesting an increasing genetic influence (Plomin *et al,* 1997). It is difficult to account for these potentially relevant genetic factors in correlational studies (Song, Spier and Tamis-LeMonda, 2014).

An alternative possibility is that the relationship between parent talk and child vocabulary development is the result of child effects on the parent and the role of the child should not be understated. Parents can only provide responsive utterances to children's language if the child provides them with the opportunity to do so by vocalising. As outlined in section 2.3.2, there was wide variation in children's vocalisations in Tamis-LeMonda, Bornstein and Baumwell's (2001) study and there was also variation in the overall frequency of maternal imitations and expansions. When children were aged 0;9, mothers used between 0-11 imitations or expansions and at age 1;1, mothers used between 0-21. Although for other measures of responsiveness, Tamis-LeMonda, Bornstein and Baumwell (2001) coded maternal responses to verbal and non-verbal child acts, the same is not possible for imitations and expansions, which by their nature are contingent on child verbal language. Increased contingent responses by mothers could be dependent on the opportunities available from children's language use; therefore, the relationship may be biased by children's level of productivity. The concept of

parenting more generally has been recognised as a reciprocal process (Kochanska and Aksan, 2004, Tamis-LeMonda and Bornstein, 2002). The responsiveness of the child may provide some useful insight into this bidirectional progression (Bornstein *et al,* 2008). Furthermore, Masur, Flynn and Eichorst (2005) highlighted the importance of controlling for previous parent or child language when measuring predictive relationships to account for the role of initial differences.

The reciprocal nature of the relationship between parent and child language has important implications for evaluating SLT intervention research. Many studies have measured parent and child outcomes at the same time point, which makes it difficult to determine the direction of the relationship between parent and child and it is possible that child language improvements may lead to changes in parent language behaviour (Baxendale and Hesketh, 2003). This possibility is particularly difficult to rule out in studies that have not included a no-intervention control group, which also cannot clearly determine whether any child language gains were the result of involvement in the intervention specifically rather than the result of maturation or a Hawthorne effect. It is also possible that intervention involvement modifies more general, non-language specific aspects of parents' behaviour, which drives changes in the child and subsequently in PCI. One study that compared language-specific parent training and more general cognitive skills parent-training demonstrated that the language-specific condition produced greater language gains for children (Gibbard, 1994). The importance of the language-specific training is consistent with findings in the TD literature that support a modular and specific relationship between parent language style and child language development (Bornstein *et al,* 2008). For example, parental responsiveness to either children's language or play behaviour has been found to have specific associations with either their subsequent language or play abilities, respectively (Tamis-LeMonda *et al,* 1996). Further research that compares different parent-training strategies is necessary to strengthen the understanding of why interventions are effective.

2.4.3 Understanding individual development

The section above identifies the difficulty untangling the direction of the relationship between parent and child language. This issue becomes more complex when taking into account the changing nature of this relationship throughout development. Studies investigating the direction of the relationship between parent and child language over time have demonstrated differences dependent on the particular characteristics examined. Huttenlocher *et al* (2010)

highlighted the difficulty determining the direction of the relationship in studies that examine parent language measures at one point in time in relation to child language measures at that same time or a period in the future. They proposed that any relationship found could be the result of shared topics during the one-off observations or the influence of the child on their parent. Huttenlocher *et al* (2010) carried out 90-minute observations of 47 parent-child dyads from a range of SES backgrounds every four months, with children from age 1;2 to 3;10. The study examined the variety of words, phrases and clauses in parent and child language used during typical activities at home. The findings demonstrated that the diversity of parent language predicted later child language diversity. Lagged correlation was used to measure the direction of the relationship between parent and child language use. The analysis found a reciprocal relationship for measures of child vocabulary, whereby earlier vocabulary also predicted later parent speech. This was not the case for measures of child syntax (grammar) for which only a unidirectional relationship was found in the form of a forward correlation from parent to child. The effect of SES was found to be smaller when parent speech was included in the analysis, which suggests that parent speech, at least moderately, mediated the influence of SES (Huttenlocher *et al,* 2010). In a study of 70 low SES families, with children aged 2;0-3;0, Song, Spier and Tamis-LeMonda (2014) found that the amount of maternal talk and the diversity of maternal language was positively related to the subsequent language skills and growth of diversity in children's language use. A bidirectional relationship was not found, suggesting that child language was not associated with later maternal language, in contrast to the findings of Huttenlocher *et al* (2010).

The apparent contradiction in findings regarding the direction of the relationship between parent and child could be related to the age or language level of children in the studies. Song, Spier and Tamis-LeMonda (2014) suggested that the reciprocal nature of the relationship between child and parent language may increase as children's language skills improve. The children in Huttenlocher *et al*'s (2010) study were followed for 10 months longer and were from a range of SES backgrounds, and those from the higher SES backgrounds may be expected to have greater language skills (Song, Spier and Tamis-LeMonda, 2014). Song, Spier and Tamis-LeMonda (2014) did find a bidirectional relationship between maternal language and children's cognitive development. It should be noted that their study used the Mental Development Index (MDI) of the Bayley Scales of Infant Development (BSID-II; Bayley, 1993) as the measure of cognitive abilities, which is administered verbally and includes language-

specific tasks; therefore, it could be interpreted that the results do in fact support a bidirectional relationship between maternal language and child language more broadly. The relationship between parent and child language may vary for different characteristics measured. Parental talkativeness has generally been found to be relatively stable over time (Huttenlocher *et al*, 1991, Rowe, 2012, Song, Spier and Tamis-LeMonda, 2014) suggesting it is not affected by children's developing language. Whereas other measures such as diversity of parent word use (Huttenlocher *et al,* 2010) might be influenced by the child's own vocabulary use. Rowe (2012) examined a number of maternal language characteristics during 90-minutes of naturalistic PCI in participants' homes, when children were aged 1;6, 2;6 and 3;6, and their relationship with child vocabulary growth the year following each time point. Rowe (2012) found that while the amount of parent talk remained stable over time, qualitative aspects of parent language did show steady increase over time, including the proportion of rare words and decontextualised language, i.e., pretend play, explanations and event narratives. Furthermore, different aspects varied in importance to child language across development. At age 1;6, the amount of input was most significant, and children may benefit most from increased exposures to vocabulary during early language stages. At age 2;6, when children's language skills had advanced, the diversity and sophistication (use of rare words) of parental vocabulary was important. By age 3;6, parents' decontextualized language (talk not related to the here and now) was more highly related. Rowe (2012) suggested that the use of decontextualized language, particularly narratives, might be dependent on child factors, such as attention, which are required to maintain this type of interaction. This pattern of increasingly complex parent language is consistent with Vygotsky's (1978) notion of the zone of proximal development (see section 1.4) in which parents provide input that is appropriate but challenging according to children's language level (Rowe, 2012).

The changing nature of the relationship between parent and child language has implications both within and across studies, and is problematic for studies using broad inclusion criteria in their samples. Some studies recruited fairly homogenous groups of children with similar SES backgrounds at the same chronological age; however, there can be wide variation in children's language development even in these studies. For example, Tamis-LeMonda, Bornstein and Baumwell (2001) observed children from higher SES backgrounds interacting with their mothers at two time points and at each time participants ranged in age by only two months; children aged 0;9 produced between 2-51 vocalisations, and later at age 1;1, children produced between 1-91 vocalisations. Taking into account the existing individual differences in

study samples, it may not be appropriate to compare findings from studies with similar, often higher SES backgrounds, with studies that recruited children at a different age or from a different SES background. Children from higher SES backgrounds, more commonly recruited in research, have been shown to generally possess advanced language skills. Comparisons with children from lower SES backgrounds at the same chronological age may be confounded by differences in language level (Tamis-LeMonda, Bornstein and Baumwell, 2001). Other studies have recruited more heterogeneous samples, including children from wider age ranges. For example, Hoff and Naigles (2002) recruited 63 children aged 1;6-2;5 and Domsch and Camarata (2008) recruited 20 children aged 2;0-3;3. With a sample of children who range in age by over a year, it is plausible that developmentally specific influences were lost in analysis. In fact, changing relationships between maternal responsive and directive behaviours and child language were found at three stages measured in a longitudinal study that examined parent and child language over a year (Masur, Flynn and Eichorst, 2005).

The systematic review conducted to support the present study (Blackwell *et al*, 2015) highlighted similar issues regarding the variation in the language status and demographic profile of children in the PCI studies examined. The measure of child language ability varied across studies. The extent of children's expressive language delay was often based on their MLU, and standardised measures were not used in all studies. Furthermore, studies did not always measure or report on children's receptive language ability, despite receptive delay being related to more persistent problems (Law *et al,* 2000) and less positive response to SLT intervention (Law, Garrett and Nye, 2003). Within groups, children ranged in their age and relative language delay; therefore, differences in the characteristics of PCI for individual mother-child dyads could have been lost when analysed at the group level. Some of the studies that found evidence for limited or no group differences included children with less severe language delays (Fey *et al*, 1999, Proctor-Williams *et al*, 2001, Rescorla *et al*, 2001, Rescorla and Fechnay, 1996). Group differences could have been more marked if studies included more homogenous groups of children with greater language delay or impairment.

Understanding PCI from a developmental perspective was also important when interpreting findings from the case-control studies in the systematic review. Children with PLI were matched to either age or language equivalent groups of TD children. Differences in PCI with children with PLI compared to age-matched peers could reflect parents adjusting to their child's language ability. As outlined earlier, parents can only provide contingent response to

language children actually produce (Paul and Elwood, 1991) and their opportunities are likely to be reduced with children with PLI who, by definition, are behind their chronological age expectations. In contrast, children with PLI would be likely to be ahead of their younger, language-matched peers, in non-verbal ability, and parental differences when interacting with the two groups could be related to developmental differences. No studies in the review used both age- and language-matched groups. Furthermore, language is a multidimensional skill and Plante and Swisher (1993) highlighted caution for matching language using one or only a few measures as this approach can weaken construct validity. There are also challenges to ensuring that groups are matched adequately, on a number of relevant variables other than language or age, such as SES. There is a dearth of research with lower SES samples yet research has demonstrated clear differences between SES groups that include a reduced exposure to parental talk in the homes of children from lower SES backgrounds, which is related to poorer language outcomes for children (Hart and Risley, 1995).

The methodological issues discussed in this section highlight the complex nature of the relationship between PCI and child language development and can be used to inform future research. Where possible, studies should endeavour to collect multiple child and parent language measures, including measures that are independent of each other. The use of parent report tools allows for the standardised collection of vocabulary data from large numbers; whereas, language sampling can provide information about how parents and children use language to interact. Due to the time constraints of collecting language samples and risk of attrition from longitudinal research, large studies, such as the CDI norming study (Bates *et al*, 1994), use a cross-sectional design. These studies can only provide evidence of the variation that exists at different ages within the early preschool period. Longitudinal studies are preferable for understanding factors related to child language development in order to track growth over time and provide evidence for the rate of development. Issues remain for understanding individual growth when studies analyse data at the group level (e.g., Ukoumunne *et al*, 2012), which can provide an overall description of average development but not the actual development of individual children. In order to more readily examine the dynamics of the relationship between PCI and child language development it is beneficial to analyse this relationship over time at the individual level. This is especially true for the clinical population of children with PLI for which there is a dearth of research that incorporates a developmental perspective despite the impact that developmental changes could have effectiveness or suitability of intervention strategies.

2.4.4 Language learning in different contexts

The final issue, which runs through the methodological concerns highlighted above, was the use of brief observations of dyadic play to measure PCI. Variation in the characteristics of PCI has been found during different activities, which questions the representativeness of studies using play sessions alone to measure PCI. Reading is another activity during which PCI has been commonly examined and along with toy play, these contexts have been utilised during SLT intervention strategies. However, not all parents report playing or reading with their children on a daily basis and increasing the frequency of these activities could be beneficial for some families. The following section reviews evidence regarding variation in PCI across different contexts and the daily activities involved in family life, and introduces a new technology: the LENA (Language ENvironment Analysis) system, which offers new insights into children's naturalistic home environments. The LENA system enables researchers to examine the range of different activities that children experience in their typical environments and how the language of the children and those in close proximity to them changes across activities. LENA uses a small audio recorder worn by a child to collect language data from the child and other people in their environment (LENA Research Foundation, 2011) (see section 4.4.2.2).

Characteristics of parental talk and interactions with their TD children have been found to vary according to the context of the interaction (Dunn, Wooding and Hermann, 1977, Hoff-Ginsberg, 1991, Lewis and Gregory, 1987, Vandermaas-Peeler *et al,* 2009). These differences have implications for understanding the language learning opportunities individual children are exposed to, as well as assessing the validity of existing PCI research. In a study of 33 higher SES and 30 lower SES families, Hoff-Ginsberg (1991) observed mother-child dyads in four settings at home: mealtime, dressing, toy play and reading. During reading mothers used greater lexical diversity and complexity and demonstrated increased contingency to their children, which was measured by increased topic-continuing replies. In contrast, mothers were more directive and used fewer conversation-eliciting utterances during toy play. Rates of conversation-eliciting utterances were highest during mealtimes and dressing. These contextual differences highlighted the limitations of generalising findings from studies using PCI observations from a single setting, often toy play, which was found to include fewer characteristics considered to be facilitative of language development that were instead more distinct during mealtimes and dressing (Hoff-Ginsberg, 1991).

Furthermore, differences in PCI across contexts have been found based on SES backgrounds. Vandermaas-Peeler *et al* (2009) examined PCI during play and reading with 13 low SES and 24 middle SES families. While the overall amount of guidance provided by the parent did not differ across SES groups, the type of interaction strategies varied, and middle SES parents were more likely to report reading daily with their children. Middle SES parents provided almost twice as much teaching and praise during reading compared to lower SES parents, while these characteristics were more comparable across groups during play. Lower SES parents demonstrated more directive behaviour during play, using less open-ended and more directive suggestions to facilitate play than middle SES parents. There was no difference in parents' ratings of child enjoyment during the activities. Variation in PCI across families highlights the need for a multifactorial approach to understanding the complex nature of the relationship between parent and child language and the broader language environment.

Play and book reading have also been utilised in SLT interventions as contexts to implement language learning strategies (e.g., Blewitt *et al,* 2009, Crowe, Norris and Hoffman, 2004, Dale *et al,* 1996, Landry *et al,* 2008) and relative differences in PCI have been found across activities with children with PLI. A recent study of 24 children with PLI (Stich *et al*, 2013) found that mothers' language was more complex during book reading, in line with previous TD findings (Hoff-Ginsberg, 1991), and children's lexical diversity was greater during book reading compared to toy play. In terms of dialogue participation, mothers generally talked more (number of utterances) than their children but this was more pronounced during book reading than toy play. Mothers used more commands and yes/no questions, suggestive of a directive style, during play. However, mothers also used more *wh*-questions and clarification questions, suggestive of a responsive style, during play. These joint strategies may have encouraged children to use more verbal utterances during play resulting in more balanced dyadic interaction (Stich *et al,* 2013). These findings could be seen to contradict with those of Hoff-Ginsberg (1991), which demonstrated reduced conversation-eliciting language in a TD sample during play. It should be noted that all dyads carried out the toy play observation during a second visit and differences across contexts could be confounded to some extent by increased familiarity with the research team and the experience of being video-recorded. It is also possible that differences reflect parents adapting to their children's language delay and emphasise the importance of considering different interaction contexts when assessing children with language difficulties and planning interventions (Stich *et al,* 2013).

In addition to investigating the contextual differences in PCI between toy play and book reading, Stich *et al* (2013) explored the relationship between the structural (i.e., complexity and diversity) and discourse (i.e., responsiveness) features of PCI and children's expressive language skills. The findings have important implications for understanding two compatible assumptions regarding the relationship between parent and child language. The structural hypothesis suggests that more complex parental language facilitates child language development through the provision of sematic and syntactic language models that are slightly above the child's level of ability. The responsivity hypothesis proposes that parental language input facilitates child language development when it matches the child's current activity or interest because these responses reduce uncertainty and increase the child's available cognitive resources for learning. Stich *et al* (2013) found a significant positive association between the complexity of maternal talk (MLU in morphemes) and children's expressive language skills. There was also a relationship between maternal complexity and responsiveness that suggested mothers who used longer, more complex utterances also used more responsive utterances when interacting with their children. Regression analysis found that only maternal language complexity was a significant predictor of children's language skills. These findings supported the structural hypothesis and the value of using language models that exceed children's language complexity to facilitate development. Although the findings showed a significant association, they could not demonstrate cause and effect (Stich *et al*, 2013). As outlined in the sections above, caution must be taken in identifying predictive relationships when measures are taken at the same point in time because it is difficult to untangle the direction of the relationship between parent and child. Interestingly, an earlier study that measured parent language and then child language four months later found support for the responsivity rather than structural hypothesis (Girolametto *et al,* 1999). It is possible that the structure of parental language is more strongly related to children's current language skills or that the structural and discourse features of PCI are differentially related to child language skills across development. Differences in study findings highlight the importance of further research investigating the specific characteristics of PCI used over time with homogeneous samples, including children of similar age, language level and SES background, as well as tracking the relationship in individual parent-child dyads in order to understand the developmental nature of the relationship between parent and child language.

Study findings that have demonstrated PCI differences across contexts have implications for the validity of study procedures. Many studies carried out brief (10-30 minute) observations of

PCI with a set choice of toys in a laboratory playroom (e.g., Conti-Ramsden, 1990, Cunningham *et al,* 1985, Paul and Elwood, 1991, Song, Spier and Tamis-LeMonda, 2014) or at home (Fey *et al,* 1999, Proctor-Williams, Fey and Loeb, 2001). Others were less restrictive, observing PCI for longer periods of time (90 minutes) during the family's normal activities, which may include meal times, playing and reading (e.g., Huttenlocher *et al,* 2010, Rowe, 2008). The former makes an assumption of a typical situation in which parent and child sit uninterrupted and play with toys together. It is not clear how representative study observations of play or reading are of children's typical activities (Marchman and Weisleder, 2011) and the extent to which differences might have been overlooked for children with PLI, or from different SES or cultural backgrounds. Even studies that aim to explore contextual differences have generally been restricted to toy play and book sharing. These activities are not necessarily common, daily occurrences for all families. A recent survey of over 14,000 families found variation in the frequency of self-reported parent-child activities across families; 22% of mothers reported that they played, 51% read and 13% told stories to their children every day (Brocklebank, Bedford and Griffiths, 2014). The survey was part of the Millennium Cohort Study that examined social, health and economic factors for children born 2000-2002 in the UK that used stratified cluster sampling to select families from a diverse range of backgrounds (Dex and Joshi, 2004). Logistic regression was used to identify the factors related to variation in the frequency of activities. Single mothers were less likely to report playing with their children weekly and mothers from lower SES backgrounds were less likely to report playing and reading weekly to their children compared to those from higher SES backgrounds. Mothers working full-time were less likely to report playing or reading weekly compared to those who worked part-time or were students or unemployed. Mothers with more than one child, as well as younger compared to older mothers, were less likely to report playing, reading or telling stories. Differences were also found in the frequency of activities according to mothers' ethnic group, which might represent cultural differences. Encouraging families to take part in play and reading more frequently could be a beneficial goal of both universal and targeted interventions for children with, or at risk of PLI. Recognising the different types of activities that are common in children's home environments could support speech and language therapists to identify families who might be well suited to approaches that target PCI and how to tailor strategies to individual home environments.

Further research is needed to identify the range of activities parents and children partake in at home and how PCI varies accordingly. It is important to distinguish between PCI in an optimal

situation where the parent has time, no distractions and is highly motivated to focus solely on their child, and the actual frequency of opportunities families have for this type of interaction in the home. During observations of PCI, an observer effect is possible whereby parents behave differently as a result of knowing they are being observed, and the extent of such an effect could vary across individual dyads. The LENA system has given researchers an opportunity to record children in their natural environment, whether it is at home, nursery, playing outside or visiting people or places, without an external presence and for up to 16 hours. The data from the LENA audio recorder can be uploaded to a computer, and accompanying LENA Pro software analyses the data to provide histogram reports of adult word counts (AWC); child vocalisation counts (CVC); conversational turn counts (CTC); and information about the audio environment. One study using this technology investigated adult and child vocalisations according to the type of activities TD children engaged in at home or in day-care (Soderstrom and Wittebolle, 2013). In both settings, general playtime and naptime were the most frequent activities, together constituting around 50% of total time. Mealtimes constituted around 10% of total time for both, while organised/outside play were high in day-care settings (approximately 10%) but not at home, and story time was low in both (<2%). In both settings story time and organised playtime were the highest ranked activity for AWC. Soderstrom and Wittebolle (2013) found that in the home setting, family outside visits (i.e. to a relative's house) were also ranked highly for AWC, and these top three activities were not significantly different. In both settings travel and outside play had the lowest AWC; TV was also ranked low for AWC in the home. Story time was also the highest ranked activity for CVC in both settings. In the home this was twice as high as at day-care, perhaps as it is more likely to be a one-to-one activity at home, rather than a group activity at day-care; therefore, storytime may be more interactive at home (Soderstrom and Wittebolle, 2013). In daycare, outside and organised playtime were similarly high to storytime for CVC, whereas in the home personal care was the next highest ranked activity for CVC. It should be noted that outside playtime was high for CVC in both settings but was comparatively low for AWC.

Soderstrom and Wittebolle (2013) drew an important distinction between their findings that demonstrated high quantity of language input during structured activities (story time and organised playtime) and the relative frequencies of these activities. They highlighted the importance of understanding the difference in the influence of these less common activities on children's language development compared to activities such as personal care and general playtime which make up a larger proportion of children's language environment. Furthermore,

the analysis did not consider qualitative differences in children's language input such as parental lexical contingency, which as outlined previously, may have influence on children's language development beyond the amount of adult speech (Tamis-LeMonda and Bornstein, 2002). In addition to differences in children's language input across contexts, systematic differences have also been found according to the time of day with peaks in language input during early morning and early evening and reduced adult language at midday (Greenwood *et al,* 2011). Similar results were only found by Soderstrom and Wittebolle (2013) when naptime was included in their analysis; therefore, they suggested that sleeping patterns and possibly the typical timing of children's activities more generally, could be responsible for the apparent effects of time of day.

Overall, there is a need for more research to examine whether characteristics of PCI relate to the vocabulary development of children with PLI at the level of the individual given the vast heterogeneity of children's trajectories of language development, the characteristics of parent talk and interactions and the different structures of everyday family life. A better understanding is needed of the different language learning opportunities present within children's home environments. The range of different activities present for families from a range of backgrounds, and how PCI varies in different contexts, needs to be explored including children with PLI. Better understanding of PCI within broader everyday contexts could inform SLT intervention that involve parent training to individualise approaches that are acceptable to both parents and children.

2.5 Parents' perspectives on children's language development and interventions

In order for interventions to be effective, taught strategies should fit into the structure of everyday family life (Andrews and Andrews, 2000). In addition to understanding how families communicate in their natural home environments, speech and language therapists need to take parents' perceptions regarding language development into account, to ensure that intervention approaches are acceptable and suitable for individuals, encouraging engagement with the process. Within health care there has been a growing emphasis on involving service users in the support they receive as well as including them in the decision making process. In the field of SLT for children, it is important to consider the perspectives of children and their parents on their experiences of services. Interventions that aim to modify characteristics of PCI are based on a number of assumptions about parents' beliefs regarding the value of talk and their role in teaching their children language as well as the presence of dyadic PCI in the home. van Kleeck (1994) highlighted that these beliefs vary across cultures and a cultural bias exists in

the research that predominantly includes white middle-class families in western cultures. The final section of this literature review presents research into parents' perspectives of language development and SLT interventions, which highlights the need to establish shared frames of reference and shared decision-making between parents and speech and language therapists. Understanding the structure of family lives and parents' beliefs about therapeutic strategies can support SLT services to engage families and increase the success of interventions.

Parents are integral to the process of providing early interventions to children with PLI, both in terms of their support for the initial referral and subsequent engagement with SLT services. Parents' underlying beliefs about language development are likely to influence their expectations of intervention strategies. Marshall, Goldbart and Phillips (2007) used grounded theory to analyse interviews with parents and speech and language therapists in order to examine their respective beliefs about language development. There was some overlap found regarding the beliefs of parents and therapists and the factors they considered important could be broadly categorised as either internal or external to the child. There was greater focus from parents on the roles of gender, personality and imitation; whereas, therapists focused on the importance of an appropriate environment, including the parent-child relationship, focused input to the child and socio-economic elements. While the parents in Marshall, Goldbart and Phillips' (2007) study demonstrated their understanding of a range of factors that could influence language development, interviews with other parents have found that they may take language development for granted (Glogowska, 1998, Glogowska and Campbell, 2004). Despite the level of insight into factors that might be associated with children's language development, studies identified parents' confusion at their children's language difficulties (Marshall, Goldbart, Phillips, 2007, Glogowska, 1998). Glogowska (1998) found that parents were more concerned about what could be done to help rather than understanding any possible underlying causes. Establishing parents' beliefs could help therapists frame discussions when planning interventions that develop on parents' existing understanding of language development.

It is important to encourage parent engagement in any type of SLT approach but this is particularly important for interventions that explicitly aim to modify PCI. In Marshall, Goldbart and Phillips's (2007) study parents discussed the role of their children's environment, including the opportunities they had for interaction, family relationships and the impact of siblings. Parents often questioned the role of their own behaviour and sometimes expressed guilt over

their children's difficulties (Glogowska ,1998, Glogowska and Campbell, 2004). In contrast, parent interviews with families involved in the Hanen Programme (targeting PCI) did not find evidence for parental feelings of guilt, even in cases where children failed to make progress and instead parents related their children's limited language development to their natural progress (Baxendale, Frankham and Hesketh, 2001). Despite differences in the study findings therapists should not ignore the potential blame that parents can place on themselves. Speech and language therapists have the difficult task of proposing to parents that the best way to support their children's language is to change the way in which they interact with them, while not suggesting that parents are at fault for those difficulties (Marshall, Goldbart, Phillips, 2007). Glogowska and colleagues proposed that discussions with parents regarding the nature of language difficulties could help to assuage guilt.

Despite some similarities in parents' and speech and language therapists' beliefs about language interventions (Marshall, Goldbart and Phillips, 2007), a number of studies have identified parental uncertainty during the initial stages of intervention. Parents were found to express uncertainty before intervention began as they did not always know what to expect and in some cases parents' expectations about interventions did not match the reality (Glogowska and Campbell, 2000). Some parents involved in interventions that taught PCI strategies reported some initial confusion about why they had to attend sessions (Baxendale, Frankham and Hesketh, 2001). While parents' expected that they would have some involvement in the overall process, such as tasks to consider at home, they had not necessarily expected that they would be the focus of the intervention itself (Lyons *et al*, 2010). The apparent mismatch between the expectations of parents and therapists demonstrated the need to clarify roles during the initial stages of intervention and Lyons *et al* (2010) highlighted the value of developing shared frames of reference to support shared understanding.

Baxendale, Frankham and Hesketh (2001) found that following involvement in PCI interventions, parents recognised the value of their involvement and felt they had helped their children's language improve. In contrast, parents whose children had received clinic therapy believed that the speech and language therapists were in the best position to help their children. Baxendale, Frankham and Hesketh (2001) highlighted that therapists should address parents' beliefs about their own role in children's language development even when children are receiving one-to-one therapy in the clinic. Parents have talked about the speech and language therapist as the expert who is consequently expected to make the decisions and

Carroll (2010) questioned whether collaborative decision-making was always taking place. Collaboration is important to the development of shared partnership and promotes parents' participation in the therapy process. Discussions about parents' expectations should be addressed early on to avoid misunderstanding and support parents' involvement with the SLT process (Glogowska and Campbell, 2000).

In addition to addressing parents' perception of the therapy process it is important to establish parents' expected goals to avoid later disappointment. Parents often expressed the importance of seeing progress in their children's development (Baxendale, Frankham and Hesketh, 2001) and it was related to their satisfaction with the therapy process (Carroll, 2010, Lyons *et al*, 2010, Rannard, Lyons and Glenn, 2004). It is necessary to understand what parents hope to achieve for their children through intervention and how they measure success. The parents of school-age children in Carroll's (2010) study were concerned about 'fixing' their children's expressive language; whereas, parents in the Better Communication Research Programme (BCRP) focused on the importance of improvements in children's communication skills to facilitate their independence and inclusion (Roulstone *et al*, 2012a). Parents' goals should be explored during the initial stages of intervention and therapists should work with parents to set realistic expectations for the outcomes of intervention (Carroll, 2010).

Overall, collaborative working with parents is fundamental to the success of interventions and they should be involved in the decision-making process throughout. Exploring parents' beliefs about language development and difficulties, their expectations for the therapy process and preferred goals should enable therapists to avoid misunderstanding and improve the acceptability of interventions for families. Parents' perspectives of SLT could influence their compliance and their engagement is fundamental to intervention success.

2.6 Summary

The research reviewed in Chapter 2 demonstrated that there are vast individual differences in children's developmental trajectories in TD children and those who have PLI regarding both the rate and composition of early vocabulary growth. Language performance over the preschool stage has been shown to fluctuate, and typical or delayed status is not always stable and predicting children's later language skills from a single measure or time point is not always accurate. Rate of vocabulary growth has been a more successful predictor of later language

ability and could be useful for professionals who need to identify which children require additional support with language.

The amount of parent talk and certain characteristics of PCI have been shown to facilitate child language development. Language interventions that include parent training to optimise children's language learning opportunities have been shown to have positive effects on children's language. However, parent training approaches are more suited to some families than others. Exploration of the structure of individual families lives and parents' perspectives regarding their role in children's language development could support speech and language therapists to identify families best suited to these interventions. The precise nature in which these interventions bring about change are not always clear because not all studies actually measure change in parent language.

A number of methodological issues were highlighted in the literature review including how and when to measure aspects of parent and child language. Parent report is a commonly used tool for collecting language data but it does not reflect how successfully children actually use language during interactions. On the other hand, observational studies collect language data during interactions but they are more resource intensive. Furthermore, findings can be influenced by the productivity of the child, which may not reflect their typical interaction style or wider language knowledge. Observational studies have often collected language data during brief parent-child play sessions; however, the characteristics of PCI have been shown to vary across different activities. It is necessary to understand children's language environments more broadly and measure characteristics of PCI across a range of contexts that more accurately represent everyday language learning opportunities.

Longitudinal studies of PCI in TD populations found that the characteristics of parent language were differentially related to children's language depending on children's age or language level. Evidence for the changing relationship between parent and child language has implications for reconciling findings across studies of children at different ages, and within studies using a wide age range of children. It is important to consider the role of PCI developmentally when planning interventions that use parent training as these may need to be adaptive in nature, recognising how parents can optimise their language at different stages of their child's development. There is a dearth of longitudinal studies exploring the dynamics of

the relationship between parent and child language in the clinical population of children with PLI.

Chapter 3 Study aims and research questions

3.1 Aims and objectives

The present study aimed to understand the dynamics of the relationship between parent-child interaction (PCI) during everyday activities and the trajectories of vocabulary growth of children with primary language impairment (PLI). The study intended to address gaps in the currently available research identified in the previous chapter. In particular, the study examined the relationship between PCI and the vocabulary development of children with PLI from a developmental perspective, in order to build on existing research that has examined the relationship at a single time point. The study used LENA, an innovative technology that enabled language data to be collected from whole-day recordings of children in their home environments, without the researcher present, in order to develop an understanding of PCI that more accurately reflects children's everyday interactions. This naturalistic observation aimed to broaden current research that focuses on dyadic play activities. Multiple sources of data collection were used in the present study in order to develop a detailed picture of individual children's language development from standardised assessments and language sampling from both structured and unstructured settings.

The study adopted a social-interactionist perspective of language development, which was consistent with PCI interventions that are informed by evidence that parent language plays an important role in children's language development. Understanding the extent to which characteristics of PCI change over time as children's language skills develop may provide information about the extent to which speech and language therapists can, or should aim to modify characteristics of PCI. Understanding how parent and child language varies across different activities in the home environment, as well as the frequency of these contexts, can help therapists to individualise their approach in a manner that is suitable to the home environment of individual families. Furthermore, the perspectives of parents were collected to contextualise findings and considered the acceptability of interventions for parents.

The specific objectives of the present study were as follows:

- Examine the individual trajectories of vocabulary growth of children with PLI: Collect data on expressive vocabulary using an independent measure and from language samples during naturalistic interactions over a period of approximately nine months.

- Examine the relationship between parent and child language: Transcribe and analyse samples of PCI and identify characteristics of PCI used over the study period as children's vocabulary develops.
- Examine children's expressive language and PCI in the context of their everyday language learning opportunities: Select samples of PCI from whole-day recordings of children at home and identify features of parent and child language more broadly across different contexts.
- Incorporate the perspectives of parents in the study findings: Interview parents during and after the study to recognise their experiences and concerns of having a child with PLI.

3.2 Research questions

Specifically, the study aimed to address the following research questions:

1. *What is the rate and composition of early vocabulary development of children with PLI?*
2. *To what extent do characteristics of PCI change as the early vocabulary of children with PLI develops?*
3. *To what extent do child and parent talk and interactions vary across contexts in their natural home environments?*
4. *How do parents perceive having a child with PLI?*

Chapter 4 Methodology and methods

The current chapter outlines how adopting pragmatism as the research paradigm for the present study (4.1.1) guided the decision to use a multiple case study methodology (4.1.2). Details of the procedure for recruiting cases to the study (4.3) are followed by a discussion of the measures used to collect baseline information about children's developmental skills (4.4.1) and language data from parents and children over time (4.4.2). The general procedures are outlined for the pilot study (4.5.1), which assessed the feasibility of measures, and the full-scale multiple case studies (4.5.2). The comprehensive data analysis (4.6) plan aimed to maximise the reliability of the study. The study design and implementation, including all data collection and analysis, except for reliability checking, was conducted by the PhD student, referred to as the Chief Investigator or researcher in this thesis.

4.1 Research design

4.1.1 Philosophical assumptions

The philosophical assumptions adopted when conducting research guide decisions about study design. Ontological assumptions are concerned with the nature of reality and can broadly be defined based on whether a study uses a quantitative or qualitative approach. Quantitative research generally assumes that there is an objective reality that can be controlled and examined through experimental measures. In contrast, qualitative research maintains that there are multiple realities that can be explored to present the complex perspectives of different individuals (Creswell, 2007). Epistemological assumptions are concerned with the nature of knowledge. While quantitative research intends to examine aspects of the world objectively and remains distant from participants, qualitative research identifies subjective knowledge of participants, minimising the distance between the researcher and participant. Postpositivism and constructivism are two notable paradigms that have been previously associated with either quantitative or qualitative research, respectively. Postpositivism comprises a scientific approach, which is often reductionist and based on a priori theory and hypothesis testing; whereas constructivism is inductive in nature and aims to understand the views of a particular problem or social issue from the perspectives of the participants (Creswell, 2007). Over the last century, researchers have debated the relative value of adopting either a quantitative or qualitative research paradigm. The purists' position denied the combination of these approaches: the Incompatibility Thesis (Howe, 1988), in the on-going paradigm war. A mixed methods approach was subsequently put forward as the third

paradigm, seeking to abandon the previous dichotomy and maintain the value of both approaches; therefore, offering a more practical alternative (Johnson and Onwuegbuzie, 2004). Furthermore, Creswell (2007) outlined the application of both the postpositivist and constructivist approach to qualitative research, in addition to other alternative worldviews that can be adopted. Pragmatism is one such alternative, which is not bound to a particular set of philosophical assumptions (Creswell, 2007) and rather than focusing on the method used to study a phenomenon, is concerned with the outcome of the research. Adopting a pragmatist approach emphasises the importance of being guided by the research questions, which supports the selection of methods that will provide the most useful answers, in a pluralistic methodology.

4.1.2 Case study methodology

The present study used a multiple case study methodology that was underpinned by the adoption of pragmatism, the reasons for which are outlined below. A number of common objectives to case study research are discussed alongside explanations of how these issues were addressed.

Pragmatism is often associated with mixed methods research, and it is consistent with the use of both qualitative and quantitative methods in a case study design. In a review of mixed methods studies, Greene, Caracelli and Graham (1989) identified five purposes of the approach: development, initiation, triangulation, complementarity and expansion. The latter three are particularly relevant to the present study, triangulation of data from different sources aimed to support the validity of findings and assess the value of the methods used. Complementarity of different techniques sought to enhance the interpretation of findings. Expansion related to the overall aim to provide a broad description of children's early environments, using various sources of information to understand the different components of interest. A case study approach can be viewed as a 'bridge that spans the research paradigms' (Luck, Jackson and Usher, 2006) because it encompasses a wide range of methods to understand a phenomenon. The study used both qualitative and quantitative techniques for data collection and analysis and intended to examine naturalistic behavioural language data with no explicit researcher control over events.

The current study aimed to examine PCI over time to address the dearth of literature regarding the developmental nature of children's language growth for children with PLI. Furthermore, the case studies collected data within the context of children's home environments,

minimising the impact of external control, in order to recognise natural variation across individual families. The current study considered the individual preschool child with PLI to be the case, within the context of their language learning experiences, specifically their interactions with parents. The current study was viewed through the lens of social-interactionist theory (see section 1.4) to focus on the application of findings to SLT interventions that include parent training. The orientation towards improving practice is consistent with adopting the philosophical position of pragmatism (Johnson and Onwuegbuzie, 2004). The use of multiple case studies was considered to be an appropriate methodology to achieve the research objectives, which would produce an in-depth description of the issue within a naturalistic setting. Creswell described case study research as follows:

> *…a qualitative approach in which the investigator explores a bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes.*
>
> Creswell (2007) p.73

There are a number of proposed limitations to the case study methodology; in particular the issues of generalisability, causality and lack of scientific rigour are addressed below. A common objection to the case study approach is an assumed limitation to the ability to generalise findings from only one case, or a small number of cases. However, case studies are intended for analytic generalisation, using theoretical propositions as a comparative template for study findings, in order to expand and generalise theories (Yin, 2009). In contrast, experimental studies seek large sample sizes to achieve statistical generalisation to make inferences at the population level. The use of multiple case studies increases the external validity of study findings using replication logic, in the same way that replicating experimental findings strengthens their validity. When two or more cases support a theory, or do not support a rival theory, then this strengthens theoretical understanding. In the present study literal replication was anticipated through the selection of similar cases, which were expected to demonstrate similar results. It is important to make the distinction between replication logic in selecting multiple studies, and sampling logic in selecting participants for an experimental study (Yin, 2009). Four case studies are considered to be equivalent to four separate experiments, and not a sample size of four. The particular number of cases selected was a trade-off between the time and resources available and the detail required to appropriately answer the research questions.

A second objection to the case study is a difficulty demonstrating causal relationships. However, as previously discussed, establishing causality within the particular area of interest is also not straightforward for experimental designs. The relationship between parent and child language has been shown to be reciprocal and there are numerous contributing factors that have made clear causal pathways difficult to establish for existing experimental studies. The present study aims to expand on existing theories and complement findings from observational studies of PCI as well as intervention studies that aim to utilise PCI as the vehicle for change in children's language. Examining children's natural language environments specifically aims for minimal experimenter control over events, which makes the case study approach a suitable method of inquiry to develop a broader and more detailed picture of children's natural language learning in the home environment.

A lack of scientific rigour has also been cause for concern for case study research. To address the issues of rigour and lengthy time commitment, predominantly structured quantitative data collection methods were used, with previously established acceptable levels of reliability and validity. Available norming data also allowed for some comparison with larger samples of TD children. The approach reduced the necessary time commitments and intrusion into the family life of the participants involved in the study. As previously discussed, research has identified vast individual differences regarding children's developmental trajectories, the relative role of parent language input and the mediating effects of parent knowledge of child development and context. Consequently, a single method of data collection was not considered to be sufficient to form a broad understanding of children's language environments. A number of quantitative measures were used to collect data on changing parent and child language over time, and qualitative methods were used to enhance the interpretation of these changes, contextualising findings. Interviews with parents gained their perspectives regarding the phenomenon under investigation. A systematic approach to both data collection and analysis ensured the reliability of the present study, adhering to Yin's (2009) guidelines to follow a detailed study protocol, establish databases to manage findings and minimise errors, and conduct reliability checking with another researcher to reduce bias.

Yin (2009) recommended that theoretical propositions be established for case study research, which are used to focus the scope of data collection to ensure that the study remains within feasible limits. The propositions are not used as hypotheses for testing; instead they provided a template for the comparison of empirical findings for data analysis. Existing theories of

language development were used to establish the specific study propositions outlined below, following the review of the literature in Chapter 2.

1. a) Children's vocabulary size and complexity were expected to increase across the study period, although the trajectories of growth were expected to vary across cases. The rate of children's vocabulary growth was expected to relate to their later vocabulary size.

   b) The composition of word types in children's vocabularies was expected to change with development with a decreasing proportion of naming words over time. A possible trend for a higher proportion of nouns in children's early vocabularies together with faster vocabulary growth was also explored.
2. The characteristics of PCI were proposed to change over time, in particular, responsivity was expected to increase as children's vocabulary developed.
3. There was expected to be some variation in the daily activities that children were involved in across families and the amount of parent and child talk and interaction was expected to vary across different contexts.

4.2 Ethical considerations

An application was made to the NHS Health Research Authority: NRES Committee South West – Central Bristol. Approval from the Research Ethics Committee was received as well as R&D approval. The relevant documentation was also reviewed by the University of the West of England (UWE) Faculty Research Ethics Committee. Approval codes are below:

- NHS REC reference number: 12/SW/0142
- R&D reference: 2862
- UWE application number: HLS/12/08/91

The study took place over a period of almost a year from initial contact; therefore, it was important to consider the commitment and engagement of families over this time. Participant information sheets (Appendix B) ensured that families were fully informed about the nature of the study and time commitment required for it, and a flexible approach was adopted that accommodated the needs of families. The study methods required limited researcher involvement, apart from the initial baseline assessments, and the methods of data collection did not require the children to do anything that diverged from their everyday activities. It was

possible that observations and assessments could be uncomfortable for parents or children. All possible steps were taken to ensure the project was not intrusive and to put families at ease, which was particularly important during parent interviews and other discussions at home visits concerning sensitive issues. Families were informed that data would be made anonymous and that their personal details would be kept strictly confidential. The study aimed to examine PCI over time as it naturally occurs; however, it is possible that external involvement, such as SLT intervention, could influence PCI (see section 8.2.7). It would be inappropriate to ask families to avoid seeking support for their children's language but any involvement from professionals was discussed with families and recorded for consideration.

4.3 Case study recruitment

Preschool children with PLI aged up to 5;11 (years; months) were identified by local speech and language therapists in Bristol and staff at preschool settings e.g., children's centres and nurseries, or parent groups in Bristol. Advertisement flyers that invited parents to express an interest in participating in the study were also used to maximise recruitment potential. To be included in the study, children had to meet the criteria outlined below:

1. Delayed expressive language on the PLS-3 (Zimmerman, Steiner and Pond, 1992) with an expressive communication (EC) standard score more than 1SD below the mean (<85).
2. Age-appropriate developmental abilities, determined by scores on the BSID II Mental Development Index (MDI) (Bayley, 1993).
3. Be in the early stages of language, i.e., using only single words.
4. Be from monolingual English speaking homes.
5. Have no evidence of other sensory, developmental or neurological difficulties.

The names and addresses of families were identified by the local NHS SLT service and letters were sent to parents inviting them to express an interest in the study. Alternatively, parents were given details of the study by SLT services, preschools or via the study flyers and they could then provide the research team with their details and agree to be contacted to discuss the study in more detail (Figure 4.1). The study information documents clearly outlined the expected time commitments for families, and they were informed that a flexible approach would be established to fit around their needs. Parents expressed an interest either verbally, by phone or email, or by returning a reply slip by free post, and providing their contact details. Screening questions were asked to obtain background family and demographic details and to

confirm that their child fit the general inclusion criteria. The study intended to recruit similar cases to enable literal replication across cases. Children were recruited to the study at the early stages of language development, i.e. using only single words, and had been identified by preschool staff, parents or SLT services as having a primary difficulty or delay with language rather than a more general delay. The present study was interested in monolingual language acquisition in English and due to the differences in bilingual language development, children were only recruited from homes that spoke English exclusively. While child participants were similar according to these criteria, wide sampling was used across this population; therefore, children were included with both delayed and non-delayed receptive language skills, which were measured on the PLS-3 by the auditory comprehension (AC) score. Children with parents from different educational or economic backgrounds were included.

Potential families were sent information sheets (Appendix B) and had two weeks to consider their involvement in the study, with time to ask the researcher any questions. Follow up phone calls were used if parents had not contacted the researcher regarding their intended involvement after this time. After families confirmed their involvement in the study, the primary caregiver signed consent forms (Appendix B) on behalf of themselves and their child. Initial assessment sessions were arranged with children to ensure that they met the study inclusion criteria; any children who did not meet the criteria were excluded at this stage. No compensation was given to families for their involvement in the study. Information about support and resources for language was made available.

Initially, children with PLI referred to the SLT services in Bristol were identified locally by the service manager, and the names and addresses of parents were retrieved (see Figure 4.1 Recruitment 1). All identified families were sent letters inviting them to express an interest in the study. However, there were fewer children identified than had been anticipated by both the researcher and service manager (n=10). Only two families expressed an interest, neither of whom fit the inclusion criteria when checked by the screening process. In order to improve the potential for study recruitment, ethical approval was sought to expand the process to include the identification of children with PLI by staff at preschool settings e.g., children's centres and nurseries, or other parent groups in Bristol. In order to maximise parental engagement approval was also requested for the researcher to use advertisement flyers and engage with families directly to explain the study and invite parents to express an interest through a more informal approach (Figure 4.1).

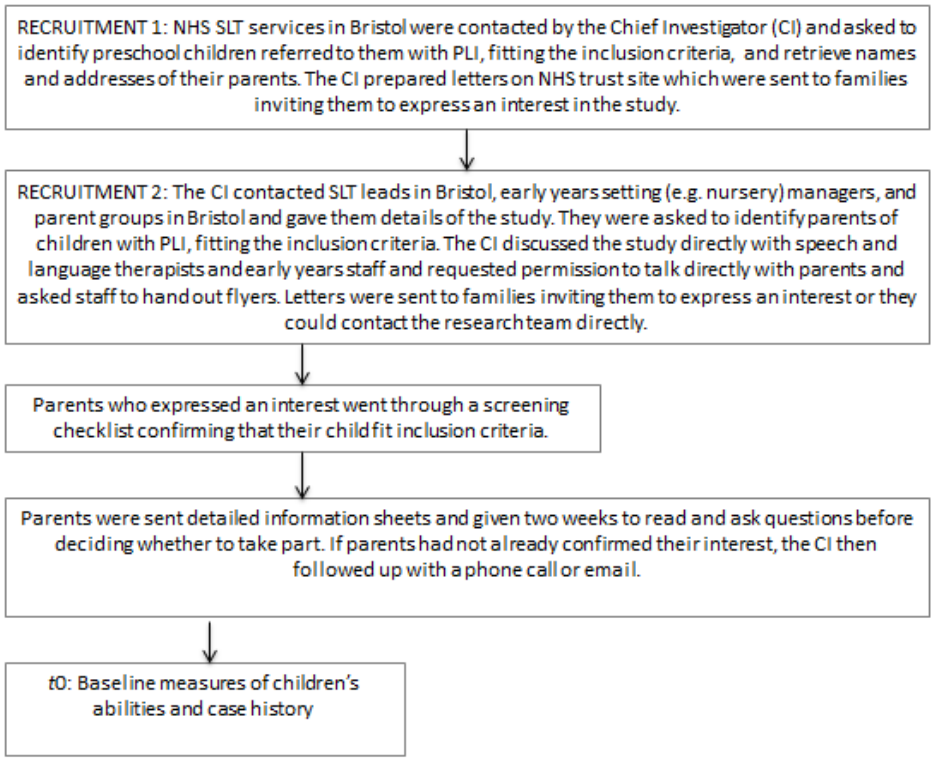

Figure 4.1 Flowchart of study recruitment process

Six families expressed an interest in the study. One family (identified though SLT services) withdrew before the initial assessment session, stating that they no longer felt that their child had significant language difficulties. The remaining five families confirmed their interest and initial baseline assessment sessions were arranged. The primary caregivers (in all cases the mother) signed consent forms on behalf of themselves and their children. Delayed language status was confirmed at baseline assessment (section 4.4.1), defined as an expressive language standard score <85 (1SD below the mean) on the Preschool Language Scales-3 (Zimmerman, Steiner and Pond, 1992). One child scored 96 on the expressive language scale and was excluded from the study at this assessment stage. The remaining four families were included in the study.

4.3.1 Participants

Four children (all male) with expressive language delay or expressive and receptive language delay, and their families were recruited according to the definition of PLI used for this study and the inclusion criteria outlined previously. Pseudonyms were used in all cases to refer to children as shown in Table 4.1, which includes details of baseline assessment scores and case study details. Two children were recruited through SLT services and two were recruited through preschool staff or parents; therefore, at the start of the study two of the children

were receiving SLT support. One child began to receive SLT support mid-way through the study period and the fourth child was referred to SLT services by the health visitor but did not receive any support before the end of the study. All four cases remained in the study for its entirety, which took place over approximately nine months, following baseline assessments.

All four children had expressive language standard scores ≤80 on the expressive communication (EC) scale of the PLS-3 and one also had a delayed receptive language standard score on the auditory comprehension (AC) scale of the PLS-3(Zimmerman, Steiner and Pond, 1992). One child had an above average receptive language score and cognitive age estimated at six months above chronological age based on the nonverbal items of the BSID II (MDI) (Bayley, 1993). Two children had cognitive ages two months below their chronological age. All children achieved behaviour scores on the BSID II Behaviour Rating Scale (Bayley, 1993) that were within normal limits.

Table 4.1 Overview of case studies

	Ben	*Christopher*	*Aaron*	*Daniel*
Recruitment	Parent responded to advertisement	Speech and language therapist	Speech and language therapist	Parent responded to advertisement
Professional involvement	Monitored by health visitor and referred for SLT at end of study.	Received SLT before/during study (NHS and independent). Later discharged for review starting school.	Received SLT at start of study and discharged after a few sessions.	Support from inclusion worker before study re: frustration/ communication. Received SLT from mid-way through study.
Chronological age at start	2;2	3;5	3;1	2;8
Expressive language score	80 (1.3 SD below the mean)	74 (1.7 SD below mean)	74 (1.7 SD below mean)	71 (1.9 SD below mean)
Receptive language score	124 (1.6 SD above mean)	88 (0.8 SD below mean)	81 (1.3 SD below mean)	86 (0.9 SD below mean)
Cognitive age	2;8 (6 months above)	3;5 (age appropriate)	2;9 (2 months below)	2;6 (2 months below)
Behaviour rating	116 (73rd percentile)	109 (49th percentile)	103 (29th percentile)	113 (64th percentile)
Birth order and siblings	Second born: older sister,	Second born: one older sister	First born: no siblings	Second born: one older sister

	Ben	*Christopher*	*Aaron*	*Daniel*
	younger brother born during study			
Residency arrangements	Lives with mother, father, sister and brother	Lives with mother, father and sister	Lives with mother, contact with father	Lives with mother, father and sister
Mother's highest qualification	Post graduate	Degree	NVQ3	NVQ4
Father's highest qualification	Postgraduate	Unknown	Unknown	GCSE/O Level
Mother's initial concerns	Limited vocabulary	Limited vocabulary, difficult to understand	Only using single words	Limited vocabulary

4.4 Baseline measures and study methods

The following section outlines the assessments used to determine children's baseline language and cognitive abilities (4.4.1) and the methods used to measure children's vocabulary development, characteristics of PCI and the typical daily activities for children and their families. Interviews were also conducted to explore parents' perspectives on having a child with PLI (4.4.2).

4.4.1 Baseline measures

Baseline measures were used to determine whether children met the study inclusion criteria. The Preschool Language Scale-3 (PLS-3) was used to measure children's expressive and receptive language performance. The Bayley Scales of Infant Development II (BSID II) (4.4.1.2) was used to measure children's cognitive and developmental level.

4.4.1.1 Preschool Language Scales-3 (PLS-3)

This assessment measures expressive and receptive language development and communicative skills of young children aged 0;0-6;0. The PLS-3 is organised into two standardised subscales (M=100, SD=15): Auditory Comprehension (AC) and Expressive Communication (EC), to assess a child's expressive and receptive language skills (content, form and use) as well as potential precursors to language. This assessment was administered according to the instructions in the manual (Zimmerman, Steiner and Pond, 1992). The PLS-3 was selected as it has been widely used in research with children with typical and delayed language development as a baseline or outcome measure of language ability (Baxendale and Hesketh, 2003, Bedore and Leonard, 1998, Boudreau and Hedberg, 1999, Crowe, 2000, Moyle

et al, 2007, Thorpe, Rutter and Greenwood, 2003, Tomopoulos *et al,* 2006) and can assess even very basic language skills.

4.4.1.2 Bayley Scales of Infant Development II (BSID II)

The BSID II assesses the development of infants and young children aged 0;1-3;6 (M=100, SD=15). It consists of three scales: the Mental Scale, the Motor Scale and the Behaviour Rating Scale which assess the child's current level of cognitive, language, personal-social, and fine and gross motor development. The Mental Development Index (MDI) includes measures of cognitive, linguistic and personal-social functioning. Developmental age of children in the present study was based on the MDI cognitive facet alone as the delayed language of these children would likely impact on their overall test performance; therefore, nonverbal test items were used as a more appropriate measure of cognitive ability (Paul and Elwood, 1991). Scores no more than six months below chronological age were considered to be appropriate. The assessment was delivered according to the manual instructions (Bayley, 1993). Some researchers have questioned its predictive validity, especially for clinical populations of children with low cognitive functioning (Hack *et al,* 2005, Nellis and Gridley, 1994). For the purpose of this study, the baseline measures were not intended to be predictive of later functioning; therefore, this was not a cause for concern. The BSID II was selected because the scales have been shown to be sensitive to clinical populations or children at risk of delay (Bayley, 1993) and it has been widely used in research investigating both typical and atypical development in young children (Baker *et al,* 2003, Delgado *et al,* 2002, Robertson and Weismer, 1999, Yirmiya *et al,* 2006, Sylva *et al,* 2011)

4.4.2 Study methods

There were four study methods used to collect data regarding children's vocabulary development, characteristics of PCI and activities included in children's daily lives. These methods were repeated four times (Figure 4.2) over the study period at approximately three month intervals and the details of each have been outlined below. Children's vocabulary development was measured using vocabulary scores on the MacArthur-Bates Communicative Development Inventories (CDIs) (4.5.2.1) and cumulative number of different words. The number of words produced was measured during samples of PCI from all-day audio recordings in children's home environment using the LENA Pro System (4.5.2.2). The samples from LENA were also used to measure child and parent characteristics of PCI used over the study period. The Thorpe Interaction Measure (TIM) (4.5.2.3) was also used to assess parent teaching behaviours in a consistent picture-book context with their child. The different activities that

children partake in, and the amount of child and parent talk and interaction across these activities, were coded from the audio-recordings using LENA. Parents also recorded their children's daily activities (4.5.2.4) for three days at each time point. At the mid-way and end points of the study, parent interviews (4.5.2.5) were carried out to capture parents' perspectives on having a child with PLI. Data analysis plans are outlined in section 4.6, including details of the operationalised set of measures used in the study.

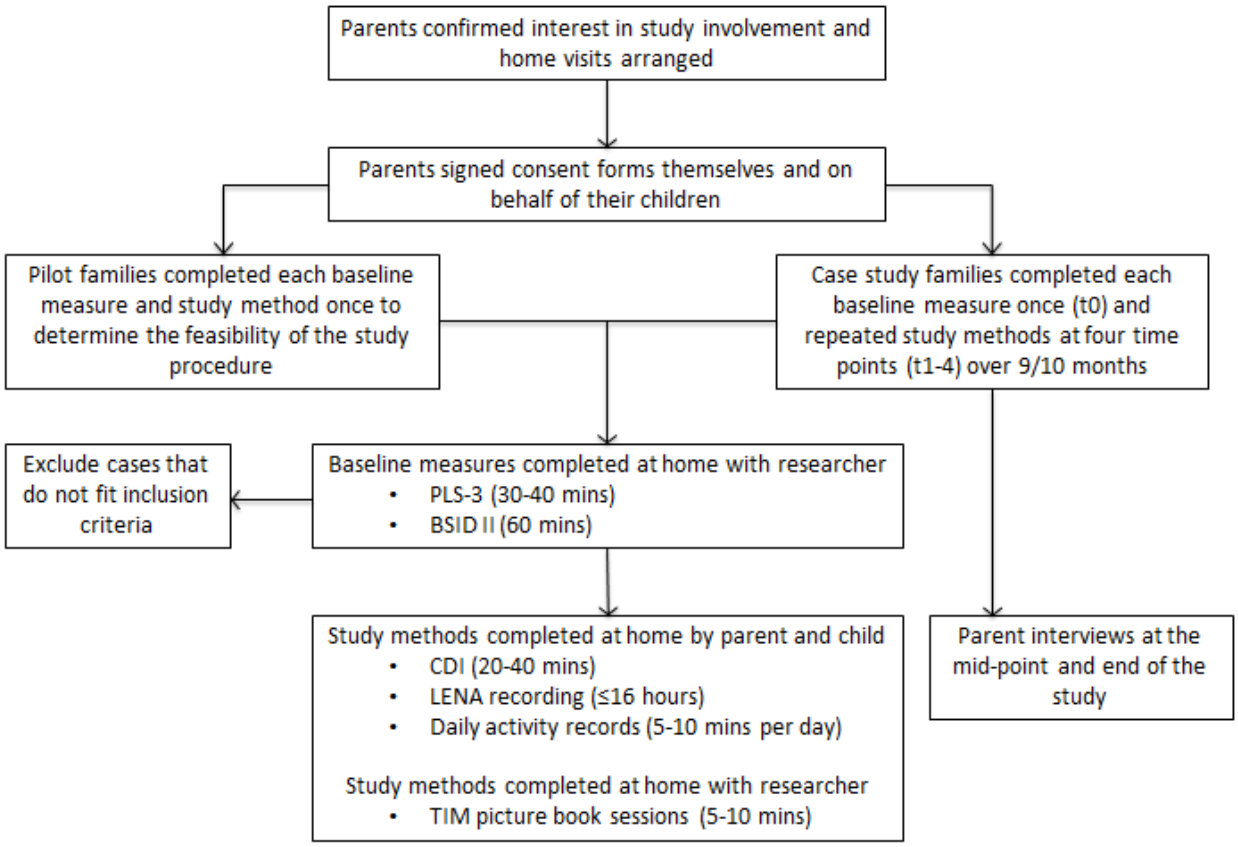

Figure 4.2 Flowchart of study procedure

4.4.2.1 MacArthur-Bates Communicative Development Inventories (CDIs)

The CDI - Word and Sentences is a parent report checklist of 680 words children may use, which relies on parents' recognition from an extensive list. The CDIs are intended for TD children aged 1;4-2;6; however, the forms can be used with children with delayed language development with linguistic skills equivalent to those chronological age ranges, providing a valid measure, particularly for language production (Thal *et al,* 1999). The CDIs provide a quick (approximately 20-40 minutes), cost-effective method of utilising parents' expert knowledge of their children's language. The CDIs were used in the present study to measure children's vocabulary development, including the rate of growth and the composition of the different word types used over time. A parent report tool was used as a measure of children's overall

vocabulary knowledge, which would not necessarily be captured during language sampling alone and issues with intelligibility of children's speech could bias measures differentially across individuals. Written instructions are provided for parents at the beginning of each section in the CDIs, which were generally found to be sufficient in the CDI normative study (Fenson *et al,* 2007). If parents had any questions in the present study, the researcher was able to discuss all of the methods used with families during initial data collection sessions. The parents were given the CDI to capture children's language development from early single word utterances to more complex language ability.

The CDIs provide a useful measure of children's language due to the elimination of reliance on children's engagement and have been demonstrated to be useful predictors of later language (Cattani *et al,* 2010). The CDIs have been found to lack carry-over effects (Reznick and Schwartz, 2001), meaning they do not alter parent's perception of their child's language as a consequence of their use; therefore, they provide a reliable method for tracking individual development. CDIs have been used in studies with children with delayed language that examine language change longitudinally (e.g., Hick *et al,* 2002) as well as the influence of children's language environments (Bornstein and Cote, 2004). High levels of concurrent validity have been found between CDI scores for language production and behavioural measures of language ability (Thal *et al,* 1999) and CDIs have been shown to have reliable correlation with other measures (Dale, 1991, Heilmann *et al,* 2005). However, some issues have been found when using parent reports. In a comparison of reporting accuracy Furey (2011) found no differences between parents from high and low socioeconomic status (SES) backgrounds but in both groups child vocabulary was underestimated. In contrast, Bloom, Tinker and Margulis (1993) found an overestimation of naming words. These issues highlight the potential limitations of using indirect observations. Bias was addressed in the present study through triangulation of vocabulary data with the number of different words used during children's actual interactions in the home. Furthermore, the aim of the present study was not to predict future language ability from these reports but rather to track developmental trajectories, and any potential parental bias were expected to be consistent over time.

The CDIs were developed with a US population, which was the basis for the normative data (Fenson *et al,* 1994). Hamilton, Plunkett and Schafer (2000) found lower scores for both production and comprehension for children in the UK compared to US norms. Furthermore, the US forms include some American-English terms but the UK CDI adaptations are less

extensive than the US forms and there is no normative data available. There is a UK based team developing a standardised version of the CDI for the UK but this was not available at the time the study commenced (Dale and Penfold, 2011). Following correspondence with Professor Larry Fenson (Chair of the CDI Advisory Board) it was decided that the US forms would be used for the present study, and permission was granted from Professor Fenson to substitute any American-English words for their British alternatives (Appendix C). The current study did not intend to produce findings that could be generalised to a wider population, and analysis of data was not reliant on norms for comparison with a TD population. The US forms were considered to be sufficient; however, the potential differences in children's performance in the UK compared to the US should be taken into consideration when drawing comparisons between studies.

4.4.2.2 LENA Pro System

The LENA system uses innovative technology and software for collecting and analysing large amounts of data on children's language use, development and interactions (LENA Research Foundation, 2011). The LENA system uses a digital language processor (DLP), a small unobtrusive electronic recording device weighing 70g, which the child can wear in the pocket of a specialised vest (Oller *et al,* 2010). The processor records up to 16 hours of audio in the child's natural environment, without the presence of the researcher. A team of engineers, researchers, linguists, and speech and language therapists developed the LENA system in response to Hart and Risley's (1995) seminal study, which found vast differences in the amount of parent speech in the homes of children in the US. The aim was to extend and confirm these language differences in the home using a method that could collect data on a much larger scale (Gilkerson and Richards, 2009). The LENA system was used in the present study to collect information about the daily activities of children with PLI as well as to select and analyse samples of PCI from across children's natural home environments (see section 4.6). This method was selected as it eliminated the need for researcher involvement and was easy for parents to operate.

LENA has changed the way that researchers and clinicians can monitor and assess language and it is being used increasingly to study both typical and atypical populations, including children born preterm (Caskey and Vohr, 2013); with hearing impairment (Caskey and Vohr, 2013, VanDam, Ambrose and Moeller, 2012); from low SES backgrounds (Weisleder and Fernald, 2013); with autism or language delay (Oller *et al,* 2010); and with social, emotional and behavioural difficulties (Charlton and Law, 2014). Recordings often take place at children's

homes but they have also been collected at day care settings (Soderstrom and Wittebolle, 2013) and in neonatal units (Caskey and Vohr, 2013). These research studies have used LENA as an assessment tool for adult and child language use. LENA also has potential for use as a screening or intervention tool (LENA Research Foundation, 2011).

The LENA team constructed algorithms and statistical models for adult and child language from over 18000 hours of audio collected from over 300 families, which was used to develop software that could automatically analyse language audio (LENA Research Foundation, 2011). The reliability of this system was ascertained by comparing the automatic LENA coding to that of phonetically trained listeners (Oller *et al,* 2010, Xu, Yapanel and Gray, 2009). Pearson product moment correlation between LENA and human transcript estimates for AWC was r = .92, p< .01. There was 75% agreement regarding child vocalisations and 84% agreement on child non-vocalisations. Most misclassifications were found to be false negatives, which result from LENA's elimination of overlapping speech (Xu, Yapanel and Gray, 2009). The feasibility and reliability of the LENA system was piloted prior to study commencement (see section 4.5.1).

4.4.2.3 The Thorpe Interaction Measure (TIM)

The TIM (Thorpe and Bell, 1994, Thorpe, Rutter and Greenwood, 2003) was used to assess PCI. The TIM was designed to examine parent responsivity and cognitive scaffolding (teaching behaviours) used with preschool children during observations of picture-book sharing and it was used in the present study as an additional measure of PCI. Parents were presented with a book consisting of 10 pictures of preschool age children in situations that are likely to be familiar to them e.g., at the park, playing in a ball pool. Parents were observed looking at the book with their children. Sessions were coded using the TIM to assess broad features of the relationship: physical proximity, verbal and nonverbal communication, controlling style, warmth, management of the environment and reaction to the task. The TIM includes seven cognitive scaffolding dimensions: labelling, short and long elaboration, concept structuring, linking, and involving the child through language or active participation (see Table 4.2). The cognitive scaffolding strategies used by a parent when looking at each picture are scored one or zero depending on whether the parent does or does not display the behaviour. The TIM guidelines (personal communication) outline the changing expectations of parental teaching style as children get older; less verbal input from the parent is anticipated as the child develops demonstrating a shift from labelling and statements to increased questions.

The TIM was originally used to assess early PCI in the Avon Longitudinal Study of Parents and Children (ALSPAC). ALSAPC is a prospective, population based cohort study of approximately 14000 children born 1991-1992 in the west of England, which examined children's health, behaviour and development (Golding *et al,* 2001). A random 10% sample (Children in Focus) were assessed directly every six months to age 5;0, including TIM observations. These assessments provided normative data for the TIM at ages 1;0 and 5;1 from approximately 1000 children. At age 1;0, 34% of parents' total teaching behaviour was labelling and 26% was short elaboration, which were the two most common behaviours. At 5;1 the proportion of short elaboration had remained stable (26%) while labelling had decreased (15%) and involving the child (language) had increased to be the most common (21% to 30%) (Northstone *et al*, 2010). This pattern reflects the expected changes outlined in the TIM guidelines.

The psychometric properties and predictive validity of the TIM have not been widely explored. However, in a subsequent analysis of the ALSPAC data the TIM was demonstrated to be a robust measure of early PCI (Boyle *et al,* in preparation). Reliability analysis demonstrated that short elaboration and involving the child (identify items) achieved acceptable levels of internal consistency; therefore, these were used as a composite measure of cognitive scaffolding. In addition to gender, birth order and maternal education, cognitive scaffolding as well as maternal warmth and control (at age 1;0) had predictive validity for children's receptive language at 2;1. Cognitive scaffolding was associated with warmth of parenting, but not maternal control, and analysis suggested that the effects of maternal teaching on child language were partially mediated by maternal warmth and was a stronger predictor of language for children with mothers who had lower levels of education. These findings highlighted the importance of understanding the influence of PCI on child language within the context of the broader parent-child relationship and wider socioeconomic background and suggested that the TIM could serve as a useful tool to support evaluation of parenting interventions.

The present study updated the picture-book following the pilot (see section 4.5.1) and extended the original coding scheme (see Table 4.2). The new scheme coded every occurrence of different parent teaching behaviours to obtain frequency counts. Each instance was further coded according to the particular content of the utterance, using the criteria outlined in the TIM guidelines for the teaching behaviours expected at different child ages. In Table 4.2, descriptions numbered 1 refer to expected parental teaching at child age 1;0 and those

numbered 2 refer to teaching expectations at child age 3;0, both dimensions of involving the child remained the same at both ages. The children in the present study ranged from ages 2;2-3;5 at the start of the study, but all had language levels that resembled children under age 3;0. Incorporating both descriptions of the teaching dimensions for different ages allowed for a more comprehensive assessment of the complexity of parents' cognitive scaffolding. The picture-book sessions provided a consistent context across the study and the sessions were also transcribed and analysed using the same coding applied to the LENA samples in order to make comparisons between the two types of sampling. A second researcher coded a 25% selection of the transcribed TIM sessions to establish levels of agreement (section 4.7.3).

4.4.2.4 Daily activity records

Parents completed daily activity records (Appendix D) across the study period to map out typical daily activities for their children, e.g., playing at the park, family visit, meal times. These documented the daily events on two days of parents' choice during the week, to most widely represent their typical activities where possible, e.g., week and weekend day; home and nursery day. The third daily record documented the LENA recording day. Parents were asked to make a note of the time the recorder was turned on and what time their child went to sleep at night, as well as any instances where the recorder was removed. The records included space for comments on the people that the children were with and their language and mood or behaviour. These records were used to provide additional contextual information about children's home environments. The records were compared to LENA audio to examine the language learning opportunities available to the child in their home environment and how this related to parent and child language use. The activities recorded were categorised and used to classify the contexts coded from the LENA recordings (see Table 4.9).

Table 4.2 Extended TIM coding scheme

Cognitive style	*Description*	*Example*
Labelling	1. Names items	"It's a dog"
	2. a) Asks for label	"What's that?" "Who's that?" (pointing)
	b) Repeats child label	"Yes, it's a…"
	[include use for clarification/interpretation of child]	
	c) Corrects wrong label	"No, (it's not a…) it's a…"
	d) Provides label when asked	
	[include labelling child gesture/unintelligible utterances]	
Short elaboration – (descriptions)	1. Describes picture content only	"The boy is playing on the swing"
	2. a) Questions about picture content only	"What's happening here?"
	b) Repeat/extend child description	"(child)In ball pool" "(adult)Yes he's in the ball pool"
	[include providing appropriate utterance for child gesture/unintelligible utterances	
Long elaboration – (inference)	1. Develops story beyond content	"I think they're going for a picnic"
	2. a) Questions elaborate on content	"Do you think she will catch a fish?"
	b) Extend child description	"(child)Go to airport" "(adult)They're going to the airport on holiday"
Concept structuring	1. Use picture to instruct about concepts, e.g. colour, size, shape, feelings (e.g., happy, sad, angry), relationships between objects	"His top is blue"
	2. Discuss categories - question/extension/confirmation	"It's his little brother"
		"Yes, his shoes are red"
		"What colour balls can you see?"
Linking	1. Link to child's own experiences	"Do you remember when we played on the swings?"
	2. Respond to child's linking	"Yes it does look like daddy"

Cognitive style	*Description*	*Example*
Involvement of child – (language)	Ask child to identify items/people (not actions) in the picture (prompted labelling), often using "what" and "where" questions [include deliberate false labelling to encourage correct response]	"What are they riding?" "Where is the boy playing?" ["What's that?" coded as labelling above]
Involvement of child – (active participation)	Engage child and extend interaction with picture e.g. ask child to copy expressions, search for items not immediately evident, ask child to make up a story, extending from content in picture to other knowledge (not eliciting labelling which should be coded in above category)	"Can you show me how you would blow bubbles?" "What does it say on the boy's socks?" "How many bubbles can you count?" "What is the little boy colouring in?"

4.4.2.5 Parent interviews

Semi-structured interviews took place at parents' homes or workplace, or over the phone, for 30-60 minutes. The interviews were audio recorded and transcribed verbatim. A copy of the topic guides can be found in Appendix E. Field notes were kept after each visit with families in order to record impressions, questions, emerging themes and parents' comments that arose during the extensive study period. Keeping a contemporaneous record was an important part of the longitudinal research, which ensured that important details could be recalled later on in the process of the study, being useful for subsequent interpretation and analysis of data (Duff, 2008). The field notes were useful for building up a continuous line of inquiry and were used to facilitate interviews with parents. Particular areas that emerged from the field notes were used as prompts for the parents to discuss their perspectives on having a child with PLI and taking action to support their language development. The interviews intended to add contextual information to the language data, provide information about parents' experiences that could inform early years professionals and include factors that are important to families. The value of understanding parents' perspectives is particularly important for speech and language therapists aiming to engage parents in the process of intervention and is fundamental to the success of approaches that directly involve parent participation and training.

4.5 General procedure

A pilot study was carried out with two families to determine the practicalities of the study methods. Some refinements of the study procedures and methods were carried out in response to the pilot. Families were then recruited for the full-scale case studies. Details of the study procedures were outlined in Figure 4.2.

4.5.1 Pilot study

A pilot study was carried out in order to ensure the feasibility of the proposed methods and subsequently refine the data collection plan prior to the full-scale case studies. The focus of the pilot was on the practicality of the proposed methods of data collection. This provided an opportunity to practise baseline measures and refine methods where necessary. As the purpose of the pilot was to ensure practicality and feasibility of methods, the children recruited did not have to fit the inclusion criteria for the full-scale study; therefore, two TD preschool children and their primary caregivers were recruited. In both cases the mothers participated. These children were recruited to the pilot through family and personal

acquaintances who were interested in assisting with the study. Table 4.3 outlines the background details for each pilot case.

Table 4.3 Background details of pilot cases

Pilot	*Participant*	*Age*	*Sex*	*Language status*	*Birth order or family status*
A	Child	3;0	Male	No known difficulties	Third born (of 3)
	Primary caregiver	40	Female (mother)	No known difficulties	Single parent
B	Child	2;1	Female	No known difficulties	Second born (of 3)
	Primary caregiver	32	Female (mother)	No known difficulties	Dual parent family

4.5.1.1 Baseline assessments

The BSID II and PLS-3 were carried out with children. These were not scored, as the purpose of piloting the baseline measures was for the researcher to become familiar and confident with the use of these assessments. These measures presented no difficulties during testing. However, it was apparent that keeping the child focused and allowing breaks was important for ensuring they were able to complete the tests, and this highlighted the general practicalities of timing. It also highlighted the importance of gauging children's reactions to tasks carefully and giving appropriate encouragement when they are presented with something challenging to manage potential disengagement. The pilot was a useful opportunity to get an understanding of what children were capable of in relation to their age and ability.

4.5.1.2 Daily activity records

These parent records were used to document what the study child was doing during their normal day: the activities they did, who they were with, their mood, and any comments on their language use. It was first intended that parents would be asked to fill in a record form each day for the week for a seven-day data collection session. On reflection from the pilot this was reduced for the full-scale study. Parents in the pilot felt that this was too much to ask of busy parents and that it could lead to less accurate or less complete records. Instead parents suggested that asking for three representative days would be more appropriate. These days would include the LENA recording day and two days of their choice, which preferably reflected the typical range of activities for that child (e.g., a weekend and week day, or nursery and home day etc.). The pilot parents also made some practical suggestions to facilitate the use of the daily activity records. These focused on ensuring the records were easily and clearly accessible to encourage parents to fill these out during the day rather than waiting for retrospective accounts at a later time. It was decided that it would be most useful to put the

record form into a plastic wallet that could either be hung on a hook or attached to the fridge with magnets. A pen was also attached. Finally, there were a few suggestions made to make the wording in the instructions clearer and more accessible to parents.

4.5.1.3 McArthur-Bates CDIs

There were no problems experienced with the CDIs although this was an opportunity to discuss the proposed changes to certain words from their American-English to British-English alternatives. It was commented that these forms take some time to fill out and it was suggested that parents could be instructed to fill these out in chunks when they had time. These forms were also kept in the plastic wallets with the daily activity records.

4.5.1.4 The Thorpe Interaction Measure (TIM)

The TIM uses a photo picture-book to elicit interaction between parent and child. During the first pilot, pilot A, the key child and a friend looked at the book with the mother. The primary purpose at this stage was to determine the quality of the pictures, which were moderately dated and faded having been previously used approximately 20 years ago, which made them unclear. This book was used with ease and the children were keen to look through it and discuss the events in the pictures. It was apparent that in some cases they struggled to identify what was happening in the pictures. For example, when looking at a picture of a young boy feeding a lamb at the farm, they interpreted the picture as 'scratching snow' or 'a dog'. In order to elicit meaningful conversations with parents it was important to ensure that pictures were clear.

The researcher who designed the original TIM was contacted to discuss making appropriate substitutions for an updated version of the photo book. No response was received; therefore, pictures were chosen for the present study to replace the originals following the instructions in the TIM guidelines. This included pictures of children of a similar age to those being tested in situations which were likely to be familiar to them e.g. playing in the park. The pictures were selected to reflect those in the original TIM as closely as possible, taking into account the age and nationality of children; the likely familiarity of situations; the other people present; and the overall number of items shown. The new pictures were used in pilot B where there were no apparent difficulties for children in identifying the content. The parent commented that the photo album style, similar to the original, was distracting and did not sufficiently resemble a typical book sharing session. For the full-scale case studies, a standard licence for 10 royalty-free, high-quality images (FreeDigitalPhotos.net, 2013) were put into a bright colour picture-book (Table 4.4).

Table 4.4 Old and new pictures in TIM book

Old Image	*New Image*
Boy feeding lamb	Boy playing with dog
Playing with Christmas presents	Family in a car
Feeding doll	Girl blowing bubbles
Bathing a baby	Boy drawing
Children in playground	Boy on swing
Grandfather and child building patio	Mum and girl on tandem bike
Child in bed with toys	Girl sucking her thumb
At beach fishing	Family at the beach
Playing in a ball pool	Boy in ball pool
Cat on Dad's head	Girl trying to walk dog

4.5.1.5 The LENA System

Parents expressed no difficulties in using the LENA recorder. However, they did express concerns that their child would not necessarily be willing to wear the recorder and LENA vest for the whole day. In the full-scale study the researcher discussed this potential problem with parents. It was agreed that parents would gently encourage children if they expressed a wish to take the recorder and vest off, as they would with normal clothing issues. If they persisted the parents were asked to take off the vest and place it near to the child and this would be taken as withdrawal of assent to participate from the child. They were then asked to encourage the child to put it back on, if and when they felt it was appropriate. Recording days could be rescheduled if insufficient data was collected. Parents were asked to document these events in the daily activity records.

In order to assess the reliability of using LENA to capture information about children's language environment LENA recordings were collected for three and a half hours and 16 hours for pilot cases A and B respectively. Automated analysis provided frequency histograms of child vocalisations, adult words, conversational turns and audio environment information. These were used to identify high levels of interaction from which five-minute samples were transcribed for detailed analysis of child and parent talk and interaction.

The LENA recordings demonstrated clear, high quality audio; however, methodological considerations were highlighted, including the problem of overlapping speech for accurate transcription of child language. The LENA system is a useful, practical tool for collecting large amounts of data but there are problems with unintelligible speech, which could be more pronounced for children with language delay. Consequently, LENA may be more suitable for transcription of language input. Reliability of the automated analysis was also questionable in some instances, including incorrectly coding 'TV speech' as 'real' adult words. Xu, Yapanel and

Gray (2009) demonstrated 71% sensitivity agreement for LENA TV coding with human transcription based on 70 hours of audio. However, issues with reliability may be of greater importance to studies with a small samples using detailed analysis; therefore, validity checks should be carried out according to individual aims and sample size for individual data sets. Xu *et al* (2008) distinguished between the micro and macro level detail that could be obtained using LENA. It is expected that LENA will make under and overestimations in the frequency counts but these are likely to cancel each other out over a large sample. The overall error rate for LENA estimations decreased rapidly between one minute and five hours of recording time after which the error rate was fairly stable but shows a decreasing trend (Xu *et al,* 2008). These findings highlighted the importance of the daily activity records for the triangulation of data regarding the child's environment to support the LENA reports. Reliability of LENA was examined in the present study and is discussed in section 4.7.

4.5.2 Multiple case studies

Following the pilot study, families were recruited to the full-scale case studies. Initial assessments were organised to determine whether children met the study inclusion criteria (4.6.2.1). In cases where PLI was confirmed home visits were arranged to carry out data collection (4.6.2.2).

4.5.2.1 Initial assessment

Initial assessment sessions were organised to suit the needs of individual families. These were held at their homes and lasted one and a half to three hours. Sessions were split over several sessions as appropriate according to the time constraints of the families and children's engagement. Initial sessions began with an introduction to the study with the parent directly involved in the procedures (in all cases this was the mother). This was a chance for them to ask any further questions about the study. A case history was taken, based on those used by NHS speech and language therapists in Bristol (personal communication) and outlined in the CDI manual (Fenson *et al,* 2007). Children then completed baseline measures assessments of language (PLS-3) and non-verbal ability and behaviour (BSID II) to confirm that children met the inclusion criteria. When baseline assessments were complete, and children were confirmed to fit inclusion criteria, consent was confirmed and times were arranged with parents for the first data collection visit (section 4.3).

4.5.2.2 Main study methods

The researcher delivered the study materials to participants' homes, most of which could be completed by parents without the researcher present. One parent was visited at work for the

parent's convenience and meetings took place in a private room. Parents were given the daily activity records and the parent checklists (CDIs) to complete as well as a LENA recorder with a specialised vest and instructions. These included detailed step-by-step instructions for using LENA, a quick reference *Recording Do's and Don'ts* sheet and a *Quick Reference Guide* (personal communication, LENA Research Foundation, 2011). These materials were given to parents in a plastic wallet with an attached pen. The researcher went through guidance on how to complete the parent reports and operate the LENA recorder, with an opportunity to ask any questions. The parents were informed that each data collection point would take place over a week and the timing of these sessions was chosen to suit the families. Parents were asked to complete tasks over the seven days. However, in some instances parents requested to keep the materials for longer as unforeseen circumstances, e.g., illness, prevented completion within that time.

Parents were asked to carry out the LENA recording on a day of their choice when the child was at home with them. Parents were asked to turn on the recorder when their child woke up and insert it into the LENA vest and dress the child as usual. The recorder had to be removed by the parent and placed next to the child if they had a nap, went swimming or had a bath, or wore a seat belt in the car. When children went to sleep at night, parents were asked to place the recorder next to them, which then automatically turned off after 16 hours. All parents completed full 16-hour recordings at each time point. Daniel wore the recorder preschool at t2; this was a second attempt at recording as he had been resistant to wearing the recorder. No consent had been sought from preschool staff or parents; therefore, the audio from t2 was only partially analysed, excluding the time at preschool. Due to initial resistance from Daniel to wear the vest, a less conspicuous t-shirt was made with a specialised pocket that could hold the recorder securely. Daniel was willing to wear the t-shirt but at each time point requested that it was taken off during the evening and language data output from these recordings were only reliable until approximately 6pm.

At the end of the week, the researcher returned to carry out an observation session in which parents were video-recorded sharing a picture-book. The sessions were coded using the TIM, which allows for other children to be present and involved. The researcher observed from a position that would not be too intrusive but sufficiently close to watch the interaction. Parents were told to look at the picture-book with their child as they normally would do when looking at other books or activities together. The researcher then ensured that all records were

complete and all of the materials were collected. Each data collection point required 30-60 minutes for parents to complete forms and up to 10 minutes for the parent and child to complete the book sharing observation. On the day of the LENA recording the time commitment from parents was limited to turning on the recorder on in the morning and removing it when necessary. The CDIs were photocopied and colour coded after each session; at the next time point parents were given back the original form and asked to check only the new words that their children was using. This procedure aimed to reduce repetition and time required of parents in the process of filling out the CDIs. At the end of each data collection point a preliminary date was set for the next data collection session and parents were contacted a week prior to this date for confirmation via the parents' preferred form of contact. Any changes were made to arrangements where necessary and all efforts were made to keep these flexible to suit the needs of individual families. The procedure was followed for each of the four time points approximately three months apart over a 9-10 month period.

Field notes were recorded after each home visit, which were used as a basis for interview topics. Semi-structured interviews were arranged with parents mid-way through and at the end of the study period, which lasted 30-60 minutes. Interviews were audio recorded and aimed to examine parents' perspectives on having a child with PLI and their experiences supporting their language development.

4.6 Data analysis

The following section outlines the operationalised measures used in the study. The selected measures intended to reduce subjectivity and enhance construct validity, the absence of which has been previously proposed as a limitation of case study research (Yin, 2009). The study methods were used to measure children's vocabulary development (4.6.1), characteristics of PCI (4.6.2) and parent and child talk and interactions in different contexts (4.6.3). The case study data were first analysed for each case to acknowledge individual differences, followed by comparisons across cases (4.6.4) to identify patterns in the data. Framework analysis was used to identify themes in the parent interviews (4.6.5).

4.6.1 Vocabulary development

The vocabulary measures from the CDIs and LENA recordings are outlined in Table 4.5 below. The measures were used to examine the trajectories of children's vocabulary growth as well as the rate and composition of their vocabularies over time. The total number of words that parents recorded on the CDIs provided an overall score for vocabulary size. Children's total

vocabulary scores on the CDIs were compared to the median age equivalent scores in the technical manual (Fenson *et al*, 2007) to give an indication of their level of vocabulary delay at each time point. The CDI manual suggests that the CDI can be useful for interpreting language performance for children with chronological ages above the suggested range when their scores do not exceed the median age 2;6 scores; using the CDI to determine children's language level after this cut-off point was likely to underestimate their growing ability (Fenson *et al,* 2007). All scores were input into an Excel spread sheet, which formed part of the case study database. Vocabulary scores were plotted according to children's chronological age, against the mean scores and ±1SD from the CDI norming study with children aged 1;4-2;6, to display trajectories of vocabulary growth. The average rate of vocabulary growth was also calculated between each time point, and over the whole study period.

The cumulative number of different words children used during the LENA samples was also plotted to provide estimates of children's trajectories of growth based on words used during interactions with others. The method for sampling from LENA is outlined in section 4.6.2 below. Triangulation of child language data from two sources aimed to increase construct validity, combining retrospective parent reports (CDIs) with naturalistic data of children's language in the home (LENA). The two methods aimed to establish a more representative assessment of children's growing vocabulary skills in the context of communicating with others.

Children's vocabularies recorded on the CDIs were divided into different words classes based on Bates *et al*'s (1994) study to determine the composition of their early vocabulary knowledge. The proportions of different word types were compared to the proportions with which they are represented on the CDIs: common nouns (41%), predicates (24%), and closed class words (15%). Not all words, such as animal sounds, were included in these three categories; therefore, composition analysis was based on 549 of the total 680 words on the CDI list.

Table 4.5 Child vocabulary measures collected from the CDI and LENA study methods

CDI	*Transcribed LENA samples*
Total vocabulary size	Total number of words
Vocabulary composition	Cumulative number of different words
Rate of vocabulary growth	Intelligibility
Trajectory of vocabulary growth	

4.6.2 Parent-child interaction

Samples of PCI were transcribed and analysed from the LENA audio recordings and the video-recorded picture-book sharing sessions. The process for selecting samples from the LENA audio has been outlined below. In addition, the picture-book sessions were analysed using the TIM to assess cognitive scaffolding.

The samples of PCI were selected from the LENA audio based on automated LENA counts. The LENA recorder can be connected to a computer via a USB port and the audio data is automatically analysed by the accompanying LENA Pro software (V3.1.0). Interpreted Time Segments (its.) are created for each audio file (Xu *et al,* 2008). The audio stream is first separated into segments according to acoustic features using iterative modelling algorithms. The type of sound segments are classified according to the best fit with statistical models developed from acoustic training data. These include: adult male, adult female, key child, other child, overlapping speech, noise (e.g., bumps), electronic media, and silence (Xu, Yapanel and Gray, 2009). Noise, unclear or overlapping speech, electronic media sounds and child non-speech sounds are then eliminated and certain segments are processed further. Key child segments are analysed to differentiate vocalisations (including words, babbles and squeals) from non-speech sounds. Adult speech segments are analysed to determine the number of adult words. This process provides the basis for conversational turn estimates. LENA automatically provides histogram reports for adult word count (AWC), child vocalisation count (CVC), conversational turn count (CTC), and information about the audio environment (Table 4.6). The output can be viewed in five-minute, hourly, daily, or monthly time formats (Appendix F). Normative information is available from the LENA norming study, which was based on 2682 12-hour recordings, from over 300 families of children aged 2-48 months old (LENA Research Foundation, 2011). Data can be exported from LENA Pro in different formats for use in other programmes, including Excel (.csv files) and transcription software (.trs files). Data can be exported to provide different levels of detail, including a breakdown of the LENA counts for each five-minute or one-hour block of audio.

Table 4.6 Definition of LENA output variables

LENA output	*Description*
Adult word count (AWC)	Frequency count estimate of the number of adult words spoken to and near the key child in range of the recorder, regardless of context.
Child vocalisation count (CVC)	Frequency count of the estimated number of vocalisations of at least 50ms in duration used by the key child, preceded and followed by 300 ms of something else (silence or non-speech). One vocalisation could be made up of more than one word or speech sound, or, if the child pauses once for 300 ms or more during a sequence of words or speech sounds, this will count as two vocalisations. CVC was classified into meaningful speech, to include canonical babbles, protophones (e.g. squeals and growls) and actual words, which are differentiated from vegetative and fixed-signal sounds (e.g. coughing, laughing) by the LENA system algorithm and are not represented in the CV report. There is also an additional categorisation for cry segments.
Conversational turn count (CTC)	Frequency count of reciprocal speech segments, i.e., back and forth interaction between the key child and any adult that occur within 5s of the other conversational partner. Turns are counted in pairs of child-adult speech and conversations are separated by >5s. Counts are made with no content or meaning.
Audio environment	Silence and background – including electronic media with average sound pressure level <32dB Noise – general non-speech sounds e.g. dog barking, hands clapping, burps and rattles TV and electronic sounds – including TV and radio, media sounds, synthesised toy sounds Distant – speakers not near the child or speech that does not fit models well Meaningful – live, in the room distinguishable human speech comprised of Adult Male, Adult Female, Key Child and Other Child speakers. This is not part of overlap and is near and clear to the key child. Distant language ≥ 6 feet away from the recorder or unclear/overlap speech is excluded.

Source: Caskey and Vohr (2013) and LENA Research Foundation (2011)

The method for selecting samples of PCI from LENA in the present study was informed by a recent case study by Oller (2010), which demonstrated the use of representative sampling from LENA recordings. Thirty-nine five-minute samples were taken from recordings over approximately 12 months. These were selected based on automated LENA counts that reported high levels of vocalisations. Oller (2010) analysed the samples in more detail not available from the LENA analysis alone, recording the word types and tokens used by the key child and adult speakers in three different languages to examine the relationship between the languages spoken to the child and the child's production in different languages. The present study adapted this method of representative sampling to select samples of high level interaction from the audio based on the automated LENA counts of conversational turns.

The present study exported the LENA data into Excel and sorted the individual five-minute samples according to the CTC; segments with the highest counts were then selected for transcription and further analysis. Six samples of PCI were taken from the LENA recording at each time point, which equated to approximately 30 minutes of naturalistic interactions. In total 24 samples of PCI were transcribed for each child (approximately two hours). Analysing six samples intended to broaden the sampling of language from across the day. The selection of 30 minutes of audio from six samples is also consistent with the Bristol Language Development Scales (BLADES) (Gutfreund, Harrison and Wells, 1989), which suggested that 30 minutes of spontaneous conversation was suitable for capturing children's language production for assessment, and that this was best achieved through sampling shorter five-minute periods. The use of LENA maximised the opportunity for sampling PCI as the automated counts made it possible to select audio from periods where there were high levels of talk.

In order to examine change in the characteristics of PCI over time it was necessary to transcribe samples of the same parent. In each case study the mother was the primary caregiver; therefore, mother-child interactions were selected. In some cases there were many examples of high-level interactions between the child and mother, while in other cases these samples were more limited. In some cases there were a number of high CTC samples excluded because the child was interacting with another adult, most often their father or a grandparent. To be included in the study, the proportion of adult-child turns in a five-minute sample had to be predominantly with the mother (≥65%). Analysis of PCI with different adults, as well as

interactions with other children, was beyond the scope of the present study but is an important avenue for future research.

LENA analyses language data without content and high CTCs did not always identify periods in which parent speech was directed at the key child. The total number of conversational turns determined from a manual count of the transcripts had to be ≥70% of the LENA CTC to be included in the study for analysis. This level was chosen to reflect reported LENA reliability with human transcribers (Xu, Yapanel and Gray, 2009). Discrepancies between the LENA and manual counts were most often because the key child was talking aloud close to adults who were speaking to each other or to other children. Consequently, periods of adult talk followed by child talk were artificially coded by LENA as conversational turns. See Appendix G for tables of the included and excluded samples. The selected five-minute samples were exported from LENA as .trs files that could be imported into transcription software, Transcriber 1.5.1 (Boudahmane *et al*, 2008), and transcribed using the conventions for SALT (Miller, 2010). Utterance boundaries for individual speakers were recognised according to grammatical conventions for sentence closure unless intonation or pauses suggested the start or end of an utterance. All speech was transcribed where possible; unintelligible speech was coded according to the SALT guidelines. The SALT measures of PCI transcripts have been outlined in Table 4.7 below. Transcripts were kept together in Word files and case study notes were made to record ideas and impressions of PCI that occurred at the time of analysis for later retrieval. Analysis of PCI was arranged according to the characteristics of PCI identified in the systematic review (Blackwell *et al*, 2015) outlined in Chapter 2 (section 2.3.3).

Table 4.7 SALT language measures of PCI transcripts

Language measures	
Quantity	Total utterances
	Total completed words
Diversity	Number of different words
	Number of total words
	Type token ration (TTR)
Complexity	Mean length of utterance (MLU)
	Mean length of utterance in morphemes (MLUm)
	Mean turn length

Note: The quantity measures were based on the entire transcripts, while the diversity and complexity measures were based on clear and intelligible utterances alone.

4.6.2.1 Quantity, diversity and complexity of language

The quantity, diversity and complexity of maternal language were measured using the SALT scores outlined above. The measures were recorded for the individual five-minute LENA samples, overall for each time point, and for the transcripts of the picture-book sharing

sessions. The total, mean and range LENA AWC for each recording day provided measures of the amount of maternal talk more broadly, which would include both high levels of interaction sampled for transcription and lower levels of interaction across all daily activities. A considerable amount of the 16-hour LENA recordings were silent as they continued after children went to bed as well as during daytime naps; therefore, means were calculated excluding segments with counts of zero. Omitting zero-count samples was useful for making comparisons across the study as children stopped taking naps and also the start time affected the number of hours recorded after the child went to sleep at night. LENA also calculates percentile scores for AWC based on comparisons with norming data.

4.6.2.2 Dialogue participation

In addition to the standard SALT output, every utterance in the PCI transcripts was coded for four categories outlined in Table 4.8 below, which were used to measure dialogue participation and purpose and responsiveness of maternal utterances. Every adult and child utterance in the transcript was coded according to three categories: syntax (e.g., *wh*-questions, imperatives); pragmatic function (e.g., request information, bid for attention); and topic management (e.g., child/adult initiations). Adult utterances were also coded according to the fourth category of lexical contingency (e.g., imitation, expansion); this category was only coded for child utterances when they had imitated an element of the preceding speech of their conversational partner. Each category was mutually exclusive; utterances that could fit more than one category for syntax were coded according to the following order for consistency: imperative, complex, negative, declarative, fragment, unclear. These coding categories were based on the coding scheme used by Paul and Elwood (1991) for adult utterances, identified in the systematic review of studies comparing PCI with TD children and those with PLI (section 2.3.3). In the present study the codes were also applied to child utterances where appropriate and some additional codes were included, which have been indicated using * in Table 4.8. Categories were discussed and agreed with experts in the field of child language and development. The pragmatic function codes included identification of utterances that were not directed at the key child (PX; Table 4.8), to account for interactions that included other adults or children. No further codes were recorded for topic management or lexical contingency when the utterance was not directed at the key child. Paul and Elwood's (1991) coding scheme covered the main areas of interest identified in the systematic review and Yin (2009) recommended the use of operational measures established within the existing literature in order to reduce subjective judgement in planning the analysis and increase construct validity.

Dialogue participation referred to the relative sharing of interactions between the parent and child. The total number of maternal or child utterances used provided a broad measure of participation regarding the amount of input each partner contributed to the interaction. The number of conversational turns initiated provided more detailed information about interaction sharing. Although LENA produces automated counts of conversational turns, they are not coded with any reference to the interaction content and only provide an estimate based on temporally close adult and child speech; therefore, turn initiations were counted manually for the transcribed PCI samples. Manual counts followed the same criteria outlined in Table 4.6 for the LENA CTCs; however, turns were counted according to the content of the interactions. Manual turn boundaries were determined by the same criteria for utterances boundaries outlined above, which was more practical than using the temporal restrictions (5s) imposed by the automated LENA system. The total number of turns between the child and other adults were counted, as well as the number initiated by either the child or adult, and counts where separated for child-mother and child-other adult turns. Topic initiations were coded within the topic management category (Table 4.8). The numbers of new topics initiated in an interaction were calculated to determine the equality of shared interaction content between the mother and child.

4.6.2.3 Purpose and responsiveness of communicative acts

The syntax, pragmatic function, and lexical contingency codes (Table 4.8) were analysed for the individual samples and overall for each time point to determine the type of utterances mothers used with their children. Responsiveness was assessed by examination of maternal expansions, extensions, recasts, imitations, and interpretations, as well as reference to children's current activity. The proportion of maternal contingent responses was calculated in relation to the number of child-directed utterances, to account for interactions with other people present. The rate per minute of contingent utterances during PCI was also calculated for each sample. Reliability of the transcription and coding process was determined by a 10% check by a second researcher, outlined in section 4.7.

Table 4.8 LENA transcript PCI codes

Category	*Type*	*Code*	*Definition*
Syntax (parent and child)	Declarative	SD	A statement e.g. "The grass is green"
	Negative	SN	States something not true/incorrect e.g. "The grass is not green"
	Question - *Wh*	SQW	*Wh*- question
	Question - Yes/No	SQYN	Yes/No question
	Question - Tag	SQT	Tag question
	Question - Action/information	SQA*	Question that demands information or action
	Complex	SC	Sentence with two or more main verbs (does not include "We have got" "I am going" "You will have")
	Imperative	SI	A direct command or request e.g. "Sit down"
	Fragments	SF	Lacking the components of a complete sentence (either no verb or object or subject) "Green grass"
	Unclear	SU*	Insufficient information to determine sentence type, it may be possible to determine child's intended meaning when some parts of word are present and adult interprets (inaudible, cut off, abandoned)
Pragmatic function (parent and child)	Request information	PI	Request information about child's internal state, nonlinguistic environment, activities, includes request for clarification
	Comment - positive	PCP	Comments on own/other behaviour or activities
	Comment - negative	PCN	Comments on own/other behaviour or activities which correct or contain a negative linguistic form
	Request action	PA	Request action - someone to do or stop doing something
	Conversational device	PD	One-word or short phrases or miscellaneous noises/sound effects e.g. "Yeah" "Oh" "Ah!" "night night"
	Bid for attention	PB	To obtain attention of someone else e.g. "look" "hey" "mum!"

Category	*Type*	*Code*	*Definition*
	Respond to bid for attention	PC	Reply to attention bids e.g. "Yes?" "Mhm?"
	Not directed to child	PX*	Adult or other child conversation directed to someone other than key child (when key child not part of the interaction)
	Games, songs, stories	PG*	Nursery rhymes, formal/structured games, songs, stories
	Child intention unclear	PU*	Intention unclear
Topic management	Mother initiates	MI	Adult or other child initiated topic (with specific content, not just bid for attention/ instruct behaviour etc.)
	Mother maintains own/other adult	MMI	Adult or other child maintains own/other adult topic
	Mother maintains child	MMC	Adult or other child maintains child topic
	Mother re-introduces own/other adult	MRI	Adult or other child re-introduces own topic
	Mother re-introduces child	MRC	Adult or other child re-introduces child topic
	Child initiates	CI*	Child initiates topic
	Child maintains own	CMI*	Child maintains own topic
	Child maintains adult	CMM*	Child maintains adult/other child topic
	Child re-introduces own	CRI*	Child re-introduces own topic
	Child re-introduces adult	CRM*	Child re-introduces adult/other child topic

Category	*Type*	*Code*	*Definition*
	Mother - N/A	MNA*	Not part of previous or existing topic but not aiming to start new topic - may be comment on/request for behaviour or no content in utterance, this will not necessarily lead to topic change
	Child – N/A	CNA*	
	Child unclear	CU*	Child utterance unclear
Lexical contingency	Mother imitates	LMI	Adult or other child imitates child (instances of specific word production within a topic/from conversational partners previous turn)
	Child imitates	LCI*	Child imitates adult or other child (for first instances of specific word production within a topic/from conversational partners previous turn)
	Expansion	LEP	Adult or other child adds grammatical markers and sematic details e.g. "tree green" "The tree is green"
	Extension	LET	Adult or other child adds semantic information
	Reference to child's activity	LA	Adult or other child references child's *current* activity (reference to present objects/actions/emotions when speaking directly to the child)
	Recast	LR*	Adult or other child expands child utterance into a different kind of sentence
	Interpret child utterance	LINT*	Adult or other child interprets child utterance or provide full adult label
	Unclear or N/A	LX*	Adult or other child utterance not in response to a particular child utterance; doesn't fit appropriate category; or unclear
	Non-contingent	LN	Adult or other child utterance unrelated to child's previous utterance when utterance *directed* at that conversational partner

Note: * indicates codes added to Paul and Elwood's (1991) original scheme

4.6.2.4 Cognitive scaffolding

In addition to the PCI samples from the LENA recordings, the picture-book sharing sessions were transcribed and coded as outlined above and compared to the samples taken from children's naturalistic home environments. The picture-book sessions provided a structured and consistent context for PCI throughout the study. These sessions were also coded using the TIM, which coded parental utterances for the teaching style used with their child as labelling, short or long elaboration, concept structuring, linking, or actively involving the child through language or action (see Table 4.2). The proportions of each teaching style were calculated based on the total number of teaching behaviours used during the interaction while looking at each picture in the book. Total scores were calculated to identify patterns of overall change across the study period. All TIM scores were kept in an Excel spread sheet as part of the case study database. Impressions and ideas that emerged from observing the TIM videos were also recorded at the time of analysis. Reliability of TIM coding has been discussed in section 4.7 below.

4.6.3 Parent and child talk and interactions in different contexts

Using LENA recordings and the daily activity records kept by parents, the present study examined the different activities the children were involved in and how child talk and interaction with others varied according to these contexts. The parent records were used to derive appropriate categories for coding the LENA audio (Table 4.9). Time constraints precluded coding the entire 16-hour recordings; therefore, LENA CTCs were used to organise contextual coding of 25% of the audio between the time the recorder was turned on in the morning and when the child went to bed at night (or took the recorder off at the end of the day). Approximately three hours of the audio were coded for each of the 16 LENA recordings.

The LENA data were exported into Excel where the 12 individual five-minute segments for each hour were ordered from smallest to largest based on CTCs. The lowest, middle and highest counts were established for each hour of audio. These three samples were selected in order to capture a broad overview of the child's day with varying levels of interaction, and examine how parent and child talk and interactions varied according to contexts. There were an even number of samples for each hour and the sixth highest was always used as the middle sample. In instances where there were multiple samples with the same CTC, the sample with the highest CVC was selected for the highest and middle samples, and the lowest CVC was selected for the lowest sample. Where samples could not be distinguished by their CVC, AWC

was then used and if all counts were the same, samples were selected to represent the broadest spread across the hour.

Once the high, middle and low sample times had been established the corresponding five-minute audio was played from start to finish. Information about each five-minute sample was recorded in an Excel spread sheet regarding: the people present; a brief description of the sample; the type of talk used, either child-directed speech (CDS) or overheard speech; an appropriate activity code was assigned to the sample (Table 4.9); and the CTC, CVC and AWC were recorded (Appendix H). The parent descriptions for the LENA recording day were documented on the same spread sheet, adjacent to the corresponding hours. Parent records provided additional details about activities that could inform decisions about the context code to assign when the context was ambiguous. The total CTC, CVC and AWC for the different activities coded across the day's samples were recorded as well as the mean and range of counts. The number of samples coded for each activity was used to examine the relative frequency of the different activities over the day. Previous studies have shown that the frequency of joint parent-child preschool activities is positively related to later vocabulary and other literacy skills within a TD population (Wood, 2002). It was important to consider the frequency of different language learning opportunities as well as the characteristics of PCI during the transcribed examples of high-level interaction.

Table 4.9 Daily activity categories and descriptions

Activity	*Description*
Meal time	Eating a meal alone or together, formally or informally, includes sitting together for snack time but not eating while getting on with other things around the house
Bath time	Washing or having a bath
TV	Watching TV programme or film on television or electronic device
Visit (public)	Trip to public place, including shops, events, school run
Visit (private)	Visit family or friends, generally at someone else's house Note: when visiting, use in place of 'around the house,' use other codes where more salient
Travel	Travel on foot, in the pushchair, by car, on scooters etc.
Around the house	Non-specific activities around the house e.g. chatting together, putting away shopping, tidying up toys, mix of different activities
Playtime: general interactive	Playing with toys/pretend play/doing unstructured activity with other children/adults
Playtime: general alone	Playing with toys/ pretend play/doing unstructured activity alone
Playtime: organised interactive	Playing structured games or activities (i.e. follow particular rules or sequence) with other children/adults, e.g. puzzles, helping cook
Playtime: organised alone	Playing structured games or activities (i.e. follow particular rules or sequence) alone
Outdoor: interactive	In the garden at home or at the park (child with other children/adults)
Outdoor: alone	In the garden at home or at the park (child alone)
Transition	Movement from one context to another, or waiting/preparing for something e.g. waiting by the door to leave the house, going upstairs ready for a nap
Book reading	Adult or other child reading or looking through books with child
Personal care	Using the toilet, nappy change
Sleep	Having a nap or going to bed at night
PRESCHOOL	At nursery (excluded from analysis where consent not obtained)

4.6.4 Comparisons across cases

The findings for each case were first reported individually and were then reviewed collectively for each area under investigation. Pattern matching was used to identify trends found across the cases and to determine whether findings were consistent with the existing literature. Yin (2009) proposed that case study analysis could make use of theoretical propositions (section 4.1.2) as a template for data analysis, in order to appropriately probe the findings. The areas for investigation in the present study were determined by a deductive strategy through detailed review of relevant literature, and a targeted systematic review of research that compared PCI with children with PLI and their TD peers. The results of the case studies addressed the propositions, which were linked with the research study questions. The characteristics of PCI examined were considered in turn, according to the PCI categories identified in the systematic review reported in Chapter 2 (section 2.3.3). Threats to internal and external validity were considered. The process of identifying trends was extended to develop explanation building (Yin, 2009). The aim of case study research is not to generalise findings to a wider population. Instead, understanding the current findings in relation to the previous literature provided a means to establish analytic generalisation to the theoretical understanding of a topic. Replication logic was used in reviewing the cases, whereby if two or more individual cases supported the same theory replication has been achieved and the validity of findings was strengthened.

4.6.5 Parents' perspectives

The parent interviews aimed to capture their experiences of having a child with PLI and supporting their language development. Framework analysis was used to provide a descriptive overview of the interview data and extract themes that emerged from across cases. The framework method was selected to analyse the interview data for the present case studies because of the unique matrix output. It was important to understand the perspectives of all parents in the present study collectively to understand the overarching similarities in parents' experiences; however, it was also important that the individual voices of parents were not lost. The matrix output not only maintains the individual interview data for each parent in the context of their case, but the structure of the matrix also supports ease of pattern recognition (Gale *et al,* 2013). The Framework Method follows a systematic process for analysing complex interview data that evidences the stages from analysing the raw data to the development of final interpretative themes. The transparency of the framework process has resulted in the growing popularity of the method, in contrast to similar methods such as thematic analysis,

which do not include such a clear process of how the themes were created from the original data. In contrast to the framework approach, thematic analysis is viewed as more subjective and open to misinterpretation (Smith and Firth, 2011). The Framework Method is appealing to researchers with less experience of in depth qualitative analysis; however, Gale *et al* (2013) highlighted the temptation to quantify the output, and the need to ensure that interpretation aims "to capture diversity around a phenomenon (p. 6)". Gale *et al* (2013) outlined a procedural guide to the framework method, which included seven stages that were followed in the current study:

1. Transcription
2. Familiarisation with the interview
3. Coding
4. Developing a working analytical framework
5. Applying the framework
6. Charting data into the framework matrix
7. Interpreting the data

Parent interviews were recorded on Dictaphones, and audio files were exported in mp3 format to Transcriber 1.5.1 (Boudahmane *et al*, 2008) for verbatim transcription. The interviews were re-played and initial analytical notes and impressions were recorded. Copies of the interviews were printed and initial codes were recorded by hand, which included single words or short phrases that described elements considered to be important and highlighting possible interpretations. The interview scripts were first coded by hand in their entirety and a running list of codes was recorded. After the first half of the interviews were assessed, the list of codes was organised into categories and where appropriate similar codes were combined. Outlining a definition of each code assisted with the process of organisation as similarities and differences between descriptions emerged. This process produced a working analytical framework, which was used as a basis for coding the second half of the interview transcripts. Any new codes were added to an updated version of the framework.

When all transcripts had been coded by hand, the interview documents were imported into NVivo version 10.1.0 (QSR, 2014), a computer assisted qualitative data analysis software (CAQDAS) package that supported storage and retrieval of the interview data. The framework matrix was added to the NVivo file and each transcript was coded. A framework matrix was

then drafted in Excel, which included a separate spread sheet for each framework category and had a column for each code and a row for each interview. The text from an individual interview was summarised in the matrix for each code in turn. Illustrative quotes from the interviews were copied directly into the matrix (Appendix I). Overarching connections that emerged were recorded, as well as any clear differences between interviewees, throughout the process of forming the framework matrix. Once complete, the matrix was reviewed as a whole, and potential explanations were developed to interpret the patterns that emerged across codes and categories, which formed the final, overarching themes.

4.7 Reliability of the methods of measurement

The LENA system and the TIM have not previously been used in a study with a case study design for detailed analysis of PCI; therefore, it was particularly important to establish the reliability of these tools. The present study used high CTCs derived by LENA to identify six five-minute samples from each recording day to transcribe for further analysis of PCI. The accuracy of the automated LENA counts was estimated through comparisons with SALT counts from the 93 five-minute transcribed interactions (4.7.1). A 10% sample of interactions was also transcribed and coded by an undergraduate linguistics student to determine the inter-rater reliability of the PCI analysis (4.7.2). A 25% check of the TIM coded picture-book sharing sessions was also carried out by a second researcher to determine the inter-rater reliability of the measure (4.7.3).

4.7.1 Agreement between automated LENA and researcher transcribed counts

In total, 93 five-minute samples were selected from the LENA audio for transcription, which allowed for comparison between the LENA automated counts and the scores computed using SALT. Accuracy of the LENA system was measured using intra class correlations (ICC) following guidance from Landers (2015), which suggested moderate to strong reliability for the CTCs, AWCs and CVCs: ICC(2,2) = .648; ICC(2,2) = .858; and ICC(2,2) = .697, respectively. It is important to highlight that the LENA automated counts are based on temporal proximity of adult and child vocalisations and LENA does not account for the content of interactions in the manner that is possible during transcription. Some discrepancy between the LENA and SALT turn counts would be expected. Although there was variation across the individual five-minute samples regarding the reliability of counts, overall LENA underestimated individual turn counts (M=19) compared to the transcribed samples (M=23). The differences between the automated and manual counts could be related to the exclusion of overlapping speech by LENA. It was

sometimes possible to identify adult or child speech when listening to the audio for transcription despite overlapping speech and background noise that could be excluded by the LENA software.

It is important to note that LENA samples were excluded from transcription if the manual count was less than 70% of the LENA count (section 4.6.2); therefore, any bias introduced by the inclusion process should be considered. Ben had five samples excluded across the study recordings, Christopher and Daniel had 10 samples excluded and Aaron had 41 samples excluded (Appendix G). Only five of the 66 samples were excluded because the manual counts were below 70% of the LENA counts. On one other occasion, Aaron was at a 'Punch and Judy' show and the characters' utterances were coded as adult words. Over half (37) of all exclusions were made because the child was talking to someone other than the mother, which was the focus of the present study. Most of Aaron's excluded samples were from t3 (28) and t4 (11) when he visited family with his mother and a number of interactions included his grandmother and other family members. These exclusions reflect the study restrictions rather than a lack of LENA reliability. Almost a third (20) of the other samples were excluded because the child or mother were talking concurrently but not to each other, and the temporal proximity of their utterances was coded as turns by the LENA software. The difficulty distinguishing temporal from meaningful turns appeared to be the main issue with the reliability of LENA and its accuracy may be reduced in environments where there are often multiple people present, which may differ across families. Family structure should be taken into consideration when planning studies that rely on the LENA counts.

The LENA AWCs include all adults near to the child, not just mothers; accordingly, counts were compared to all adult words in the PCI transcripts. Similar to the CTCs, LENA underestimated the number of words in individual samples (M=244) compared to the SALT scores (M=318). Caution must be taken when comparing AWCs across families or even individual recordings because counts include all adults talking near to the child and the number of adults present may vary across the range experiences in daily family life. For example, counts would be expected to differ when a child is at home with one parent compared to when more family members or other adults are present, which may differ over a typical week, particularly between weekdays and weekend days.

In comparison to the CTCs and AWCs, LENA slightly overestimated the number of child vocalisations (CVC; M=49) in individual samples compared to the number of child utterances transcribed (M=44). The LENA CVCs are estimated based on the number of vocalisations of at least 50ms used by the child, followed by silence or non-speech (Table 4.6). It was difficult to make accurate comparisons manually within these specific time parameters; therefore, differences with the manual counts were anticipated. Overall the count agreement was similar across the four cases, which suggested they were appropriate for making comparisons.

4.7.2 Transcription and analysis of audio from LENA recordings

A 10% check of the PCI samples was transcribed and coded by a second researcher, and analysed using SALT. The intra class correlations (ICC(2,2)) suggested moderate to strong reliability for both the child (range .750 to .978) and mother (range .669 to .993) scores. The first researcher was familiar with the families and had spent time interacting with them in their homes; however, the second researcher had never met the families and transcriptions were based on audio recordings with no visual cues. Although agreement levels were good, difficulty in determining the correct child speaker based on the audio was mentioned. The second researcher also coded each utterance in the transcribed samples to determine the reliability of utterance codes. The contingent utterances were of particular interest as maternal responsiveness has been discussed in detail in the study findings. The frequency of contingent utterances was relatively low. Intra class correlation of the combined number of utterances coded as expansions, extensions or recasts suggested strong reliability of ratings: ICC(2,2)= .761. There was also strong reliability estimated for coding utterances not directed at the key child: ICC(2,2)=.980.

4.7.3 Coding picture-book sharing sessions

The picture-book sharing sessions were assessed using the TIM, which coded each parental utterance according to the teaching behaviour used with the child. A second researcher carried out a 25% reliability check of the TIM utterance coding; one TIM session was second coded for each of the four cases. Intra class correlation for each dimension scored on the TIM showed consistently strong reliability of the rating process (ICC(2,2) >.9).

Overall, inter-rater reliability was moderate to high across the measures outlined above. The issues highlighted with the LENA system suggest that differences in family structures should be taken into account when planning studies that rely on the automated counts as measures of

adult and child talk. Controlling for the number of adults in the household, particularly those present on a recording day, in analyses could be beneficial. The reliability of LENA should be measured for individual studies.

4.8 Summary

Chapter 4 has outlined the decision to adopt a multiple case study methodology in order to examine the trajectories of vocabulary growth over 9-10 months in four case studies of children with PLI (Chapter 5). Vocabulary growth was measured using both parent report and language sampling and the study investigated how child and parent talk and interactions varied across naturalistic contexts in the home. The audio from the LENA recordings was coded to determine the prevalence of different activities and how talk varied accordingly. Mothers also completed records of children's daily activities. The case studies examined the extent to which characteristics of PCI changed as children's vocabulary developed (Chapter 6). The use of the LENA system provided a new innovative method of collecting samples of PCI from the home environment without the presence of a researcher, in order to understand interactions in the context of everyday family life. Mothers were also observed sharing picture-books with their children and the TIM was used to assess cognitive scaffolding strategies. The study intended to inform SLT interventions that aim to modify PCI. Interviews with parents were conducted to explore their perspectives on having a child with PLI (Chapter 7). These findings produced recommendations regarding how PCI intervention strategies could be tailored to the daily lives of individual families.

Chapter 5 Recognising difference in development

5.1 Introduction

This chapter reports findings from each individual case (5.2-5.5) with a focus on children's vocabulary development as well as the daily activities they engaged in at home and the extent to which their interactive experiences varied accordingly. The findings from the present study were from four detailed case studies and as such were not intended for statistical generalisation to a wider population of children with PLI. Instead the findings aimed to establish analytic generalisation that expands on existing theories (Yin, 2009). Section 5.6 draws comparisons across the cases to highlight individual differences and similarities in children's early experiences. An innovative new technology: the LENA system, was used to capture PCI in children's home environments as it naturally occurred, with limited external controls from the researcher regarding the timing or context of interactions that has often been present in studies of child language. The final section (5.7) of this chapter reviews parents' perspectives on the study methods, offering insight into their perceived validity of the tools used, as well as their experiences of participating in the study.

5.2 Case study 1: Ben

Ben was the youngest child in the study and had only recently turned two years old at the start of data collection. His mother was concerned about his limited vocabulary and he was being monitored by the health visitor. At the end of the study a referral was made to speech and language therapy (SLT) services. Ben's expressive language standard score was 1.3 SD below the mean suggesting that he had the least severe delay of the four children at the start of the study (Table 4.1). Furthermore, he showed good receptive language skills with a standard score 1.6 SD above the mean. No other children in the study demonstrated receptive skills above the mean. Ben was second born and lived with his mother, father and sister, until half way through the study when his younger brother was born.

At t1, Ben was aged 2;3 (years; months), and his total vocabulary (63 words) was equivalent to the median MacArthur-Bates Communicative Development Inventories (CDIs) (Fenson *et al*, 2007) score for children aged 1;5-1;6 based on the CDI technical manual (Table 5.9 in section 5.6). This comparison suggested that Ben's vocabulary was approximately 9-10 months delayed at the start of the study. The extent of Ben's delay in terms of his total vocabulary decreased across the study period. The trajectory of Ben's vocabulary growth shown in Figure

5.1 followed a similar pattern compared to the CDI norms for younger children, but after an early vocabulary delay Ben began to catch up with typically developing (TD) levels. Ben's overall increase in total vocabulary measured on the CDI suggested he made an average increase of 52 words per month across the study period, which was the largest average increase across the four cases. The rate of growth was greatest between t1 and t2 with an average increase of 70 words in each of the first three months. At t1, when Ben's vocabulary size was below 100 words (total words 63), just over a quarter (27%) of his vocabulary was classed as common nouns, which was lower compared to their frequency on the CDI checklist (41%). The proportion of common nouns increased to half of Ben's vocabulary at t2 (total words 274), which was in line with his fastest rate of vocabulary growth over the study. The proportion of nouns then declined after he reached around 400 words. Predicates accounted for almost 20% of his vocabulary at t1 and showed a steadily increasing across the study. The proportion of closed class words appeared relatively stable over time.

The parent report data was supplemented using naturalistic language samples collected from all-day audio recordings in children's home environments using the LENA system (LENA Research Foundation, 2011). The analysis of PCI transcripts from the LENA recordings provided an additional measure of vocabulary use across the study. Analysis of Ben's total words in SALT (Miller, 2010) showed an increase in the total number of different words produced during clear and intelligible utterances from the naturalistic LENA language recordings in the home at each time point (Table 5.1). A particularly large increase of 100 words was found between t2 and t3, compared to a 35 word increase between t1 and t2, and a 20 word increase between t3 and t4. There was a notable difference in the level of intelligibility between t2 (48%) and t3 (71%), which could have affected the increase in the number of intelligible words between t2 and t3. However, a similar increase was also found between t2 and t3 in the total number of words based on all utterances. The trajectory of Ben's vocabulary development was also plotted using the cumulative number of different words produced in the transcribed samples over time, which demonstrated a similar pattern of growth to the CDI scores (Figures 5.5 and 5.6 in section 5.6).

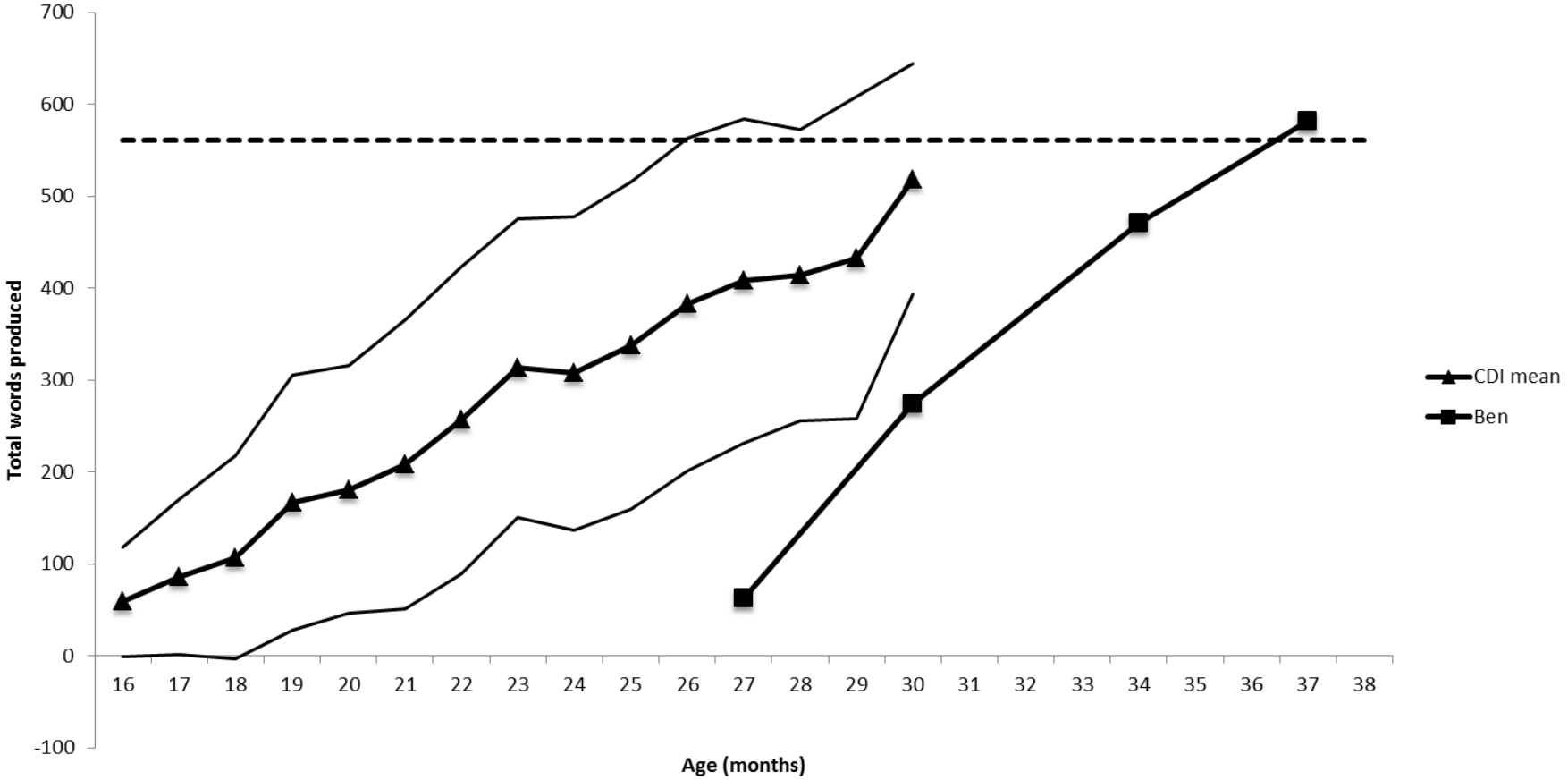

Figure 5.1 Ben's vocabulary produced compared to CDI mean scores (*Note*: The single lines represent ±1 SD for the mean scores and the dashed line represents the 30-month median age score from Fenson *et al,* 2007)

Table 5.1 Ben's SALT data for LENA and TIM transcripts

SALT category	*LENA t1*	*TIM t1*	*LENA t2*	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	278	56	290	104	296	70	343	76
Total words	332	58	378	123	685	105	828	147
No. different words	16	6	51	23	151	41	171	54
No. total words	154	32	174	69	470	87	541	120
Type/token ratio	0.1	0.19	0.29	0.33	0.32	0.47	0.32	0.45
Mean turn length	1.36	0.89	1.78	1.13	2.95	1.49	3.99	1.82
Intelligible utterances	55%	67%	48%	65%	71%	91%	60%	93%

Note: Number of different words and number of total words are based on clear and intelligible utterances only

Ben's growing vocabulary enabled him to engage in interactions more completely over the study period. At t1 he used a limited number of different words (16) during the LENA samples (Table 5.1), including 'mummy' 'daddy' and 'yeah', and approximately half (55%) of his utterance were intelligible. However, there were many examples of turn-taking and both his mother and sister, who were present in all t1 samples, appeared to generally understand what Ben said and responded positively to his attempts to interact.

Ben: Mamama.
Mother: That's where George pig should go isn't it?
Ben: XX {unintelligible} daddy.
Mother: Daddy pig.
Mother: Mummy pig.
Mother: Can you say Peppa pig?
[Ben makes a noise]
Mother: Just, you gonna grunt?
[Ben makes a noise]

Ben, mother and sister having breakfast
t1, sample 1

Mother: Do you want to help?
Ben: Yeah.
Mother: Ok, you pass me {interrupted}.
Ben: Mum, mum.
Mother: That's your swimming suit isn't it?
Mother: We'll hang it.
Ben: Yeah.
Mother: What else can you find to pass to mummy?
Ben: XXX {unintelligible}.
Mother: That's sister's dress.
Ben: Yeah.

Ben and his mother hanging out clothes
t1, sample 2

Three of the six transcribed LENA samples at t2 were dyadic interactions between Ben and his mother. At this stage he used a larger number of different words across the sampled interactions (51). The activities recorded included putting the shopping away and travelling in the car, which offered opportunities for vocabulary practise. Ben's mother believed that having more one-to-one time with him since his sister had started school had facilitated his vocabulary learning.

Mother: That is, that's fruit, tinned fruit.
Ben: Tin X {unintelligible}.
Mother: That's honey that one.
Ben: Honey.
Mother: Clever boy.

Mother: Honey.

Ben and his mother putting the shopping away
t2, sample 2

Ben's vocabulary use had increased greatly by t3 and t4 in terms of the number of different words he used (151 and 171 respectively). Ben engaged in more conversations about events that were not related to the present and demonstrated his attention to other people's conversations even if they were not directed at him. At t3 Ben's grandmother visited and she was present during all of the transcribed interactions. His grandmother visited regularly although she could not always understand his speech to the same extent that Ben's mother could.

Mother: Who was gonna come stay XX {whispers}?
Ben: Huh?
Mother: Who was the dog that [Grandmother] looked after before?
Ben: [Dog's name].
Grandmother: [Dog's name].
Mother: [Dog's name]'s coming back to stay isn't she, with [Grandmother]?

Ben, his mother and grandmother talking at lunch time
t3, sample 3

Mother: Um, you can watch 20 minutes of it?
Ben: Yeah, yeah Monsters University {pronounced <monunsty> /mɒnʌnstaɪ/}.
Mother: Monsters University.
Ben: X not seen it before {pronounced <for> /fɔ/} [Grandmother]?
Mother: No, [Grandmother] hasn't.
Grandmother: No XX {overlapping}.
Ben: Funny dragon {pronounced <dagon> /dægən/} in it.
Grandmother: Am I invited to watch?
Ben: Yeah.
Grandmother: Ok.
Ben: Blow {pronounced <bow> /bəʊ/}, dragon blow fire [Grandmother].
Grandmother: Hmm, oh fire.
Ben: Yeah.
Mother: But it's not scary is it?
Ben: No.

Ben, his mother and grandmother talking at lunch time
t3, sample 5

The interactions transcribed at t4 were most often dyadic and included games and book reading. These activities offered good opportunities for vocabulary learning and turn-taking as well as Ben receiving more focused attention from his mother.

Mother: It's called matching dominoes.
Mother: So look, you need to match up all the pictures.
Mother: Is it my go?

Ben: No, it's my go!
Mother: Ok.
Ben: I need to X {unintelligible}.
Mother: No he doesn't fit there.
Mother: Cuz look the end of the row is a frog or a whale.

Ben and his mother playing games
t4, sample 2

Mother: "Now I had something to eat" says Buster.
Mother: What's inside?
Ben: Marmite.
Mother: Marmite.
Ben: Biscuits {pronounced <bissits> /bɪsɪts/}.
Mother: What else?
Ben: Cake.
Ben: We get that from a shop.
Mother: Yeah, we're gonna buy a cake aren't we today?

Ben and his mother reading a book
t4, sample 3

The PCI samples transcribed across the study period varied according to the activity in which Ben and his mothers, and sometimes others, were engaged. Across the 24 five-minute LENA samples, meal times (12) and activities around the house (5) were the most common contexts recorded. Understanding the contexts in which children demonstrate high levels of talk with their parents is particularly important in order to inform PCI interventions. To be successful these interventions need to teach parents strategies that can be integrated within everyday family lives (Andrews and Andrews, 2000); however, research into PCI has often been confined to observations during short periods of toy play.

As shown above many interactions sampled from LENA for transcription due to high levels of talk were not examples of dyadic play. A 25% sample of the entire audio from the LENA all-day recordings was coded (Appendix H) in order to understand the language learning opportunities and levels of parent and child talk and interactions throughout a typical day. All four of Ben's LENA recordings were carried out on weekdays and his daily routine was very similar on each day. The daily activity records stated that he woke up 06:45-07:00 on each of the days. The early morning generally included having breakfast and getting ready to walk Ben's sister to school. During the day Ben had some one-to-one time at home with his mother. Mid-way through the study Ben's brother was born but one-to-one time was possible when his brother was having a nap. There was often some quiet time watching television as well as visits to toddler-based activities or with friends or family. In the evening Ben was read a story and went to bed at approximately 19:00. Ben's father worked during the week and was present in

recordings early in the mornings and at night putting Ben to bed; most of Ben's interactions during the week were with women. Ben's father was a teacher and had long holidays from work, during which his mother felt that the additional opportunities for one-to-one interactions facilitated Ben's language development.

The 25% sample of the LENA audio that was coded included 30-36 five-minute samples during each of the four all-day recordings (approximately three hours). At every time point the highest total automated LENA conversational turn count (CTC) from the context coding for Ben was during samples coded as meal times. The number of five-minute samples coded for each context category across the day confounded the total CTC scores, e.g., Table 5.2 shows that there were 21 meal time samples, which represented 15% of the 138 samples coded for Ben over the study. Mean CTC were calculated to address this issue, which was particularly important given that only a 25% selection of each day's audio was coded and some activities could have been over or underrepresented. The context with the highest mean CTC remained meal time at t1 but was general interactive playtime at t2 and organised interactive playtime at t3 and t4. General interactive playtime had the third highest mean CTC (12); however, these samples did not often include Ben actually interacting with his mother. In contrast to the limited mother-child play samples, meal time and around the house were both frequent across the study period and both of these had relatively high mean CTCs, which was consistent with the common contexts recorded across the 24 LENA transcripts. Other common contexts from the whole-day coding were transition, TV and visit (public) but these generally had lower overall CTCs.

Overall, Ben showed delays in his expressive language only and he had the fastest overall rate of vocabulary growth of all four children in the study. His more advanced receptive language skills were demonstrated when engaging with other family members, even when he only had limited linguistic input. It appeared that high levels of interaction between Ben and his mother occurred more regularly in unstructured and non-specific activities, such as getting ready to leave the house or putting shopping away. During these contexts there was often a great deal of background distraction that could prevent focused, dyadic conversations, e.g., organising other children and getting on with household chores. However, there were many opportunities for turn-taking and vocabulary learning as well as a lot of praise from his mother for his efforts to use words.

Table 5.2 Context coding of five-minute audio samples from Ben's four recording days

Category	*Total CTC*	*Total CVC*	*Total AWC*	*No. samples*	*Mean CTC*	*Mean CVC*	*Mean AWC*
Playtime - organised interactive	69	147	1129	3	23	49	376
Meal time	322	840	6207	21	15	40	296
Playtime - general interactive	159	671	2207	13	12	52	170
Around the house	195	756	4216	22	9	34	192
Playtime - general alone	76	337	1763	11	7	31	160
Transition	81	364	1703	16	5	23	106
Travel	48	214	785	10	5	21	79
Book reading	2	4	459	1	2	4	459
TV	30	90	530	17	2	5	31
Outdoor (interactive)	2	9	291	2	1	5	146
Visit (public)	11	123	389	12	1	10	32
Bath time	2	5	341	3	1	2	114
Sleep	0	1	71	7	0	0	10

5.3 Case study 2: Christopher

Christopher was the oldest child from the four cases and he was already receiving intensive SLT at the start of the study, which involved alternating six-week blocks from an NHS and independent therapist. Christopher had delayed expressive language, scoring 1.7 SD below the mean on the baseline assessment (Table 4.1), his receptive language score was also below the mean (0.8 SD) but fell within typical limits based on the PLS-3 (Zimmerman, Steiner and Pond, 1992). His mother was concerned about his limited vocabulary as well as the difficulty people had understanding his speech. Christopher was second born and lived with his mother, father and older sister and attended the local preschool. He was discharged from SLT services later in the study but there were arrangements in place to review his progress when he started at school.

At t1, Christopher was aged 3;6 and his total vocabulary score (71 words) was equivalent to the median CDI score for children aged 1;6, suggesting a delay of two years (Table 5.9). Christopher's vocabulary delay remained stable over the study, demonstrating a similar, but delayed, trajectory of vocabulary growth compared to CDI norms (Figure 5.2). Christopher's average increase in vocabulary size over the study period was 42 words per month. However, a faster rate of growth was found between t2 and t3 in which his vocabulary increased by an average of 75 words per month during the three-month period, after reaching a vocabulary size of 100 words. At the start of the study, a third (34%) of his vocabulary recorded on the CDI consisted of common nouns, which later peaked at 50% (t3, total words 366) and then declined after reaching 400 words. The proportion of predicates showed a steady increase over the study period (17% to 24%), while the proportion of closed class words remained low and stable (<10%).

The SALT analysis of PCI transcripts showed a steady increasing trend in Christopher's language diversity measured by the number of different words produced during clear and intelligible utterances. The total number of words used during 30-minutes of PCI at each time point showed the greatest increase between t3 and t4 (Table 5.3). There was a substantial increase in Christopher's level of intelligibility from t1 (26%) to t4 (67%) that could have affected the extent to which SALT scores accurately represent Christopher's vocabulary knowledge and production.

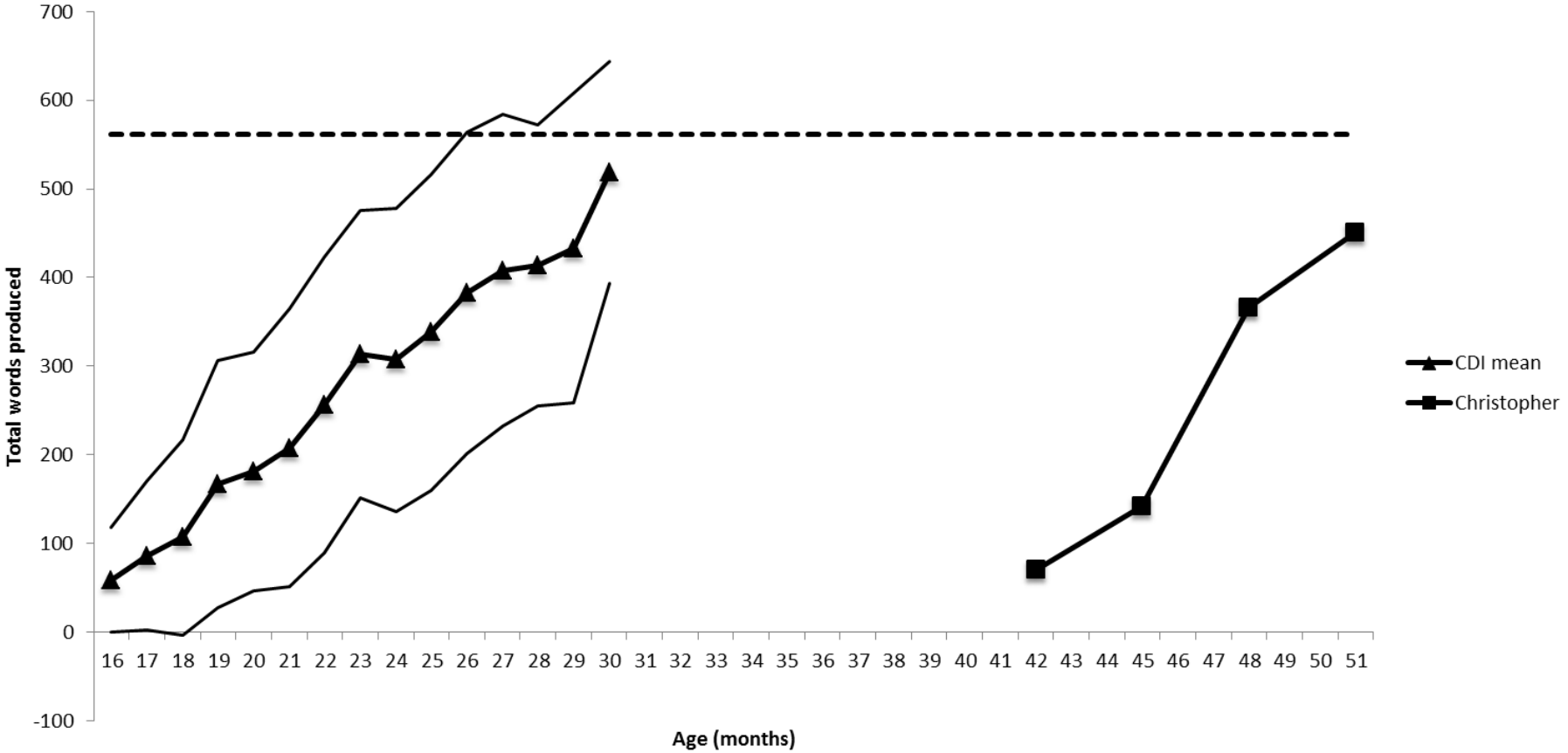

Figure 5.2 Christopher's vocabulary produced compared to CDI mean scores (Note: The single lines represent ±1 SD for the mean scores and the dashed line represents the 30-month median score from Fenson et al, 2007)

Table 5.3 Christopher's SALT data for LENA and TIM transcripts

SALT category	*LENA t1*	*TIM t1*	*LENA t2*	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	241	62	249	86	190	37	215	41
Total words	252	63	323	99	312	56	539	77
No. different words	12	11	33	15	61	22	99	42
No. total words	64	27	121	39	146	32	356	60
Type/token ratio	0.19	0.41	0.27	0.38	0.42	0.69	0.28	0.7
Mean turn length	1.21	1.11	1.56	1.29	1.9	1.58	3.4	1.88
Intelligible utterances	26%	44%	43%	49%	42%	69%	67%	85%

Note: Number of different words and number of total words are based on clear and intelligible utterances only

The transcribed LENA samples were all selected due to high levels of talk between parent and child. Christopher's selected recordings across the study period were often of structured play, including puzzles, games and activity workbooks. These activities were often rule-based, offering many opportunities to practice turn-taking and vocabulary learning through labelling and repetition. Only two of Christopher's 24 samples over the study were dyadic interactions with his mother. All other interactions included his sister and sometimes also his grandparents. At the start of the study, Christopher used only a small number of different words (12) throughout the six LENA transcripts analysed. Only a quarter (26%) of his utterances were recorded as intelligible and his mother and other family members could not always interpret what he was saying.

Mother: Have a look.
Mother: What shape does that look like?
Christopher: XXX {unintelligible}.
Mother: Does that look like a teddy bear?
Mother: Like a bunny?
Mother: Or like a train?
Christopher: XXX {could be attempting train}.
Mother: Train, that's a good boy, well done.

Mother: It says join the pairs with a line.
Mother: There we've got {interrupted}.
Christopher: XXX {unintelligible}.
Mother: So we've got a scarf.
Mother: Can you see any, another scarf Christopher?
Christopher: XXX.
Mother: Can you see another scarf?
Christopher: Yeah.
Mother: Can you join the two scarves up together?
Christopher: Oh.
Mother: That's it.
Christopher: XXX.
Mother: X we can do it.

Mother doing activity books with Christopher and his sister
t1, sample 2

At t2 and t3, the proportion of Christopher's utterances that were intelligible had increased; however, this remained below half during the sampled interactions (43% and 42% respectively). The number of different words he used increased at t2 (33) and again at t3 (61). Structured games or book reading with his mother and sister remained common in the transcribed samples and by t3 there were some more examples of spontaneous and intelligible interactions that were not related to specific games.

Mother: "One day daddy and I went to the beach in the car and of course Pippo came as well".
Mother: There's the beach.
Christopher: Pippo.
Mother: Pippo.
Christopher: X {unintelligible} daddy X.
Mother: Is that you and daddy is it?
Christopher: Yeah.

Mother reading to Christopher and his sister
t2, sample 1

Mother: Right, who reckons they can find where this bit goes, Christopher?
Sister: Me.
Mother: Let, let Christopher have a go.
Christopher: Er, there.
Mother: And where do you think the piece in your hand goes then?
Christopher: Er.
Christopher: It goes.
Mother: Up a bit.
Christopher: Up.
Mother: Up.
Christopher: Up.
Mother: There we go.
Sister: My turn.
Mother: One, two, three.
Mother: Those are your three bits.
Mother: And those are your three bits to put where you think they go Christopher.
Christopher: Yeah.

Christopher doing a puzzle with his mother and sister
t2, sample 5

Mother: Is there a circle ahead of you Christopher?
Christopher: Er, yes, here.
Mother: Ok, so move the spider up to the circle.
Christopher: Mummy, two circles down here.
Mother: No, move your spider up.
Christopher: Spider up.
Mother: Move your spider up to the circle.
Mother: Ok, and then spin.
Mother: Spin.
Mother: Oh no, weee, back down the drain pipe.

Christopher playing a game with his mother and sister
t3, sample 5

At the last time point, two thirds (67%) of Christopher's utterances were recorded as intelligible and the number of different words he used had increased (99). Structured play was recorded but there were more examples of conversations between Christopher and his mother that were not related to the present or to a specific game they were playing. The two

dyadic interactions that were transcribed with Christopher were both at t4 during unstructured activities around the house.

Christopher: Daddy having a rest in bed.
Mother: Yeah daddy, do you know it's bedtime where daddy is?
Mother: It's night time.
Christopher: Night.
Mother: You saw the picture didn't you?
Mother: It's night time over there.
Christopher: Yeah, daddy not going to be, daddy not going sleep yet.
Mother: Yeah, daddy go to sleep.

Christopher talking to his mother about his father being away
t4, sample 1

Mother: You count.
Christopher: One.
Mother: One fairy.
Christopher: One, two.
Mother: Two slippers.
Christopher: X other.
Mother: Well that's not {interrupted}.
Christopher: Two, three.
Mother: No, that's two.
Christopher: That two slippers.
Mother: Two slippers.
Christopher: One, two, three.
Christopher: Mama, read.
Mother: Three birds.
Sister: {in the background} Mummy don't look what I'm doing.
Christopher: One, two, three, four.
Mother: Four octopuses.

Christopher and his mother doing an activity book
t4, sample 3

The 25% activity coding of the entire LENA samples helped to determine how representative the transcribed samples were compared to activities across the whole day in Christopher's home environment. From across the four LENA recording days, 141 five-minute samples of the audio were coded, of which there were 10 organised interactive playtime samples (7%) (Table 5.4). In contrast, organised play accounted for 13 of the 24 LENA samples (54%) selected for transcription based on high automated LENA turn counts (CTCs). Comparison of the mean and total CTCs for the different activities showed that organised play included high levels of parent and child talk but was less common across the whole day compared to other activities.

Table 5.4 Context coding of five-minute audio samples from Christopher's four recordings days

Category	*Total CTC*	*Total CVC*	*Total AWC*	*No. samples*	*Mean CTC*	*Mean CVC*	*Mean AWC*
Playtime - organised interactive	158	371	2106	10	16	37	211
Personal care	40	119	512	3	13	40	171
Visit (private)	55	211	1281	6	9	35	214
Book reading	44	75	3260	5	9	15	652
Around the house	275	1056	4289	32	9	33	134
Transition	63	230	1196	9	7	26	133
Outdoor (alone)	21	107	366	3	7	36	122
Playtime - general alone	13	61	152	2	7	31	76
Meal time	48	190	1817	10	5	19	182
Visit (public)	32	140	511	7	5	20	73
Outdoor (interactive)	26	244	327	7	4	35	47
Playtime - general interactive	35	420	444	12	3	35	37
TV	25	98	504	20	1	5	25
Bath time	1	13	69	1	1	13	69
Sleep	2	13	261	5	0	3	52
Travel	2	47	69	9	0	5	8

The highest mean LENA CTCs, taking into account the frequency of the different activities, were found for organised interactive playtime at t1 to t3 (ranged 14-20). At t3 meal times had an equally high mean CTC. At t4 the highest mean CTC was general alone playtime but this was based on only one sample in which Christopher was actually playing by himself, occasionally talking with his sister, while his mother and grandmother were talking together in close proximity to Christopher. The other high mean CTCs at t4 were found for meal time and around the house. In contrast the highest total LENA CTC was organised interactive playtime at t1 only at the other time points the total turns were highest for activities around the house. The mean automated LENA count of the number of adult words (AWC) were high for organised play samples; however, at each time point the mean AWC was highest during book reading. The highest mean automated count of child vocalisations (CVC) was found during general activities while visiting family at t1, during organised play activities at t2, and during meal times at t3 and t4.

Across the four recording days, around the house was a commonly coded category (23%), which had mean CTCs ranging 7-10 for the five-minute samples. Generally each day included breakfast between 08:00-09:00, after some initial quiet time playing with his sister or watching TV after waking up. There were 12 general interactive playtime samples coded from the whole-day audio, during which Christopher and his sister were playing together, but these included very limited adult involvement. Outside of the organised activities Christopher engaged in with his mother, he spent a lot of time playing with his sister, there was also time playing outside and visiting his grandparents or going to a friend's party; a lot of time was spent interacting with others. Bedtime was at approximately 19:00 after reading a story.

In summary, Christopher demonstrated a persistent and extensive vocabulary delay of approximately two years. Over half of the LENA samples of high level talk between Christopher and his mother were of organised play activities. These were most commonly recorded for Christopher, both for the selected samples for transcription and from the whole-day activity coding. However, organised play accounted for a higher proportion of the transcribed samples than occurred across the whole day.

5.4 Case study 3: Aaron

Aaron was the only child who demonstrated delayed expressive and receptive language based on his PLS-3 scores (Zimmerman, Steiner and Pond, 1992) at the start of the study (1.7 SD and 1.3 SD below the mean respectively). His mother was concerned about his limited vocabulary, which was an issue that was originally highlighted through the health visitor, but his mother had gone through the GP for a referral to SLT services. Aaron was receiving SLT at the beginning of the study but he was discharged from the service after a few sessions. Aaron was a first born child and he did not have siblings. He lived with his mother and had contact with his father.

At t1, Aaron was aged 3;2 and his total vocabulary (137 words) was equivalent to median CDI scores for children aged 1;7-1;8. Aaron's vocabulary was delayed by approximately a year and a half at t1 and this level was maintained over the course of the study (Table 5.9 in section 5.6). The trajectory of Aaron's vocabulary growth showed a similar pattern to the CDI norms but at a later chronological age to the TD children (Figure 5.3). Aaron's overall increase in vocabulary size suggested a relatively steady rate of growth, using approximately 38 new words each month based on the CDI checklist. The proportions of common nouns (42-46%) and closed class (13-17%) words were similar to their representation on the CDI checklist (41% and 15% respectively). Predicates were initially lower (11%) but increased over time (24%).

The SALT analysis of PCI transcripts from the LENA recordings showed an overall increase in the total number of different words used during the 30 minutes of naturalistic PCI at each time point (Table 5.5). The largest increase in the number of different words used was between t3 and t4. Aaron's cumulative vocabulary production demonstrated a similar trajectory of growth when compared with the CDI scores (Figures 5.5 and 5.6 in section 5.6).

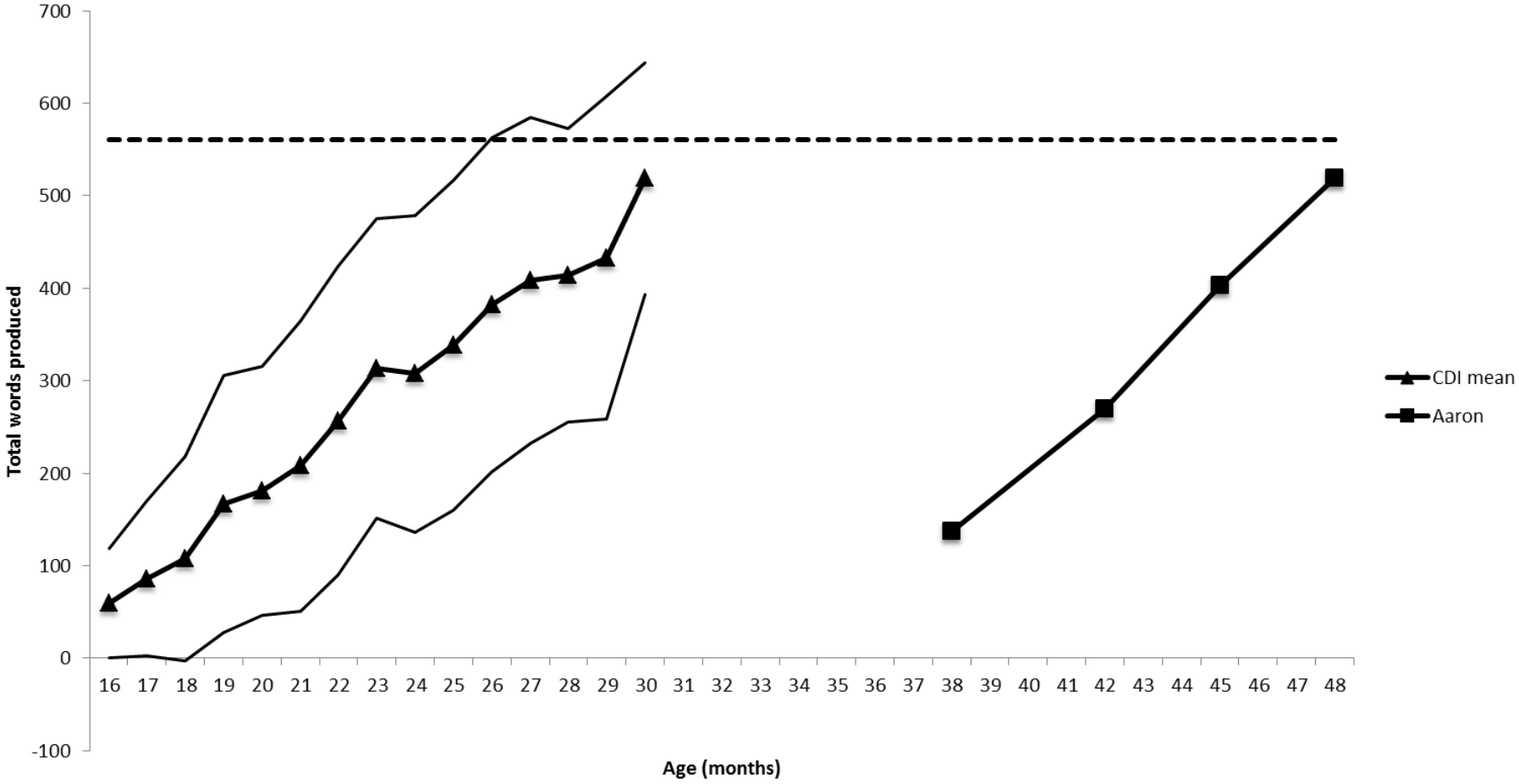

Figure 5.3 Aaron's vocabulary produced compared to CDI mean scores (*Note*: The single lines represent ±1 SD for the mean scores and the dashed line represents the 30-month median score from Fenson *et al,* 2007)

Table 5.5 Aaron's SALT language data for LENA and TIM transcripts

SALT category	*LENA t1*	*TIM t1*	*LENA t2*	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	321	34	304	59	229	54	312	57
Total words	485	62	756	149	631	150	1190	191
No. different words	71	14	103	44	102	42	179	50
No. total words	258	25	439	102	368	95	874	137
Type/token ratio	0.28	0.56	0.23	0.43	0.28	0.44	0.2	0.36
Mean turn length	2.61	1.34	3.59	2.21	4.58	2.43	7.35	2.78
Intelligible utterances	50%	65%	57%	87%	62%	78%	80%	96%

Note: Number of different words and number of total words are based on clear and intelligible utterances only

Aaron lives at home with his mother only; therefore, all of the transcribed samples from LENA were dyadic interactions, except in one instance when he talked to his grandmother on the phone. There were often quiet periods when Aaron's mother was busy and he was playing alone and she was not always able to engage fully when he attempted to interact if there were other things she was doing. Two thirds of the transcribed samples of PCI were coded as around the house as they often talked during unstructured activities. Aaron's mother felt that he has made noticeable improvements in his expressive language even between the time of the initial baseline assessments and the first LENA recording day. During the first six samples at t1 he used 71 different words, which was the more than the other children at the start of the study. Aaron also had started to combine words and half of his utterances were intelligible at the start of the study (Table 5.5). Aaron initiated a similar proportion of turns to his mother and used more utterances than she did. They often talked about present or upcoming activities or interests and Aaron often repeated words or phrases.

Mother: Don't touch it cuz it'll go bang.
Aaron: Bang.
Mother: It'll go bang.
Aaron: Go bang.
Mother: It's a air freshener and it'll go bang if you touch it.
Aaron: Go bang.
Mother: Yeah, it'll go bang.
Aaron: Go bang.
Aaron: Go bang.
Mother: Yeah, go bang.
Mother: You shouldn't be touching it.
Aaron: Go bang.
Mother: Yeah.
Aaron: Go bang please {pronounced <pees> /piz/}.
Aaron: Go bang.

Aaron and his mother talking in the house
t1, sample 2

Mother: What would you like for tea?
Aaron: X {unintelligible} house.
Mother: [Grandmother]'s house?
Mother: We're not going to [Grandmother]'s house for tea love.
Mother: We're gonna stop and have something on the way home.
Aaron: X noise?
Mother: That's the car going over the stones.
Aaron: Car X.

Aaron and his mother in the car going home
t1, sample 5

At t2 there are more examples of general talk around the house as well as some more structured activities, including Aaron and his mother creating Christmas decorations and making dinner. At this stage the number of different words Aaron used in the sampled interactions had increased (103) and he was using longer utterances.

Mother: Oh, that's looking good innit?
Aaron: X {unintelligible} looking good.
Mother: Looking good.
Aaron: X go there.
Mother: There ain't no, no glue on there yet.
Mother: Gotta stick some more glue on.
Aaron: I need glue.
Aaron: Put it on, put it on glue.
Mother: Let me cover this with glue and then we can.
Aaron: What's this?
Aaron: X baubles.
Mother: Yeah, baubles will be going on in a minute.

Aaron and his mother making decorations
t2, sample 3

Aaron: What's this?
Mother: Paprika.
Mother: Smell it.
Aaron: I want smells it.
Aaron: What's this?
Aaron: What's it?
Aaron: I want smells it.
Mother: Taste a bit if you like.
Aaron: I want put my fingers in.
Aaron: I want put my fingers in.
Mother: Well it gotta be mixed up.
Mother: Hang on.
Mother: Gotta be mixed up first.
Aaron: XXX {unintelligible}.
Aaron: Me mix it.
Aaron: I X mix it.
Mother: No.
Mother: Don't be silly.
Mother: Bit more.
Aaron: XXX.
Mother: No.
Aaron: More, we need some more.
Aaron: No more, no more, no more.
Aaron: XXX.
Aaron: More, more.
Mother: No, no more.

Aaron and his mother making dinner
t2, sample 6

The number of different words Aaron used during the LENA samples remained similar at t3 (102) but increased at t4 (179). At the end of the study, the majority (80%) of his utterances were intelligible and the length of his utterances continued to increase.

Mother: Aaron, what's that?
Aaron: Er that, I don't know.
Mother: You dunno what that is?
Aaron: I, er.
Mother: What's Tom and Jerry?
Aaron: It's, it is.
Mother: It's a cat and a what?
Aaron: It is, it's Mickey Mouse.
Mother: Mickey Mouse, that's right.
Aaron: And cats eat rat get dead X {unintelligible}.
Mother: What's [Pet's name 1] Aaron?
Aaron: Yeah.
Mother: What is he?
Aaron: He.
Mother: You know [Grandmother]'s bird [Pet's name 1] what's, what is he?
Aaron: He duck.
Mother: He's not a duck, no.
Mother: What is he?
Aaron: Chick chick chick chicken.
Mother: No, he's not one of them either.
Mother: He's a boy chicken.
Mother: What's his, what's a boy chicken called?
Aaron: It, it's, it's.
Mother: What's a baby dog?
Aaron: I don't know.
Mother: No.
Aaron: Er, a dog barks.
Mother: What's [Pet's name 2]?
Mother: What's [Pet's name 2]?
Aaron: I don't know.
Mother: He's a turkey.
Aaron: Turkey, yeah.
Mother: Yeah, he's a turkey.
Mother: What about {interrupted}.
Aaron: Cockadoodoo.
Mother: Cockadoodle yeah.
Mother: Cockerel.
Aaron: Cockerel.

Aaron and his mother talking at home
t3, sample 2

Aaron: You can't eat this bit.
Mother: Hmm.
Aaron: Cuz it will hurt you mind.
Mother: What will it hurt me for?

Aaron: Cuz it's got green thing on it.
Mother: It's a tomato.
Mother: It can't hurt you.
Aaron: Cuz it got green thing on.
Aaron: Cuz it's got green.
Aaron: Cuz it's like choo-choo train.
Aaron: Got green.
Aaron: X {unintelligible} peas green, peas are green.

Aaron and his mother making dinner
t4, sample 1

Two thirds (67%) of the 24 transcribed LENA samples were during unstructured activities when Aaron was around the house. This was also the most common context from the coding of the whole-day LENA audio (25%) and activities around the house had the highest overall automated turn count (CTC) (Table 5.6). Mean CTCs were calculated to account for the frequency of different activities, which varied for Aaron across the four LENA recording days. At t1, the highest mean CTC was found for around the house and outdoor (interactive) activities; at t2 it was for organised interactive playtime; and at t3 and t4 it was for visits (private). The contexts with high CTCs generally also had high mean child vocalisations (CVCs) and number of adult words (AWCs).

The highest mean CTC from across the study period was for organised interactive playtime but there was only one sample of this activity out of 126 coded (<1%). Private visits were more common (10%) for Aaron compared to the other cases (see section 5.6.2) and this context had relatively high mean CTCs. Aaron's mother mentioned in an interview that she went out on recording days to keep Aaron distracted from the fact that he was wearing the recorder. Aaron and his mother went to an adventure park at t1; they played at home and then visited their horse at t2; during t3 and t4 they visited family. Public visits (13%) and TV (15%) were common but had low mean CTCs. Interactive play was only recorded from the sampled audio at t2 (three five-minute samples), accounting for 2% of the samples that were coded from across the study.

In summary, Aaron demonstrated a stable vocabulary delay of approximately 18 months over the study period. He interacted exclusively with other adults during the LENA recordings at home and the most common activity for interacting with his mother was around the house. Aaron attended a child-minder where he has relationships with other children and he also went to the local preschool.

Table 5.6 Context coding of five-minute audio samples from Aaron's four recording days

Category	*Total CTC*	*Total CVC*	*Total AWC*	*No. samples*	*Mean CTC*	*Mean CVC*	*Mean AWC*
Playtime - organised interactive	24	66	256	1	24	66	256
Outdoor (interactive)	152	460	1166	7	22	66	167
Playtime - general interactive	43	108	565	2	22	54	283
Visit (private)	233	558	2939	12	19	47	245
Around the house	467	1400	5676	31	15	45	183
Transition	47	234	803	5	9	47	161
Outdoor (alone)	21	110	153	3	7	37	51
Meal time	26	81	247	5	5	16	49
Visit (public)	73	520	960	16	5	33	60
Playtime - general alone	43	217	649	12	4	18	54
Travel	22	60	364	7	3	9	52
TV	36	175	371	19	2	9	20
Bath time	7	15	333	6	1	3	56

5.5 Case study 4: Daniel

Daniel's expressive language score (1.9 SD below the mean) suggested that he had the most severe delay of the four cases, based on the PLS-3 (Zimmerman, Steiner and Pond, 1992). He had a receptive language score below the mean (0.9 SD) but just within typical limits. Daniel had been referred to SLT services at the start of the study and he had previously been seen an inclusion worker in his preschool setting to help him cope with frustration and difficulty communicating. He had very limited vocabulary and his family, preschool staff and other children struggled to understand him. Throughout the study period, Daniel saw three different speech and language therapists to support him with his language. His SLT sessions were on-going at the end of study and they were anticipated to continue into school. Daniel was the second born child and lived with his mother, father and older sister.

At t1 Daniel was aged 2;10 and his total vocabulary (23 words) was below the 1;4 age CDI median score (the checklist floor) suggesting that his vocabulary was delayed by at least a year and a half (Table 5.9 in section 5.6). At t2, aged 3;2, his vocabulary score remained below the CDI floor. Daniel had reached a 60-word vocabulary at t3 and 73-word vocabulary at t4; equivalent to approximate CDI median scores for children aged 1;6. These later scores suggested a vocabulary delay of approximately two years. During the early stages of vocabulary growth (<50 words) just under a third of Daniel's words were classed as common nouns and approximately a quarter were either predicates or closed class words. The proportion of common nouns increased slightly as Daniel's vocabulary grew to between 50 and 100 words but remained below the proportion on the CDI checklist. There was limited change in predicates and closed class words but overall their proportions decreased over the study.

The trajectory of Daniel's vocabulary development (Figure 5.4) demonstrated a slower rate of growth compared to the CDI norms as well as occurring at a much later chronological age. Daniel's vocabulary size increased by 50 words over the study, equivalent to approximately five new words a month. A similarly small increase was found in Daniel's use of different words from the LENA naturalistic samples (Table 5.7); there was an overall increase from t1 although the largest number of different words used (19 words) was at t3. Daniel's cumulative vocabulary production during the LENA samples demonstrated a similarly slow trajectory that was suggested by the CDI scores (Figures 5.5 and 5.6 in section 5.6).

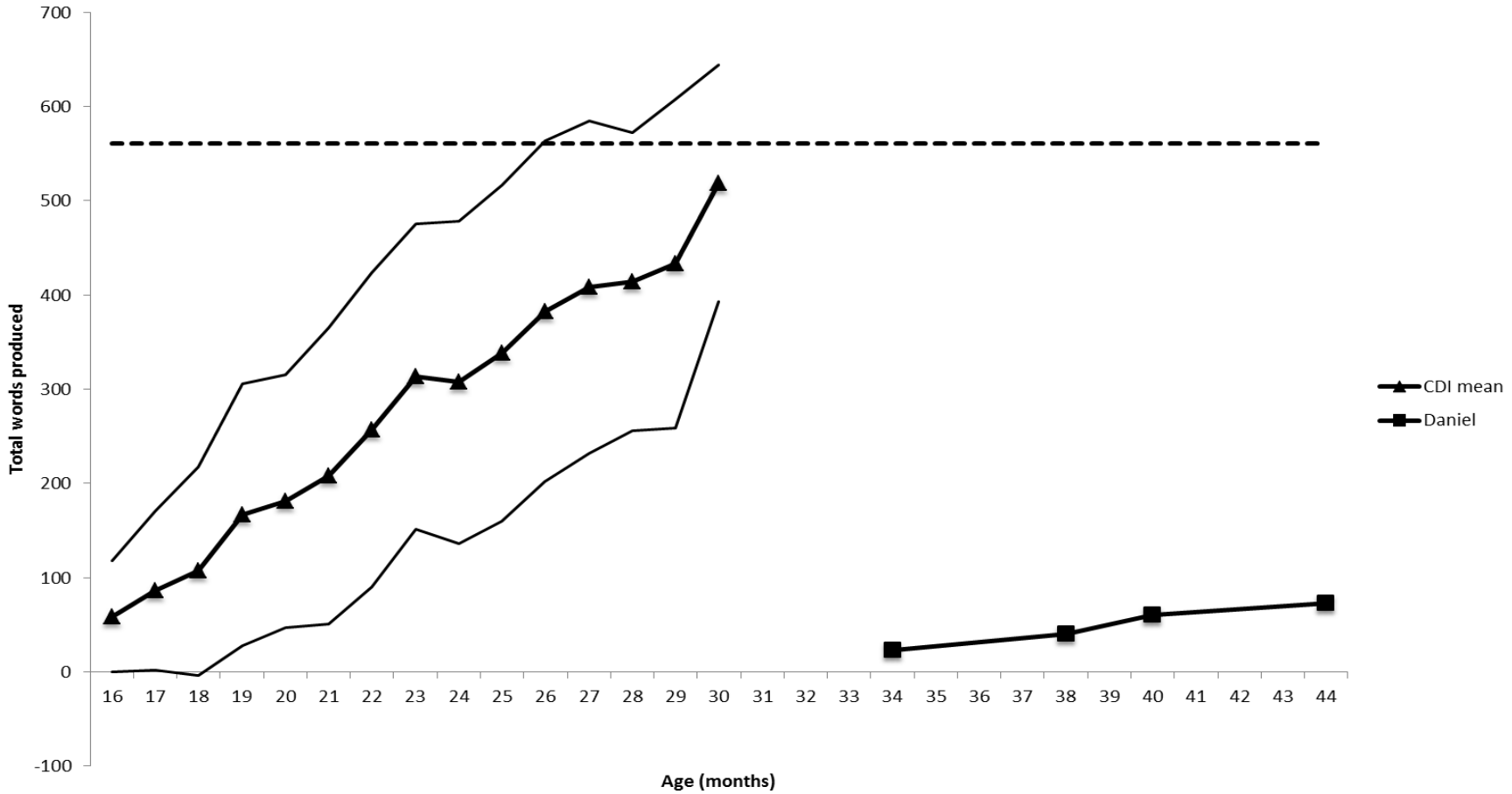

Figure 5.4 Daniel's vocabulary produced compared to CDI mean scores (*Note*: The single lines represent ±1 SD for the mean scores and the dashed line represents the 30-month median score from Fenson *et al,* 2007)

Table 5.7 Daniel's SALT language data for LENA and TIM transcripts

SALT category	*LENA t1*	*TIM t1*	*LENA t2*	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	247	40	141	44	242	58	257	48
Total words	289	43	163	52	276	67	349	66
No. different words	10	8	12	8	19	11	17	8
No. total words	114	27	59	26	104	36	161	23
Type/token ratio	0.09	0.3	0.2	0.31	0.18	0.31	0.11	0.35
Mean turn length	2.07	1.14	1.75	1.3	1.53	1.16	1.95	1.57
Intelligible utterances	37%	63%	39%	55%	39%	48%	53%	40%

Note: Number of different words and number of total words are based on clear and intelligible utterances only

It is important to note that at t2, Daniel wore his recorder at preschool but consent had not been obtained from staff and parents; therefore, the majority of the audio was excluded from analysis and only three five-minute samples were transcribed. The SALT measures at t2 were based on 15 minutes of audio, which was half the time compared to other time points. There was also less choice for selecting samples of mother-child interaction from across the day but represented the three examples of high-level interaction between Daniel and his mother before he attended preschool.

The majority of PCI samples from the LENA audio included Daniel interacting with his mother, and often his father and sister, during unstructured activities around the house or on visits involving interactions with his grandparents. Daniel produced a limited vocabulary throughout the study and was often unintelligible but his family tried to interpret what he meant, even if this took a few attempts. He often tried to engage his family in interactions but there were also many examples of Daniel playing alone while others were talking near to him. Familiar games and book reading provide Daniel with opportunities to use and learn vocabulary.

Daniel: XXX {unintelligible}.
Mother: Yes.
Daniel: XXX.
Mother: No jumping on my bed.
Daniel: Yeah!
Mother: No way!
Mother: No jumping on my bed.
Daniel: XXX.
Daniel: XXX.
Mother: Oh.
Mother: No more monkeys jumping on the {singing}~
Daniel: Bed {laughing}.
Mother: Bed, that's it.
Daniel: More {pronounced <moomoo> /mumu/}.
Mother: No more monkeys jumping on the bed.
Daniel: Oo oo {monkey noises}.

Daniel and his mother playing in the morning
t1, sample 1

Mother: Come on then.
Daniel: No.
Mother: You wanna carry some do you?
Daniel: XXX {unintelligible}.
Mother: You can't carry that one.
Mother: It's too heavy.
Mother: Carry that one.
Daniel: No.

Mother: All right?
Mother: Come on then.
Daniel: Dada.
Mother: Dada, yeah.
Mother: Dada's by there.
Daniel: Mum.
Mother: No, you can't carry this one as well.
Mother: Get Dada carry that one shall we?
Daniel: No.
Mother: Well how are you gonna hold on to your bike and do that?
Mother: What, now what you gonna do?
Daniel: XXX.
Daniel: Dada.
Daniel: Dada, dada.
Father: You want me to hold that one?
Daniel: Yeah.
Father: Ok.

Daniel in the park with his family
t1, sample 2

Mother: That's not my pirate {book}.
Daniel: XXX {unintelligible}.
Mother: That's not my pirate it's hat's too soft.
Daniel: Yeah.
Mother: No.
Daniel: No.
Mother: That's not my pirate her shirt is too~
Mother: Silky.
Daniel: XXX {possibly trying to imitate}.
Mother: What colour's her shirt do you know?
Daniel: Yellow {pronounced <ello> /ɛləʊ/}.
Mother: It's not yellow.
Daniel: XXX.
Mother: Pink.
Daniel: XXX.
Daniel: Oh no.
Mother: Hh, that's not my pirate his eye patch is too~
Daniel: XXX.
Mother: Bumpy.
Daniel: XXX.
Mother: Can you say bumpy?
Daniel: XXX.
Mother: That's not my pirate his cutlass is too~
Daniel: XXX {follows appropriate intonation pattern for response}.
Mother: Glittery.
Mother: Good boy, glittery.
Daniel: No.

Daniel and his mother reading a book
t2, sample1

At later stages in the study there were some more examples of Daniel attempting to use vocabulary as well as encouragement from others to do so. The second speech and language therapist he saw helped him focus on specific words that his mother targeted for learning with him at home. During the first three recordings, just over a third of Daniel's speech was intelligible, by t4 there were some improvements in the clarity of Daniel's speech and just over half (53%) of his transcribed utterances were intelligible. Although Daniel uses the highest number of total words at t4, the number of different intelligible words remained limited (17) and slightly below the number used at t3 (19).

Daniel: Mama?
Mother: Yes love.
Daniel: XXX {unintelligible}.
Mother: Use your words.
Mother: You want some food?
Daniel: Yeah.
Mother: No, you say it.
Mother: What do you, how do you say food?
Daniel: XXX.
Mother: Food, good boy.
Mother: Yeah, I'll get you something now.
Mother: What do you want to eat?
Daniel: Cracker {pronounced <dada> /dædə/}.
Mother: A cracker.
Mother: Four crackers?
Daniel: Yeah.

Daniel: Mum, mum.
Mother: Who is it?
Daniel: Uh, gaga {/gægæ/}.
Mother: Yeah, who's that?
Daniel: Gaga.
Mother: What, when you were a baby?
Daniel: Yeah!
Mother: Yeah, what's your name {focus of recent SLT}?
Daniel: Gaga {/gægæ/}.
Mother: Yeah, when you were a baby, gaga.
Daniel: Yeah, yeah.
Mother: What's your name though?
Daniel: XXX {unintelligible}.
Mother: D~
Daniel: Daniel.
Mother: Daniel.
Daniel: Yeah.

Daniel talking to his mother at his grandparents' house
t3, sample 1

Daniel: Mummy.
Mother: Look Daniel this is what mummy plays when mummy goes to netball with [friend's name].
Mother: This is what mummy plays when I play netball.
Daniel: Mine.
Mother: You wanna play netball?
Daniel: Yeah.
Mother: You gotta throw a ball around really fast and then shoot it in the goal.
Mother: Do you reckon you could do that?
Daniel: Yeah.

Daniel watching TV with his mother
t4, sample 2

Daniel went to preschool most days during the week and he generally wore the recorder on a weekend day when his mother, father and sister were all at home. Daniel and his family often went out either to the park, to visit family or take part in other activities. He had breakfast between 06:00 and 09:00 depending on the day and went to bed between 19:00 and 20:00.

Unstructured activities around the house accounted for over half of the high-level interactions transcribed and analysed from the LENA audio. The context coding of the whole-day recordings found these activities were also common across the day more broadly. The highest overall turn count (CTC) for each of the LENA recording days, and across the study period, was found when Daniel was around the house. This context was coded for 31 of the 111 samples from the whole-day recordings and this was the most common context across the study (28%), except for TV (31%). The CTCs ranged across the individual around the house samples from 0-17 (M=7) (Table 5.8). The only samples with higher mean CTCs were for visit (private) (21) and meal times (12) but these contexts were both only coded once across all four study days. The high mean adult word counts (AWCs) and child vocalisation counts (CVCs) were generally found for similar contexts as high mean CTCs. However, the second highest mean CVC was found when Daniel was playing alone. Interactive play accounted for three samples (3%) although there were 10 interactive outdoor samples where Daniel was playing with his parents and/or sister (9%).

In summary, Daniel demonstrated limited language growth over the study period. At the start of the study his vocabulary size was below the CDI checklist floor but could be estimated as at least a year and a half delayed. Daniel's vocabulary increased by 50 words over the study showing a slow rate of growth and a delay of more than two years by t4.

Table 5.8 Context coding of five-minute audio samples from Daniel's four recording days

Category	*Total CTC*	*Total CVC*	*Total AWC*	*No. samples*	*Mean CTC*	*Mean CVC*	*Mean AWC*
Visit (private)	21	49	171	1	21	49	171
Meal time	12	34	92	1	12	34	92
Around the house	209	797	3355	31	7	26	108
Playtime - general alone	50	364	638	8	6	46	80
Visit (public)	18	61	650	3	6	20	217
Playtime - organised interactive	6	22	85	1	6	22	85
Transition	34	175	490	6	6	29	82
Outdoor (interactive)	35	302	449	10	4	30	45
Outdoor (alone)	3	19	102	2	2	10	51
Travel	13	67	251	11	1	6	23
Playtime - general interactive	2	49	30	2	1	25	15
TV	31	164	919	34	1	5	27
Sleep	0	0	12	1	0	0	12

5.6 Comparisons across cases

The present study aimed to understand the dynamics of the relationship between PCI and the trajectories of children's vocabulary growth and examine the differences in development in the context of children's naturalistic environments. The sections above reported on children's vocabulary data individually in order to highlight their actual rates of growth and the unique nature of their language learning opportunities at home. This section draws comparisons across cases to establish the level of variability regarding the early trajectories of vocabulary development for the four children with PLI.

5.6.1 Vocabulary development

There were different profiles of vocabulary development found across the four cases of children with PLI in the present study. As shown in Figure 5.5 below, Ben, Christopher and Aaron showed relatively steady growth over time; however, Ben was the youngest child at the start of the study and showed a peak in growth rate between t1 and t2. Ben was the only child who appeared to catch up to TD levels throughout the study. Compared to the other children, Ben started with the smallest vocabulary delay of 9-10 months based on CDI scores (Table 5.9). Over time the extent of this delay decreased in comparison with the CDI median age equivalent scores and at t3 was less than six months delayed. Ben was the only child to score above the median CDI score for children aged 2;6 by the end of the study at which point his vocabulary size was 582 words. Ben had the highest average rate of growth out of the four cases; his vocabulary increased 52 words per month overall. The largest rate of growth for Ben was found when his vocabulary size was between 63-274 words, he used 70 new words per month on the CDI between t1 and t2.

Table 5.9 Children's vocabulary size and estimated delay based on comparisons with the CDI median age equivalent scores (Fenson *et al*, 2007)

		t1	*t2*	*t3*	*t4*
Ben	CDI vocabulary score	63	274	471	582
	Delay (months)	9-10	7-8	4-5	--
Christopher	CDI vocabulary score	71	142	366	451
	Delay (months)	24	25-26	23-24	22-23
Aaron	CDI vocabulary score	137	269	403	519
	Delay (months)	18-19	19-20	19-20	18-19
Daniel	CDI vocabulary score	23	40	60	73
	Delay (months)	>18	>22	22-23	25-26

Note: The CDI manual does not recommend using the checklists to determine language level for children with developmental delays after their scores exceed the 2;6 CDI median (561 words). At t4 Ben scored above the 2;6 median; therefore, his language level could no longer be determined accurately from the CDIs.

As shown in Table 5.9, the extent of the Christopher and Aaron's vocabulary delays were maintained over the study based on comparisons with CDI median norm scores; Aaron and Christopher exhibited vocabulary delays of approximately one and a half years and two years respectively. On average, Aaron's vocabulary size increased 38 words per month based on CDI scores. The largest rate of growth of 45 words per month was found when Aaron's vocabulary size was between 269-403 words. Christopher's rate of vocabulary growth was similar, on average producing 42 new words per month based on the CDI checklist. The largest increase in his vocabulary was 75 words per month when his vocabulary size was between 142-366 words.

In contrast to the other three cases, Daniel had the slowest rate of growth (Figure 5.5); on average his vocabulary increased by five words per month based on the CDI scores. The largest rate of growth of 10 words per month was found between t2 and t3. Daniel's also had the smallest vocabulary at the start of the study, which was below the youngest CDI median age score. Daniel's vocabulary was at least one and a half years delayed at the start of the study and increased to approximately two years delayed.

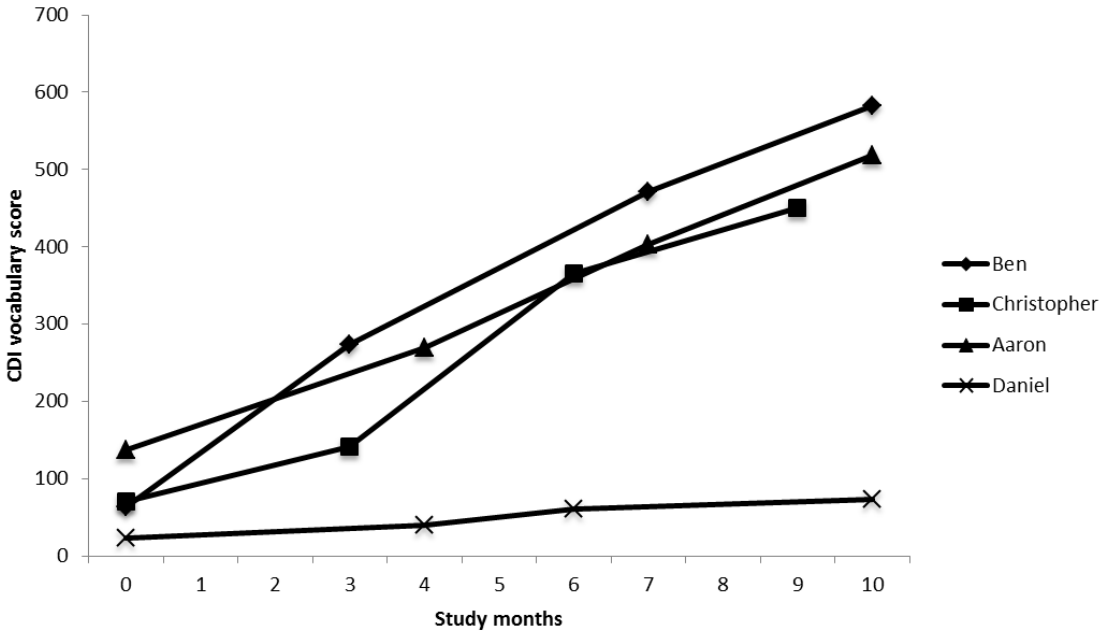

Figure 5.5 Vocabulary growth of each child based on CDI scores

The CDIs use parent reports to record children's overall vocabulary knowledge; however, these do not necessarily represent their productivity during everyday interactions. In addition, the CDIs use a finite checklist of words and as children's vocabulary develops, and they approach ceiling levels, the CDIs may underestimate children's skills. Figure 5.6 below outlines the

cumulative number of different words children used during the transcribed LENA samples. The patterns of growth were similar to the CDI scores, which supported the parent report data. Aaron used the highest number of different words at the start of the study and showed steady growth over time. Christopher used a smaller number of different words but also showed a relatively steady increase over the study. Ben demonstrated an increase in the use of different words between t1 and t2 that was similar to the CDI scores outlined previously. Although he did not use more different words compared to Aaron during the LENA samples, Ben did catch up during the second half of the study despite being 11 months younger. Daniel used the smallest number of different words of all four children and he demonstrated slow growth over time, which was consistent with his CDI scores.

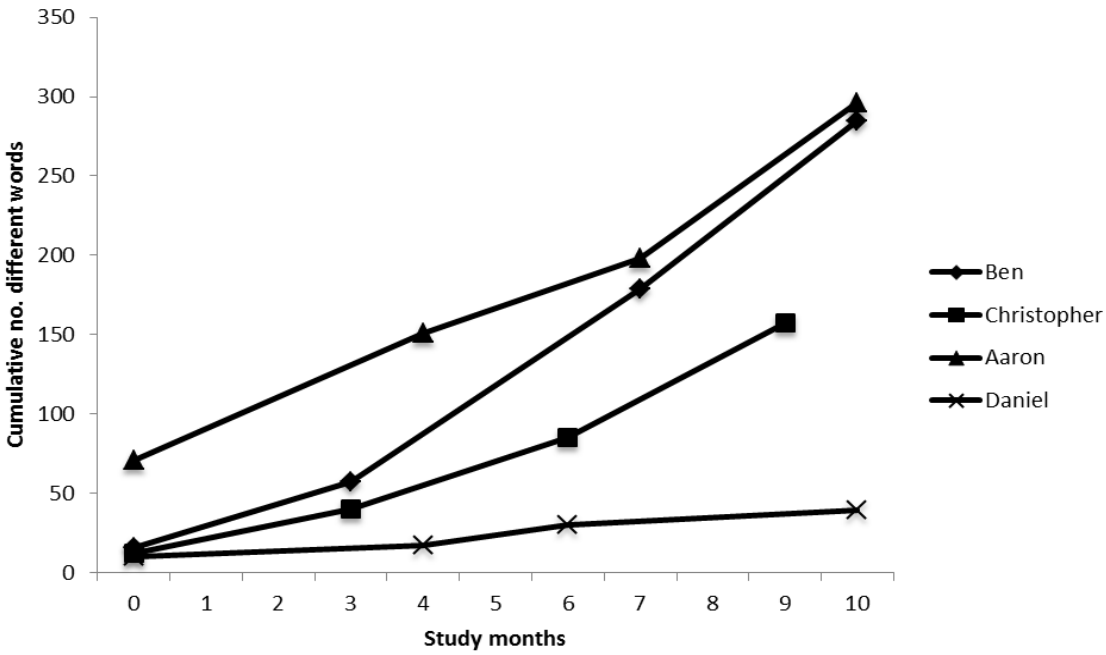

Figure 5.6 Cumulative vocabulary produced during transcribed LENA samples

The four children started the study with different vocabulary sizes; therefore, it was not always possible to make clear comparisons between them regarding their very early vocabulary composition before achieving 50 words. At t1, Ben, Christopher and Daniel all had vocabulary sizes under 100 words at which time common nouns accounted for approximately one third of their vocabularies or less (range 27-34%). During the study, Daniel's vocabulary did not exceed 100 words. The highest proportion of common nouns was found for Aaron between 101-200 words (46%); for Ben between 201-300 words (50%); and for Christopher between 301-400 words (50%). The proportion of common nouns declined slightly for these three children after reaching 400 words (range 42-46%).

The proportion of common nouns showed the largest increased for Ben between t1 (27%) and t2 (50%) during which time he also showed the fastest rate of vocabulary growth (approximately 70 words per month). Common nouns increased from 42% at t2 to 50% at t3 for Christopher and this was also the time during which he demonstrated the largest vocabulary growth of 75 words per month. Aaron and Daniel showed smaller increases in the proportion of common nouns between individual time points and they had smaller overall rates of vocabulary growth.

The current study developed theoretical propositions that acted as a template for comparing case study findings (Yin, 2009) from existing understanding of children's vocabulary development based on the research literature (section 4.1.2). Firstly, children's vocabulary size was expected to increase over the study period but the trajectories of growth were expected to vary across cases, with the possibility of children's delayed status shifting. Secondly, the rate of children's vocabulary growth was expected to relate to their later vocabulary size. The purpose of examining vocabulary growth was to inform understanding of the relationship between children's rate of change and subsequent delayed status. Finally, the proportion of nouns in children's vocabularies was expected to decrease over time and a possible trend for higher proportion of nouns in children's early vocabularies was expected to be found concurrently with faster vocabulary growth.

The findings from the four cases suggested that delayed vocabulary status from approximately age 3;0 onwards, may be a clearer indicator of persistent or severe delay, compared to earlier time points. A previous study of four children with PLI (Ellis Weismer, Murray-Branch and Miller, 1994) found that their vocabulary caught up with TD levels. The children had initial vocabulary delays at ages 2;1-2;2 (25-87 words) but by the end of the third year, aged 2;10-2;11, they had vocabularies of over 500 words. Across the four cases, only Ben demonstrated vocabulary growth that apparently caught up with TD levels, as the extent of his delay decreased over time, and he was the youngest at the start of the study (aged 2;3). The other three cases had similar, small vocabulary sizes at the start of the study but they were much older (aged 2;10-3;6) and they showed comparatively slower rates of growth over time. These three children maintained their delayed vocabulary status at the end of the study. Catch up to TD levels by Ben during his third year supports the notion that monitoring language progress may be the most appropriate course of action, as suggested by Paul (1996).

The present study supported the notion that rate of vocabulary growth could be a useful guide for estimating children's later language performance, which has been demonstrated in previous research with children with PLI (Rescorla, Mirak and Singh, 2000). Ben had the fastest rate and the largest vocabulary size at the end of the study, showing a trajectory that was catching up with TD levels. In addition to Ben, Christopher and Aaron both also exceeded the level of vocabulary growth shown by children in Rescorla, Mirak and Singh's (2000) study who were classified as demonstrating rapid growth; however, only Ben was within the age range of the children in the study. It is important to recognise that Ben was the youngest of the four cases and demonstrated the rapid growth at an earlier age compared to the other three children. Ganger and Brent (2004) highlighted the fact that all children who become skilled adult language users will eventually achieve a certain rate of word learning, such as 35 words per month, in the process of developing language. The study findings highlight the importance of using rate of growth as an indicator of later performance within set parameters including the age of the child.

The present case studies did not show clear evidence for an early noun preference in the composition of children's vocabularies that has been found for TD children. There was some support from the case studies that increased rate of vocabulary growth was related to periods of increased noun learning. The proportion of nouns showed a large increase for Ben (27% to 50%) between the time points in the study in which he showed the fastest rate of vocabulary growth. Christopher also showed an increase in the proportion of nouns (42% to 50%), albeit smaller than Ben's, that was concurrent with his fastest rate of vocabulary growth. In contrast, Aaron and Daniel showed smaller increases in the proportion of nouns between individual time points. These findings follow the same trend as the findings in Rescorla, Mirak and Singh's (2000) study that found children with PLI who had a faster rate of growth had a higher proportion of nouns in their vocabularies. In comparison, the proportion of nouns recorded for children with slower rates of growth were lower and below the proportion represented on Language Development Survey (LDS) (Rescorla, 1989), the parent report tool used in their study. Smaller proportions of nouns in children's vocabularies could identify the benefit of targeting specific word learning with children.

Overall, the present study findings regarding children's vocabulary development were consistent with previous research that has identified large variation across the preschool years. The case studies emphasised the value of examining actual trajectories of growth for

individual children. The findings support previous suggestions that rate of growth before age 3;0 could be a useful indicator of later vocabulary size as well as the need for prioritising intervention in cases where language delay is persistent past age 3;0.

5.6.2 Child and parent talk across different contexts

Understanding the broader family picture is important when planning interventions to support children's language development. This chapter has reported the different activities present in children's home environments and how parent and child talk varied accordingly, which has added to understanding of the daily language learning experiences of children with PLI. The similarities and differences across the four cases regarding the variation in parent and child talk were examined. There were similarities amongst cases regarding the activities in which the highest levels of talk and interaction occurred. Mean counts were calculated to account for differences in the frequency of activities and have been summarised across cases in Table 5.10. In total, 507 five-minute samples (>42 hours) of LENA audio were coded from across the four cases.

As shown in Table 5.10, the highest mean CTCs for three cases were during organised interactive play for Ben (23), Christopher (16) and Aaron (24). The highest mean CTC for Daniel was found for private visits for (21) when he was visiting his grandparents, and the CTC during organised play was much lower (6). Interactive play between mother and child was not a frequent context for PCI and was only recorded for 19 samples across all four cases (4%). The majority (10) of these samples were found in Christopher's audio across the four recording days, accounting for 7% of his coded activities. The proportion of mother-child interactive play coded for the other three children was lower. There were five samples coded for Ben (4%), three for Aaron (2%) and only one for Daniel (1%). Other activities were more common, although CTCs were lower during individual five-minute samples there were more occurrences over the day resulting in higher total CTCs. In contrast to interactive play, general activities around the house and meal times were more common, collectively accounting for over a quarter (29-31%) of the LENA audio that was sampled for all four cases.

Table 5.10 The CTCs for each context and the proportions coded from the 25% sampling of LENA audio

	Ben		*Christopher*		*Aaron*		*Daniel*	
Category	*CTC total (mean)*	*%*	*CTC total (mean)*	*%*	*CTC total (mean)*	*%*	*CTC total (mean)*	*%*
Playtime - organised interactive	69 (23)	2%	158 (16)	7%	24 (24)	1%	6 (6)	1%
Playtime - general interactive	159 (12)	9%	35 (3)	9%	43 (22)	2%	2 (1)	2%
Outdoor (interactive)	2 (1)	1%	26 (5)	5%	152 (22)	6%	35 (4)	9%
Visit (private)	-	-	55 (9)	4%	233 (19)	10%	21 (21)	1%
Around the house	195 (9)	16%	275 (9)	23%	467 (15)	25%	209 (7)	28%
Meal time	322 (15)	15%	48 (5)	7%	26 (5)	4%	12 (12)	1%
Personal care	-	-	40 (13)	2%	-	-	-	-
Transition	81 (5)	12%	63 (7)	6%	47 (9)	4%	34 (6)	5%
Book reading	2 (2)	1%	44 (9)	4%	-	-	-	-
Playtime - general alone	76 (7)	8%	13 (7)	1%	43 (4)	10%	50 (6)	7%
Outdoor (alone)	-	-	21 (7)	2%	21 (7)	2%	3 (2)	2%
Visit (public)	11 (1)	9%	32 (5)	5%	73 (5)	13%	18 (6)	3%
Travel	48 (5)	7%	2 (0)	6%	22 (3)	6%	13 (1)	10%
TV	30 (2)	12%	25 (1)	14%	36 (2)	15%	31 (1)	31%
Bath time	2 (1)	2%	1 (1)	1%	7 (1)	5%	-	-
Sleep	0 (0)	5%	2 (0)	4%	-	-	0 (0)	1%
Total	997		840		1194		434	

The highest total CTC was during meal times for Ben and the mean CTCs during meal times were also high for Ben (15) and Daniel (12). The highest total CTCs for Christopher, Daniel and Aaron were found when they were involved in general activities around the house, and the total CTC was also high for Ben in this context. Mean CTCs were high during general interactive play for Ben (12) and Aaron (22), and during personal care for Christopher (13). The total number of conversational turns in the audio sampled were higher for Aaron (1194), Ben (997) and Christopher (840), compared to Daniel (434). The number of five-minute samples that were coded varied across cases but the overall mean CTC remained lowest for Daniel (4) when compared to the other three children (range 6-9).

The amount of adult (AWC) and child talk (CVC) during different activities showed similar patterns to conversational turns. Mean CVCs were high during organised interactive play for three cases: Ben (49), Christopher (37) and Aaron (66), but remained lower for Daniel (22). Similar differences were found for mean AWCs, which was lower for Daniel (85) compared to the other three children (range 211-376). The highest mean AWC for Daniel was during public visits (217). The mean CVCs during meal times were high for Ben (40) and Daniel (34); mean AWCs during meal times for these two cases were 296 and 92 respectively. The most notable difference between the LENA counts was found during samples of book reading. This activity was coded in two cases during which the mean AWCs for Ben (459) and Christopher (652) were the highest recorded, while the mean CVCs (4 and 15 respectively) and CTCs for both cases were comparably low. Between 12-15% of the coded audio was TV watching for Ben, Christopher and Aaron, while TV was twice as common for Daniel (31%). All three LENA counts were low across cases when watching TV. The LENA counts were also consistently low during travel.

The context coding demonstrated that interactive play and book reading with parents were both relatively infrequent in children's daily lives compared to more general unstructured activities around the house. These findings challenge the representativeness of these contexts for studying PCI and highlight the need for a broader understanding of children's everyday learning opportunities. Understanding differences in the amount of talk and interaction that occurs during different activities, and the relative proportion of time children spend in these different contexts, can support speech and language therapists to develop strategies that are compatible with families' typical home environments. In addition, recognising a lack of certain activities for interaction could be addressed with some parents in discussions around how

children learn language and the activities they could use to facilitate growth. The findings regarding parent and child talk across different contexts are discussed in Chapter 8 (sections 8.2.3 and 8.3).

5.7 Parents' reflections on the study

The contextual coding of the whole-day recordings provided an indication of whether the high-level interaction samples occurred during activities that were typical of children's broader home environment. It was also important to establish whether parents' believed that the recordings reflected their typical daily lives, given the innovative new technology used, in order to avoid making assumptions about families and to inform future studies that intend to use the LENA system. Mothers were asked, to reflect on their experiences of being involved in the study during interviews at the end of the study, which provided a distinctive insight into the validity of the study methods.

The two main issues with the use of the LENA recorder were the child's willingness to wear the recorder and vest, and the extent to which parents modified their behaviour on account of their awareness of "someone listening". The parents had their own method of encouraging the children to wear the recorder. Ben's mother referred to the LENA recorder as "his little computer" and reported that he enjoyed wearing it. Difficulties wearing the recorder were generally related to the vest rather than the recorder itself. The vest is worn over normal clothing and although one vest was plain blue, the larger size was red and decorated with yellow stars. The children became more conscious of wearing the vest as they got older. Daniel refused to wear the vest altogether and a t-shirt was made for him instead, which he agreed to wear. Requesting t-shirts when using LENA with older children may be more successful in future studies.

> *Fine when he was younger but as he's got older, the last couple of times, probably that last time more so, he's like, what, I mean he just likes to fiddle and it was more of a case "no you need to put it on, just don't touch it just leave it alone". It was more it was like, "I don't want to wear it" so "this is a spaceman, this is a special spaceman vest". That was probably the most difficult.*
>
> Christopher's mother

> *It's took some persuasion. I don't quite know what it is because once he's actually, once he's kind of forgotten, you know, it's fine.*
>
> *There was no way he would have kept the vest on…it's almost like dressing up clothes, and you don't keep dressing up clothes on all day, so with the t-shirt it was almost like*

general clothes, so it worked really well. I don't think it would have worked otherwise [laughing].

Daniel's mother

All the mothers commented on their awareness that they were being listened to, and while some suggested that they were unaffected by this, others said that they monitored their behaviour and their language. In particular, they commented on trying not to shout or swear while the recorder was on. Some mothers mentioned that they were more aware of how much they talked to their children and others suggested that they planned certain activities so that they did not have to be at home all day while their child was wearing the recorder.

I do remember one particularly bad day when I was just thinking "oh my goodness me" I wouldn't necessarily choose to have someone listening in on this window of you going "argh" [laughing].

Ben's mother

Cuz I think you're also very much aware when he's wearing it, it's like "ok, we can't really scream and shout at you, or maybe tell you off quite as much as normal cuz you've got the recorder on" [laughing]. So I think that probably, um, because you're more…I think you're more aware of it so maybe you're more, you shouldn't be really but I think you're a bit more aware of how you talk and how much you talk to them. Cuz I'm thinking, "oh my gosh they'll think I never talk to my child or anything"… you maybe, maybe you sort of overcompensate by doing it more than you would normally because you know it's there… Maybe you'd like, have like a one word sentence to him, you'd probably go a little bit overboard by making it a little bit more pretty and flowery.

Christopher's mother

I always had to plan it on a day when I knew we were off and we could actually just get on and do stuff. And I think in some respects it was quite a good thing because then I thought right, if he's gonna wear this recorder he's gonna play me up if I keep him in all day so if we go off and do something for the day, so actually it was a win-win situation cuz we got to spend some good time together. One of the days we went down Puxton Park so I knew he was out and about and doing stuff…

Aaron's mother

Yeah and it was really hysterical cuz at one stage I wanted to swear so then I spelt it out and then they were like, and then DAD went, "she can spell" [laughing]…definitely you're aware of like you've got it on…the children just don't care, they just carry on, whereas me and DAD, you do, like you do, you do forget about it, and you do just act normal cuz you can't not, you know, not act normal but you do know that it's there.

Daniel's mother

In addition to the experience of using the LENA recorder, families were asked about the video-recorded book sharing sessions. All of the mothers mentioned that being videoed was not a

preferable experience but they did not feel that it impacted on the way in which they behaved with their children. In contrast, the presence of the camera was reported as a distraction for the children, and to varying degrees, they wanted to look through it and do some recording of their own. This interest in the camera increased as children got older and more inquisitive. The children were given time to have a look and play with the camera before they looked at the picture-book to reduce curiosity during the book sharing. This process worked well for most of the children but Christopher was consistently more interested in the camera than anything else and his mother felt that this impacted on his responses to the book. Rather than engaging in the way that Christopher normally would, his mother reported that he gave more one-word answers and was less interactive than she would normally expect. Limited input or engagement from the child could impact on their parent's behaviour, and the individual child's response to the situation should be taken into account when considering the appropriateness or validity of using video recorders in assessments.

> *I think unfortunately with Christopher, just the fact that there was a camera there would take, it wouldn't matter what he had, he could have a book that he absolutely loved to death but there's a camera there, that's something to fiddle with … unless you're gonna have a room that's got hidden cameras that you can, then no, it wouldn't have made any difference.*
>
> Christopher's mother

Some of the mothers mentioned that their children preferred sharing story books and that these would be more representative of the type of books that they would look at together, especially as the children got older.

> *I think the only thing for Ben is he probably would, he much would prefer a story now, and that's because he's got an older sibling, who's used to having stories that are or longer stories about more complicated things and all the rest of it but they were, they were fine, it wasn't a problem doing it.*
>
> Ben's mother

Two of the mothers highlighted the value of the picture-book sessions as an opportunity to observe progress over time; as the activity stayed the same the changes made over time were clearer.

> *…that was quite nice to see how he changed you know and that he could get more descriptive and you could ask him like "what colour's his t-shirt?" and "What colour's the dog?" you know, and it was quite nice to see over the time… that last time when he*

was a bit more descriptive about things and you could ask him questions that he knew what he was talking about, really confident in what he was talking about as well.

Aaron's mother

And I feel like we've made progress in those… cuz he does now say a bit more doesn't he? And like today, I thought to myself, I can't remember what bit he said now and I was like "ahh", maybe he said "swing" or something like that, and I thought "oh, that's kind of new cuz you didn't say that the first couple of times"…So that's interesting just that showing that progression really. How different he is with the book.

Daniel's mother

The current TIM uses a selection of 10 photograph-style pictures. The parents' views regarding the picture-book sessions suggested that a book that had a narrative running through it may be more engaging for children. Using illustrated pictures may more accurately represent the books children are used to reading. The perspectives from parents regarding the LENA recordings highlighted the difficulty for studies to achieve a truly accurate sample of PCI as it occurs naturally without awareness of external observers. However, it is reasonable to expect that observer effects would be increased during brief observations when there is a researcher in the room or behind a one-way mirror, compared to recordings taken over an entire day without a researcher present.

In summary, the study used a new technology to capture PCI in children's naturalistic home environments, which parents felt reflected their typical daily lives, despite varying levels of awareness of being recorded that are difficult to eliminate in research of this nature. Chapter 5 outlined the early vocabulary development of four children with PLI, highlighting variation in their early trajectories of growth. Ben was the youngest child at the start of the study, and especially after his sister started school he had many opportunities for dyadic interactions with his mother as well as his father during the school holidays. Ben's had the least severe expressive language delay and he was the only child who had receptive language skills above the mean. His vocabulary development appeared to catch up with TD levels throughout the study period. Christopher and Aaron were the oldest two children; both had already had their third birthday at the start of the study. These boys demonstrated expressive vocabulary delays of two years and a year and a half respectively, which were maintained over time. Although both children were receiving SLT at the start of the study, Christopher had more intense support from both an NHS and independent therapist; whereas, Aaron was discharged after only a few sessions as they felt he was making progress. Christopher spent a lot of time playing with his sister when he was at home and even when he was interacting with his mother, his sister was often also present. In contrast, Aaron lived at home with his mother and there were

many opportunities for dyadic interactions but also more periods of quiet compared to the other children. Of the four cases, Daniel showed the slowest rate of vocabulary growth as well as persistent issues with intelligibility and he was rarely combining words by the end of the study. He scored below the CDI floor at the start of the study and limited progress suggested an increasingly severe delay compared to TD levels. He was expected to require ongoing support from SLT services into school. Daniel's sister and father were often present during recordings at home and he spent much of the week at preschool. The findings highlight the differences across cases in terms of children's language ability and development as well as their family contexts that are often overlooked in larger group studies. Despite these differences, a number of similar themes emerged regarding the characteristics of PCI over time with the four children. These are presented in Chapter 6, first for each case to maintain the focus on each child as an individual, followed by a comparison across cases.

Chapter 6 Parent-child interaction and vocabulary development of children with PLI

Parent language data was based on the primary caregiver, who in each case was the mother; therefore, in order to examine change over time the focus in the present study was on mother-child interactions[2]. Maternal language was assessed through the all-day LENA audio recordings, which produced automated counts of child vocalisations (CVC), adult words (AWC) and adult-child conversational turns (CTC). The CTCs were used to identify high levels of interactions in children's naturalistic home environments and samples were transcribed for detailed analysis. In addition, PCI was assessed using the Thorpe Interaction Measure (TIM) of videoed picture-book sharing sessions. The chapter first addresses the findings for individual cases (6.1) and then draws comparisons across cases to identify any patterns in the characteristics of PCI used over time as children's vocabulary developed (6.2). The final section discusses the study findings in relation to previous research (6.3). The analysis of the PCI transcripts was guided by the findings from the systematic review of the literature (section 2.3.3) and was organised according to the characteristics of PCI identified in the review.

6.1 Parent-child interaction and the vocabulary development of individual children

Chapter 5 demonstrated the value of examining individual differences in children's vocabulary development. Chapter 6 examines the dynamics of parent and child talk and interactions over the study period in order to examine the extent to which characteristics of PCI relate to children's individual development.

6.1.1 Parent-child interaction with Ben

Ben demonstrated the smallest vocabulary delay of the four cases, he also had the overall fastest rate of vocabulary growth and the extent of his delay decreased over the study period.

6.1.1.1 Quantity, diversity and complexity of maternal talk

The SALT analysis of the PCI transcripts suggested that there was limited change the quantity, diversity or complexity of Ben's mother's language over the study period (Table 6.1). Maternal mean length of utterance in morphemes (MLUm) remained relatively constant over the study period. There was a slight increase at t3 in Ben's mother's MLUm as well as an increase in the

[2] The influence of other adults and children present in the key child's language environment was also expected to have an important role in their language development but exploration of this was beyond the scope of the current study.

total completed words despite a decrease in the total number of utterances (Figures 6.5-6.7 in section 6.2). It is possible that these differences were related to the people present during the interactions sampled. Each of the six samples from t3 included Ben, his mother and grandmother.

The SALT analysis of the PCI transcripts was run twice: once on all utterances and again to exclude utterances that were not directed at the child; the SALT scores for child-directed utterances are shown in brackets in Table 6.1. Ben's mother's MLUm was higher at t3 for both sets of SALT analysis; however, when utterances not directed at the child were excluded at t3, maternal MLUm reduced by 0.66. In contrast, the difference in MLUm for all maternal utterances and child-directed utterances ranged between 0.01 and 0.17 for other time points. The presence of Ben's grandmother in the triadic interactions at t3 could have altered his mother's typical style that would be used when she was involved in dyadic interactions or interactions with only other children. It is feasible that the involvement of another adult would result in talk that was more complex, inflating MLUm scores. This assumption is further supported by evidence from t2, which contained the one other five-minute LENA sample that included another adult. Ben and his mother had visited a friend and his mother's MLUm was 8.05, which was 2.24 higher than the overall MLUm (5.81) for that time point. Furthermore, the TIM sessions at each time point were dyadic interactions between Ben and his mother, and Ben's mother's MLUm demonstrated a more consistent MLUm during all sessions across the study (range 5.57-5.96).

Although the presence of other adults in conversations could have influenced maternal talk, maternal utterances not directed to the key child were kept in the SALT analysis. These utterances were included because overheard speech was considered to be an important part of children's natural language environment and they provided a complete picture of children's language exposure. The people present within an interaction must be taken into account when interpreting differences across contexts. Ben was very attentive to the speech of adults even when they were not talking to him directly and he often followed their conversations and joined in spontaneously, for example:

Table 6.1 Maternal SALT data from Ben's LENA and TIM transcripts (*Note*: Figures from child-directed utterances only shown in brackets)

SALT category	*LENA t1*	*TIM t1*	*LENA t2*	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	441 (368)	113	407 (357)	146	354 (261)	115	412 (401)	164
Total completed words	2461	548	2226	774	2503	564	2261	802
MLU words	5.52 (5.47)	4.75	5.32 (5.14)	5.09	6.84 (6.32)	4.84	5.49 (5.48)	4.86
MLU morphemes	6.02 (5.98)	5.65	5.81 (5.64)	5.96	7.61 (6.95)	5.61	6.01 (6.00)	5.57
No. different words	428 (377)	149	379 (345)	192	467 (359)	159	440 (438)	188
No. total words	2201 (1817)	522	1766 (1563)	708	2045 (1492)	552	2043 (1999)	777
Type/token ratio	0.19 (0.21)	0.29	0.21 (0.22)	0.27	0.23 (0.24)	0.29	0.22 (0.22)	0.24
Mean turn length	8.93	9.61	9.15	7.38	10.62	8.79	11.29	10.86
Intelligible utterances	93%	98%	85%	98%	86%	100%	91%	99%

Note: Number of different words and number of total words and MLU are based on clear and intelligible utterances only

Grandmother: Trouble is the garden's so wet it won't be, walking in the fields won't be, it'll be road walking.
Grandmother: Well path, foot path walking.
Mother: That's true actually, it's not like in the summer is it?
Grandmother: As long as we had wellies we'd be all right.
Ben: I gets my welly boot, I get my welly boots on.
Mother: Yeah, you know exactly what we're talking about: 'I'll get my welly boots', yeah.

Mother and grandmother talking about walking the dog
t3, sample 1

The automated LENA analysis of the 16-hours of audio (Table 6.2) demonstrated similar trends in the amount of adult talk in Ben's environment to the SALT analysis of the five-minute samples. The LENA adult word count (AWC) was fairly stable across the study, although there was a peak in the amount of adult words at t3, consistent with the presence of Ben's grandmother during the day. The LENA AWC includes both male and female adult words and does not refer exclusively to maternal talk. The total daily AWCs across the study were between 78-99th percentiles according to the LENA system comparisons with norming data. The LENA analysis, based on 16-hour recordings of the child, suggested that Ben was exposed to an average of 1414 words per hour across the study period. This calculation excluded zero AWC hours, to account for time when the child was sleeping. Based on the LENA transcripts from across the study, Ben heard on average 404 utterances, 2363 words and 429 different words, in 30 minutes of PCI.

Table 6.2 Summary of LENA Adult Word Count (AWC) for Ben at each time point

LENA measures	*t1 – 2;3*	*t2 – 2;6*	*t3 -2;10*	*t4 -3;1*
Total adult words	15663	16100	24449	17667
Hourly mean	1119	1238	2037	1262
Hourly range	42-2746	1-5036	191-3547	8-3931
5-minute mean	134	133	194	132
5-minute range	2-583	1-742	1-586	1-787

Characteristics of maternal language diversity appeared relatively stable over the study period. The overall type token ratio (TTR: number of different words/total number of words) for LENA samples ranged 0.19-0.23, and was just slightly higher for the TIM book-sharing sessions 0.24-0.29 (see Table 6.1). The number of different words Ben's mother used also appeared relatively stable over time but peaked at t4 with 438 different child-directed words.

6.1.1.2 Dialogue participation

Overall, Ben used fewer utterances than his mother at each time point. When utterances not directed at the child were removed, the difference between mother and child utterances was

reduced, and at t3 child utterances were higher than mother's utterances (Table 6.3). At t1, all six LENA samples included another child (Ben's sister) and at t2 half of the samples included another child (sister or friend), whereas at t4 only one of the six samples included another child. All t3 samples included another adult (Ben's grandmother). Eight of the 24 samples from across the study were dyadic interactions between mother and child, and the number of utterances in these samples was more equal (mean difference between mother and child was 19 utterances). The lower discrepancy between mother and child during dyadic interactions could be related to the ability to participate in conversations more equally in these contexts. There were two samples of dyadic interactions that were more mother dominated, during which Ben's mother was teaching him a game and reading him a book.

Assuming that the participation of mother and child was similar across the study, the most apparent change in dialogue participation over time was Ben's increasing turn length (see Table 5.1). At t1, Ben's mean turn length (in words) was 1.36, based on the six LENA samples, and by t4 it had tripled to 3.99. A similar but smaller increasing trend in turn length was found for the TIM sessions from 0.89 to 1.82 over the study period. Consistent with the increase in turn length was an increase in Ben's total words used across the study.

Table 6.3 Total utterances used by Ben and his mother based on SALT analysis of LENA transcripts

SALT utterances	*t1*	*t2*	*t3*	*t4*
Child	278	290	296	343
Mother (difference)	441 (163)	407 (117)	354 (58)	412 (69)
Mother: child-directed (difference)	368 (90)	357 (67)	261 (35)	401 (58)

LENA CTCs were based on temporally close parent and child speech, which was coded without content (see Table 4.6); therefore, the number of meaningful conversational turns between adults and child were counted for each of the PCI transcripts using the audio as a guide. The total number of turns was counted between all adults and the child and between the mother only and the child. As shown in Table 6.4 below, the total maternal and child turns at each time point was similar across the study. At t1, t2 and t4, more turns were mother initiated overall. However, the proportion of mother or child initiated turns varied across samples, showing dominance of both conversational partners on different occasions. For all TIM sessions the majority of turns were mother-initiated and there were few child initiated topics.

Table 6.4 Mother and child initiated turns (CT) and topics for each LENA sample and TIM session with Ben

	Clock time	*Total CT*	*Mother-child turns*	*Child-mother turns*	*Child topics*	*Mother topics*
t1	07:45:00	28	9	19	5	11
	09:15:00	36	16	20	5	7
	12:35:00	34	18	16	4	8
	12:45:00	24	18	6	0	5
	09:30:00	26	20	6	0	1
	07:40:00	26	19	7	1	5
	Total	**174**	**100**	**74**	**15**	**37**
	TIM	55	50	5	0	5
t2	17:25:00	31	29	2	1	4
	09:45:00	38	18	20	8	7
	09:50:00	35	16	19	6	4
	13:35:00	20	11	9	0	5
	17:40:00	18	7	11	3	6
	12:05:00	18	12	6	3	5
	Total	**160**	**93**	**67**	**21**	**31**
	TIM	95	80	15	0	6
t3	13:00:00	26	8	18	6	2
	14:55:00	21	11	10	7	3
	12:55:00	22	14	8	5	2
	12:40:00	20	8	12	2	0
	12:50:00	33	16	17	6	2
	14:50:00	27	16	11	4	4
	Total	**149**	**73**	**76**	**30**	**13**
	TIM	62	50	12	1	8
t4	17:20:00	26	14	12	8	9
	13:50:00	44	25	19	9	8
	13:35:00	27	19	8	5	20
	13:30:00	19	8	11	2	4
	15:10:00	29	18	11	7	6
	13:40:00	22	9	13	3	4
	Total	**167**	**93**	**74**	**34**	**51**
	TIM	76	56	20	2	7

Ben showed an increasing number of topic initiations from t1 (15) to t4 (34); however, Ben demonstrated fewer total topic initiations than his mother at all points except for t3. When topic initiations were included from the other adult present during all t3 samples the total was higher (23) but remained below the total number of child topic initiations. Out of the 18 five-minute samples at the other three time points, only four included more topics introduced by Ben than his mother.

6.1.1.3 Purpose and responsiveness of communicative acts

Table 6.5 outlines the overall frequency of lexically contingent characteristics in maternal speech, and their proportion of total maternal utterances directed at the child at each time point. The use of contingent responses accounted for approximately 10% of maternal utterances, except at t3 when there was a peak in the proportion of expansions, extensions and recasts. The proportion of interpretations declined over the study period. When utterances that were contingent on Ben's speech were combined with those that made reference to his current activity, these accounted for over a third of maternal utterances, expect at t2 where these only accounted for approximately a quarter of maternal utterances (see Figure 6.1). Examples of responsive utterances used over the study period are outlined below.

Ben: My daddy.
Mother: Daddy's shorts.
Ben: Yeah.
Mother: Very good.

Ben hanging out the washing with his mother
t1, sample 2

Ben: Mum church.
Mother: That is a big church there isn't it?
Ben: Yeah clock {pronounced <cock> /kɒk/}.
Mother: Do you know we {abandoned utterance}.
Mother: And a big clock, yeah!
Mother: When we go to the park you can hear the clock.
Ben: Yeah.
Mother: Do you remember went to the church at Christmas there?
Ben: Yeah.

Ben in the car with his mother
t2, sample 2

Mother: The trampoline was fine.
Mother: We cleaned that off.
Mother: I think that XX {interrupted}.
Ben: Daddy clean {pronounced <keen> /kin/} it off.
Mother: He did didn't he?
Mother: Daddy cleaned the trampoline off.
Grandmother: Daddy had to clean off did he?
Ben: Yeah, he clean {pronounced <keen> /kin/}.

Ben at home with his mother and grandmother
t3, sample 2

Mother: Out, out out my washing basket you cheeky what-not.
Ben: Please XX.
Mother: No.
Ben: Please you, please you just put me in there?

Mother: In the tumble-dryer?
Ben: Yeah, I be wash and clean.
Mother: You'll be all washed and clean.
Mother: I think I'd rather put you in the bath so you'd be all washed and clean.
Ben: No.
Mother: We normally put you in the bath.

Ben with his mother at home
t4, sample 6

Table 6.5 Frequency and proportion of lexically contingent maternal utterances during LENA samples with Ben

PCI characteristic	*t1*	*t2*	*t3*	*t4*
Expansions	4 (1%)	11 (3%)	14 (5%)	6 (1%)
Extensions	3 (1%)	3 (1%)	4 (2%)	1 (0.2%)
Recasts	2 (1%)	5 (1%)	11 (4%)	3 (1%)
Interpretation	14 (4%)	11 (3%)	6 (2%)	2 (0.5%)
Imitation	1 (0.3%)	11 (3%)	11 (4%)	11 (3%)
Total contingent	**24 (7%)**	**41 (11%)**	**46 (18%)**	**23 (6%)**
Reference to child activity	121 (33%)	57 (16%)	57 (22%)	132 (33%)
Child-directed utterances (total)	368 (441)	357 (407)	261 (354)	401 (412)

The pragmatic features of maternal language were relatively stable over the course of the study (Appendix J). Comments were the most common purpose of maternal speech, accounting for over a third of utterances at each time point. Requests for action were also common at t1, accounting for one in five maternal utterances. However, their proportion decreased across the study period to one in ten utterances at t4 and requests for information were more common than requests for action from t2 onwards. The proportion of *wh*-questions doubled over the study period but they remained relatively infrequent at each time point. Child utterances showed a decline over the study in the more basic pragmatic functions of bidding for another person's attention (14% to 3%) and use of conversational devices, such as 'yes' or 'no' responses (40% to 11%); as well as a decline in the use of fragment utterances (64% to 45%). In line with these changes, Ben exhibited an increase in the use of more complex utterances forms, including declaratives (0% to 10%), negative linguistic forms (0% to 6%) and overall question use.

6.1.1.4 Cognitive scaffolding

The Thorpe Interaction Measure (TIM) was used to assess the cognitive scaffolding (teaching behaviours) of parents in a context that remained the same at each time point across the study: mother and child looking at a picture-book together. The TIM coded behaviours used when looking at each of the 10 pictures in the book (see Table 4.2). On some occasions Ben wanted to look at the book again when they had finished, often to find his favourite picture,

additional TIM coding was not carried out but the sessions were transcribed and coded in full using SALT. Table 6.6 shows the frequency and proportion of each maternal teaching strategy used. The TIM scores demonstrated that maternal labelling (31%) and short elaboration (29%) were the most common teaching strategies at t1, similar results were found at t2, although short elaboration was then the most common (35%). Short elaboration remained the most common strategy at t3 (40%) and t4 (39%). By the end of the study labelling had declined (7%); however, the highest proportion (34%) was found at t3 just three months earlier. There was an overall increase in linking from t1 (7%) to t4 (20%) and an increase in concept structuring after t1. Ben was engaged in all four sessions and spent 81-99% of the time looking at the pictures in joint attention. Maternal responsivity and warmth were consistently high.

Table 6.6 Maternal teaching strategies used during TIM sessions with Ben

Teaching style	*t1*	*t2*	*t3*	*t4*
Labelling	26 (31%)	25 (22%)	22 (34%)	7 (7%)
Short elaboration	24 (29%)	39 (35%)	26 (40%)	38 (39%)
Long elaboration	14 (17%)	15 (13%)	5 (8%)	10 (10%)
Concept structuring	2 (2%)	8 (7%)	6 (9%)	8 (8%)
Linking	6 (7%)	16 (14%)	1 (2%)	20 (20%)
Child involvement – language	9 (11%)	9 (8%)	5 (8%)	11 (11%)
Child involvement – action	2 (2%)	0	0	4 (4%)
Total	83	112	65	98

The analysis of the TIM transcripts demonstrated very limited topic initiation from Ben (Table 6.4). Maternal MLUm was shorter during TIM sessions compared to LENA samples but relatively stable over time (Table 6.1). The proportion of maternal expansions during TIM sessions (Table 6.7) was higher at each time point than in the naturalistic LENA samples (Table 6.5). There was a greater proportion of interpretations in the TIM session at t1 compared to the LENA samples and imitations were generally higher in TIM sessions.

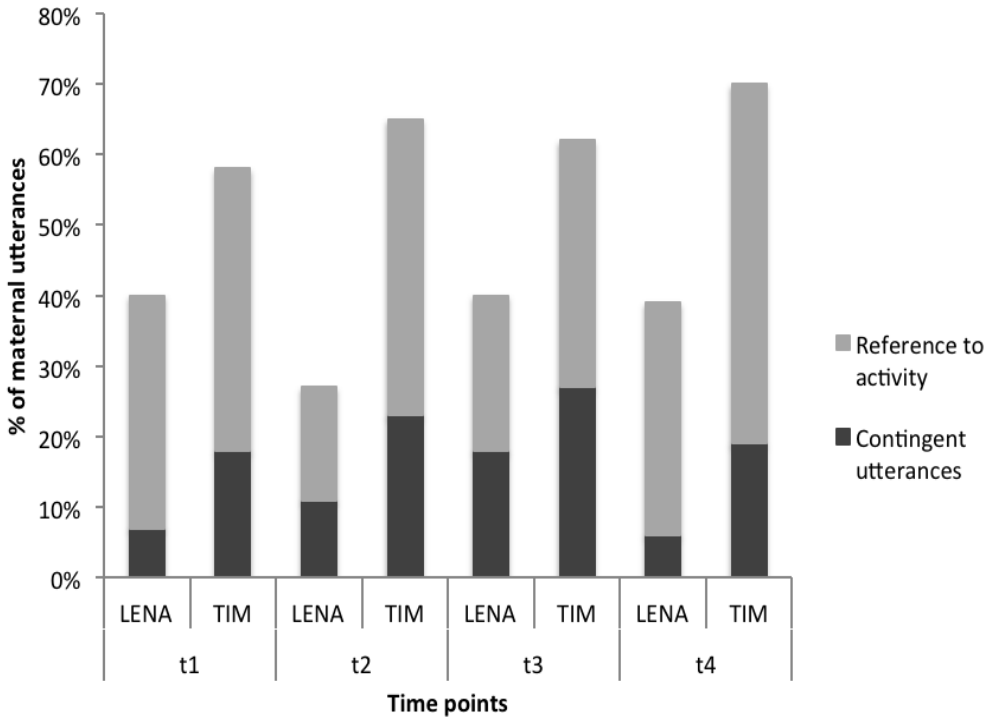

Figure 6.1 The proportion of maternal utterances that were contingent on the Ben's speech or made reference to his current activity during LENA and TIM samples

Across the study, maternal reference to the child's current activity was higher in TIM sessions and the total proportion of lexically contingent replies was also higher at each time point during TIM sessions compared to the LENA samples; when considered together these types of utterances accounted for approximately two thirds of maternal speech during TIM sessions (Figure 6.1). The same pattern in total contingent replies was found in both TIM and LENA samples: increasing from t1 to t3 and then declining at t4. The LENA and TIM recordings were carried out within a week of the LENA recordings but on a different day. Maternal total utterances were also much higher for TIM sessions (range 04:09 to 06:26 minutes) compared to individual five-minute LENA samples. The mean number of child directed utterances for individual LENA samples ranged from 44 to 67, less than half the total maternal utterances in TIM sessions.

Table 6.7 Frequency and proportion of maternal lexically contingent utterances during TIM sessions with Ben

PCI characteristic	*t1*	*t2*	*t3*	*t4*
Expansions	4 (4%)	17 (12%)	13 (11%)	3 (2%)
Extensions	2 (2%)	2 (1%)	2 (2%)	4 (2%)
Recasts	2 (2%)	6 (4%)	6 (5%)	7 (4%)
Interpretation	9 (8%)	6 (4%)	1 (1%)	1 (1%)
Imitation	3 (3%)	2 (1%)	9 (8%)	16 (10%)
Total contingent	**20 (18%)**	**33 (23%)**	**31 (27%)**	**31 (19%)**
Reference to child activity	45 (40%)	62 (42%)	40 (35%)	83 (51%)
Total utterances	113	146	115	164

In summary, Ben's mother demonstrated relatively stable amounts of talk and language complexity and diversity over the course of the study. There were more maternal than child utterances overall; however, at t3 when Ben's grandmother was present, there were more child utterances compared to maternal child-directed utterances. Dialogue participation between Ben and his mother was more equal during dyadic interactions. Over time, Ben was able to contribute longer turns as his language developed, but the topic of conversations was generally mother-initiated. The proportion of contingent replies in maternal utterances was smaller during naturalistic LENA samples (range 6-18%) compared to the picture-book sharing sessions (range 18-27%). References to the child's activity were also more common during TIM sessions, together with contingent utterances accounting for approximately two thirds of maternal talk. There was an increase in contingent replies at t3 compared to earlier in the study but the proportion declined again at t4 for both LENA and TIM samples. The purpose of maternal communicative acts remained similar across the study; comments were the most comment type of utterance. There was a decreasing trend over time in requests for action, while there were more requests for information and use of questions later in the study. Short elaboration and labelling were the most common teaching behaviours used during picture-book sharing across the study, except at t4 when labelling had decreased. There was an apparent overall increase in the use of linking and concept structuring over time.

6.1.2 Parent-child interaction with Christopher

Christopher showed a steady trajectory of vocabulary growth over the study period. His level of vocabulary delay remained relatively stable over time based on comparisons with the CDI median age equivalent scores.

6.1.2.1 Quantity, diversity and complexity of language

The SALT analysis of PCI transcripts from the LENA audio demonstrated no clear pattern of change regarding the quantity, diversity or complexity of Christopher's mother's language over time (Table 6.8). Total maternal words remained relatively stable across the study period, although there was some variation in the total number of utterances at each time point. The total number of adult words calculated by the automated LENA analysis varied across the study period, in contrast to the SALT analysis of the PCI samples, the highest number of adult words was recorded for t1 (Table 6.9). At t1, the high AWC was on the 94th percentile based on LENA norms. The counts at t2 and t3 were much lower falling below the 50th percentile (47th and 37th respectively). There are not LENA norms available after age 4;0; therefore, a comparison for Christopher at t4 was not appropriate. Across the four LENA recording days, Christopher heard an average of 1064 words per hour based on the automated AWCs. The SALT measures of language during the 30-minutes of PCI suggested higher rates of talking: averaged across the study period Christopher heard 368 utterances, 348 different words and 1992 words in 30 minutes of maternal speech. However, the transcribed samples were selected precisely because they were examples of high-level interaction. It is also important to note that the automated LENA AWCs include all adults near to the child. Variation in the number of adults present and their interaction with the child would influence the counts.

Table 6.8 Maternal SALT data from Christopher's LENA and TIM transcripts (*Note*: Figures from child-directed utterances only shown in brackets)

SALT category	*LENA t1*	*TIM t1*	*LENA t2*	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	411 (380)	91	343 (292)	121	407 (353)	46	310 (252)	64
Total words	2015	445	2134	115	2035	272	1782	357
MLU words	5.01 (5.01)	4.68	6.33 (6.39)	4.85	4.95 (5.04)	5.68	5.65 (5.07)	5.54
MLU morphemes	5.5 (5.49)	5.46	6.89 (6.97)	5.64	5.5 (5.63)	6.66	6.35 (5.69)	6.44
No. different words	333 (313)	120	392 (387)	147	284 (264)	96	384 (298)	118
No. total words	1820 (1693)	407	1981 (1867)	558	1845 (1622)	250	1479 (1090)	349
Type/token ratio	0.18 (0.18)	0.29	0.2 (0.21)	0.26	0.15 (0.16)	0.38	0.26 (0.27)	0.34
Mean turn length	10.02	6.53	10.14	7.57	8.86	8.06	10	8.59
Intelligible utterances	92%	97%	93%	99%	93%	98%	89%	100%

Note: Number of different words and number of total words and MLU are based on clear and intelligible utterances only

Table 6.9 Summary of LENA Adult Word Count (AWC) for Christopher at each time point

LENA measures	*t1 – 3;6*	*t2 – 3;9*	*t3 – 4;0*	*t4 – 4;3*
Total adult words	20000	11812	10948	14293
Hourly mean	1429	1074	730	1021
Hourly range	167-3941	48-3411	7-3310	4-3449
5-minute mean	140	109	85	125
5-minute range	1-751	2-659	1-737	1-945

Maternal MLU in morphemes (MLUm) was very similar at t1, t3 and t4, particularly when considering only utterances directed at the child (range 5.49-5.69). At t2 maternal MLUm was higher (6.97) than other time points; however, the range was also greatest at t2 (3.68-10.64). Maternal MLUm was highest during a sample in which she was reading a book to Christopher and this may have contributed to the higher overall MLUm. In contrast, maternal MLUm during the TIM sessions was higher at t3 and t4. There was some variation in maternal TTR at different time points, ranging from 0.15-0.26, the highest found at t4. The TIM session TTRs were higher, ranging from 0.26-0.38, the highest was found at t3. The number of different child-directed words was generally fairly constant although it was highest at t2 (Figure 6.6). As with maternal MLUm, it is possible that the book reading sample contributed to this increased measure of language diversity; Christopher's mother used 224 different words in the five-minute LENA book reading sample alone.

6.1.2.2 Dialogue participation

At each time point Christopher used fewer utterances than his mother (Table 6.10). In 22 of the 24 samples taken from the LENA recordings, Christopher's sister was present. Child-directed utterances included those that were directed to both the key child and other interlocutors, and his sister's presence may be related to increased maternal utterances, as her attention had to be split between them both. There are other adults present in a number of the samples, including Christopher's grandmother in eight samples, which might have also influenced the conversations that took place. There were only two transcribed dyadic interactions between Christopher and his mother; therefore, it is difficult to compare these samples to determine whether they were different to interactions with multiple people present. Over the study period, Christopher's mean turn length (in words) almost tripled from 1.21 at t1 to 3.4 at t4 (Table 5.2). The largest increase of 1.5 words was found between t3 and t4. Similarly, the largest increase in Christopher's total number of words produced during clear and intelligible utterances was found between t3 and t4 (210 words).

Table 6.10 Total utterances used by Christopher and his mother based on SALT analysis of LENA transcripts

SALT utterances	*t1*	*t2*	*t3*	*t4*
Child	241	249	190	215
Mother (difference)	411 (170)	343 (94)	407 (217)	310 (95)
Mother: child-directed (difference)	380 (139)	292 (43)	353 (163)	252 (37)

At t1 and t2 the majority of turns were initiated by Christopher's mother (Table 6.11). At t3, mother-initiated turns were more common but there was a smaller discrepancy. During the final time point, Christopher initiated more turns than his mother. In contrast, during every TIM session there were more mother-initiated topics. Across the whole study Christopher introduced fewer topics than his mother; there were more child topics in only two of the 24 LENA samples. However, Christopher showed an increase in the number of topics introduced from t1 (3) to t4 (17) as his proportional contribution increased from 9% to 43%.

Table 6.11 Mother and child initiated turns (CT) and topics for each LENA sample and TIM session with Christopher

	Clock time	*Total CT*	*Mother-child turns*	*Child-mother turns*	*Child topics*	*Mother topics*
t1	13:30:00	10	3	7	1	3
	14:40:00	23	16	7	0	5
	14:45:00	43	41	2	1	5
	14:50:00	36	26	10	1	6
	17:50:00	13	9	4	0	5
	11:05:00	23	16	7	0	6
	Total	**148**	**111**	**37**	**3**	**30**
	TIM	44	36	8	2	6
t2	11:35:00	27	20	7	0	4
	13:15:00	19	16	3	0	2
	14:35:00	21	16	5	2	3
	13:10:00	20	15	5	0	2
	13:20:00	23	18	5	1	3
	11:10:00	20	16	4	0	2
	Total	**130**	**101**	**29**	**3**	**16**
	TIM	62	52	10	2	5
t3	14:00:00	18	11	7	0	7
	15:25:00	23	15	8	5	8
	10:10:00	23	6	17	0	3
	15:05:00	13	5	8	0	2
	15:00:00	14	13	1	0	4
	14:05:00	20	17	3	1	3
	Total	**111**	**67**	**44**	**6**	**27**
	TIM	31	22	9	2	1

	Clock time	*Total CT*	*Mother-child turns*	*Child-mother turns*	*Child topics*	*Mother topics*
t4	15:50:00	23	10	13	3	4
	15:25:00	12	6	6	4	1
	15:30:00	24	6	18	4	2
	06:55:00	20	11	9	2	6
	07:55:00	17	4	13	1	4
	06:45:00	30	15	15	3	6
	Total	**126**	**52**	**74**	**17**	**23**
	TIM	38	33	5	1	2

6.1.2.3 Purpose and responsiveness of communicative acts

The proportion of contingent maternal responses ranged 4-12% across the study but there was no clear increasing or decreasing trend over time (Table 6.12). At t1, interpretations were the most common contingent response, which declined over the study period, in line with a reduction of unclear child utterances. Expansions, extensions and recasts were uncommon at most time points, although they increased at t4 to7%. Approximately a third of utterances at each time point were either contingent on Christopher's previous utterances or relevant to his current activity. The most common purpose of maternal utterances was commenting (range 32-45%), followed by requests for information and action (Appendix J). The proportion of *wh*-questions decreased over time while the use of other question types remained relatively stable. Question use accounted for approximately a third of utterances although this decreased at t3. The most apparent change in Christopher's language was his decline in unintelligibility; 73% of his utterances were classed as unclear at t1 compared to only 13% at t4. Christopher's use of conversational devices also declined over time. The majority of Christopher's clear utterances were classed as fragments at each time point. Examples of responsive interactions used over time are outlined below.

Christopher: Yellow {pronounced <gelo> /gɛləʊ/}.
Mother: Yellow.
Mother: Two, well done.
Mother: Any more?
Mother: Have a look.
Mother: I can see a couple more can you?
Christopher: XXX {unintelligible}.
Mother: One.
Christopher: XXX.
Mother: Two.

Christopher doing an activity book with his mother
t1, sample 4

Mother: Yeah but what colour is Pippo's hat?
Mother: It's got two colours.
Christopher: Er, green, white {pronounced <deen> /din/ and <dite> /daɪt/}.

Mother: What colour?
Christopher: Red.
Mother: No it's not red.
Mother: He's got, Tom's got red shorts on.
Mother: What colour's Pippo's hat?
Christopher: X red {pronounced <ded> /dɛd/}.
Mother: It is blue and white.

Christopher reading with his mother
t2, sample 1

Christopher: Mummy paint nail.
Mother: Yeah XX {unintelligible}.
Christopher: [Friends' name 1] paint nails.
Mother: [Friends' name 1] yeah, but [Friends' name 1]'s a girl love.
Christopher: Yeah [Friends' name 2], [Friends' name 2] boy.
Mother: [Friends' name 2]'s a boy, yeah.
Christopher: [Friends' name 3] girl.
Mother: [Friends' name 3]'s a girl.

Christopher talking to mother at home
t3, sample3

Christopher: Mummy.
Mother: Hh, that's a brilliant fish.
Christopher: XX {unintelligible} eye.
Mother: That is an eye.
Mother: And does it need a smile?
Mother: Ah, go and show [Grandmother] your fish.
Mother: That's a lovely fish.

Christopher drawing at grandparents' house
t4, sample 2

Table 6.12 Frequency and proportion of lexically contingent maternal utterances used with Christopher during LENA samples

PCI characteristic	t1	t2	t3	t4
Expansions	0	1 (0.3%)	5 (1%)	3 (1%)
Extensions	0	1 (0.3%)	0	8 (3%)
Recasts	0	3 (1%)	2 (1%)	8 (3%)
Interpretation	16 (4%)	7 (2%)	4 (1%)	1 (0.4%)
Imitation	2 (1%)	6 (2%)	2 (1%)	11 (4%)
Total contingent	**18 (5%)**	**18 (6%)**	**13 (4%)**	**31 (12%)**
Reference to child activity	113 (30%)	72 (25%)	106 (30%)	59 (23%)
Child-directed utterances (total)	380 (411)	292 (343)	353 (407)	252 (310)

6.1.2.4 Cognitive scaffolding

Christopher was particularly interested in the video camera that was used to record the TIM sessions and at t1 and t2 he got up a number of times to look through the lens. The TIM scores show that short and long elaborations were the most common teaching strategies at each time point (Table 6.13). Collectively, elaborations accounted for the majority of maternal

teaching strategies used (58-78%). Labelling was uncommon across the study (≤5%). There was an overall increase in the proportion of concept structuring over time, while the proportion of linking declined. Overall, involving the child remained relatively stable over the study period (10-13%); however, involvement through language was more common at the start of the study and involvement through action was more common in the latter half of the study.

Table 6.13 Maternal teaching strategies used during TIM sessions with Christopher

Teaching style	*t1*	*t2*	*t3*	*t4*
Labelling	3 (5%)	1 (2%)	0	2 (4%)
Short elaboration	16 (26%)	20 (32%)	17 (43%)	12 (26%)
Long elaboration	27 (44%)	17 (27%)	14 (35%)	15 (32%)
Concept structuring	0	10 (16%)	2 (5%)	10 (21%)
Linking	8 (13%)	9 (14%)	2 (5%)	3 (6%)
Child involvement – language	6 (10%)	6 (10%)	1 (3%)	1 (2%)
Child involvement – action	1 (2%)	0	4 (10%)	4 (9%)
Total	61	63	40	47

The analysis of the TIM transcripts found that Christopher's mother predominantly initiated turns during the book-sharing sessions at each time point, and Christopher initiated very few topics (Table 6.11). Maternal MLUm was longer at t3 and t4 during TIM sessions compared to the LENA samples. The proportion of maternal expansions and recasts during TIM sessions was greater at each time point (Table 6.14) compared to LENA transcripts (Table 6.12) and both were highest at t3. Similar to the LENA samples of PCI, there was a reduction in the proportion of interpretations over time during the TIM sessions. The overall proportion of contingent utterances was much higher at t1 to t3 although it was similar at t4 to the LENA transcripts (Figure 6.2). During TIM sessions the majority of maternal speech was either contingent on Christopher's speech or made reference to his current activity, demonstrating the focused nature of these interactions.

Table 6.14 Frequency and proportion of maternal lexically contingent utterances during TIM sessions with Christopher

PCI characteristic	*t1*	*t2*	*t3*	*t4*
Expansions	0	1 (1%)	6 (13%)	2 (3%)
Extensions	0	0	0	0
Recasts	1 (1%)	4 (3%)	3 (7%)	3 (5%)
Interpretation	14 (15%)	7 (6%)	1 (2%)	0
Imitation	0	2 (2%)	1 (2%)	2 (3%)
Total contingent	**15 (16%)**	**14 (12%)**	**11 (24%)**	**7 (11%)**
Reference to child activity	40 (44%)	62 (51%)	29 (63%)	40 (63%)
Total utterances	91	121	46	64

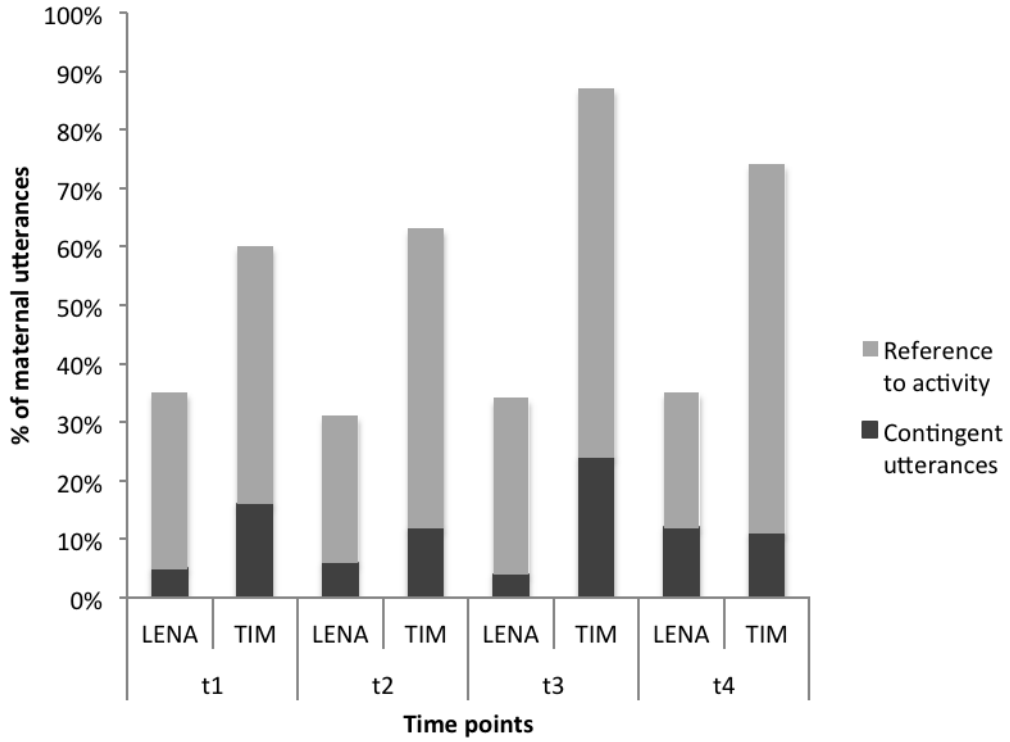

Figure 6.2 The proportion of maternal utterances that were contingent on Christopher's speech or made reference to his current activity during LENA and TIM samples

In summary, despite variation in the number of maternal utterances, the total number of maternal words appeared relatively stable over time. There was variation in maternal language complexity across the study period. During the LENA samples maternal MLUm was longest at t2, which also included the highest number of different words, whereas for TIM samples MLUm was longest at t3 and t4. Throughout the study there was not always equal participation in interactions between Christopher and his mother, particularly at t1 and t3, and his mother often introduced more topics. However, as Christopher's language developed he contributed longer and more frequent turns with a more equal share in topics at the end of the study period.

The proportion of interpretations was 4% at the start of the study and this declined over time. The use of expansions, extensions and recasts was infrequent during LENA samples at the first three time points (0-2%) but was slightly increased at t4 (7%). In contrast, these three types of contingent utterances were more common during TIM sessions and the highest proportion was found at t3 (20%). Approximately a third of maternal speech was contingent on Christopher's language or made reference to his current activity during LENA samples, compared to between 60% and 87% during TIM sessions. Comments were the most common

type of utterance during LENA samples, followed by requests for action or information. Approximately a third of utterances were classed as questions across the study, except for at t3 when questions were less common. During TIM sessions the most common teaching behaviours used were short and long elaboration. Labelling was not common and concept structuring increased over time.

6.1.3 Parent-child interaction with Aaron

Aaron had the largest vocabulary size of the four children at the start of the study period. He showed a relatively steady trajectory of growth over time and the extent of Aaron's vocabulary delay was consistent over the study period based on comparisons with the CDI median age equivalent scores.

6.1.3.1 Quantity, diversity and complexity of language

Despite some variation across time points, there was no apparent change in the amount of maternal talk or the diversity or complexity of maternal language during the LENA samples; however, an increasing trend for the amount and diversity of language was found during the picture-book sharing sessions. Maternal MLUm remained stable over time, although the overall MLUm at the start of the study, as well as the range across the different samples, was slightly lower compared to later time points. Compared to the LENA samples, maternal MLUm was shorter for TIM sessions (Table 6.15). The amount of maternal talk was similar at t1, t3 and t4, while measures of total words were higher at t2. The automated analysis of the whole-day audio suggested that the total amount of adult speech (AWC) was similar across the study (Table 6.16) but the hourly mean was higher at t3. The AWCs were between 51st and 69th percentile based on LENA comparisons with norming data. Over the study period, the LENA automated counts suggested that Aaron was exposed to 1167 words per hour on average. The transcribed LENA samples suggested that Aaron was exposed to 282 utterances, 1387 words and 271 different words on average in 30-minutes of maternal speech.

Table 6.15 Maternal SALT data from Aaron's LENA and TIM transcripts (*Note*: Figures from child-directed utterances only shown in brackets)

SALT category	*LENA t1*	*TIM t1*	*LENA t2*	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	295	62	387 (374)	85	214	87 (86)	230	95
Total words	1288	220	2071	295	991	331	1199	366
MLU words	4.45	3.57	5.27 (5.21)	3.34	4.7	3.77 (3.76)	5.14	3.84
MLU morphemes	4.9	4.41	5.66 (5.59)	4.23	5.33	4.48 (4.47)	5.59	4.78
No. different words	268	77	303 (290)	81	242	99 (97)	270	107
No. total words	1214	218	1917 (1861)	277	935	328 (323)	1105	365
Type/token ratio	0.22	0.35	0.16 (0.16)	0.29	0.26	0.3 (0.3)	0.24	0.29
Mean turn length	7.04	6.64	10.58	5.02	7.73	6.19	7.84	6.52
Intelligible utterances	94%	98%	96%	99%	94%	100%	95%	100%

Note: Number of different words and number of total words and MLU are based on clear and intelligible utterances only

Table 6.16 Summary of LENA Adult Word Count (AWC) for Aaron at each time point

LENA measures	*t1 – 3;2*	*t2 – 3;6*	*t3 – 3;9*	*t4 – 4;0*
Total adult words	12213	12931	13569	13818
Hourly mean	1018	1078	1508	1063
Hourly range	269-2805	17-2377	786-3020	1-1990
5-minute mean	105	111	141	107
5-minute range	1-699	2-466	2-616	1-488

Maternal language diversity based on the number of different words used appeared relatively stable over time (242-290 words) despite a much higher total number of words used at t2 (Table 6.15). Aaron's mother used approximately twice as many words in total at t2; therefore, TTR was lower (0.16) at t2 compared to the other time points (0.22-0.26). The TTR for maternal language used during TIM sessions (0.29-0.35) was higher compared to the LENA samples. Furthermore, the number of different words (77 to 107) and the total number of words (220 to 366) were found to increase at each time point for the TIM sessions.

6.1.3.2 Dialogue participation

The LENA samples for Aaron were almost exclusively of dyadic mother-child interactions, except for one sample at t2 during which Aaron and his mother spoke to his grandmother over the phone. Overall, Aaron used more utterances than his mother except at t2 (Table 6.17); however, participation in interactions varied across the individual five-minute samples. In contrast, at t2 all LENA individual samples were dominated by Aaron's mother. Aaron's mean turn length (words) increased from 2.61 to 7.35 over time, to almost three times longer at the end of the study (Table 5.3). Aaron's turn length during TIM sessions was much shorter but also demonstrated an increase over time.

Table 6.17 Total utterances used by Aaron and his mother based on SALT analysis of LENA transcripts

SALT utterances	*t1*	*t2*	*t3*	*t4*
Child	321	304	229	312
Mother: child-directed (difference)	295 (26)	374 (70)	214 (15)	230 (82)
Mother (difference)	As above	387 (83)	As above	As above

The total number of turns initiated by either the mother or child was very similar at the first three time points while at t4 there were slightly more child-initiated turns (55%) (Table 6.18). However, dominance from both interaction partners was found across the individual samples at each time point. The proportion of topic initiations also varied across individual samples, but overall more topics were mother-initiated at t1 and t4, while it was more equal at t2 and t3.

The TIM sessions, in contrast were all dominated by Aaron's mother regarding turn and topic initiation.

Table 6.18 Mother and child initiated turns (CT) and topics for each LENA sample and TIM session with Aaron

	Clock time	*Total CT*	*Mother-child turns*	*Child-mother turns*	*Child topics*	*Mother topics*
t1	14:35:00	24	11	13	3	3
	10:15:00	19	15	4	3	6
	10:40:00	30	11	19	5	5
	10:30:00	17	8	9	4	5
	17:00:00	47	35	12	2	11
	11:10:00	28	5	23	4	6
	Total	**165**	**85**	**80**	**21**	**36**
	TIM	32	31	1	0	5
t2	11:35:00	37	9	28	8	7
	13:40:00	37	16	21	10	5
	13:00:00	27	14	13	3	7
	13:05:00	27	18	9	0	3
	12:50:00	24	14	10	4	3
	15:30:00	36	21	15	7	8
	Total	**194**	**92**	**96**	**32**	**33**
	TIM	56	51	5	1	3
t3	12:25:00	28	8	20	6	2
	12:45:00	25	23	2	3	1
	19:05:00	26	0	26	7	1
	14:15:00	15	8	7	1	5
	14:05:05	22	16	6	1	3
	13:30:00	13	7	6	1	3
	Total	**129**	**62**	**67**	**19**	**15**
	TIM	48	45	3	2	4
t4	17:40:00	40	12	28	2	7
	18:30:00	24	7	17	2	1
	18:50:00	17	10	7	3	0
	10:50:00	25	12	13	4	4
	17:45:00	23	10	13	3	4
	17:55:00	17	14	3	5	1
	Total	**146**	**65**	**81**	**9**	**17**
	TIM	55	53	2	0	2

6.1.3.3 Purpose and responsiveness of communicative acts

The proportion of maternal utterances that were contingent on Aaron's speech, or made reference to his current activity, ranged between one and two fifths over the study, and was highest at t2 (Table 6.19). The use of interpretations and imitations was low (0-3%) and

decreased over time. The proportion of expansions, extensions and recasts remained at approximately 6% across the study. The different pragmatic functions of maternal utterances also stayed relatively constant over time (Appendix J). At each time point, comments were the most common (30-41%) followed by requests for action (23-31%). Over the study period Aaron's proportion of unclear utterances decreased from 42% to 8%. The use of less complex utterances including bids for attention (5%), conversational devices (17%) and fragments (48%) at the start of study declined over time. On the other hand, the use of more sophisticated utterances such as declaratives and questions increased. Examples of responsive utterances used with Aaron over time are outlined below.

Aaron: No, boat.
Mother: Row row row your boat.
Aaron: Yeah, boat please.
Mother: You can't go in the boat cuz mummy won't go out in the boat darling.

Aaron on a trip with his mother
t1, sample 1

Mother: Yeah microwave don't work.
Aaron: He bang.
Mother: He went bang, yeah.

Aaron and his mother talking at home
t2, sample 1

Aaron: You, you take picture of me?
Mother: I take a picture for you?
Aaron: Yeah.
Mother: Come on then let's take a picture for you then.
Mother: In your lovely little waistcoat.
Mother: Give us a smile then.

Aaron and his mother talking at home
t3, sample 1

Mother: It can go in the fridge.
Aaron: I want a juicy one.
Mother: You want a juicy one?
Aaron: Yes.
Mother: Right, can you go in and sit down for me then a minute?

Aaron and his mother talking at home
t4, sample 1

Table 6.19 Frequency and proportion of lexically contingent maternal utterances during LENA samples with Aaron

PCI characteristic	t1	t2	t3	t4
Expansions	5 (2%)	8 (2%)	1 (0.5%)	4 (2%)
Extensions	2 (1%)	4 (1%)	3 (1%)	0
Recasts	9 (3%)	13 (3%)	8 (4%)	9 (4%)
Interpretation	4 (1%)	2 (1%)	0	0
Imitation	8 (3%)	6 (2%)	4 (2%)	3 (1%)
Total contingent	**28 (9%)**	**33 (9%)**	**16 (7%)**	**16 (7%)**
Reference to child activity	66 (22%)	127 (34%)	29 (14%)	58 (25%)
Child-directed utterances (total)	295	374 (387)	214	230

6.1.3.4 Cognitive scaffolding

During all TIM sessions, labelling and short elaboration were the most common strategies used by Aaron's mother, accounting for the majority (62-92%) of maternal teaching style at each time point (Table 6.20). The proportion of these two strategies combined was lowest at t4 and the proportion of concept structuring had increased by the end of the study (24%). Long elaboration was only used three times, all during the last TIM session, and there was some infrequent use of linking. Attempts to actively involve Aaron varied across the study period. The total frequency of teaching behaviours increased over time, which was consistent with an increase in the total length of the TIM sessions from two minutes and 17 seconds at t1 to three minutes and 45 seconds at t4. Aaron was engaged for all four sessions and spent 98-100% of his time in joint attention looking at the pictures with his mother. Maternal MLUm was shorter during TIM sessions but remained relatively stable over the study period.

Table 6.20 Maternal teaching strategies used during TIM sessions with Aaron

Teaching style	*t1*	*t2*	*t3*	*t4*
Labelling	9 (18%)	24 (41%)	28 (44%)	23 (31%)
Short elaboration	31 (62%)	30 (51%)	22 (34%)	23 (31%)
Long elaboration	0	0	0	3 (4%)
Concept structuring	3 (6%)	0	11 (17%)	18 (24%)
Linking	1 (2%)	4 (7%)	2 (3%)	0
Child involvement – language	5 (10%)	1 (2%)	1 (2%)	7 (9%)
Child involvement – action	1 (2%)	0	0	0
Total	50	59	64	74

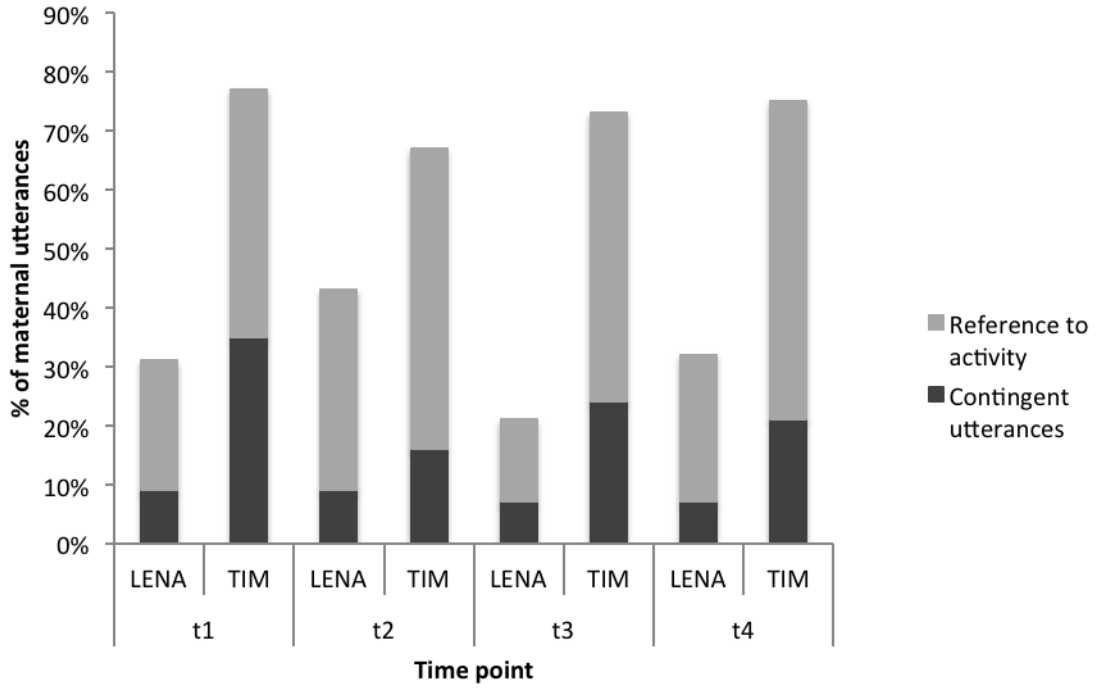

Figure 6.3 The proportion of maternal utterances that were contingent on Aaron's speech or made reference to his current activity during LENA and TIM samples

There was a much higher proportion of maternal utterances that were contingent on child speech (16-35%) or made reference to his current activity (42-54%) during the picture-book sessions, accounting for over two thirds of all utterances (Figure 6.3). Contingent replies were more common compared to LENA samples and the proportion of expansions was higher during TIM sessions (Table 6.21). Aaron's mother only used interpretations at t1 showing a similar trend to decline that was found for the LENA samples. However, the proportion of imitations, which declined in the LENA samples, was found to double over the study from 6% to 13% during TIM samples.

Table 6.21 Frequency and proportion of maternal lexically contingent utterances during TIM sessions with Aaron

PCI characteristic	*t1*	*t2*	*t3*	*t4*
Expansions	8 (13%)	5 (6%)	9 (10%)	6 (6%)
Extensions	0	1 (1%)	2 (2%)	1 (1%)
Recasts	4 (6%)	2 (2%)	2 (2%)	1 (1%)
Interpretation	6 (10%)	0	0	0
Imitation	4 (6%)	6 (7%)	9 (10%)	12 (13%)
Total contingent	**22 (35%)**	**14 (16%)**	**22 (24%)**	**20 (21%)**
Reference to child activity	26 (42%)	43 (51%)	42 (49%)	51 (54%)
Total utterances	62	85	86	95

In summary, the amount of maternal talk and language complexity remained relatively stable over the course of the study, although talkativeness was higher at t2. Maternal language diversity also remained stable during LENA samples across the study. In contrast, the total words and number of different words used during TIM sessions increased over time. There were more maternal than child utterances at t2, consistent with increased maternal talk at this time, while at the other time points Aaron produced more utterances. The proportion of mother- or child-dominated turns and topic initiations varied across individual five-minute samples but were generally evenly distributed; however, there were more child-initiated turns at t4 and more topics initiated by Aaron's mother at t1 and t4.

Responsive maternal utterances accounted for less than 10% of maternal talk during LENA samples; interpretations and imitations decreased over the study while the use of expansions, extensions and recasts remained stable. Maternal speech that were contingent on the child's language or made reference to the child's activity accounted for between 21% and 43% of utterances from these samples. Comments and requests for action were the most common purposes of maternal speech. Responsiveness was more common during picture-book sessions, the use of expansions, extensions and recasts was higher compared to the LENA samples (range 8-19%), and combined with references to the child's activity accounted for at least a third (67-77%) of maternal utterances. Labelling and short elaboration were the most common teaching strategies used during TIM sessions, and the use of concept structuring increased over time.

6.1.4 Parent-child interaction with Daniel

Daniel had the smallest vocabulary size at the start of the study and he showed the slowest rate of growth over time. Due to the limited growth in Daniel's vocabulary size, the extent of his delay relative to his age increased across the study period. While the other three children showed trajectories of growth that were similar to TD children but at a later chronological age, Daniel showed a trajectory of growth that progressed at a much slower pace.

6.1.4.1 Quantity, diversity and complexity of language

Maternal language remained relatively stable over the study period regarding talkativeness, diversity and complexity (Table 6.22). There were fewer total maternal utterances at t2 but this was because there were only three five-minute samples transcribed from the recording, rather than six.

Table 6.22 Maternal SALT data from Daniel's LENA and TIM transcripts (*Note*: Figures from child-directed utterances only shown in brackets)

SALT category	*LENA t1*	*TIM t1*	*LENA t2**	*TIM t2*	*LENA t3*	*TIM t3*	*LENA t4*	*TIM t4*
Total utterances	235 (167)	83	87 (78)	87	205 (158)	106	252 (195)	82
Total words	1096	316	394	344	1115	433	1370	306
MLU words	4.87 (4.61)	3.79	4.93 (4.89)	3.92	5.36 (4.74)	4.09	5.7 (5.36)	3.64
MLU morphemes	5.5 (5.2)	4.44	5.48 (5.47)	4.56	6.01 (5.37)	4.67	6.19 (5.82)	4.31
No. different words	247 (173)	100	146 (134)	106	296 (213)	124	301 (238)	101
No. total words	988 (655)	307	360 (313)	337	970 (673)	413	1186 (853)	291
Type/token ratio	0.25 (0.26)	0.33	0.41 (0.43)	0.31	0.31 (0.32)	0.3	0.25 (0.28)	0.35
Mean turn length	6.98	8.49	6.29	8.37	6.75	7.4	7.81	7
Intelligible utterances	87%	99%	84%	99%	89%	98%	85%	98%

Note: Number of different words and number of total words and MLU are based on clear and intelligible utterances only

* The LENA recorder was worn at nursery but without consent from staff and parents; therefore, only three samples were transcribed from t2 and consequently the total number of words and utterances are lower than other time points from which six samples were taken.

The SALT analyses of the LENA transcripts of high-level interaction suggested that Daniel heard on average (excluding t2) 231 utterances, 1194 words and 281 different words in 30-minutes of maternal speech. The total number of adult words based on the LENA automated counts varied across the four time points (Table 6.23). Daniel wore the recorder at nursery at t2, as there would have been a number of adults in the environment for most of the day this would have impacted on the LENA count. The hourly means and ranges suggested that Daniel was exposed to the least adult talk over the whole recording day at t1. Across the study AWC was below the 50th percentile based on LENA comparisons with norming data; at t1 AWC was in the 3rd percentile and at other time points it was between the 18th and 41st percentiles. Overall the LENA counts (excluding t2) suggested that Daniel was exposed to 611 words per hour on average.

Table 6.23 Summary of LENA Adult Word Count (AWC) for Daniel at each time point

LENA measures	*t1 – 2;10*	*t2 – 3;2*	*t3 – 3;4*	*t4 – 3;8*
Total adult words	6084	12094	10104	8810
Hourly mean	468	756	632	734
Hourly range	29-1477	10-3843	17-2209	89-2027
5-minute mean	56	91	73	76
5-minute range	1-323	1-640	1-351	2-386

Maternal MLUm remained relatively stable over time but showed a small increasing trend over the study (Table 6.22) but MLUm ranged across the individual five-minute samples. Maternal MLUm during TIM sessions was slightly shorter compared to the LENA samples but also appeared stable over time. Maternal language diversity was relatively stable based on TTR scores for child-directed speech at t1, t3 and t4 (0.26-0.32), although TTR was slightly higher at t2 (0.43) this may be related to the shorter time sampled. The TTR for TIM sessions also appeared stable over the study (0.3-0.35). The total number of different words used showed a slight increasing trend over time from 173 to 238 (excluding t2) in child-directed speech.

6.1.4.2 Dialogue participation

Daniel used more utterances than his mother at each time point in the study compared to both total maternal utterances and child-directed utterances (Table 6.24). There were no dyadic mother-child interactions transcribed and there were only six five-minute samples over the study in which Daniel's mother used more utterances than he did. There were other people present in all 21 LENA samples that were transcribed; most often this was Daniel's sister and/or father, and at t3 five samples included Daniel's grandparents. Daniel's overall turn length in words did not increase across the study; it ranged 1.53-2.07 but was actually highest at t1 (Table 5.4). The mean turn length during TIM sessions was similar (1.14-1.57) although it did show a small overall increase over time.

Table 6.24 Total utterances used by Daniel and his mother based on SALT analysis of LENA transcripts

SALT utterances	*t1*	*t2*	*t3*	*t4*
Child	247	141	242	257
Maternal total (difference)	235 (12)	87 (55)	205 (37)	252 (5)
Maternal child-directed (difference)	167 (80)	78 (63)	158 (84)	195 (62)

The total number of mother-child turns at each time point was similar taking into account the fact that only half the number of LENA samples were available at t2 for transcription (Table 6.25). The proportion of turns initiated by either Daniel or his mother was similar at each stage, although at t1 more turns were child-initiated (53%) and for the remaining time points more turns were mother-initiated (52-57%). At t1, there were more mother-initiated topics (77%), this was also the case at t2 and t3 but the proportion of topics introduced was more evenly shared between Daniel and his mother (56-58%). At t4, Daniel initiated slightly more topics than his mother. During all TIM sessions there were more mother initiated turns and topics.

Table 6.25 Mother and child initiated turns (CT) and topic initiations for LENA sample and TIM session with Daniel

	Clock time	*Total CT*	*Mother-child turns*	*Child-mother turns*	*Child topics*	*Mother topics*
t1	09:20:00	20	10	10	1	6
	15:45:00	13	7	6	4	2
	17:30:00	9	7	2	0	3
	13:25:00	12	7	5	0	5
	17:40:00	13	3	8	1	5
	17:55:00	16	3	13	1	3
	Total	**83**	**37**	**44**	**7**	**24**
	TIM	38	27	11	0	4
t2	07:15:00	24	17	7	2	4
	07:10:00	7	0	7	1	2
	07:20:00	10	5	5	5	4
	Total	**41**	**22**	**19**	**8**	**10**
	TIM	41	31	10	0	3
t3	12:45:00	27	14	13	1	6
	13:45:00	13	8	5	1	2
	13:40:00	12	10	2	1	2
	14:05:00	16	13	3	0	3
	13:05:00	9	1	8	4	0
	10:20:00	17	3	14	3	1
	Total	**94**	**49**	**45**	**10**	**14**
	TIM	52	33	19	0	5

	Clock time	*Total CT*	*Mother-child turns*	*Child-mother turns*	*Child topics*	*Mother topics*
t4	08:00:00	33	28	5	2	6
	10:25:00	17	11	6	1	5
	13:15:00	10	7	3	1	2
	17:55:00	13	3	10	6	0
	12:40:00	14	2	12	7	1
	10:45:00	12	5	7	3	2
	Total	**99**	**56**	**43**	**20**	**16**
	TIM	42	30	12	0	3

6.1.4.3 Purpose and responsiveness of communicative acts

Maternal utterances that were contingent on Daniel's speech, or made reference to his activity, accounted for between one and two fifths of total maternal speech (Table 6.26). Contingent maternal utterances ranged 5-13% but did not show a clear increasing or decreasing trend over time. The use of expansions, extensions, recasts and imitations remained below 5%. The use of interpretations was more common but there was an overall decline over time. At the start of the study the most common pragmatic function of maternal utterances was to request action (26%) (Appendix J). At the next time point the use of comments had increased becoming the most common function, accounting for one third of utterances. The use of requests for action and information also remained common. Maternal use of questions increased over time. Daniel used basic utterance types at each time point; his increase in the proportion of fragment utterances was consistent with the decline in unclear utterances (58% to 32%). No child utterances were classed as declarative or complex and were generally classed as either bidding for attention or as conversational devices. There was an overall increasing trend across the study period in Daniel's use of questions. Examples of responsive utterances used over time are outlined below.

Daniel: [Sister], [Sister].
Mother: What [Sister] did it now did she?
Daniel: Yeah.
Mother: Oh, you pickle.
Daniel: XXX {unintelligible}.
Mother: Oh, what, chopped your hand off?
Daniel: Yeah.
Mother: Oh no.

Daniel in the car with his family
t1, sample 6

Mother: What colour's her shirt do you know?
Daniel: Yellow {pronounced <ello> /ɛləʊ/}.
Mother: It's not yellow.

Daniel: XXX {unintelligible}.
Mother: Pink.

Daniel reading with his mother
t2, sample 1

Mother: What happened?
Daniel: Ow.
Mother: You hurt your elbow did you?
Daniel: [Sister].
Mother: [Sister] did it?
Daniel: Yeah.
Mother: Well stay away from [Sister] then and you play with your Mike the Knight stuff.

Daniel at home with his family
t3, sample 6

Mother: Do you wanna help mum?
Daniel: No.
Daniel: Out.
Mother: I know we will go out.
Mother: I'm just gonna finish tidying up a little bit and then I'll take you out somewhere.
Daniel: Yeah.
Mother: Where do you wanna go?
Daniel: That.
Mother: You wanna go play netball {laughing}?
Daniel: Yeah.

Daniel at home with his family
t4, sample 2

Table 6.26 Frequency and proportion of lexically contingent maternal utterances during LENA samples with Daniel

PCI characteristic	t1	t2	t3	t4
Expansions	0	2 (3%)	1 (1%)	1 (1%)
Extensions	0	0	0	0
Recasts	4 (2%)	1 (1%)	1 (1%)	3 (2%)
Interpretation	13 (8%)	7 (9%)	9 (6%)	6 (3%)
Imitation	2 (1%)	0	1 (1%)	0
Total contingent	**19 (11%)**	**10 (13%)**	**12 (8%)**	**10 (5%)**
Reference to child activity	33 (20%)	10 (13%)	47 (30%)	31 (16%)
Child-directed utterances (total)	167 (235)	78 (87)	158 (205)	195 (252)

6.1.4.4 Cognitive scaffolding

As shown in Table 6.27, the most common maternal teaching strategies during TIM sessions were labelling (18-27%), short elaboration (27-37%) and linking (23-31%). The proportion of these three teaching behaviours varied over time but they accounted for at least 70% at each

time point. The use of long elaboration remained relatively constant, while actively involving the child varied across the study (4-12%). Concept structuring increased towards the end of the study, although it remained below 10% at t4. Daniel was engaged with the picture-book and spent 93-98% of his time in joint attention with his mother looking at the book at each session. The length of the TIM sessions was similar each time (approximately three minutes).

Table 6.27 Maternal teaching strategies used during TIM sessions with Daniel

Teaching style	*t1*	*t2*	*t3*	*t4*
Labelling	15 (27%)	12 (22%)	12 (18%)	11 (20%)
Short elaboration	15 (27%)	18 (33%)	25 (37%)	15 (27%)
Long elaboration	4 (7%)	4 (7%)	5 (7%)	6 (11%)
Concept structuring	0	0	3 (4%)	4 (7%)
Linking	17 (31%)	14 (26%)	20 (29%)	13 (23%)
Child involvement – language	0	5 (9%)	3 (4%)	4 (7%)
Child involvement – action	4 (7%)	1 (2%)	0	3 (5%)
Total	55	54	68	56

The proportion of contingent replies used during TIM sessions was generally much higher compared to the LENA samples of naturalistic interactions, ranging from 20-28% of maternal utterances (Table 6.28). Interpretations were the most common ranging 8-17%, consistent with maternal style during the LENA samples, but interpretations used during TIM sessions did not show the same decline over time found for the naturalistic samples. The use of expansions, extensions, recasts and imitations was also higher during TIM sessions (5-12%). The proportion of maternal utterances that were contingent on Daniel's speech or made reference to his activity accounted for at least two thirds of maternal speech during picture-book sharing (Figure 6.4).

Table 6.28 Frequency and proportion of maternal lexically contingent utterances during TIM sessions with Daniel

PCI characteristic	*t1*	*t2*	*t3*	*t4*
Expansions	5 (6%)	1 (1%)	2 (2%)	4 (5%)
Extensions	0	0	0	0
Recasts	4 (5%)	1 (1%)	3 (3%)	3 (4%)
Interpretation	7 (8%)	14 (16%)	18 (17%)	11 (13%)
Imitation	1 (1%)	3 (3%)	7 (7%)	0
Total contingent	**17 (20%)**	**19 (22%)**	**30 (28%)**	**18 (22%)**
Reference to child activity	41 (49%)	47 (54%)	49 (46%)	36 (44%)
Total utterances	83	87	106	82

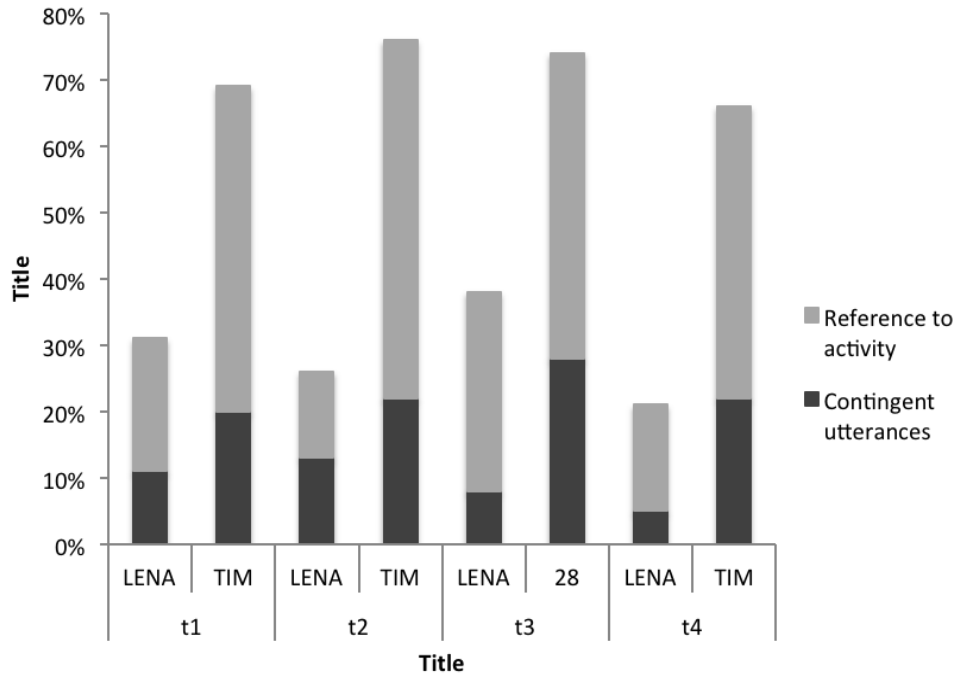

Figure 6.4 The proportion of maternal utterances that were contingent on Daniel's speech or made reference to his current activity during LENA and TIM samples

In summary, it appeared that maternal talk was relatively stable over time. There were no mother-child dyadic interactions in the 21 samples transcribed from the LENA audio. There were more mother-initiated turns in total at the last three time points; however, Daniel produced more utterances overall, and generally dialogue participation was relatively equal. There were more mother-initiated topics at the first three time points but topics appeared to be more equally shared as time went on and Daniel initiated more topics at the end of the study. Contingent responses were less common during the LENA samples (5-13%) compared to the picture-book sessions (20-28%). Early use of interpretations declined over time and was lowest at t4, but only during LENA samples. During the TIM sessions, contingent replies combined with maternal references to the child's activity accounted for over two thirds of maternal utterances. There were higher proportions of requests for action at t1, but at later time points comments were more common. Question use increased for both mother and child across the study. During TIM sessions, the highest proportions of maternal teaching strategies were classed as labelling, short elaboration and linking. Concept structuring was not used at the start of the study but increased over time, and actively involving the child varied across the study.

6.2 Comparisons across cases

The following section compared the findings across cases in order to identify any patterns in the characteristics of PCI used as children's vocabularies developed.

6.2.1 Quantity, diversity and complexity of maternal language

As shown in Figures 6.5-6.7, there was some variation at individual time points regarding the amount, diversity and complexity of maternal talk used over the course of the study. However, there were no clear trends in high or low use over time regarding the different language measures. Where differences in language were found in the LENA samples from the individual recordings, these were not replicated in the TIM samples, which provided a more consistent setting for sampling PCI. Overall, the quantity, complexity and diversity of maternal language remained relatively stable over the study.

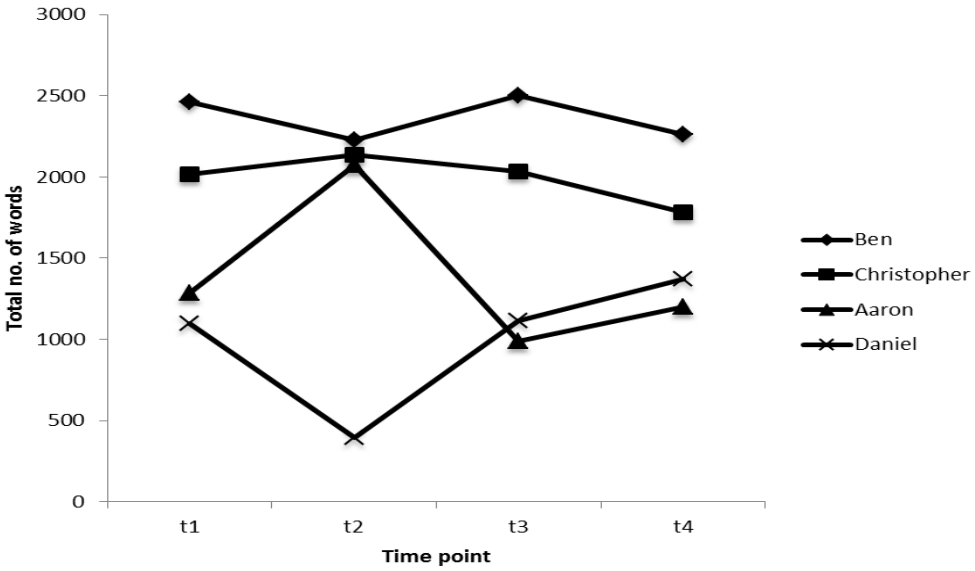

Figure 6.5 The total number of maternal words used during the transcribed LENA samples of PCI

Aaron's mother showed a trend for an increase in talkativeness and diversity during TIM sessions over the study but this was not found for the LENA samples. Conversely, Daniel's mother showed a trend for an increase in talkativeness, complexity and diversity during LENA samples (excluding t2 when only three samples were taken); however, the same trend was not found during TIM samples.

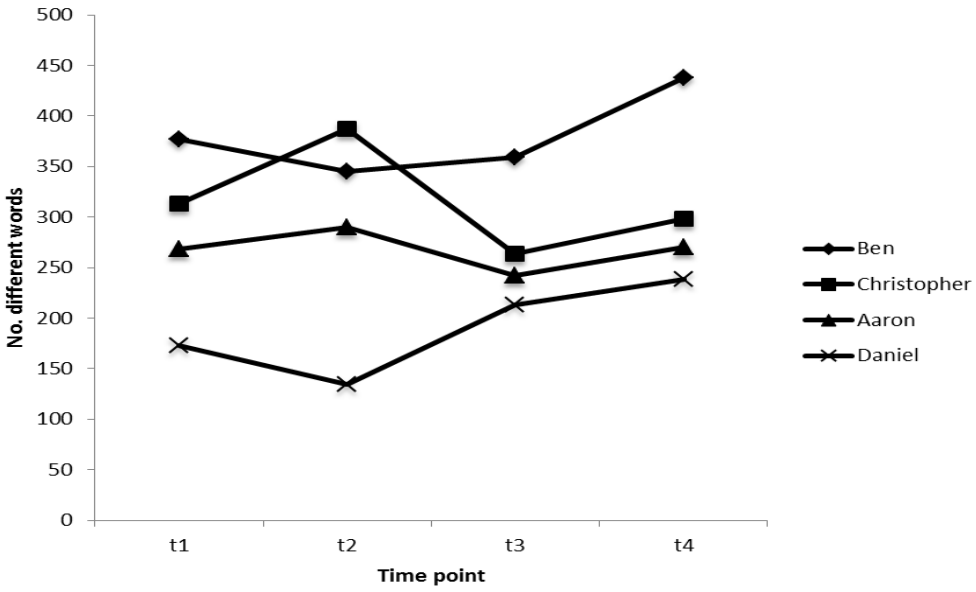

Figure 6.6 The number of different words used by mothers during child-directed utterances in the transcribed LENA samples of PCI

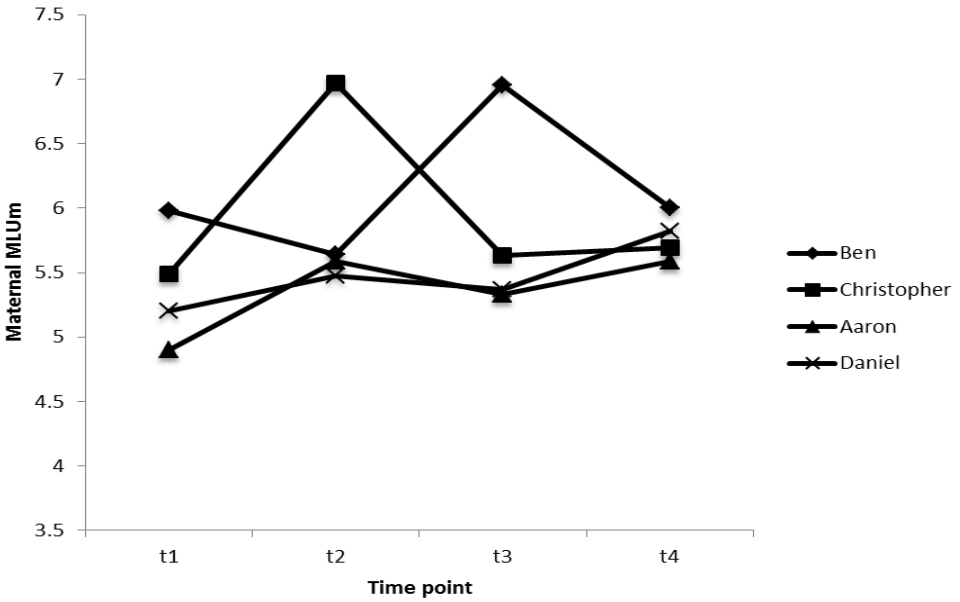

Figure 6.7 The maternal MLUm of child-directed utterances used during the transcribed LENA samples of PCI

Table 6.33 below outlines the mean or range scores for the quantity, diversity and complexity of language used by each mother and the overall change from t1 to t4 in the same measures for children. The total number of maternal words includes all transcribed talk; whereas, the number of maternal utterances, different words, TTR and MLUm excludes maternal speech that was not directed at their child. Although the amount, diversity and complexity of maternal talk that children were exposed to appeared relatively stable over time, there was variation across the different cases. Ben was exposed to 2363 words on average, during 30-minutes of

naturalistic PCI, selected as examples of high-level interaction between mother and child. In comparison Christopher was exposed to 1992 words; Aaron was exposed to 1387 words; and Daniel was exposed to 1194 words. The highest average number of maternal words used from the four cases was almost double that of the lowest average maternal words. The average automated AWC from the whole-day recordings for Ben (1414) was twice that of Daniel (648), suggesting that differences across cases in the amount of parent talk during the high-level LENA samples reflected more general levels of talk throughout the day. The average AWC for Christopher (1064) and Aaron (1167) fell between the other two cases as was found in the transcribed LENA samples of high-level interactions.

The amount and diversity of maternal talk was in line with the rate of vocabulary growth of their children; Ben had the fastest rate of growth based on CDI scores (52 new words on average per month) and was also exposed to the highest number of maternal utterances and number of different words during the LENA samples. In comparison, Daniel was exposed to the least maternal language and he showed the slowest rate of growth (five new words per month). Christopher and Aaron fell in the middle of these cases in terms of exposure to maternal language and their own rate of growth, which were 42 new words and 38 new words per month, respectively.

Table 6.29 Mean and range scores for maternal language use, and overall change in child language from t1 to t4 based on SALT scores of LENA transcripts

SALT category	*Ben*		*Christopher*		*Aaron*		*Daniel*	
	Parent	Child	Parent	Child	Parent	Child	Parent*	Child
Total words	2362	332 to 828	1992	252 to 539	1387	485 to 1190	1194	289 to 349
Total utterances	347	278 to 343	319	241 to 215	278	321 to 312	173	247 to 257
No. different words	380	16 to 171	316	12 to 99	268	71 to 179	208	10 to 17
Type/token	0.21-0.24	0.1 to 0.32	0.16-0.27	0.19 to 0.28	0.16-0.26	0.28 to 0.2	0.26-0.32	0.09-0.11
MLUm	5.64-6.95	1.04 to 2.82	5.49-6.97	1.05 to 2.67	4.9-5.59	1.67 to 4.03	5.2-5.87	1.24 to 1.19

Note: There were only three samples transcribed at t2 for Daniel; therefore, means and ranges presented did not include scores for this time point.

6.2.2 Dialogue participation

The relative equality of dialogue participation, in terms of the number of utterances produced and the turns and topics initiated during interactions, varied across the individual five-minute samples. When the samples taken at each time point were considered collectively then differences emerged across cases. In two cases mothers contributed more utterances overall compared to their children, while the reverse was found for the other two cases. Christopher's mother and Ben's mother produced more utterances than their children at each time point, with the exception of t3 when Ben's mother produced more utterances overall but fewer child-directed utterances. In comparison, Daniel and Aaron both used more utterances than their mothers at each time point, with the exception of t2 during which time Aaron's mother produced more utterances overall.

Ben initiated a similar total number of turns across the study (range 67-76) and there were more mother-initiated turns at each time point except at t3, but otherwise the difference between mother and child initiated turns showed no clear change. Ben was able to contribute longer turn lengths over time. Ben's mother generally initiated more topics than he did but the difference between the number of mother and child topics declined as Ben used an increasing number of topics (15 to 34) over the study. As outlined earlier (section 6.1.1), the presence of Ben's grandmother during the recording day at t3 could have been related to differences in maternal talk.

The proportion of mother- and child-initiated turns during Aaron's interactions were relatively even over time, except at t4 when Aaron initiated a slightly higher number of turns than his mother. The number of maternal topics introduced was higher than Aaron at t1 but was subsequently more equal but the overall number of topics introduced was lower at t3 and t4 compared to the start of the study. Christopher's mother initiated more topics than her child at each time point, and more turns at the first three time points. However, the difference between mother- and child initiations decreased over time as the number of child-initiated turns doubled over the study (37 to 74) and the number of mother-initiated turns halved (111 to 52). This finding contrasted with the more stable number of child-initiated turns for Ben, Aaron and Daniel. Unlike Christopher's mother, Daniel's mother showed an increase in the number of turns used over time. Daniel also showed an increase in the number of topics introduced across the study; therefore, the overall number of topics introduced by Daniel and his mother became more equal after t1.

Dialogue participation between mother and child varied across individual five-minute samples, as well as over the course of the study period, with no consistent pattern emerging across cases. Mothers generally initiated more turns than their children, during naturalistic samples of PCI, for Ben (except t3), Christopher (except t4) and Daniel (except t1), and Daniel's mother showed an increase in the number of turns used over time. In contrast, Aaron produced a similar number of initiations (48-55%) to his mother at each time point and a slightly higher number of turns than his mother by the end of the study. Although there were generally more mother-initiated turns for three of the children, the relative proportion of child initiated turns suggested that they was not a vast discrepancy between mother and child for Ben (42-51%) and Daniel (43-53%). In contrast Christopher initiated fewer turns than his mother, especially at the start of the study, but he showed a trend for an increase in turns initiated over time (22-40%).

In contrast to the five-minute LENA samples, there were much clearer differences in dialogue participation found during TIM sessions. Maternal initiations were higher than child initiations in all picture-book sharing sessions. Overall, at each time point there were more topics introduced by the children's mothers during the transcribed LENA samples, except at t3 for Ben and Aaron, and t4 for Daniel. All of the children showed an increase in the number of topics introduced over time, except for Aaron; however, both Aaron and his mother showed a reduction in topics during the second half of the study.

6.2.3 Responsiveness and purpose of communicative acts

Maternal contingent utterances, which responded to children's preceding utterances, varied across the study for the four cases during the samples of naturalistic PCI selected from the LENA audio. No clear pattern emerged, other than decline in the use of interpretations over time[3]. The overall proportion of contingent utterances at each time point was below 20% for all cases. The average proportion of maternal contingent utterances across the study was highest for Ben (M=11%, range 7-18%). The average proportions of contingent utterances for the other three cases were below 10%: Christopher 7% (range 4-12%); Aaron 8% (range 7-9%) and Daniel 9% (range 5-13%). The average proportions of maternal contingent utterances

[3] It is possible that the nature of contingent utterances produced could change over time, rather than the overall proportion. Conti-Ramsden (1990) found that mothers of children with PLI differed in terms of contingent responses only regarding their use of complex recasts when compared with mothers of TD children. The present study analysed the complexity (MLUm) of different contingent responses used in the current case studies but no clear pattern emerged that suggested an increase or decrease over time or across cases.

classed as expansions ranged 1-3% across cases, extensions ranged 0-1% and recasts ranged 1-4%. Contingent utterances combined with utterances that made reference to the child's activity, accounted for approximately a third of maternal utterances during PCI (range 21-43% across cases), excluding utterances that were not directed at the child.

In contrast to the samples of PCI selected from the whole-day recordings, there were much higher proportions of contingent utterances used during TIM sessions during which mothers were given a picture-book to look at with their child. The average proportions of contingent utterances used were at least twice as large compared to the LENA samples. The average proportion over the study was at least 20% for three cases: Ben 22% (range 18-27%); Aaron 20% (range 16-35%) and Daniel 23% (range 20-28%). The average proportion of contingent utterances during TIM sessions was slightly lower for Christopher (M=16%; range 11-24%). Although contingent utterances were more common during TIM sessions there was no clear pattern that emerged regarding the variation in their use over the study period, except for a trend for decreasing interpretations in three of the cases, similar to the findings from the LENA samples. A decline in interpretations was not found during TIM sessions with Daniel. Over the study period, contingent maternal replies combined with references to the child's activity accounted for approximately two thirds of maternal utterances (range 58-87% across cases), which was double the proportions found during the LENA samples of naturalistic PCI.

Contingent maternal responses are dependent on having opportunities available to elaborate on child utterances, i.e., if the child does not produce any vocalisations, their mother cannot use subsequent language that is responsive to the child's. The relationship between maternal responsiveness and child language development could be confounded by the child's level of productivity (Masur, Flynn and Eichorst, 2005). Maternal contingent utterances were also calculated as a proportion of child utterances in order to account for differences in child productivity. When all contingent utterances were considered as a proportion of child utterances, Ben's mother provided contingent replies most often during the LENA samples across the study period (M=12%, range 7-16%). In the other three cases, mothers used contingent replies to fewer than 10% of child utterances on average: Christopher 9% (range 7-14%), Aaron 8% (range 5-11%), and Daniel 6% (range 4-8%). The proportion of expansions and extensions were also calculated separately. On average across the study, as a proportion of child utterances, Ben's mother expanded 3% (range 1-5%) and extended 1% (range 0.3-1%) of his utterances. Christopher's mother expanded on average 1% (range 0-3%) and extended 1%

(range 0-4%) of his utterances. Aaron's mother expanded on average 2% (range 0.4-3%) and extended 1% (range 0-1%) of his utterances. Daniel's mother expanded 0.5% of his utterances and used no extensions. The overall mean proportions of contingent replies were similar when calculated based on either total maternal (7-11%) or child utterances (6-12%).

Maternal contingent replies were also calculated as a proportion of child utterances for TIM sessions. The overall contingency of maternal replies to child utterances for Ben was 38% on average over the study (range 32-44%), and on average more than one in 10 of Ben's utterances were expanded (M=12%, range 7-19%). Christopher's mother used contingent replies to 22% of his utterances on average (range 16-30%), and expanded 6% of his utterances (range 0-16%). Aaron's mother provided contingent replies to 41% of his utterances on average (range 24-65%), and expanded 15% (range 8-24%). Daniel's mother used contingent replies for 44% of his utterances on average (range 38-52%), and expanded 7% of utterances (range 2-13%). The difference in maternal contingency between the LENA and TIM samples was even more marked when examining replies as a proportion of children's utterances. The overall use of contingent replies to child utterances was more than twice as common during TIM sessions for all cases. Contingent responses to child utterances was more than three times as common for Ben during TIM sessions, five times more common for Aaron, and the difference in overall contingency during LENA samples (6%) and TIM sessions (44%) was particularly apparent for Daniel.

The proportional use of different utterance types accounts for differences in the amount of talk but do not reflect their frequency during interactions. For example, the overall mean proportion of contingent replies used during the LENA samples of naturalistic PCI were similar for Ben (11%) and Daniel's (9%) mothers, which was also the case during the picture-book sharing sessions (22% and 23% respectively). As outlined in section 6.2.1, Ben's mother used a larger amount of talk compared to Daniel's mother, and the overall frequency of contingent replies was higher. The actual frequency of these utterances is important as they relate to the amount of responsive language to which children are exposed. An alternative measure of parental responsiveness analyses the rate of contingent replies used during PCI. Previous research (Fey *et al*, 1999) has examined the rate of recasts used by parents, which would include the utterances classed as expansions in the present study; therefore, the rate of recasts and expansions used by mothers in the present study was analysed for comparison. Although the rate (per minute) of these utterances varied across the study, the overall mean

and range was higher for Ben (M=0.5, range 0.2-0.8) and Aaron (M=0.5, range 0.3-0.7) during the LENA samples compared to Christopher (M=0.2, range 0.0-0.4) and Daniel (M=0.1, range 0.1-0.2). The rate of recasts and expansions used was higher during the picture-book sessions but demonstrated similar differences between the parents. The mothers of Ben (M=2.4, range 1.3-3.5) and Aaron (M=2.7, range 1.8-4.4) again used a higher rate of these contingent utterances compared to Christopher (M=1.5, range 0.2-3.6) and Daniel (M=1.6, range 0.5-2.6). However, there was variation across cases at each time point, for example Daniel's mother actually used a higher rate of recasts and expansions at t1 (2.6) and t4 (2.0) compared to Ben' mother (1.3 and 1.4 respectively).

6.2.4 Cognitive scaffolding

The picture-book sharing sessions were used to measure maternal teaching style in a consistent context across the study period. As shown in Table 6.30, short elaboration was the most common strategy overall, across cases and over time, accounting for approximately a third of all maternal teaching strategy (32-38%). Labelling was also common at the start of the study and then declined over time but it varied across individual cases. Labelling declined at t4 for Ben, and demonstrated a slight decline after t1 for Daniel. In contrast, labelling remained consistently low for Christopher (0-5%); whereas, it increased for Aaron from t1 (18%), peaking at t3 (44%) and accounting for almost a third of teaching behaviours with Aaron at t4 (31%).

Table 6.30 Total frequency of different teaching styles used during picture-book sharing sessions combined for all cases

Teaching style	*t1*	*t2*	*t3*	*t4*
Labelling	53 (21%)	62 (22%)	62 (26%)	43 (16%)
Short elaboration	86 (35%)	107 (37%)	90 (38%)	88 (32%)
Long elaboration	45 (18%)	36 (13%)	24 (10%)	34 (12%)
Concept structuring	5 (2%)	18 (6%)	22 (9%)	40 (15%)
Linking	32 (13%)	43 (15%)	25 (11%)	36 (13%)
Child involvement – language	20 (8%)	21 (7%)	10 (4%)	23 (8%)
Child involvement – action	8 (3%)	1 (0.3%)	4 (2%)	11 (4%)

Long elaboration, linking and actively involving the child were relatively stable when cases were combined but varied across individuals. For example, long elaboration was a common strategy used with Christopher (27-44%) but not with Aaron (0-4%). Linking was also uncommon with Aaron (0-7%), but used often with Daniel (23-31%). Concept structuring was an uncommon strategy at the start of the study (0-6%) that later demonstrated an overall increase for all cases, but the change was smaller for Ben (8%) and Daniel (7%) compared to Aaron (24%) and Christopher (21%).

The original coding scheme used in the Avon Longitudinal Study of Parents and Children (ALSPAC) marked the presence of each parenting dimension once for each picture. The extended scheme in the present study coded every occurrence of the different parenting dimensions, providing frequency counts for each strategy. The overall trends in the use of teaching behaviours and change over time were similar using the old and new coding. However, the new scheme provides information about the frequency of teaching behaviours, which demonstrate differences between the two schemes. The total scores across cases and time points for the four cases were 18-37 using the old scheme compared to 40-112 using the new scheme. Some parents used a high frequency of only a few teaching strategies, while others used a lower frequency of more strategies. For example, Table 6.31 shows that Aaron's mother frequency used labelling and short elaboration and when frequency counts were included the total increase by 40. In comparison, Christopher's mother used a wider range of strategies, each less frequently, and when frequency was included the total increased by 18. Including frequency scores provided an additional criterion for assessing PCI. Ben's mother's total scores ranged 65-112 (M=90) across sessions; whereas, Daniel's mother ranged 54-68 (M=58).

Table 6.31 TIM scores using old and new coding scheme

	Aaron (t2)		*Christopher (t4)*	
Teaching style	*Old*	*New*	*Old*	*New*
Labelling	8	24	2	2
Short elaboration	8	30	8	12
Long elaboration	0	0	7	15
Concept structuring	0	0	5	10
Linking	2	4	3	3
Child involvement – language	1	1	1	1
Child involvement – action	0	0	3	4
Total	19	59	29	47

6.3 Discussion

The theoretical propositions developed for the present study provided a template for comparison with the case study findings. While certain characteristics of parental talk were expected to remain relatively stable over time, such as parent talkativeness, others were expected to change as children's vocabulary skills developed. Responsive utterances have been shown to be dependent on children's productivity as they relate to children's preceding utterances; therefore responsivity was proposed to increase as children's vocabulary developed. Previous studies with children with PLI have focused on PCI at a single time point,

which hinders understanding of how PCI changes over time and the impact of SLT interventions that aim to modify interactions. The case studies outlined in this thesis presented unique evidence regarding the extent to which characteristics of PCI change in relation to the developing language of children with PLI, with a focus on vocabulary, extending previous research to build a developmental perspective.

6.3.1 Quantity, complexity and diversity of language use

It was shown in the preceding section that there were no clear trends that suggested an increase or decrease in the measures of quantity, diversity or complexity of maternal language over time. There was some variation at individual time points; however, where differences in maternal language were found in the transcribed LENA samples of PCI, these were not replicated in the TIM samples, which provided a more consistent setting for sampling PCI over time. The total number of maternal utterances remained similar across the study period, which was consistent with previous studies that found parent talkativeness remained fairly stable over time (Huttenlocher *et al*, 1991, Rowe, 2012, Song, Spier and Tamis-LeMonda, 2014). There was a large difference in the overall talkativeness of the different mothers with their children during the 30 minutes of transcribed audio at each time point. Ben's mother produced twice the total number of words and number of child-directed utterances compared to Daniel's mother, which could be related to the differences in children's trajectories of vocabulary growth.

The amount of parent talk has previously been shown to have a significant impact on children's vocabulary development. Hart and Risley's (1995) pivotal study in North America, found that on average, children from high SES backgrounds heard 487 parental utterances, 2153 words and 382 different words per hour, based on monthly one-hour samples in children's homes across the first three years of life (Hart and Risley, 2003). In comparison, children from families on welfare support were exposed to 176 utterances, 616 words, and 167 different words per hour. Table 6.29 in the previous section outlined the mean number of maternal utterances, total words and different words used during the 30 minutes of transcribed audio. On average the children heard 279 utterances, 1734 words and 293 different words in half the time recorded in Hart and Risley's (1995) study, although there was large variation between cases as outlined above. The findings from the present study suggested that at least some of the children heard higher levels of language input compared to children in Hart and Risley's (1995) study. However, the transcribed samples of PCI used here

were selected from the LENA audio precisely because they were examples of high-level interaction between the mother and child and it is likely that the average amount of talk children were exposed to over the whole day would have been lower.

The LENA system was originally conceived in response to Hart and Risley's (1995) study of language in the home (LENA Research Foundation, 2011) and the automated LENA counts provided information about the number of adult words spoken near to the child (AWC) over an entire day. Examining these counts addresses the issue of estimating children's overall language input for children in the present study. These counts were more comparable with Hart and Risley's (1995) findings as they provided hourly means and included all adults present, not just mothers. The average hourly AWCs for children were approximately half the total number of words used during the high-level interactions sampled from the audio. The average words children heard based on the mean hourly AWCs over the course of the study fell between Hart and Risley's (1995) high and low SES families. The mean AWCs demonstrated similar differences between the case studies that were found in the transcribed high-level interactions and the mean AWC for Ben was again twice that of Daniel. Furthermore, these two children showed the fastest and slowest rate of vocabulary growth and the largest and smallest vocabulary size at the end of the study, respectively. These findings were consistent with previous research demonstrating the relationship between amount of parent talk and children's vocabulary development.

Differences in maternal language diversity were found between cases, which were consistent with the variation in maternal talkativeness. There was a trend for increased maternal diversity during interactions across cases in line with increased rate of children's vocabulary growth. The relationship between maternal language diversity and child language development has been demonstrated to be another important characteristic of parent language. Pan *et al* (2005) found that maternal language diversity, rather than amount of talk, predicted child language growth in a sample of low SES mother-child dyads. Maternal talkativeness was not found to be the most important factor for children's language development for their sample of children from low SES backgrounds. The study authors emphasised the importance of understanding the range of PCI characteristics mothers use with their children, including the amount and diversity of talk as well as nonverbal communication and pragmatic features of language (Pan *et al*, 2005). In a sample of children with PLI, Domsch and Camarata (2008) found that maternal language diversity was related to children's receptive, but not expressive,

vocabulary. It is not possible in the present study to determine maternal predictors of child language growth; however, the pattern across the four children was consistent with previous literature demonstrating the positive role of greater maternal talkativeness and language diversity.

The differences found across cases support the role of exposure to language for children with PLI, as well as TD children. The findings highlight the potential value of strategies that aim to increase parent talk to increase children's potential for vocabulary learning. Maternal talkativeness remained relatively stable over time as expected but there were also no clear trends demonstrating either an increase or decrease in maternal diversity or complexity of language over the course of the study. It is possible that 9-10 months was too short a time frame to find changes in these characteristics of maternal talk and studies of PCI with children with PLI over longer periods would be beneficial. It is also possible that more specific aspects of maternal words used could have changed that were not measured in the present study. For example, Rowe (2012) found that use of sophisticated vocabulary increased over time. It is possible that more subtle changes such as this were missed. Further research into the factors that facilitate change in characteristics of PCI and exploring the extent to which parents adapt to their children's language level are discussed in Chapter 8.

6.3.2 Dialogue participation

Dialogue participation during PCI referred to the relative equality of conversation sharing between the mother and child. In particular, this included the relative proportion of utterances and of conversational turns produced, as well as the number of turns and topics initiated. The systematic review of the literature (section 2.3.3) found differences in dialogue participation during PCI with children who had PLI compared to their TD peers. The present study examined whether dialogue participation changed as children's vocabularies developed. There were differences found regarding the relative equality of participation for the individual five-minute interactions but no clear pattern emerged across cases that suggested change over time, except for a decreasing trend in the discrepancy between the number of mother and child initiated topics.

Differences were found across cases regarding the dominance of either mother or child utterances produced during interactions, which challenged previous PCI research. Previous studies have found that during PCI, mothers used a greater number of utterances than their

children, and that the discrepancy between mother and child utterances was more pronounced for children with PLI compared to PCI with TD children (Paul and Elwood, 1991, Rescorla *et al*, 2001). While in two of the present cases children generally produced fewer utterances compared to their mothers, the reverse was found for the other two cases. It is possible that the context of the interaction could be related to differences in study findings. In the majority of studies within the PCI literature, interactions have been measured during short periods of dyadic toy play; whereas, in the present study, interactions were sampled from children's natural environment, and play was not a common context (see section 8.3). The interactions sampled were selected from the all-day LENA recordings based on high levels of interaction. This process sampled a number of contexts that were less prevalent in the research literature, such as visiting family and friends or playing in the garden, which may make direct comparisons with the literature problematic.

The role of the interaction context on dialogue participation was supported by the differences between the LENA sampled PCI and the observed picture-book sharing sessions. The picture-book sessions were more similar to the dyadic play settings, as dyads were provided with a book and observed during a brief, focused period of time with the researcher present, video-recording the interactions. During every session, mothers used more utterances than their children across cases. Furthermore, the limited LENA samples in which Aaron produced fewer utterances than his mother were examples of dyadic play. The findings highlight the potential limitations in the current literature for understanding children's actual language learning experiences and challenge the representativeness of dyadic toy play for understanding typical PCI.

The differences found in turn and topic initiation across PCI sampling contexts confirmed that dialogue participation was context specific for the present case studies and highlighted notable differences with previous studies of PCI. Firstly, previous research into the initiation of turns in mother-child dyads found that children with PLI (aged 3;6-5;4) initiated less (34%) than their mothers during toy play and that the discrepancy was more marked compared to younger (aged 1;7-2;9) language matched children (42%) (Conti-Ramsden and Friel-Patti, 1983, Conti-Ramsden and Friel-Patti, 1984, Conti-Ramsden, 1990). The overall proportions of child initiations in the three of the case studies (42-55%) were more similar to the TD children examined in the previous literature, and the relative sharing of turn initiations was more equal than expected. The exception was Christopher (22-40%) who showed a similar proportion of

initiated turns to the children with PLI. Although most of the children were able to contribute longer turn lengths over the study, the frequency of child-initiated turns was relatively stable over time, except for Christopher. Christopher showed an increasing trend regarding turn initiations. In contrast to the LENA samples, there were much clearer differences in dialogue participation found during the picture-book sessions. Maternal initiations were higher than child initiations during all sessions. The differences between the two sampling contexts were consistent with the differences outlined above regarding the proportion of mother and child utterances. It is noteworthy that over half of the samples of PCI transcribed from the audio for Christopher were during interactive play with his mother, which was much less common for the other cases, and Christopher's findings may be more comparable with the previous studies that sampled PCI during play sessions.

Secondly, examination of topic initiation found that there were generally more maternal topics introduced across the study for all of the present cases. In three of the cases the children showed an increase in the number of topics introduced over time. One child showed a decrease in the number of topics introduced; however, so did his mother, which suggested the difference could have been related to particular interactions sampled. There were consistently more maternal topics during the TIM sessions. The dominance of maternal topics was unexpected since previous studies have found that children with PLI, as well as TD children, introduce more topics than their mothers (Conti-Ramsden and Friel-Patti, 1984, Rescorla *et al*, 2001). The difference between the proportion of mother and child topics generally decreased over time, which was consistent with previous research that has found that older children with PLI engage in interactions more than younger children with PLI (Cunningham *et al*, 1985).

The differences between turn and topic initiations in picture-book sharing and daily activities captured in the LENA recordings could reflect the overall structure of the interaction between contexts as well as the presence of other interaction partners. Additional interlocutors were common during the LENA samples, in contrast to most research studies that have examined dyadic interactions. Aaron was the only case almost exclusively sampled in dyadic interactions and he showed a high proportion of topic initiations over the study compared to the other cases; however, he only introduced more topics than his mother overall at t3. Understanding contextual differences that influence characteristics of PCI have important implications for SLT interventions that encourage parents to follow their children's interests during interactions. Identifying contextual factors that are related to increased child topic initiations and more

equal turn sharing could help speech and language therapists provide parents with context specific strategies for modifying characteristics of their interactions. Further research into the role of context on PCI generally and for sampling in studies has been discussed in Chapter 8.

6.3.3 Responsiveness and purpose of communicative acts

Parental responsiveness, which includes contingent replies to children's preceding utterances, has been shown to be predictive of later language for both TD children (Masur, Flynn and Eichorst, 2005, Tamis-LeMonda, Bornstein and Baumwell, 2001, Tamis-LeMonda and Bornstein, 2002, Rowe, 2012) and children with PLI (Levickis *et al*, 2014, Girolametto *et al*, 1999). Characteristics of PCI found to facilitate language development, including expansions and imitations, have been taught as strategies to parents in SLT interventions that aim to modify PCI (Girolametto, Pearce and Weitzman, 1996, Manolson, 1992, The Hanen Centre, 2011). Parental responsivity is at least to a degree, dependent on children producing utterances that parents can respond to in the first place. Theoretical propositions for the present study suggested that responsiveness may be expected to increase as children's language developed and they talked more during interactions as there would be increased opportunities for parents to respond.

As reported in the previous section, there was variation in maternal contingency across cases and over time for individuals, but no clear pattern emerged other than a decline in the use of interpretations, which could be attributed to the growing intelligibility of the children. The average proportions of maternal utterances that were contingent during samples of naturalistic PCI from the LENA audio were approximately 10%. In contrast, the overall proportions of contingent maternal utterances during the TIM picture-book sharing sessions were twice as large. A decreasing trend for the proportions of interpretations was also found during TIM sessions for three cases, comparable with the LENA samples. Although a similar decline was not found for Daniel during TIM sessions, he showed limited language development over the course of the study.

The proportions of expansions, extensions and recasts used by mothers in the present study were similar to those used in Paul and Elwood's (1991) study. The maternal contingency codes used in the present study were based on those outlined in Paul and Elwood's (1991) study with children aged 1;8-2;9 (years; months) who had PLI and age-matched TD controls. Paul and Elwood (1991) found significant differences in the proportion of maternal contingent

utterances between the two groups of dyads. In the TD group, approximately 7% of maternal utterances were expansions and extensions, which was higher compared to mothers of children with PLI (approximately 2%). The current study distinguished between expansions and recasts, which would have both been classed as expansions in Paul and Elwood's study. Overall, the mean proportion of maternal utterances in the present study classed as expansions and recasts or extensions was approximately 4% across cases during the samples of PCI from the LENA audio. The proportion of contingent maternal utterances in the present case studies fell between the proportions used by the two groups of mothers in Paul and Elwood's (1991) study. However, the children with PLI in Paul and Elwood's study were younger than the children in the present case study, and they produced a much more limited number of utterances during interactions. Paul and Elwood (1991) examined differences in contingent maternal utterances between the TD and PLI dyads as a proportion of the number of utterances children produced, in order to account for differences in child productivity. They found that the proportion of utterances produced by children with PLI that received contingent replies (approximately 12%) was not significantly different to the TD group. While mothers of TD children used more contingent utterances overall, there were no significant differences in the proportion of their children's actual speech that they expanded or extended. In contrast, the level of contingency did not show similar increases in the present case studies when the proportion of child utterances that received contingent replies was examined during LENA samples. The overall proportions of contingent replies were similar when calculated based on either total maternal or child utterances. The differences between the two studies suggest that the impact of child productivity may be particularly relevant in the very early stages of language production when children use much fewer utterances than their parents. The amount of child talk in the present study was higher than found in Paul and Elwood's (1991) study and there was less discrepancy between the number of mother and child utterances compared to their PLI dyads.

The level of maternal contingency used during the present study was lower compared to previous research with older children with PLI than in Paul and Elwood's (1991) study. For example, Conti-Ramsden (1990) found that during play session with children with PLI aged 3;6-5;4, approximately 16% of maternal utterances were classed recasts. The definition of recasts used would include expansions as defined in the present study. There were much higher proportions of these utterance types demonstrated in Conti-Ramsden's (1990) sample compared to the PCI during the LENA samples in the current case studies as well as found in

Paul and Elwood's (1991) study. While the difference between Conti-Ramsden's and Paul and Elwood's samples may be explained by the very limited language of children in the latter study, this could not be claimed for differences with the present study. The findings from the TIM picture-book sharing sessions used with the case studies could help account for differences in maternal responsiveness. The proportions of maternal contingent replies were much higher for all children during the TIM sessions and closer to the Conti-Ramsden's (1990) sample. The apparent differences in maternal contingency depending on the context in which PCI was sampled could explain the differences found across studies. The TIM sessions the dyads were involved in a structured activity looking at the picture-book for a short period of time with no other distractions, as well as a researcher video-recording the interaction. These interactions were more similar to previous research using brief observations of dyadic toy play. In contrast the LENA samples were selected from periods of interactions from across children's typical home environments that often included other interlocutors, multiple distractions, and a less structured, or no activity. The findings challenge the use of a single context in studies to observe PCI and whether parents' interactive behaviour in constrained study settings may represent their typical interactions at home. Although previous studies have examined differences in PCI observed across different contexts there is a dearth of research into PCI in the natural home environment that has not been constrained by researchers, particularly with children with PLI.

Differences in maternal responsiveness were further evidenced by the rate of contingent utterances, which was analysed to account for differences in maternal talkativeness that were not reflected in proportional analysis. As reported in section 6.2.3, the rate per minute of maternal recasts and expansions showed similar differences between the LENA and TIM samples. The mean rate of these utterances used across the study was at least five times higher during TIM sessions for all cases compared to the LENA samples. Fey *et al* (1999) found that the mean rate of recasts (which would include expansions in the current study) was 1.1/minute (range 0.4-2.2), during free play with children with PLI, which was consistent with parents of TD children in their own and previous studies (Conti-Ramsden, 1990, Conti-Ramsden, Hutcheson and Grove, 1995, Fey *et al*, 1993, Fey *et al*, 1999, Fey, Cleave and Long, 1997). Rates in the present study were similar or higher for dyads during the TIM sessions but consistently showed a much lower trend for the rate of contingency during the LENA samples. The findings from the TIM sessions demonstrated that the mothers in each case can, and did, respond contingently to their children's utterances but that this responsiveness was less

apparent during the everyday samples of PCI in the naturalistic home environment. The differences in PCI found between the two types of sample suggest that the context of study observations in the literature should be examined carefully when inferring the relevance of findings to children's everyday language environments and the language learning opportunities to which they are exposed. Further research to explore the impact of context on PCI has been discussed in Chapter 8.

It is possible that the individual differences in maternal responsiveness are identifiable and consistent across different sampling contexts, despite higher levels of contingency during certain contexts. For example, the mothers who used the highest mean proportion of responsive utterances during the TIM sessions also did so during the LENA samples. Although some differences were found regarding parents' responsiveness when rates were calculated rather than proportions, the patterns were consistent across the LENA and TIM samples. However, there was variation across individual time points that demonstrated less consistent findings for the two contexts. For example, Christopher's mother used the highest proportion of responsive utterances at t4 from the LENA samples, while in contrast the proportion of maternal responsiveness used during picture-book sharing with Christopher was the lowest recorded at t4 compared to all other TIM sessions. Further research is needed to investigate whether differences found across sampling contexts in the current case studies are replicated in larger samples of children with PLI as well as TD samples. If similar differences are found, it would be useful to analyse whether there are differences in the strength of the relationship between children's later language and the characteristics of PCI sampled from children's natural environments without researcher control, compared to samples taken during the common study settings of dyadic play.

6.3.4 Cognitive scaffolding

Parent-child interaction was analysed during the picture-book sharing sessions using the TIM, which was designed to examine parental responsivity and teaching behaviours. The TIM was originally used with the ALSPAC cohort, a prospective, population based cohort study of children's health behaviour and development in the west of England (Golding *et al*, 2001). The TIM was used with children at ages 1;0 and 5;1 to assess PCI in the Children in Focus sample from ALSPAC, which consisted of a 10% random sample of the families. The following section examines maternal teaching style over time in comparison to the ALSPAC findings.

A comparison of the TIM scores for the case studies with the ALSPAC norms found a number of similarities in teaching style. At the start of the present study, and in the ALSPAC sample (Northstone *et al*, 2010) at age 1;0, labelling and short elaboration were the most common strategies used, although there was smaller trend for labelling in the present study. Patterns of change in teaching behaviours over time were generally similar for the ALSPAC and current study. Long elaboration remained relatively stable; however, the proportion across the four cases (13-16%) was higher than in ALSPAC (3-4%). The two dimensions that include attempts to actively involve the child varied across time points in the present study, in contrast to the ALSPAC study that found both dimensions increased over time. The most notable difference between the current and ALSPAC samples was found for concept structuring, which remained low in the ALSPAC study (2% to 5%) but became more common over time (2% to 14%) in the current case studies. Any differences between the children in the present study and those in the ALSPAC sample should be interpreted with caution and differences between the studies may be related to the range of language profiles in the ALSPAC study compared to the case study children with PLI, although this was difficult to determine based on the small number of cases. The children in the four cases in the present study were older than the ALSPAC sample when the TIM was first used at age 1;0, but their median age equivalent for expressive language suggested that developmentally they were similar to the ALSPC sample. Furthermore, the time period between the first and second TIM sessions was much longer than in the present study. Although broad similarities were found between the two studies, variation found across the present cases (section 6.2.4) reinforce the importance of examining individual differences that were highlighted in Chapter 5. It remains valuable to determine whether similar trends were found for the four cases when compared to the ALSPAC normative sample to determine the extent to which individual teaching styles diverge from the normative trends.

The individual styles of teaching across cases may have important practical applications because different strategies may not equally benefit children's language development. For example, variation in labelling was notable across the four cases and a recent Australian population-based study (Levickis *et al*, 2014) found that maternal labelling during interactions with children at age 2;0 was actually negatively related to language at age 3;0. It is important to identify differences in parental teaching styles in order to individualise intervention approaches effectively and identifying families who may benefit from interventions, e.g., those using a limited frequency or range of teaching strategies. Tools for assessing PCI such as the

TIM could also be used to monitor change over time for parents enrolled in interventions that aim to modify PCI.

In the original coding scheme used in the ALSPAC study, each parental teaching behaviour was recorded as a binary judgement when parents looked at each picture with their child, i.e., each behaviour was scored 1 or 0 depending on whether or not it occurred. The case study sessions were first coded according to this original ALSPAC scheme and in addition, each occurrence of parent teaching strategies was recorded to examine the frequency of different behaviours used. Comparison of the two coding schemes demonstrated similar overall trends in parents' behaviours over time; therefore, the old scheme might be well suited to large scale studies that require a brief assessment tool and an assessment of trends over time. However, the old coding scheme provided limited evidence of the number of opportunities children had for language learning during book sharing sessions. Examining the frequency of behaviours is particularly relevant for studies of children with PLI who may require increased exposure to characteristics of PCI that facilitate language development (Proctor-Williams, Fey and Loeb, 2001).

In summary, Chapter 6 demonstrated that there were limited trends emerging from the case study data that suggested clear change in maternal characteristics of PCI measured over time, despite the progress in children's vocabulary skills. It is possible that children's productivity has a more acute impact on parents' opportunities for contingent replies in the very early stages of language development when children are using only a small number of utterances. Once children are using a more substantial amount of talk the issue of productivity may be less relevant and other studies of older children with PLI have found high proportions of parental contingent utterances compared to those with younger children. The absence of clear change over time questioned the extent to which mothers adapted to their children's language level. However, there were apparent differences in PCI depending on the context in which samples were taken, which suggested that the contextual factors could be more important for facilitating responsiveness than the lexical abilities of the children in the four cases. Differences found in the TIM and LENA samples questioned the extent to which observations of PCI in a single context represent the broader experiences of parents and children during their everyday interactions. Implications for future research have been outlined in Chapter 8 (section 8.4).

Chapter 7 Parents' perspectives of having a child with PLI

7.1 Introduction

In order to develop PCI interventions that are effective it is important to understand the relationship between parent and child language but it is also necessary to identity parents' underlying beliefs about language development and intervention. Developing a more complete picture of family life and parents' beliefs should enable speech and language therapists to develop strategies that are acceptable and suitable for individual families. The perspectives of parents in the current study regarding their experiences of having a child with PLI were captured during interviews with the four mothers and two of the fathers. The interview data was explored using framework analysis, which identified four main themes regarding parents' experiences of having a child with PLI and seeking external support for their development. The following sections (7.2-7.5) outline the themes that emerged from interviews with parents. The discussion section (7.6) examines what the study findings add to the existing literature and the related implications.

Framework analysis of parent interviews was used to identify parents' perspectives regarding their children's language development, the impact this had on the children's early years, and the experiences of having a child with PLI. All four mothers were interviewed twice, once mid-way through the study and again at the end of the study. In addition, Aaron's father took part in the first interview with his mother and Daniel's father was interviewed at the end of the study. In total nine interviews were carried out with parents. Coding of interview transcripts identified 54 codes that were organised under the following nine categories (Appendix I): targeted support for the child (6); involvement of professionals (4); parents' interests (6); child-centred factors (12); parent responses to the situation (5); parents' experiences (5); parents' beliefs (5); parents' involvement supporting their child (4); and talking at home and away (7). The codes for each category were organised into a framework matrix (Appendix I), which included a summary for each individual interview, identifying relevant quotes. Overarching explanations of the interview data were identified and four themes emerged: coping with limited language; supporting the child as an individual; parental uncertainty; and lack of service resources. These themes are explored below.

7.2 Coping with limited language

The first theme reflected parents' main concern, which focused on their children's ability to cope with their language difficulties. Parents discussed the factors that affected their children's coping and issues of frustration and confidence were highlighted. All parents commented on their children's ability to form social relationships and felt that their treatment by other children and adults was particularly important.

The key concern that parents expressed related to their child's ability to cope in everyday life, and particularly at preschool and later on at school. The extent to which this concern was related to the child's specific language ability varied across cases, and was greater for children who had more severe language difficulties. Children's confidence, resilience and willingness to interact were perceived to be important mediating factors in children's coping abilities. Ben was described as a more shy child and having an internal pressure to get things right that suggested he had an awareness of his difficulties with language; therefore, his mother felt that he was often more talkative at home compared to when he was at preschool.

> *I don't know how aware a child of two is…as in aware of failure, but I think he was just really aware that he couldn't do it.*
>
> Ben's mother (Interview 1)

Ben's mother reported that he often checked what he was going to say with her beforehand for reassurance and was most open and vocal when he was involved in pretend play on his own. The other parents did not report such clear differences in children's talking depending on the setting, although both Aaron and Christopher were reported to be quieter at home in the evening when they were tired.

Most parents discussed their children's frustration when others did not understand them, and in some cases parents felt that the child's experience of not being understood could undermine their confidence. The situations during which the children's frustration manifested were varied. Ben's mother linked his frustration to an inability to participate in interactions at home during the early stages of language development and felt that it declined as his language improved. Some infrequent frustration persisted for him, which his mother reported was specifically directed towards her when she was not able to understand him and that he relied on her to support him when he was struggling to communicate clearly.

…the confidence thing is that perhaps that someone perhaps won't totally understand, or, they don't, they, are, aren't going to be able to second guess him accurately in a way that I can second guess.

Ben's mother (Interview 1)

Christopher was reported to experience less frustration. His mother reported that he was unconcerned by any difficulty he had communicating and was more inclined to think it was the other person with the problem. The experience of occasional frustration was described as a potentially useful experience for Christopher to recognise that there was an issue with his communication that meant others could not always understand him. Aaron's language developed quickly after the start of the study and any frustration regarding difficulties communicating were not mentioned. In contrast, both of Daniel's parents reported that he experienced significant levels of frustration with others when they could not understand him, both at home and at preschool. As his language improved his parents said that the frustration decreased and they, and staff at preschool, were increasingly able to manage his expectations and support him. Daniel's mother commented on the social impact he experienced as his frustration levels reduced. While it was reportedly difficult for him to play with others when he started preschool, it became much easier over time, which his mother reported as a very positive change.

…they couldn't understand him. So they didn't know why he would get so cross.

Daniel's mother (Interview 1)

…he tries to play with them...he will sit down and share, take turns , and he will try and join in with play and he will led them to what he's trying to get them to do... I think he's doing well really in a social setting.

Daniel's mother (Interview 2)

Parents talked about concerns for their children coping socially and apprehension about whether other children would treat them differently because of their language difficulties. However, parents noted that other children seemed to respond to how the children played rather than how much they could communicate. The ability or interest of the children in building social relationships that parents reported varied but they felt it was possible for their children to do so without sophisticated verbal interaction.

…the children didn't bother at all. I mean even with Christopher when he wasn't very clear, they'd go out in the woods, he'd be leader of the pack... He'd be bossing them all around saying 'go here, go there', and they just seemed to know.

Christopher's mother (Interview 2)

There's sometimes some language but there's not, it's mainly excitement that 'yeah yeah, good one good one'

Ben's mother (Interview 1)

7.3 Supporting the child as an individual

Another theme emerged that captured the value parents place on being able to understand their children and meet their needs accordingly. This understanding was reported to be important for parents themselves and other adults, particularly preschool or school teachers. Parents also discussed the significance of the relationship with the speech and language therapist, for both themselves and their children and the value of targeted intervention strategies that take into account children's needs.

All of the parents spoke about the importance of understanding their child and their individual needs. Children's mothers generally felt that they were better able to understand them than other adults, including family members, because they were the most familiar with their child. As parents' ability to understand their children improved, they felt they could more effectively meet their needs. Christopher's mother felt that this change allowed him to be more autonomous. In Daniel's case it took some time for his parents to understand what he needed as his language was so limited. His mother reported that this could lead to stressful interactions, especially with his father as he was less familiar with Daniel's communication.

I think that's the other thing I've really learnt... is actually that how he needs things to be slightly different to facilitate the environment better for him.

Ben's mother (Interview 2)

Everyone's had to learn techniques on what he needs to get through the day almost so I just think it's been a bit of an all-round effort and that's really pushed him on really.

Daniel's mother (Interview 2)

…it's easier because, you know at least you feel like you're meeting his needs... Instead of having to guess, maybe what he wanted.

Christopher's mother (Interview 1)

He can have sort of, now have more of a, input in, "oh let's go and choose some clothes, what are you going to wear today?", "I want Batman top" or "I want Spiderman top". And so in that, he's got more say over probably, or more, we understand him more, about what he wants to do…you just know what he wants because he'll say it rather than dragging you and, or pushing your head which is what he used to sort of do

Christopher's mother (Interview 1)

… cuz [father] would get stressed cuz he didn't understand. And then because [father] was getting stressed Daniel would have a flip out cuz he couldn't get himself known.

Daniel's mother (Interview 1)

It is difficult, it's difficult for me cuz you know, I want to help him but you just don't know what he wants.

Daniel's father

Familiarity with the child and their needs was also expressed as vital in order for professionals to be able to support them effectively. Parents ranged in their experiences with professionals and whether or not they felt that they were doing their best to support their child. Many experiences were positive and parents reported that their concerns about children coping outside the home had been mitigated when preschool staff had known the child, or had learnt to adapt to support them appropriately, recognising the child's additional difficulties.

…just recognising that and knowing what his triggers are, really helps him cuz he has a much better day at nursery where he's not so frustrated and cross all the time...some of the staff, just getting to know he was getting frustrated, due to a problem rather than being naughty.

Daniel's mother (Interview 1)

Professionals' ability to understand the child rather than make negative judgements about their behaviour was important to parents and something that they were concerned about in different settings. In some cases parents felt that judgement of the child precluded their ability to understand and support them appropriately, attempting to "pigeon hole" the child to account for behavioural difficulties. Aaron's mother expressed particular difficulties when she felt that professionals were not listening to her or taking account of her knowledge of her own child. She felt in some instances that they were not taking responsibility for supporting her child. Regardless of their current experiences, parents felt it was important that adequate and individualised support continued when their child started school.

I don't want him to get a reputation [at school] (laughing)

Daniel's mother (Interview 2)

… for them to then look round and say he can't build relationship with any other child is absolute rubbish but they won't listen. I've tried explaining and telling them and they just don't wanna know.

Aaron's mother (Interview 1)

But it's almost like they imply it that he's the one with the problem but actually it's them with the problem, and they struggle to deal with him and, and out of it, all this, all that's happened is that, um, he's, he's being deprived

Aaron's mother (Interview 1)

The relationship with the speech and language therapist was reported to be important for both the parent and child, particularly by parents of the children who had longer term support. Parents felt that not all strategies for supporting children's language were successful and that it was important that the therapist took time to understand what worked for the child, taking into account their engagement with the process. Parents saw their child as an active participant in the process of language intervention and the strategies used have to be acceptable to the child. For example, the therapist believed that Makaton (using signs to support language) would be helpful for Christopher but he did not want to do it and the attempts to incorporate signing could not go any further. Parents believed that therapists needed to be creative to keep the children interested, particularly when the activities were challenging and failure threatened children's confidence.

> *He did do some signing but he didn't, he didn't want to do it [Makaton], it wasn't really his thing.*
>
> Christopher's mother (Interview 1)

> *So, the first activity he does really great, sits, listens, perfect, does it great. As soon as it gets a little bit tricky he does lose a bit of confidence then, and then he'll start playing up, he'll start fidgeting or going, he'll walk away, he'll go and sit on the floor and he won't really listen. He's at that stage where actually when it is hard he knows it's hard and he really wants to try and do it and he'll give it like a two second go but then think "oh it's hard".*
>
> Daniel's mother (Interview 1)

Parents distinguished between general and targeted strategies for supporting children. In some cases general, indirect support that provided advice for parents was acceptable as it was providing guidance on different ways to interact with their child, e.g., getting down on their level and giving them enough time to respond. Other parents felt that it was difficult for therapists to give parents specific advice for what to do with their children because they did not have enough time to get to know them as individuals, resulting in only generic ideas. Furthermore, some parents felt that the information provided by therapists was very similar to what they were already doing at home with their children and were disappointed with the advice they were offered. In contrast when strategies produced clear results and they started to see progress, such as the child achieving target vocabulary, parents expressed the value of SLT. Daniel's mother valued being able to learn new strategies and share ideas with preschool staff that they had not previously been using.

> *I don't think they can to be honest cuz every child is different. They can only give you a generic idea of what you should be doing...I think ideally you know, if you had more*

input from them then yes they would get to know the children a lot better but they can't do that.

Christopher's mother (Interview 1)

I think it was everything that we do on everyday basis … you know, as part of our life, you know as part of life to say 'oh look, there's the car there' 'what colour's the car?' and say it repetitive anyway … we've been doing that for years … So I felt the first one was actually, I know all that. Whereas now I'm really learning techniques and logical stuff that I just think, oh god, yeah ok. You know, it's really opening my eyes as much as, and you can, and he's really coming along, like he grasped 'Daniel' within two weeks.

Daniel's mother (Interview 1)

7.4 Parental uncertainty

The theme of parental uncertainty emerged from parents' discussions of how they questioned their decisions regarding attempts to support their children, and the importance of external validation of their concerns. Parents spoke about not feeling properly equipped to talk to others about their children's language difficulties. Parents also discussed the factors that helped or hindered the implementation of advice and strategies that they were given by speech and language therapists.

Parents often questioned the decisions they had made or actions that they were considering taking to support their children. Concerns related to strategies that they attempted at home that they hoped would help, and the need to evaluate whether they were successful. Parents also questioned their decisions to seek help externally and decisions that might be difficult for their children in the short term, such as moving them to a new education setting. When talking about how they made decisions, parents commented on their evaluation of children's level of need as well as trusting their instincts as parents. They also reported that the observation of progress or persisting difficulties, and triggers to seeking help such as the two-year health visitor checklists, were important factors. Parents reported acceptance of the situation when they felt they had done all they could at the time and were able to put things into perspective. Validation of parents' concerns was also stated as an important driver for moving forward, especially when other people had dismissed their concerns as unfounded.

Having someone else acknowledge that actually yeah he is struggling a bit

Ben's mother (Interview 1)

To actually have someone say well actually there is an issue then helps ... And then you start thinking "well what can we do, how can we start that?"...cuz it makes you feel like you're not being silly really.

Christopher's mother (Interview 2)

Parents found that discussing their children's language difficulties and sharing their concerns was not always straightforward. They felt that other people rejected the importance of early delays with language and that having a way to frame conversations was useful.

> *…you have more helpful conversations...with people around you... Because it's got a label, like he's in a study, like that label applies…*
>
> Ben's mother (Interview 1)

> *Everyone said 'oh you know he's fine, he's only young'*
>
> Christopher's mother (Interview 1)

In some cases parents had experienced challenges when out in public. People would assume that their child would be able to say more at their age and when children did not meet their expectations parents often talked about their discomfort at people's confusion. There was a concern for their child being judged in these brief, passing situations out in public as well as in their everyday educational settings.

> *I think you feel a little bit awkward to, to start off with ... you could see them looking like, "oh, well, why's he not speaking?"*
>
> Christopher's mother (Interview 2)

> *… you could get upset every two minutes just try not to think about it too much and just try to get on with it …*
>
> Daniel's mother (Interview 2)

Parents expressed a need to be guided by professionals or have additional insights and advice about their child's situation and the best action to take. The level of support that parents wanted varied according to their existing knowledge about child development and language learning.

> *… unless they show you the best ways and give you case studies of the best ways to deal with this and how to encourage him, then you know, that's not going to happen is it? Cuz as far as I'm concerned how difficult is it to say 'mummy', you know?*
>
> Aaron's mother (Interview 1)

> *I've never come across someone who's, who struggles to speak like that.*
>
> Daniel's father

The extent to which parents reported being able to use taught strategies varied across cases. Some parents described the use of more general interaction techniques as getting easier as they became more familiar with implementing the approach. Other parents did not always feel that general strategies were appropriate for their interactions, for example, one parent found

it did not work with their child to get down on their level. Parents also struggled to implement strategies when they did not feel that they were receiving clear and consistent advice, for example, being told to talk to you child as much as possible but also that sentences should be shorter and simpler. Not only was it difficult to reconcile such differences but parents also found it difficult to remember to do everything as the speech and language therapist had suggested.

> *you don't realise how difficult it is, when you're driving along and you know they're saying you know, you've got to talk to them all the time. And you're thinking "well I do talk to them all the time" and then well yes you're, you're thinking actually well "I'm not talking to him now".*
>
> Christopher's mother (Interview 2)

Parents also reported difficulty in adapting the strategies from SLT to use at home in a manner that was acceptable for their child. Christopher and Daniel both had long-term support from SLT and although their parents agreed that sessions with the therapist were successful they found that their children were less interested in engaging with similar activities at home.

> *So you know he didn't ... want to sit all the time matching cards up but you would do something else to get him to say, to do the same sort of thing.*
>
> Christopher's mother (Interview 1)

> *he didn't enjoy them that much. He was fine doing them with the speech therapist but "no, that's their, their games mummy". So we used to have to adapt what they were showing us to do… So it was having to try and find ways to use it in everyday life rather than actually sitting down and saying "listen we've got to do this". Because he was a bit like "no I'm not doing this".*
>
> Christopher's mother (Interview 2)

Parents felt that there was a difference between children knowing that they had to follow the instruction of the speech and language therapist during sessions and being willing to go through the same effort at home. Parents discussed having to adapt SLT approaches and incorporate the strategies into everyday life. This approach was not always easy and parents said they were not clear about exactly how this should be done. Furthermore, parents talked about difficulties remembering to use strategies and suggested that adopting new methods of interacting with their child and integrating these into their typical interactions was a challenge. Understanding the logic of the SLT approach and being able to learn something new was reported as valuable for parents.

It's quite hard to do really you don't think it is but it is very hard to sort of, to do... I think it's remembering to do it...because, you know, you just don't take, you just don't realise... probably how much you need to say.

Christopher's mother (Interview 1)

it's just you're busy aren't you and I don't often get a chance to sit down and, we do a lot of repeating of the words when we're out and about and making sure, that we, we don't correct him, but making sure that we repeat things...but yeah we don't do it a lot at home. I just think he's had literally all day here, he's tired... I'm not very good at the whole sitting "come on let's sit down and"

Daniel's mother (Interview 2)

They [the speech and language therapists] say to get on his level because then that gives him the chance to lead ... to lead it so he feels like he's in control, um, but then, not really [told purpose of strategy].

Christopher's mother (Interview 1)

I can see the whole logic in it because, the, the first six weeks when he, she was, um with the other lady, if he wasn't saying 'car', he's not gonna get 'wardrobe' when we were looking at houses, you know, it would be little bit random ... Whereas now I'm really learning techniques and logical stuff that I just think, oh god, yeah ok. You know, it's really opening my eyes … and he's really coming along

Daniel's mother (Interview 1)

7.5 Lack of service resources

The final theme covered parents' frequent references to the need for more guidance and support, particularly support that was targeted to the needs of their children. Parents talked about the lengthy wait for referral and subsequent intervention from SLT services, which contradicted the need for early intervention. In accessing services parents often felt that they had to be the driver of the process and faced challenges from limited service provision as well as from other family members or friends who did not recognise their concerns.

Parents had different expectations about the type and level of support that they required for their children; however, in all cases they expressed a desire for more guidance, readily available access to specialist support or intense and consistent intervention. The parents talked about the importance of early intervention, recognising the rapid development that children undergo during the early years. They felt that the long referral period before children could be supported by a speech and language therapist was in direct contradiction of the need for pre-emptive action to advance children's language development. In Christopher's case, he had been seen by a therapist before the age of three for which his mother felt fortunate.

I think that if they actually looked at it, and it is almost like a massive contradiction … to leave such a big gap when you're left to your own devices you could possibly be

doing that child more harm than good … or it's just delaying everything cuz like we said, if the health visitor could have just gave you some general information

Aaron's mother (Interview 1)

I don't think we'd be here now if he'd had been waited till he was three, I think we'd still be working towards getting him speaking. I think the early intervention has helped.

Christopher's mother (Interview 2)

All of the parents talked about their concerns regarding the availability of support; therefore, they felt that they had to be the drivers of the process to get help for their child. In one case, a mother attempted her own strategies to support her child's language but wanted more targeted and expert advice for the specific areas of deficit. In another case, parents felt that they needed professional advice before they could adequately make changes to support their child. Neither child in these two cases received intensive support from a speech and language therapist during the study. Their parents felt that some advice could have been provided earlier through a more informal process that did not include extensive waiting times. Parents suggested access to drop-in sessions that offered resources and a tiered system for different levels of need. However, the message from parents was not always clear; for example, in one case the child's mother felt that it would be beneficial to use health visitors to provide more generic support for parents regarding early language development, but she also suggested that the advice of a more specialist professional in the field would be more respected.

especially if they'd come up with the admission that they don't' have children themselves, it's like "who are you?", you know, "how dare you start reeling off what you listen to in your textbooks and all that and you know, and try and tell me what to do"...I think if you need something doing then you need to see the specialist in that field.

Aaron's mother (Interview 2)

Some parents were willing to pay privately for additional support from an independent therapist. Others endeavoured to get support from all relevant public agencies. For some parents making the decision to seek help was difficult and they felt that they had to balance their own concerns and desire to do the best for their child with the possibility of being fussy and overbearing, or in opposition from other family members or friends who dismissed their fears. Parents demonstrated great tenacity and strength in getting the support they felt necessary for their children.

it's very difficult to sort of be strong enough to think, "well no, I want something done". I think we're lucky in that actually something was done.

Christopher's mother (Interview 2)

And I pushed for everything that I get ... if I didn't push the health visitor he wouldn't have been seen even cuz everybody was saying "oh they don't refer children before the age of three"'. And I was like well that's not gonna be no good, he needs support now
Daniel's mother (Interview 2)

In summary, the concerns of parents in the current study focused on their children's ability to manage in their preschool (and later school) setting and to be accepted by others. Parents talked about their hopes that other children would not treat them differently because of their language difficulties. They also expressed concerns that preschool staff would recognise that their children had additional needs and not make assumptions that they were naughty or difficult. Parents discussed their desire to be able to meet their children's needs. Parents often reported uncertainty regarding their decisions about how best to help their children. Parents who received advice from speech and language therapists about how they could support their children's language development also expressed some confusion about how to integrate strategies into everyday life and the reason why techniques were important. All parents reported their dissatisfaction with the long waiting time for referrals to SLT services and the lack of targeted support in the interim. It is important to recognise the views of parent regarding their children's language difficulties and their experiences of services in order to integrate parents' expectations into the process for identification and support of children with PLI. Parents' engagement with services is vital for the success of interventions to improve children's language development and it is important to facilitate their involvement and plan interventions that are acceptable to individual families. Integrating both parents' expectations, and the opportunities available in children's home environments, into interventions and associated advice for parents could help inform interventions that are acceptable to families.

7.6 Discussion

Interviews with parents examined their perspectives on the experience of having a child with PLI. Parents are vital to the success of early interventions, particularly when they target PCI; parents must recognise their own role in children's language development and engage in the process of learning interaction techniques. Previous literature has explored the perspectives of parents before, during and after a planned intervention and has demonstrated the importance of involving parents in the decision making process, avoiding misunderstandings and improving parent engagement and satisfaction (Carroll, 2010, Glogowska and Campbell, 2000, Lyons *et al*, 2010). The present study aimed to identify factors that could inform SLT services regarding how to make interventions a success for parents and children. The children in the study were not all receiving SLT services at the start of the study and the interview findings also have

implications for other professionals and highlight the need for increased awareness of language learning difficulties.

Parents did not often talk explicitly about concerns for their children's language but rather their concerns for the impact of difficulties communicating with others. Primarily, parents were interested in their children's ability to cope in everyday life, which included their ability to build relationships with peers, and not be left out or treated differently by other children. In addition, parents wanted preschool or school staff to understand their children's individual needs and not judge their behaviour. The ability for education settings to meet children's needs was important to parents, and was often related to reducing frustration or increasing children's confidence. These findings were consistent with the Better Communication Research Programme (BCRP), which reviewed services for children and young people with speech and language difficulties and included an exploration of preferred outcomes for children and parents. The BCRP found that parents were concerned about children's communication skills as a means of determining their independence and social inclusion (Roulstone *et al*, 2012a). Similarly, their work with children and young people suggested that there was a need to address issues around their social acceptance (Roulstone and Lindsay, 2012). Another study that carried out focus groups and questionnaires with parents (Carroll, 2010) found that parents were more concerned about resolving issues with children's speech rather social outcomes. It is possible that parents' preferred outcomes vary depending on the age of the child or the severity and nature of the language problem. In the present study Daniel's mother was concerned about how he coped in his preschool setting but also judged the success of intervention with the speech and language therapists based on his ability to produce target vocabulary. These specific language-focused goals may have been particularly relevant for Daniel as he had a very limited vocabulary size and demonstrated slow vocabulary growth over the study period. Carroll (2010) highlighted the need to negotiate interventions goals with parents to improve their satisfaction with the process and establish realistic expectations for parents to avoid disappointment. Preferred outcomes may change over time as children's language develops and social outcomes may become more important as children's basic language skills develop. It may be useful to review progress and goals over the course of intervention, particularly for children who require longer term support.

Previous studies with parents often found that they commented on the importance of seeing progress for their children (Baxendale, Frankham and Hesketh, 2001, Glogowska and Campbel,

2000, Lyons *et al*, 2010), which was also discussed by parents in the present study. All parents commented on the value of the study and its methods, in particular the CDI checklists and the picture-book sharing sessions, as they provided an opportunity to clearly identify progress. It is difficult to recognise change in children's language when there is no objective measure as parents see their children every day. The use of a simple tool to help parents identify change could further encourage their engagement with services and their own role in supporting their children's language; they could also serve as prompts for parents to carry out recommended strategies. The goals of SLT interventions should go beyond the child's language development to include practical aims for social inclusion and school readiness as well as parental understanding of their child's language difficulty, SLT support provided and parents' own role in that support, to increase the chances of engagement and success.

Parents in the present study discussed the difficulties they faced sharing their concerns about children's language with friends and family, and they often felt their worries could be dismissed as unfounded. Parents did not want to feel that they were being overly anxious and appreciated external validation of their concerns. In two cases, mothers talked about situations where their child interacted with members of the public, such as in shops or restaurants, and their discomfort when people reacted to their child's limited verbal interaction abilities with confusion. The perception of stigma was identified in previous studies of parents (Glogowska and Campbell, 2004, Rannard, Lyons and Glenn, 2004) and Glogowska and Campbell suggested the potential barrier that stigma could be for parents in accepting the involvement of SLT services. The mothers in the present study were very committed to the intervention process and doing anything they could to support their children's language; however, the potential impact of stigma should not be ignored. Parents talked about their desire to meet their children's needs and in some cases parents found it distressing when they could not understand what their child wanted. Speech and language therapists should consider how to support parents to communicate their children's needs to both professionals and family members or friends in order to have constructive dialogues with others. In addition, helping parents to identify the positive aspects of their communications with children could facilitate the empowerment of parents and their role in their children's language development and support their active participation in the therapy process.

A number of issues in the process of referral to, and support from, SLT services were identified in the present study. The resource constraints on the local SLT services meant that families

experienced long waiting periods, blocks of support followed by further waiting time, and in one case support from a succession of different therapists. Issues with the consistency of support that was available was a cause for concern for the parents of children receiving longer term SLT and they felt that this disrupted children's progress. Parents all commented on the importance of building good relationships with professionals, for both their children and for themselves, and the distress caused when relationships were strained. In a retrospective study of parents whose children had been supported in a language unit (Rannard, Lyons and Glenn, 2004) some parents also expressed frustration at waiting times. When comparing experiences of families allocated to either intervention or a period of monitoring, some parents expressed disappointment at being in the wait group as they believed that children would benefit from earlier support (Glogowska and Campbell, 2000). However, some felt that their children would not have been ready or that it was preferable to give them the opportunity to develop at their own rate. In the present study, some parents suggested that the provision of targeted strategies or activities that they could use during the interim periods could be improved for the future. The parents discussed the lack of clear and detailed guidance that they felt was currently available. Providing parents with tools that allow them to take a proactive approach while waiting for intervention could help to reduce frustration. Taking into account previous studies, it is important to recognise that not all parents will necessarily want to take this approach and it should be discussed on an individual basis.

The parents in the present study with children receiving long term support from SLT services were not always confident about the strategies that they had been given by therapists. Although their children were receiving one-to-one support and the focus of therapy was not necessarily PCI, it remains important to address the role of parents in their children's language development (Baxendale, Frankham and Hesketh, 2001). Parents often felt that the advice that therapists gave them was generic and not different to what they were already doing at home; they reported the value of intervention when it was individualised to suit their children's needs, and they were able to learn something new as parents. These reflections were consistent with previous study findings that the engagement of some parents was threatened when they felt therapists were telling them what they already knew (Glogowska and Campbell, 2000) and one of the parents in Lyons *et al*'s (2010) study was dissatisfied with the focus on parents' communication rather than on the child. In Baxendale, Frankham and Hesketh's (2001) study, some parents described the strategies taught in the Hanen Parenting Programme as common sense but believed that the emphasis on their importance remained useful.

Consequently, the study authors suggested that the course could be modified depending on the strategies already present in parents' interactions. The differences in parents' perceptions of interventions that teach interaction techniques highlighted the need for early discussions regarding parents' expectations and concerns (Glogowska and Campbell, 2000). Parents in the present study also struggled to articulate the purpose of SLT strategies and expressed difficulty in remembering to carry out advice they had been given in everyday situations. It is important for therapists to develop shared frames of reference with parents that reduce the chance of misunderstanding and clarify their roles in the intervention process (Lyons *et al*, 2010). In addition to parents concerns regarding SLT strategies, two parents in the present study reported that their children recognised certain SLT activities that parents attempted to carry out at home and refused to participate in their home setting. Future research should consider the acceptability of interventions from children's perspectives. The Children and Families Act 2014 outlined that in the UK, services must take the views of children and parents into account when considering how to support the children with special educational needs or disabilities. These legal changes highlight the importance of understanding how best to capture to perspectives of children, especially very young children and those with limited abilities to communicate verbally.

Chapter 7 has provided important insight into the experiences of parents of children with PLI. The case studies included parents of children in the early stages of identification or intervention for PLI and their views related to SLT interventions, but also to other professionals, such as health visitors as well as preschool staff and experiences with friends, family and the general public. Broadly, parents' perspectives could be divided according to outcomes for their children or themselves, and challenges they face in providing support for their children's language development, which have important implication for research and practice. Parents in the present study discussed the generic nature of SLT strategies that their therapist addressed and the value they placed on learning new skills. Implications for future research and practice are discussed in Chapter 8.

Chapter 8 Understanding interactions in children's everyday lives

This final chapter outlines a summary of the findings from the four case studies (8.1), followed by an overview of the strengths and limitations of the study methods (8.2). Considerations include how language was measured and the value of examining individual development within children's natural environments, as well as the challenges this presents and the potential bias introduced by involvement with professionals to support children's language. Section 8.3 discusses the representativeness of dyadic toy play for understanding PCI that occurs during children's broader daily activities. The implications from the present study for future research and practice are then reviewed in section 8.4, followed by final study conclusions (8.5).

8.1 Overview of study findings

There are four key findings from that emerged from the present case studies. Firstly, there were different trajectories of vocabulary growth found for the children with PLI. Secondly, mothers were generally found to dominate interactions with their children in a manner that differs from previous research findings. Thirdly, the case studies did not find evidence for clear changes in maternal responsiveness over the study period. Finally, there were clear differences in PCI found from the naturalistic samples of interactions from all-day recordings compared to the video-recorded picture-book sessions. The findings question the representativeness of the brief dyadic toy play observations for understanding children's everyday interactions more broadly.

The present study examined the individual trajectories of vocabulary growth of four children with PLI in order to identify variation across cases. The four children in the present case studies demonstrated variation in their rate of vocabulary growth and their overall developmental trajectories. Three broad trajectories were seen in the individual vocabulary data. Two children demonstrated steady vocabulary growth, which suggested that they maintained their level of vocabulary delay over the study period. One child showed a slow rate of growth and consequently, an increasing trend for his level of vocabulary delay. Finally, one child demonstrated a faster rate of growth compared to the other children, and a decreasing vocabulary delay as he caught up with TD levels. Although these profiles were from only four children, the findings emphasised the value of tracking actual individual trajectories of growth. Due to the large amount of variation, the range of trajectories in early vocabulary

development can be missed in large scale studies that report average patterns of growth from group level data (see section 8.2.2).

During interactions sampled in the present study, mothers were generally found to initiate more topics and turns than their children. However, the discrepancy regarding the number of turns between mothers and children were relatively small. These findings contradict previous research with children who have PLI, which have found a much larger discrepancy between mother and child turns (Conti-Ramsden, 1990, Conti-Ramsden and Friel-Patti, 1983, Conti-Ramsden and Friel-Patti, 1984). Furthermore, previous research has demonstrated that both TD children and those with PLI introduced more topics than their parents (Conti-Ramsden and Friel-Patti, 1984, Rescorla *et al*, 2001). These findings suggest that children in the four case studies were not generally controlling the topic of interactions with their mothers. These findings are particularly important as speech and language therapists recommend that parents aim to follow their child's lead during interactions (Girolametto, 1988, Kaiser *et al*, 1996). Understanding factors that facilitate child topic control could help speech and language therapists to teach parents strategies for talking with their children that optimise existing interaction styles.

The case studies found no clear trends that suggested an overall increase or decrease in responsive utterances across the study period, except for a reduction in interpretations. These findings suggested that the maternal contingency did not adapt to children's developing skills over the study period. The lack of change was unexpected because previous research suggested that children's productivity impacts on parents' opportunities to use contingent replies (see section 2.3) and as children's vocabulary skills develop they produce increased talk to which their parent can reply (Paul and Elwood, 1991). It was not apparent that children with limited language elicited less language from their parents, based on the present study findings. The apparent lack of change in maternal responsiveness over the study period questions the extent to which the mothers adapted to their children's developing vocabulary skills. It is possible that the samples of interactions selected in the present study, or the particular measures of child and parent language, were too broad and did not capture more specific adaptive PCI changes over time. Differences in maternal teaching style were found over time based on the Thorpe Interaction Measure (TIM) scores from the picture-book sharing sessions, and there could be other important characteristics of PCI that were not considered. Furthermore, the interactions selected for transcription were based on high numbers of

mother-child conversational turns, and this measure might not be the critical feature for identifying interactions that are important for child language learning. It is possible that the influence of children's productivity is particularly important during the very early stages of language when children are producing only a few verbal utterances. However, in the present study there were not large discrepancies in the amount of parent and child utterances, in fact some children produced more utterances over the study than their mothers. Although the vocabulary skills of the four children in the present case studies were limited, particularly at the start of the study, it is possible that because they were already using a large number of utterances, increased diversity or overall vocabulary knowledge, as well as longer conversational turns and topic introductions had limited impact on their mothers' interaction behaviours. It should not be ruled out that the period of 9-10 months was too short to identify changes in PCI or that important changes occurred that were not measured in the current study.

Finally, the present study found consistent differences in PCI sampled from the naturalistic all-day LENA recordings from children's home environments, compared to the brief video-recorded picture-book sessions. The rates and proportions of responsive utterances that mothers used during the LENA samples often appeared below those used by parents in previous studies with TD children and children with PLI. In contrast, there was a trend for increased maternal responsiveness during the picture-book sharing sessions compared to the naturalistic samples. These differences suggest that context in which PCI was sampled had a greater impact on the characteristics of the interaction than the language skills of the children. The contextual coding of the LENA audio provided insight into the how parent and child talk and interactions varied across activities in children's home environments. There were similarities across cases, which highlighted that activities involving high levels of interaction such as playtime were not necessarily frequently occurring across a typical day. Play was of particular interest as it has been commonly used to observe PCI in research studies and intervention evaluations (e.g., Baxendale and Hesketh, 2003, Conti-Ramsden, 1990, Fey *et al*, 1997, Fey *et al*, 1999, Rescorla *et al*, 2001) but the findings from the present study have led to questions regarding whether or not brief play sessions are appropriate for representing typical PCI. Subsequent research is needed to identify whether sampling differences are replicated in larger samples of children with PLI. Implications for future research have been discussed in section 8.4 of this chapter.

8.2 Strengths and limitations of the current study

Research into PCI must consider the validity of the study methods used to measure parent and child language and the extent to which sampled PCI represents the true nature of everyday interactions. The following section outlines the strengths of this study regarding the use of multiple language measures, examination of individual vocabulary development, sampling PCI from children's naturalistic home environments and selecting multiple samples of PCI. The limitations of having limited control over the data collection, sampling from a larger data source and the potential bias from involvement with SLT services are then considered.

8.2.1 Use of multiple language measures

The present study used both parent report and naturalistic interactions to measure language in order to improve the validity of findings. There are issues regarding the extent to which different language measures accurately represent children's language skills. The most appropriate method for measuring child language may change depending on the child's age and language level. For example, at a particularly young age when children are only using a very limited vocabulary, utilising parents' expert knowledge of their children in parent report tools ensures that the broadest range of children's ability is captured. Parent report offers a fast approach to data collection that can be used to collect information for large samples of children. However, parent checklists do not provide information about how children actually use language (Pan *et al*, 2005), including whether they use the words appropriately in context; they may also underestimate children's language as they reach ceiling levels. Language samples are more resource intensive and require time to carry out observations, transcribe and analyse samples, but they provide information about how children use language for communicative purposes during interactions with others. Both methods have advantages and disadvantages but using one method alone can limit the representativeness of study findings and can make comparisons between studies difficult. Triangulation of data across the different measures demonstrated the reliability of the study findings. For example, the rate of child vocabulary growth was compared for the CDI vocabulary measure and the cumulative growth in the number of different words during the LENA samples and similar trends were found across cases (see Figures 5.5 and 5.6 in section 5.6).

The present study was interested in the dynamics of the relationship between parent and child talk and interactions, which meant it was necessary to take concurrent measures from PCI samples. However, the CDIs were also used as an independent measure of vocabulary that was

not directly influenced by the nature or the context of the interactions. The inclusion of an independent measure was important due to the reciprocal relationship between parent and child language (Huttenlocher *et al*, 2010, Song, Spier and Tamis-LeMonda, 2014), which is a particularly important consideration for studies that intend to identify characteristics of parent language that facilitate children's later language performance and examine predictive relationships. If child and parent language measures are taken from the same interaction at one time point it is difficult to determine the direction of the relationship between the characteristics of parent language and the child's language level. It is also possible that measures of child language taken during interactions with parents could be "contaminated" by the influence of parent talk; therefore, Rowe (2012) chose to examine the relationship between parent and child language using standardised language tests of child performance that were independent of PCI samples.

8.2.2 Examining individual development

The current study presented unique data that examined the individual trajectories of vocabulary development of four children with PLI and the dynamics of child and parent talk and interactions that occurred throughout a 9-10 month period of development. Many studies of children's vocabulary development examine group level data, which does not reveal actual trajectories of growth. These studies have demonstrated vast variation in early vocabulary skills across the preschool stage, which may confound attempts to identify how external factors relate to children's developing language abilities. Broadly, in the present study, there were three different trajectories of growth shown by the case study children (see Chapter 5 for details). One child showed an initial delay followed by acceleration in vocabulary growth early in the study that caught up with TD levels. Two children demonstrated relatively steady increases in vocabulary over time and the extent of their delays was maintained. The remaining child showed a slow rate of growth that evidenced an increasing level of vocabulary delay relative to his age over time. The latter three children showed consistently delayed vocabulary over time. Latent class analysis of a large population based sample of children did not identify a profile of development that included persistent delay over the preschool period. Ukoumunne *et al* (2012) identified five profiles of language development in a population based sample of 1113 children from age 0;8 to 4;0 in Australia. Two of the profiles identified from the group level data included children with impaired language; however, these profiles included children who showed either TD language followed by impaired performance, or the reverse. Children without data at each time point were excluded from the analysis and they were found

to be more likely to have poorer language scores, which could in part explain the lack of a constantly impaired profile. Although children in the present study were followed for a shorter period of time compared to Ukoumunne *et al*'s (2012) study, the fact that three of the four children showed consistently delayed vocabulary highlights the difficulty in understanding individual development based on average group performance.

8.2.3 Sampling language in children's naturalistic environments

The present study used an innovative technology, the LENA system, to select samples of PCI from all day recordings in children's natural environments, to address the dearth of literature examining PCI as it naturally occurs in children's homes with children with PLI. It has been common practice in PCI research to sample parent and child language during brief dyadic interactions (e.g., Conti-Ramsden, 1990, Fey *et al*, 1999, Rescorla *et al*, 2001). Although frequently carried out at children's homes, families have often been provided with a selection of toys and books to play with to ensure that materials are consistent across participants. Some studies have asked parents to behave as they normally would with their children in a range of activities in their homes (e.g., Huttenlocher *et al*, 1999, Rowe, 2012); however, this approach is less common and more resource intensive. The LENA system has enabled researchers to collect large quantities of language data from large samples of children but it has not been used as a tool for sampling a broad range of characteristics during PCI from transcriptions of the audio. The technology provides an exciting opportunity for further research into children's home language environments and the insights gained from the present study are important for informing potential future studies. Sampling PCI using LENA was chosen to more accurately reflect the true nature of families' daily lives.

The pattern of activities in children's home environments in the present study were similar to that found for TD children by Soderstrom and Wittebolle (2013), extending the findings to the homes of children with PLI. Soderstrom and Wittebolle (2013) used LENA to investigate the daily activities that children engaged in, comparing home and day care settings with TD children aged 1;0-2;5 (years; months). Their study found that general playtime accounted for approximately a third of children's activities at home; general playtime was defined when the child was playing with toys, running around, and not engaged by adults in specific activities. Similar findings emerged in the present study for children with PLI. General playtime for the case studies was further broken down to include 'around the house', 'playtime – general alone' and 'playtime – general interactive', although the latter did not specifically exclude play

with adults, it was found to be uncommon. Collectively, these three categories accounted for 33-36% of children's activity over the study. In contrast Soderstrom and Wittebolle (2013) found that organised play was not common in children's home environments (0.2%), which was consistent with three of the cases in the present study (1-2%), although organised play was more common with Christopher (7%). The importance of these findings is discussed in section 8.3.

Book reading also accounted for a small proportion of children's daily activities in both Soderstrom and Wittebolle's (2013) study (<2%), and the present case studies (0-4%) across the four recording days. However, there were differences between the studies regarding the amount of child talk. Soderstrom and Wittebolle (2013) found that the LENA automated child vocalisation count (CVC) was highest during story time, while in the present study mean CVC was low for the two cases that had book reading activities coded. The extent to which parents encourage children's involvement when reading varied in the case studies, even within families; for example, Ben played a more passive role in the book reading sessions sampled for the activity coding, demonstrated by the low CVC and CTC, but he was a more active participant during two of the transcribed LENA samples. Book reading has been a common activity examined in the research literature and research has shown links between home literacy activities and children's later language (e.g., Aram and Aviram, 2009, Karrass and Braungart-Rieker, 2005, Sénéchal and LeFevre, 2001, Sénéchal *et al*, 2008).

Examination of the amount of talk and interaction during different activities found that high levels often occurred during contexts that were not common throughout the day. Although parent-child play and book reading are important contexts for language learning, the LENA coding provides information about PCI during more common activities in the home. Soderstrom and Wittebolle (2013) examined variation in the number of adult words and child vocalisations across contexts and found that story time, organised play and family visits had the highest levels of talk in the home environment. Findings were generally consistent for the children in the present study, which also examined the number of conversational turns across contexts; however, not all activities were coded for each of the four cases. Furthermore, organised play had high mean adult word count (AWC) for three of the children but it was much lower for Daniel, and there were some differences across cases regarding the activities that included high amounts of adult talk. In addition to finding high levels of interaction during organised play for three cases, mean CTCs were high during meal times for two cases, general

interactive play for two cases, private visits for one case and personal care for another case. Mean CTCs were low during bath time, TV and travel across cases. Recognition of the variation in interaction between parent and child across different activities, and the frequency of activities in the home, could facilitate discussions with individual families involved in PCI interventions regarding how to integrate strategies into their daily lives.

The analysis of the LENA audio from the four cases provides preliminary information about natural variation in PCI, within the home environments of children with PLI. The findings are generally consistent with Soderstrom and Wittebolle's (2013) study of six TD children in their home environments in Canada. Any comparison between the two studies should be interpreted with caution due to the small number of children in each; the children in the Canadian home samples were younger (M=1;9) than the present study (M=2;11 at the start of the study); and there was no indication that they had any difficulties with their language. Future studies should extend these findings to a larger sample of children, with a range of language abilities and from diverse cultural and socio-economic backgrounds. A US study of 71 children aged 0;2-4;0 (Zimmerman *et al,* 2009), found that conversational turns were robustly associated with child language development using LENA automated counts as a measure of PCI. The effect of the number of adult words was partially mediated by conversational turns, which highlighted the value of examining parental engagement of children in interaction. Greater understanding is needed of the relationship between PCI during more common activities around the house and children's later language. Identifying how parents typically interact with their children and during which contexts could help speech and language therapists to individualise their approach so that techniques build on existing patterns of communication.

8.2.4 Use of multiple samples

In addition to variation in the context of PCI across samples, differences were also found regarding the characteristics of PCI across individual five-minute samples at each time point, which highlight the importance of collecting multiple samples. The number of maternal utterances fluctuated during individual five-minute interactions, for example, at t4, the number of maternal utterances used with Ben ranged 29-98 across the trancribed LENA samples and the number of different words used ranged 96-188. A large range was also found for maternal mean length of utterance in morphemes (MLUm) during the individual five-minute interactions. Maternal responsiveness also varied across the LENA samples and

picture-book sharing sessions, which suggested that variation occurred even in similar contexts. For example, Christopher's mother produced the lowest mean rate of recasts and expansions during the picture-book sessions over the study, but at t3 produced the second highest rate recorded from across all individual 16 sessions for the four cases. The variation found highlights the difficulty of using single time points to estimate the typical nature of PCI in individual families or to make comparisons across them. Future studies should consider taking multiple samples of PCI from families, which reflect children's typical activities, to determine whether differences are consistent and take into account the amount of variation between samples.

8.2.5 Lack of external control

A case study methodology was selected for the present study specifically because reduced researcher control was required in order to examine PCI as it naturally occurs, and to acknowledge the individual differences across families regarding the contexts in which there are high levels of talk between mother and child. It is necessary to identify the limitations of this approach for drawing direct comparison across PCI samples or for representing PCI for children with PLI more broadly. Six five-minute samples were selected from each LENA recording for transcription; however, the context of the selected PCI samples varied across cases and over time, which must be taken into account when making comparisons between samples. Half of Ben's LENA samples were from meal times, while over half of Christopher's were of organised play. Mixed activities around the house were most often sampled for Aaron and Daniel (Appendix G). None of Aaron's samples included other adults or children, except on one occasion in which he talked with his grandmother briefly on the phone. In contrast, there were only seven samples of dyadic interaction with Ben, two with Christopher, and all samples with Daniel included other interlocutors.

Controlling the PCI samples transcribed for the present study according to the activity would have enabled more direct comparisons to be made across contexts. However, the activities that often included high levels of talk, such as mother-child play, were not common throughout the day and they did not necessarily occur during every recording day. For example, there was a number of high-level interaction samples with Aaron at t2, involving focused dyadic mother-child play, which were transcribed for analysis. There was no mother-child play transcribed at the other three time points, or coded from the 25% sampling of the all-day audio. Ensuring that the same activities were coded at each time point would have

required direction from the researcher, which would have conflicted with the study intentions to reduce external control and capture naturally occurring interactions. In future studies, a targeted approach to transcribe PCI from a range of contexts from the home environment would be useful. Carrying out a number of recordings over a few days could enhance the possibility of capturing the full range of children's everyday experiences. Multilevel analyses in future research that account for child, parent and context data could help to explain the interactions between different variables.

8.2.6 Coding samples from the whole-day recordings

It is important to note that due to time constraints only 25% of the audio was coded during children's waking hours and some activities could have been underrepresented in the coding. This issue might be particularly relevant for uncommon contexts such as book reading. For example, book reading was not coded from the selected audio for two of the cases but it is possible that some occurrences were missed by the sampling. The mothers recorded reading with their children at each time point on the activity records that they kept, which covered three days during each data collection period. However, reading was only recorded on two of the LENA recording days for Aaron and Christopher, demonstrating that not all parents read daily with their children.

8.2.7 Potential bias from professional involvement

All four cases had sought external advice regarding the child's language development, which must be taken into account when interpreting the findings of the present study. Throughout the study the health visitor was monitoring Ben's language progress; at the end of the study he had been referred to SLT but he had not been assessed. Ben's mother did not report that the health visitor had provided any specific language strategies but his mother discussed a number of methods that she had attempted to support his production of sounds. The other cases had involvement from SLT services. At the start of the study, Aaron had two sessions with a therapist, during which his mother was given some universal interaction strategies, including the OWL (observe, wait and listen) strategy that is used in Hanen (Manolson, 1992, The Hanen Centre, 2011). This advice was not part of a more extensive PCI intervention. Christopher and Daniel both had more extensive SLT support throughout the study period. Both children received one-to-one support from more than one therapist. Christopher saw an NHS and independent therapist in order to provide continuous support. Daniel saw a succession of the different therapists as a result of requiring more targeted support, as well as changing

therapist due to caseload restrictions. Neither mother reported that PCI was a primary target of the SLT, although PCI targets cannot be discounted. Both mothers reported generalised advice that they had been given by the speech and language therapists to support their children's language. However, the mothers both found it difficult to remember to implement strategies at home, and did not clearly understand the purpose of the strategies given.

Parent training from therapists that included teaching strategies for interacting with children could influence the behaviour of parents during PCI and affect differences, or lack thereof, found across time points for the individual cases. None of the cases were part of a targeted PCI intervention programme that gave parents specific feedback on their interactions with their children. It would be typical for speech and language therapists to provide parents with general strategies regardless of the type of intervention or support provided; therefore, it would be difficult to avoid some input from professionals regarding PCI. As mentioned in Chapter 4 (section 4.2), it would have been unethical to restrict families from receiving support. It is possible that the advice parents received or their involvement in the process of SLT, observing sessions between the therapist and their child, could influence how parents subsequently interact with their children. The potential for external influence on PCI was considered in the systematic review (Appendix A). The issue was raised in Fey *et al*'s (1999) study; they found that parents' interactions style remained unchanged over time despite their interest in SLT. The present study also found limited change over time in the characteristics of parents during naturalistic interactions but any external influence cannot be discounted.

8.3 The toy play fallacy

Findings from the present study questioned the validity of using brief samples of video-recorded dyadic play at children's homes or in a clinic room, with a set of toys provided by the research team that are often used in PCI studies. These samples do not provide information about PCI that occurs more broadly throughout children's everyday interactions. It requires a great deal of time and resources to collect language samples. Hart and Risley's (1995) seminal study collected language data from 42 families for two and a half years and subsequent data analysis lasted six years and it is not surprising that researchers have often relied on brief observations in order to collect language data from large samples of parent-child dyads. The LENA system has provided a new opportunity for collecting all-day recordings and the present study is the first, as far as is known, to examine PCI according to the different daily activities of children with PLI in their natural environment, sampled without the control of a researcher.

Context coding of the LENA audio found that mother-child play was less common compared to other activities. Furthermore, parent and child talk and interactions varied depending on the method used for sampling.

The activity coding of the LENA audio found that interactive mother-child play involved high levels of maternal and child talk and interactions for most cases; however, this activity was not often coded (see sections 5.6.2 and 8.2.3). The majority of these samples were found in Christopher's home environment for whom there were 10 organised interactive playtime samples out of the 141 samples coded across the four LENA recording days (7%) (Table 5.10). During these samples Christopher and his mother, and sometimes his sister, took part in various structured activities, including playing board games and puzzles involving a lot of turn taking, making cakes, and playing educational games which involved learning about words and letters. Although these activities accounted for less than 10% of the contexts coded throughout the study, organised play accounted for 13 of the 24 LENA samples selected for transcription based on high CTCs. There were 12 general interactive playtime samples coded from the whole-day audio, during which Christopher and his sister were playing together, but these included very limited adult involvement. Interactive mother-child play was infrequent across the transcribed samples for the other children. The whole-day audio coding for Ben found that most interactive play samples were with his sister. In total, there were only five examples of interactive playtime between Ben and his mother out all the samples that were coded (4%) across the study and only one of his 24 transcribed LENA samples included a dyadic, interactive play situation with his mother. There were three interactive play samples coded for Aaron (2%) and four of the 24 transcribed LENA samples of PCI with Aaron were examples of interactive play with his mother. There was one interactive play sample recorded between Daniel and his mother (1%) and this context accounted for one of his transcribed PCI samples. The characteristics of PCI were not clearly different in the transcribed samples of play compared to other contexts; however, there were not sufficient examples selected to make meaningful comparisons in the present study.

The small proportion of structured play with parents in children's daily lives has important implications for research and practice, which often restrict observations of PCI to brief dyadic toy play sessions. Not all families report playing regularly with their children (Brocklebank, Bedford and Griffiths, 2014) but it is also a common context used during SLT practice. In interviews with parents and speech and language therapists, Marshall, Goldbart and Phillips

(2007) found that although play was often used during SLT assessment and interventions, therapists reported that they did not believe parents were always aware of the importance of play and its association with language development. The therapists suggested that the concept of play for some parents may vary from their own and they may not have much experience of play. Variation across families regarding their involvement in, and understanding of, different activities in the home and the related interactions with children cautions against the universal use of play during interventions. Marshall, Goldbart and Phillips (2007) suggested that speech and language therapists should discuss the role of play with parents when considering the use of play during SLT sessions.

Book reading was also an infrequent activity recorded in children's homes. It was only coded from the audio for two children: once for Ben and five times for Christopher. A single episode of book reading was identified in the PCI samples selected for transcription for these two children. However, all mothers reported reading to their children regularly, although not always daily, on the activities records they completed during the study. Due to time constraints, the current study only carried out coding for a selection of the audio and it is possible that some instances of these activities could have been missed in the sampling. The fact that mother-child play and book reading were not sampled often does not mean that they did not occur but that they were uncommon in relation to other contexts. The limited amount of dyadic mother-child play challenges the representativeness of the observational studies used in the existing literature that focus solely on mother-child toy play for understanding children's broader interactive experiences.

In addition to finding limited mother-child play in children's home, the analysis of the transcribed PCI samples found higher levels of maternal responsiveness during the picture-book sharing sessions compared to the naturalistic LENA samples (see section 6.3.3). Maternal utterances that were contingent on the child's language were at least twice as common during picture-book sessions compared to the LENA samples for all four cases. The rate of utterance types also showed a trend for increased responsiveness during the picture-book sessions compared to the LENA samples. The importance of maternal differences across sampling contexts is unclear and requires further investigation to address the potential implications for understanding the relationship between parent and child language. It is possible that despite increased maternal responsiveness in different sampling contexts, individual differences across families are maintained, i.e., mothers who use more responsive utterances would do so in a

range of contexts. In the present study the mean proportions and rates of responsive utterances demonstrated similar overall differences across families for both the picture-book sessions and LENA samples, which could support the use of brief observations for capturing meaningful individual differences across families. However, the findings from the case studies also showed variation at individual time points, which questioned the consistency of maternal characteristics of PCI between the picture-book and LENA samples over a smaller sample of interactions. These findings reinforce the recommendations made previously that studies should aim to take multiple samples of PCI to account for the variation in maternal and child talk and interactions used in brief, single samples and increase the validity of results.

8.4 Implications for future research and practice

A number of issues have been highlighted within the individual thesis chapters and the implications discussed for future research have been organised here for clarity. It is important to restate that the current case studies did not aim to achieve statistical generalisation; therefore, recommendations have been made for potential studies that can investigate the relevance of the findings in larger samples of children with PLI. Firstly, research into the effect of context and sampling of PCI is discussed to address the issues outlined in the previous section. Secondly, the importance of making interventions acceptable to individual families is considered.

Dyadic toy play sessions used in the existing literature demonstrate how parents are able to interact with their children in a focussed, uninterrupted setting. These observations do not necessarily represent the actual language learning opportunities that children are most often exposed to at home. In the four case studies, high levels of interaction between mothers and children sampled using LENA occurred more regularly in unstructured and non-specific activities, such as getting ready to leave the house or putting shopping away. In contrast, the video-recorded picture-book sessions involved a brief, focussed activity, similar to previous toy play settings. Differences in the nature of the sampling contexts could relate to the differences found regarding maternal responsiveness in the two settings. The study findings highlighted a need for further research to identify the factors that influence parental responsiveness, as well as other characteristics of PCI, and whether differences between sampling methods are observed in studies using large samples of children with PLI. There is also more work needed to identify whether the differences are more salient when compared to observations of book sharing specifically or are also found in other contexts such as the toy play observations that are often used in research. Sampling PCI during a range of contexts, including different people,

distractions and involvement in specific activities from children's naturalistic home environments could identify whether there are systematic differences in PCI that are persistent across individual families. The extent to which the structure of family lives and interactions vary across a broader range of socioeconomic and cultural backgrounds also requires attention. Such research could help elucidate the factors that facilitate parents' use of responsive language.

Further research is needed to explore the relevance of maternal PCI differences across contexts in relation to children's language development. Studies should measure PCI during different activities and settings and determine whether there is a difference in the extent to which children's subsequent language development can be predicted. For example, PCI could be measured during everyday activities using a tool such as LENA and in more controlled settings that allow for focused dyadic interactions. The potential differences in characteristics of PCI according to the sampling context also have implications for SLT intervention research. Although some studies of PCI interventions examine parent language before and after therapy, they often use brief observations of play. Examination of naturalistic PCI in the home setting, from a range of samples, would help determine whether parents had integrated taught PCI strategies into everyday interactions. Understanding the level of treatment fidelity may help speech and language therapists to understand why some families show greater improvements than others following PCI interventions. It is necessary to determine whether parents who demonstrate increased target behaviours in brief dyadic observations show similar changes throughout everyday interactions in the home environment. Furthermore, understanding the characteristics of PCI used during different activities at home could help speech and language therapists to identify contextual factors that facilitate the use of taught strategies.

The interviews with parents in the present study identified a number of areas to consider in order to support families with children who have PLI and make PCI interventions more acceptable. At a general level, parents expressed difficulties sharing their concerns about their children's language with others, which were sometimes dismissed as unnecessary, and their appreciation when professionals validated concerns. In addition, parents discussed their worries that preschool or school staff, as well as other parents and members of the public, would judge their children as naughty or different, and that they might be left out by other children. In part these issues reflect the need for greater awareness of PLI. This issue has already been raised by professionals in the field of child language and has led to the RALLI

(Raise Awareness of Language Learning Impairments) Campaign. The campaign was launched a few years ago by leading academics to increase the profile of these language difficulties, which are more common that autistic spectrum disorders but often remain hidden to both families and teachers (RALLIcampaign, 2014).

Sharing information with parents from initiatives, such as the RALLI Campaign, in the early stages when concerns are raised could provide families with a better understanding of early language development and difficulties. The parents in the present study were all keen to take an active role in supporting their children's language but felt that there was not sufficient support or resources available during the wait for SLT services. The provision of tools that parents can use with their children offered by early years professionals, such as preschool staff and health visitors, could ensure that parents feel that responses to their concerns are proactive. These approaches could help to empower families to have conversations with other people, help tackle parental uncertainty and reduce frustration while waiting for interventions.

The parents of the two children in the present study who were receiving long-term support from SLT services reported that their therapists had discussed strategies that parents could use at home with their children. However, they expressed a lack of confidence in these strategies, and in their ability to implement them at home and why they were important for supporting children's language development. In particular they discussed the generic nature of therapists' advice and valued the prospect of learning something new that they did not feel they were already doing. Addressing PCI approaches with parents that make direct links to existing patterns of interactions, for example, identifying that a family often talks during meal times, could help them to engage with the intervention process. All of the parents talked about the value of the study methods, particularly the parent report checklists and picture-book sharing sessions, for identifying progress that their children were making. The use of tools to help parents monitor change could support their engagement with the intervention process. Parents did not often comment on children's language skills explicitly and it is important that speech and language therapists set and review shared goals with parents that match their expected outcomes, such as making friends at preschool, in addition to progress in their language skills. Although SLT services are stretched, addressing some of the issues outlined by parents in Chapter 7, including shared goal setting and identification of relevant changes, which can demonstrate that interventions are tailored to the individual child, could help to achieve successful outcomes for families and increased satisfaction of parents.

In summary, short-term actions include sharing currently available resources with parents to help them support and monitor their children's language development and understand the surrounding issues. Mid-term actions focus on new research proposals that use technology such as the LENA system to examine PCI in children's naturalistic environment. Particular areas of interest include: investigating whether PCI sampled in this way would demonstrate stronger predictive relationships with children's later language; comparison of PCI across different contexts in naturalistic and controlled settings; and assessment of parental implementation of taught interactive strategies at home to further understanding of individual differences in the effectiveness of PCI interventions. Finally, long-term goals of this work are to improve the way in which PCI interventions can be tailored to individual family lives and raise awareness of PLI more broadly.

8.5 Conclusions

This thesis has reported findings from four case studies that have provided unique insight into the daily lives of children with PLI, and the nature of PCI during everyday activities. The present study went beyond the current literature, which has often used brief observations of PCI, during optimal conditions that allow for focused dyadic interaction between mother and child, to examine children's actual language learning opportunities in their home environments. In addition, the study examined the developmental nature of PCI over a period of 9-10 months, while tracking the individual trajectories of children's vocabulary growth. The study has contributed to current understanding of variation in PCI across a range of activities in children's homes and the potential impact of sampling contexts on studies of PCI. Further research is needed to explore these findings in a larger sample of children with PLI. The previous section proposed future directions for research required to examine the nature of PCI in children's naturalistic environments for language learning, and test the validity of the toy play setting, for understanding individual differences in PCI across families. There were also suggestions regarding how studies could extend the current findings to explore whether variation in parent and child language across PCI sampling contexts is differentially related to the strength of the relationship found between characteristics of PCI and child language development. The impact of the sampling context also has implications for SLT interventions that aim to modify PCI. Assessment of PCI in naturalistic settings would improve the evaluation of interventions and develop more robust evidence for their effectiveness. The present study has demonstrated the value of new technology for understanding PCI that occurs during real,

everyday interactions. Technology such as the LENA system presents an exciting opportunity for research into the language development of young children. Recording children in their home environments captures the nature of interactions used by individual families, across cultural and socioeconomic backgrounds, without restricting observations to a single activity that does not acknowledge the variation in family life.

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Appendices

Appendix A: Systematic review of parent-child interaction studies

Abstract from the systematic review article submitted to Communications Disorders Quarterly (Blackwell *et al*, 2015).

The importance of parent-child interaction (PCI) for language development has been well established. This has led many speech and language therapy (SLT) interventions to focus on modifying PCI as a means to improving children's early language delay. However, the success of such programmes is mixed. The current review compares PCI, observed in naturally occurring contexts, with preschool children with language delay and age- or language-matched typically developing (TD) controls. A systematic review of the literature searched 10 databases for studies using a case-control design and extracted data concerning participants, matching, selection, design, assessments, measures, findings, statistics and bias. Quality appraisal used the Critical Appraisal Skills Programme (CASP, 2012) case-control checklist. The search identified 17824 papers, which were reviewed against exclusion criteria. The final review included nine studies, which were diverse in terms of matching, delay criteria and PCI measure. A narrative synthesis was conducted. The evidence for PCI differences between children with language delay and TD peers was limited and any suggestion that parents were less responsive could be attributed to limited language skills of children with language delay. The findings question the assumption that communicative environments of children with language delay are different, although the evidence is from a small sample of children from middle class families. Children with language delay may instead be less able to learn from their environment. The review highlights the gap in understanding the relationship between parent and child language use during PCI. The need for further, longitudinal research is emphasised, including children ranging in type and severity of delay, across diverse socioeconomic backgrounds.

Appendix B: Study documents for recruitment

PARENT/GUARDIAN INFORMATION SHEET

Profiles of delayed language acquisition

The research team at the University of the West of England would like to invite you and your child to take part in this PhD research study investigating the developing word use of preschool children with language difficulties. Below is information about what the study would involve so that you can understand what we would be asking of you and your child. If you have any questions about the study we would be happy to answer them and go through the information with you.

What is the study about?

- More than 1 in 20 young preschool children have difficulties with language which are not related to another condition or a more general delay, many of whom will be referred to speech and language therapy services for support.
- There are a number of theories which attempt to explain these difficulties. However they tend to be more concerned with older school-age children.
- This study is therefore interested in trying to understand how the language skills of young preschool children develop and the role of their environment, e.g. their interactions with others, in the changes which occur from single words to more complex language use.
- This study will investigate children's vocabulary over a 15 month period.

What will happen to me and my child if I decide to take part?

- A researcher will visit you and your child at your home several times over a period of 15 months, the exact number will be discussed with you, and timings are outlined below.
- We will carry out some activities with your child to get an idea of what they can do at the start of the study.
- We will also talk to you about your child's language.
- In order to follow their development we will ask you to complete a checklist of the words that they can use and understand.
- We will also ask you to keep a brief record of how they spend their time in a typical week.
- Your child will be asked to wear a small audio recorder for a day, during their normal everyday activities.
- We would also like to watch your child interacting with you at home during different activities e.g., book reading, playing and meal times - these meetings would be video recorded to ensure that all the information is captured and can be looked at again later.

Initial activities completed once at the start of the study					
Activities	Case history	Language assessment	Non-verbal assessment	Communication assessment	Repetition test
Action	Researcher to discuss with parent/guardian	Researcher to carry out with child	Researcher to carry out with child	Researcher to carry out with child	Researcher to carry out with child
Time	30-60 mins	30-45 mins	30-60 mins	15-20 mins	10-15 mins
Total	**2 - 3 1/2 hours over 1 to 2 weeks at your home**				

Study visit (repeated for up to 5 visits)				
Activities	Report of child's language use and understanding	A worksheet of child's daily activities	Voice recorder worn by child	Recording of parent/guardian and child interacting
Action	Completed by parent/guardian	Completed by parent/guardian	Worn by child, turned on/off by parent/guardian	Observed and recorded by researcher
Time	20-40 mins	15-20 mins	All day	40-60 mins
Total	**1 1/4 - 2 hours plus all day recording over 1 week at your home Items will be delivered and collected in the week by the researcher**			

This study visit process will be repeated up to five times over the 15 months at roughly three month intervals. This is meant as a guide and will be negotiated with you to suit the needs and convenience of your family. After initial assessments, this will include a maximum of 10 hours of commitment from you and your child, as well as up to five all day recordings. At the end of the study, an interview will be held with you, using the daily activity records as prompts to look back over the study period, to discuss changes in the communication of you and your child. This will take 30-60 minutes. A timetable of the process if you decide to take part is shown below:

Month	Activity	Time
i	Contacted about study and decided to take part	
1 -3	Initial assessments at home Study visit 1	up to 3 1/2 hours up to 2 hours and all day recording
4 - 6	Study visit 2	up to 2 hours and all day recording
7 - 9	Study visit 3	up to 2 hours and all day recording
10 - 12	Study visit 4	up to 2 hours and all day recording
13 - 15	Study visit 5 Reflective interview	up to 2 hours and all day recording 30-60 mins

Why have we been invited?

You and your child have been invited to join the study because your child has been identified as having some difficulty or delay in starting to talk.

Will my information be kept confidential?

All recordings will be kept securely, for 10 years after the study ends, and will not be accessible to anyone outside the study. After this time they will be destroyed: digital audio and video

recordings will be deleted and any hard copies of data will be destroyed using a cross-cut shredder. Any information produced from the study will be kept separately from anything which contains your personal information to ensure that they remain confidential. Audio recordings and interview data will be transcribed (making a written copy) to be studied. No video recordings will be used for commercial purposes or used in any study reporting. Quotations may be used in reporting but any reports produced will have names and other personal information removed so that they cannot be identified.

Do we have to take part?
No, taking part is completely voluntary. This sheet outlines the study and what you and your child will be asked to do. We will be happy to answer any questions you have about the study. If you decide to take part you will be asked to sign a consent form, for yourself and on behalf of your child. If at any point during the study you want to leave you can do so without reason and this will not affect your relationship with your local services. The study will not involve any treatment to support your child's language skills or have any effect on any support they may currently receive.

Will the study benefit my child?
This study is not designed to directly help your child but rather to explore what language they use, to understand the changes they make over time. You may benefit from getting an insight into your child's development and the factors which seem to influence this.

Can I withdraw from the study?
Yes, you can leave the study at any time without giving a reason and with no consequences. Your participation in this study will not influence the support your child receives from your speech and language therapy service. If you withdraw from the study, or anything happens during the study which means you are no longer able to consent, the information collected up to that point will be used unless you specifically request that we do not do so, in which case it will be destroyed.

What will happen with the study findings?
Information from the initial study activities can be provided if you are interested. You may want to discuss this with your speech and language therapist or preschool staff. Summarised results will be available at the end of the study which will outline the general findings across the different children involved. All personal information will be removed in any report produced from the study to ensure that no one involved in the study can be identified. The data collected from this study may be used for the purpose of future research and the terms of confidentiality and anonymity will remain.

Please note: according to child protection laws if anything arises during the study which suggests a child is at risk from harm the researcher will discuss this with you and report it to the appropriate authorities. The researcher has a criminal records check and child protection training.

If you would like further information, or would like to volunteer to take part in the study, please contact us at the Speech and Language Therapy Research Unit, Frenchay Hospital, Bristol, by or phone 0117 340 6529 or email:

Anna Blackwell (research student) - Anna.Blackwell@uwe.ac.uk
Sue Roulstone (research supervisor) - Susan.Roulstone@uwe.ac.uk

PARENT/GUARDIAN CONSENT FORM (CHILD PARTICIPATION)

Profiles of delayed language acquisition

Please read and confirm the following statements:	**Please initial box**
I have read the information sheet provided for the above study and I understand the nature and purpose of the study.	
I have been given the opportunity to ask questions about this study.	
I understand that the participation of my child in this study is entirely voluntary and that I am free to withdraw my consent at any time before or during the study, without having to give reason and without consequences.	
I understand that the study will run for 15 months.	
I give permission for study sessions to be audio or video recorded.	
I understand that my child's participation is voluntary and that if they do not want to take part in activities or they appear uncomfortable at any time they can stop taking part in a study session.	
I understand that the data my child provides will be made anonymous and will be kept separately to any personal identifying information.	
I understand that audio and video recordings will be analysed by members of the research team, which may include transcription (making a written copy), and these will be made anonymous with any personal identifying information removed for reporting.	
I understand that the words of my child may be quoted in publications, reports, and other research outputs and these will have any identifiable information removed.	
I understand that the investigation is designed to promote scientific knowledge and I agree that the University of the West of England can keep and use the data my family provide for research purposes only.	
I understand that the University of the West of England may use the data collected in this study in a future research project but that the conditions on this form still apply.	
I hereby fully and freely consent to my child's participation in this study.	

……

Name of child

……

Name of parent/guardian Signature Date

……

Name of researcher Signature Date

PARENT/GUARDIAN CONSENT FORM

Profiles of delayed language acquisition

Please read and confirm the following statements:	**Please initial box**
I have read the information sheet provided for the above study and I understand the nature and purpose of the study.	
I have been given the opportunity to ask questions about this study.	
I understand that my participation in this study is entirely voluntary and that I am free to withdraw my consent at any time before or during the study, without having to give reason and without consequences.	
I understand that the study will run for 15 months.	
I give permission for study sessions to be audio or video recorded.	
I understand that the data I provide will be made anonymous and will be kept separately to any personal identifying information.	
I understand that audio and video recordings will be analysed by members of the research team, which may include transcription (making a written copy), and these will be made anonymous with any personal identifying information removed for reporting.	
I understand that my words may be quoted in publications, reports, and other research outputs and these will have any identifiable information removed.	
I understand that the investigation is designed to promote scientific knowledge and I agree that the University of the West of England can keep and use the data my family provide for research purposes only.	
I understand that the University of the West of England may use the data collected in this study in a future research project but that the conditions on this form still apply.	
I hereby fully and freely consent to my participation in this study.	

……

Name of parent/guardian Signature Date

……

Name of researcher Signature Date

Appendix C: American to British English alternatives

Table C1 below outlines the words on the CDI checklist for which British alternatives were provided, and the relevant British words selected.

Table C1 CDI words with British English alternatives presented to parents

CDI original word	*British alternative*	*CDI original word*	*British alternative*
block	brick	garbage	bin
firetruck	fire engine	tape	sellotape
sled	sleigh	trash	rubbish
stroller	push chair	vacuum	hoover
truck	lorry	basement	cellar
rooster	cockerel	bathtub	bath
candy	sweets	closet	cupboard
cookie	biscuit	couch	sofa/settee
French fries	chips	crib	cot
jello	jam	living room	lounge
lollipop	lolly	oven	cooker
muffin	bun	refrigerator	fridge
noodles	pasta	hose	hose-pipe
popsicle	ice lolly	pool	pond
potato chip	crisps	sandbox	sand pit
sauce	ketchup	shovel	spade
diaper	nappy	sidewalk	path/pavement
pants	trousers	street	road
sneaker	trainer	downtown	city centre
snowsuit	rain coat	gas station	petrol station
sweater	jumper	movie	cinema
underpants	pants/knickers	store	shop
zipper	zip	yard	patio
owie/boo boo	ouch	mailman	postman
can	tin		

Appendix D: Daily activity record

The images below are samples of the daily activity records that parents completed and the guidance provided.

Guidelines

- These worksheets are being used to try and get an idea about how your child spends their time during a typical week – please complete a record for 3 days in the week including the LENA recording day
- This record book asks you to fill in what activities your child does throughout the day
- You can use the symbols or descriptions on the front of this book or add your own
- There is also space for you to make comments about your child during these times:
  - where they are and who they are with; any comments about their language
  - how interested they are in the activity, what they are focused on, and their mood
- Below is an example of how you might fill in the record
- If your child goes to preschool or day care for the day any comments from staff could also be added
- You do not need to spend lots of time on these, it shouldn't take more than a 10 minutes a day
- Please also record whether the day is normal for your child or whether something different has happened e.g. child is ill; birthday; visitor staying; school holiday for older brother or sister; holiday
- Please also indicate the day on which your child wore the recording device by circling 'LENA'
- On a LENA day please record the time you turned the device on and the time your child went to sleep at night

Date: Monday 24th		Type of day: normal day	LENA
Time	**Activity**	**Comments**	
6 am – 7 am	Bed – woke up 6.30	Excited about seeing Gran	
7 am – 8 am	Breakfast	Playing with toy car alone, making car noises	
8 am – 9 am	Playing with toys with me and brother	Was upset when brother wouldn't share,	
9 am – 10 am	↓	Practised saying 'Gran', read a book with me	

Date: _____ Type of day: _____ LENA

Time	Activity	Comments	Time	Activity	Comments
6 am – 7 am			4 pm – 5 pm		
7 am – 8 am			5 pm – 6 pm		
8 am – 9 am			6 pm – 7 pm		
9 am – 10 am			7 pm – 8 pm		
10 am – 11 am			8 pm – 9 pm		
11 am – 12 pm			9 pm – 10 pm		
12 pm – 1 pm			10 pm – 11 pm		
1 pm – 2 pm			11 pm – 12 am		
2 pm – 3 pm			12 am – 3 am		
3 pm – 4 pm			3 am – 6am		

Appendix E: Interview topic guides

Parent reflective interview 1: Topic guide

The purpose of this interview is to get your perspective on your child's talking and experiences since the start of the study.

Child's talking

How has your child's language changed since the start of the study?

- have they made progress in all/certain areas
- language use and understanding
- gesture, word sounds, naming words and other types of words, combining words and using them spontaneously, intelligibility

Has there been anything in particular which you think has contributed to these changes/or lack of changes?

- any coping strategies your child uses
- anything which has supported/hindered progress
- life changes, significant events

Impact

How does your child's language impact on their daily life, e.g., friendships, confidence?

- has this changes since the start of the study – in terms of their difficulties and/or the impact

Do you think that your child's language difficulties impact them socially or emotionally?

- frustration, happiness, behaviour at home/preschool, friends
- other's awareness of child's language difficulties
- independence

Your concerns

Have your concerns about your child's language changed since the start of the study?

- still have concerns
- concerns may have changed
- starting preschool

What are your future expectations?

- for your child's language
- other related factors e.g. reading, coping at pre/school, friendships, confidence

Daily routines

Have there been any noticeable changes in your child's daily routines since the start of the study, e.g., starting preschool:?

Talking with your child

Has the way you talk with your child changed over the study period?

- have your interactions changed, what you talk about, how you feel about these interactions
- what has contributed to these changes

When do you normally talk to your child the most?

- what time of day
- during what kind of activities

Services and support

What support have you and your child received from community/slt services?

- how appropriate/satisfied have you been with these experience
- examples

Have you been given any advice or support that has helped you to understand your child's language development?

- did you find this useful, was there anything you feel you wish you had be told but weren't

What can you tell me about what your child's speech and language therapist does to help with their language?

- describe a typical session with the slt
- what strategies do they use
- what works/doesn't work
- do you participate or observe
- what did you understand the purpose was of slt

Have you been given any advice on things that you can do to help support your child's language development?

- what and how have you found this, easy/hard, does it fit in with your routine, can it be implemented without effort
- do you think this has been important/made a difference
- have you done anything at home with your child that targets their language/communication

Other

Is there anything else you would like to discuss or tell me today?

Parent reflective interview 2: Topic guide

This interview aims to get your perspective on your child's development now that the study has finished. Some of the questions cover the same kind of things we discussed last time to get an idea of any changes since then. There are also some questions about what it has been like to be involved in the study.

Child's progress

- change since the start of the study
- how do you feel about child's language ability now and what are your expectations for the future
- prompts: initiating behaviour (purpose of talk), stability vs. change, confidence, self-awareness, frustration, intelligibility

Context

- how would you describe how child talks/plays (with you; other adult; other children; alone and across different activities)
- what features of interactions impact on his language or behaviour (interest, topic, focus, willingness to talk)
- are there differences in your involvement in/or motivation for different activities (enjoyment, distractions, teaching activities)
- link to SLT activities

Influencing factors

- has support from services been important for making improvements (anything in particular that has helped)
- have these affected you as well as your child (does advice relate to your family/child)

Study methods

- CDI: how easy to decide whether or not to tick off words
- LENA: any comments/ difficulties for you or your child
- how representative were recording days/TIM sessions
- how would you describe the experience of using different materials
- any feedback
- any important things missed by methods of data collection

Appendix F: Examples of LENA output

Figure F1 shows an example of the automated output from the LENA system. The display shows the language data in five-minute segments, including information about the audio environment such as meaningful noise and silence, child vocalisations counts (CTCs), conversational turn counts (CVCs) and adult word counts (AWCs). The histogram view enables quick identification of high levels of interaction as shown below. The audio corresponding to each individual segment could be played from this area in the LENA software. Alternatively, the data could be exported, in audio form for use in transcription software or in data form for analysis in Excel.

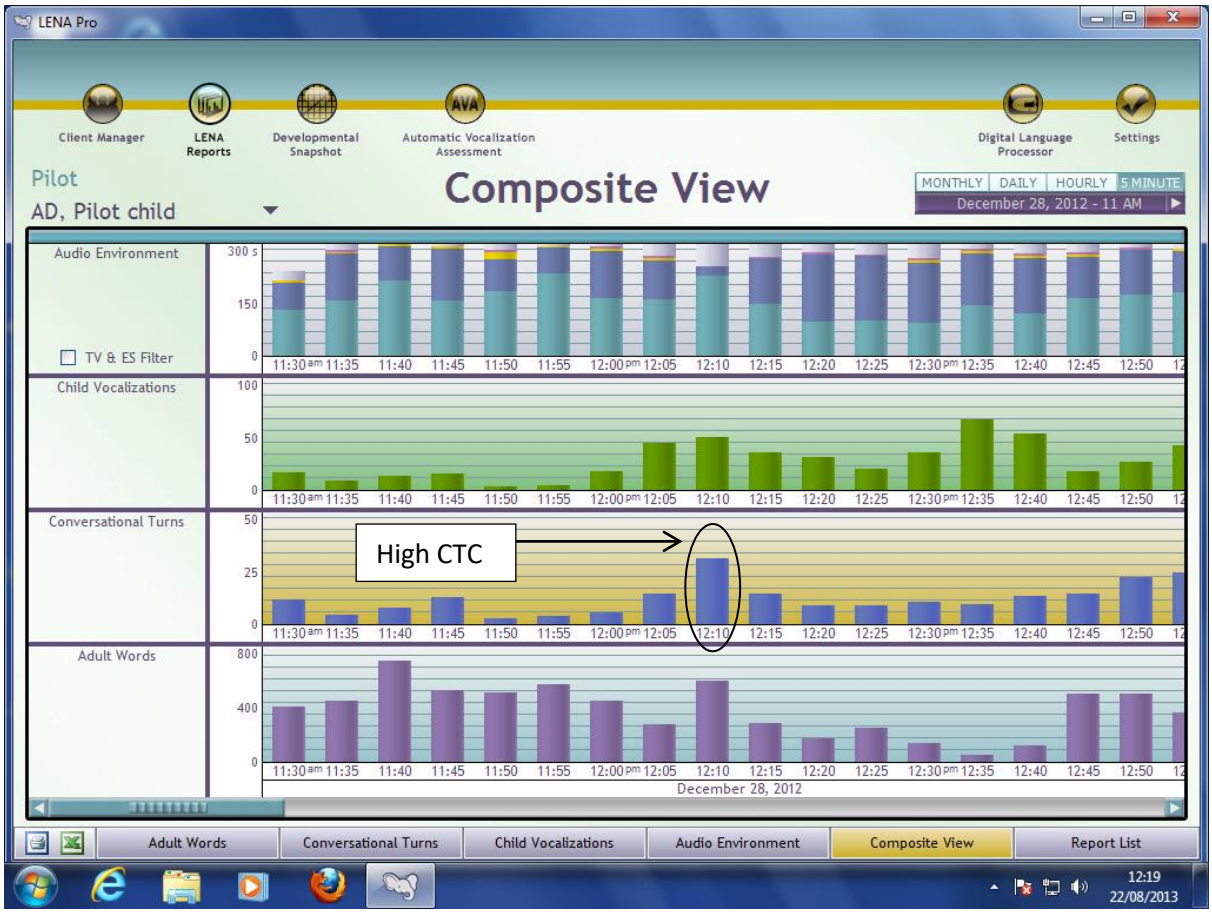
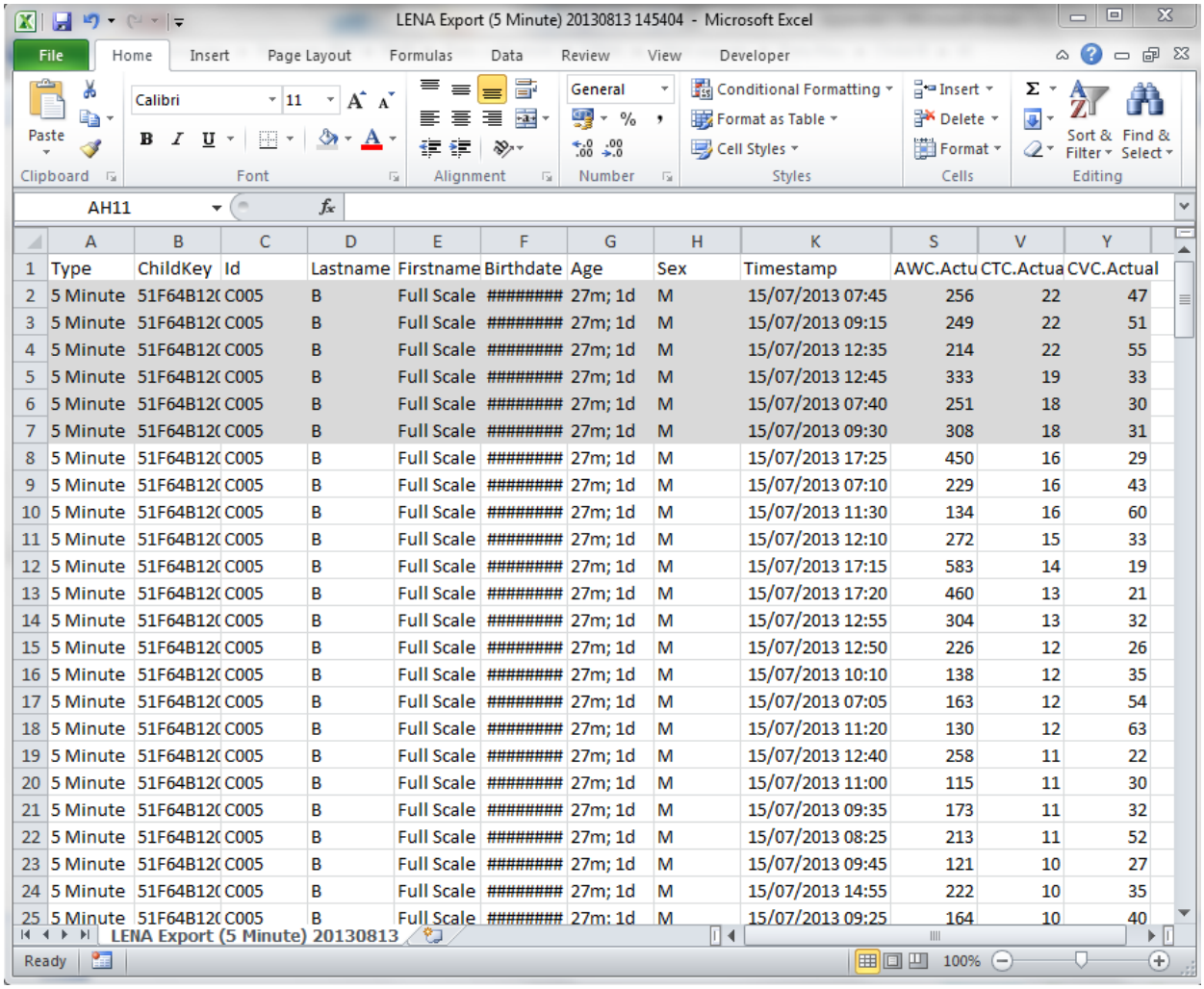


Figure F1 Output of LENA automated language variables

Figure F2 shows an export of the LENA automated data in Excel. The five-minute data exports were sorted according to the conversational turn counts (CTCs), found in column V, to identify the six highest samples from the day's recording.



	A	B	C	D	E	F	G	H	K	S	V	Y
1	Type	ChildKey	Id	Lastname	Firstname	Birthdate	Age	Sex	Timestamp	AWC.Actu	CTC.Actua	CVC.Actual
2	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 07:45	256	22	47
3	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 09:15	249	22	51
4	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 12:35	214	22	55
5	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 12:45	333	19	33
6	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 07:40	251	18	30
7	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 09:30	308	18	31
8	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 17:25	450	16	29
9	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 07:10	229	16	43
10	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 11:30	134	16	60
11	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 12:10	272	15	33
12	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 17:15	583	14	19
13	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 17:20	460	13	21
14	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 12:55	304	13	32
15	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 12:50	226	12	26
16	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 10:10	138	12	35
17	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 07:05	163	12	54
18	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 11:20	130	12	63
19	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 12:40	258	11	22
20	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 11:00	115	11	30
21	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 09:35	173	11	32
22	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 08:25	213	11	52
23	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 09:45	121	10	27
24	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 14:55	222	10	35
25	5 Minute	51F64B12(	C005	B	Full Scale	########	27m; 1d	M	15/07/2013 09:25	164	10	40

Figure F2 Five-minute LENA data export in Excel

Appendix G: Included and excluded LENA samples

Table G1 Five-minute included LENA samples selected for transcription, time of sample, activity and other people present

	Ben		*Christopher*		*Aaron*		*Daniel*	
	Time (CTC)	*Context (others)*	*Time (CTC)*	*Context (others)*	*Time (CTC)*	*Context (others)*	*Time (CTC)*	*Context (others)*
t1	07:45:00 (22)	Meal time (sister)	13:30:00 (15)	Outdoor interactive (sister and grandmother)	14:35:00 (15)	Visit (public)	09:20:00 (12)	Around the house (father and sister)
	09:15:00 (22)	Around the house (sister)	14:40:00 (29)	Playtime organised (sister and grandmother)	10:15:00 (22)	Around the house	15:45:00 (7)	Outdoor interactive (father and sister)
	12:35:00 (22)	Meal time (sister)	14:45:00 (29)	Playtime organised (sister and grandmother)	10:40:00 (18)	Around the house	17:30:00 (12)	Visit public (father and sister)
	12:45:00 (19)	Meal time (sister)	14:50:00 (22)	Playtime organised (sister and grandmother)	10:30:00 (17)	Around the house	13:25:00 (10)	Around the house (sister)
	09:30:00 (18)	Playtime general interactive (sister)	17:50:00 (14)	Transition (sister and grandparents)	17:00:00 (15)	Travel	17:40:00 (8)	Visit public (father and sister)
	07:40:00 (18)	Meal time (sister)	11:05:00 (13)	Around the house (sister)	11:10:00 (15)	Transition	17:55:00 (8)	Travel (father and sister)
t2	17:25:00 (21)	Meal time (sister)	11:35:00 (26)	Book reading (sister)	11:35:00 (32)	Around the house (grandmother)	07:15:00 (17)	Around the house (father and sister)
	09:45:00 (15)	Around the house	13:15:00 (20)	Playtime - organised interactive (sister)	13:40:00 (29)	Around the house	07:10:00 (6)	Playtime general interactive (sister)
	09:50:00 (16)	Travel	14:35:00 (19)	Playtime - organised interactive (sister)	13:00:00 (28)	Playtime general interactive	07:20:00 (5)	Around the house (father and sister)
	13:35:00 (15)	Transition	13:10:00 (20)	Playtime - organised interactive (sister)	13:05:00 (28)	Playtime general interactive	--	--
	17:40:00 (15)	Around the house (sister)	13:20:00 (18)	Playtime organised interactive (sister)	12:50:00 (27)	Playtime general interactive	--	--
	12:05:00 (14)	Meal time (mother's friend and her child)	11:10:00 (13)	Around the house (sister)	15:30:00 (24)	Playtime organised interactive	--	--

	Ben		*Christopher*		*Aaron*		*Daniel*	
	Time (CTC)	*Context (others)*	*Time (CTC)*	*Context (others)*	*Time (CTC)*	*Context (others)*	*Time (CTC)*	*Context (others)*
t3	13:00:00 (35)	Meal time (grandmother)	14:00:00 (19)	Playtime organised interactive (sister)	12:25:00 (26)	Around the house	12:45:00 (21)	Visit private (grandparents)
	14:55:00 (29)	Around the house (grandmother)	15:25:00 (19)	Playtime organised interactive (sister)	12:45:00 (21)	Around the house	13:45:00 (18)	Visit private (grandparents)
	12:55:00 (31)	Meal time (grandmother)	10:10:00 (18)	Around the house (sister)	19:05:00 (18)	Transition	13:40:00 (16)	Visit private (grandparents)
	12:40:00 (29)	Meal time (grandmother)	15:05:00 (17)	Playtime organised interactive (sister)	14:15:00 (14)	Around the house	14:05:00 (14)	Transition (grandparents)
	12:50:00 (28)	Meal time (grandmother)	15:00:00 (16)	Playtime organised interactive (sister)	14:05:05 (13)	Around the house	13:05:00 (13)	Playtime general alone (grandparents)
	14:50:00 (27)	Meal time (grandmother)	14:05:00 (16)	Playtime organised interactive (sister)	13:30:00 (12)	Around the house	10:20:00 (12)	Around the house (father and sister)
t4	17:20:00 (25)	Meal time (sister and brother)	15:50:00 (31)	Visit (private) (sister and grandmother)	17:40:00 (29)	Around the house	08:00:00 (14)	Around the house (sister)
	13:50:00 (23)	Playtime organised interactive	15:25:00 (26)	Visit (private) (sister and grandmother)	18:30:00 (23)	Around the house	10:25:00 (12)	Around the house (father and sister)
	13:35:00 (21)	Book reading	15:30:00 (24)	Playtime organised (sister and grandmother)	18:50:00 (21)	Around the house	13:15:00 (12)	Meal time (father and sister)
	13:30:00 (17)	Book reading	06:55:00 (18)	Around the house	10:50:00 (20)	Around the house	17:55:00 (11)	Around the house (father, sister, adult)
	15:10:00 (17)	Transition (brother)	07:55:00 (18)	Around the house (sister)	17:45:00 (19)	Around the house	12:40:00 (10)	Around the house (father and sister)
	13:40:00 (17)	Around the house	06:45:00 (15)	Around the house	17:55:00 (19)	Around the house	10:45:00 (9)	Around the house (father and sister)

Table G2 Five-minute LENA samples excluded from transcription

Ben		*Christopher*		*Aaron*		*Daniel*	
Time (CTC)	*Reason*	*Time (CTC)*	*Reason*	*Time (CTC)*	*Reason*	*Time (CTC)*	*Reason*
12:00:00 (18) t2	Not true turns (overlap with adults talking)	16:30:00 (18) t1	Not true turns (overlap with adults talking)	18:50:00 (37) t3	Not true turns (overlap with adults talking	13:35:00 (23) t3	Not true turns (overlap with adults talking)
11:45:00 (17) t2		16:45:00 (17) t1		18:55:00 (21) t4		13:00:00 (19) t3	
		15:45:00 (20) t4		18:40:00 (21) t4		13:30:00 (18) t3	
		15:10:00 (16) t4				12:55:00 (15) t3	
17:35:00 (16) t2	Limited turns			14:00:00 (17) t1	Punch and Judy show (not 'real' turns)	14:25:00 (13) t4	
		14:30:00 (25) t1	For privacy – potty training			14:45:00 (13) t4	
16:55:00 (33) t3	Talking with grandmother	14:25:00 (17) t1				14:35:00 (13) t4	
15:00:00 (28) t3		13:50:00 (16) t1				13:30:00 (12) t4	
				09:00:00 (22) t1	Limited turns	14:30:00 (10) t4	
		11:30:00 (20) t2	Commenting while mother reading	18:55:00 (21) t3			
		11:40:00 (14) t2		19:25:00 (17) t3		13:15:00 (14) t3	Talking with grandparents
				18:05:00 (16) t3			
		18:20:00 (18) t3	Talking with father	17:40:00 (35) t3	Talking with grandmother or another family member		
				16:40:00 (32) t3			
				16:50:00 (31) t3			
				17:15:00 (31) t3			
				16:45:00 (28) t3			
				15:55:00 (27) t3			
				17:35:00 (26) t3			
				18:25:00 (25) t3			
				17:55:00 (23) t3			
				17:45:00 (23) t3			
				17:25:00 (23) t3			
				18:45:00 (19) t3			
				17:10:00 (17) t3			
				17:05:00 (17) t3			

Ben		*Christopher*		*Aaron*		*Daniel*	
Time (CTC)	*Reason*	*Time (CTC)*	*Reason*	*Time (CTC)*	*Reason*	*Time (CTC)*	*Reason*
				16:15:00 (17) t3			
				18:00:00 (16) t3			
				17:50:00 (16) t3			
				16:55:00 (16) t3			
				16:20:00 (16) t3			
				15:50:00 (16) t3			
				18:15:00 (14) t3			
				16:05:00 (13) t3			
				16:25:00 (13) t3			
				17:30:00 (13) t3			
				14:55:00 (34) t4			
				11:50:00 (31) t4			
				14:45:00 (28) t4			
				15:10:00 (26) t4			
				15:05:00 (23) t4			
				12:15:00 (23) t4			
				11:55:00 (22) t4			
				14:50:00 (20) t4			
				13:00:00 (20) t4			

Appendix H: Example of activity coding from LENA audio

The table below reports the information collected from the five-minute samples of the LENA audio used to code the activities that children were involved in at home. A 25% sample of the audio was selected based on the highest, middle and lowest conversational turn counts (CTC) produced automatically by LENA to capture the range of activities across a range of interaction levels.

Table H1 Sample context coding for an hour of LENA audio

	7am (median = 12, mean = 11)		
Count	High	Medium	Low
Time	07:10	07:30	07:50
Context	Breakfast time	Playing	Playing
People present	Ben, father, mother and sister	Ben, sister and mother	Ben and sister (mother in background)
Notes	All having breakfast together, dad helping Ben eat, mum talking to Ben about the day, talking about their friends who are poorly, Ben needs the toilet	Ben and sister playing pirates, taking it in turns with the sword (with guidance), mum talking to them, lots of talk from sister	Ben and sister playing, mum asking them not to throw plates (in background), Ben repeats some things sister says, they go to play upstairs
Category	**Meal time**	**Playtime - general interactive**	**Playtime - general interactive**
CTC	**25**	**12**	**2**
CVC	58	49	78
AWC	422	175	17

Appendix I: Framework analysis of parent interviews

Outlined below are the codes that were allocated to each of the nine categories developed from the framework analysis of the parent interviews. A matrix was developed for each category in Excel. Table I1 below provides an example of how descriptions of two of the codes from the *parents' beliefs/understanding* category were added to the matrix for each individual interview. Underlined sections in the table identify direct quotes.

Targeted support for the child:
Assessment of the child; Availability of support; Support strategies; Parent's understanding of support; Implementation of 'taught' strategies; Child's experience of support

Involvement of professionals:
Professional's knowledge of child; Relationship with professionals; Parent's experience of services and support available; Specialist knowledge/skills

Parents' interests
Child's ability to cope; School ready; Child's relationship with others; Child's experience of preschool; Meeting the child's needs; People's treatment of child

Child-centred factors
Language characteristics; Non-language characteristics; Identifying overall progress; Independence; Initiation; Confidence; Barriers to talking; Child's awareness (of language difficulty); Child's frustration; Child's desire to communicate; Active attempts to use language; Child's strategies

Parents' responses to the situation
Parent's frustration; Acceptance; Anxiety; Affect: Parent's emotional response; Reassurance

Parents' experiences
Sharing concerns/experiences; Validation; Other people's expectations and opinions; Family relationships; Understanding own child

Parents' beliefs/understanding
Parent's knowledge of language development and difficulties; Parents' perspective about child development; Importance of early intervention; Reciprocal influence between parent and child; Children as individuals

Parents' involvement supporting child
Taking action; Evaluating support; Need for action; Tenacity and strength

Talking at home and away
Opportunities for interaction/language use; Talkativeness; Child's typical activities; Interacting with other children; Play behaviour; Child being understood by others; Context specific

Table I1 Example of matrix entries for two of the codes

Interview	*Children as individuals*	*Importance of early intervention*
Aaron (1 mother and father)	Not all children fit the normal mould, shouldn't try and pigeon hole them. Just because a child is different it doesn't mean there's something wrong with them. Need different strategies for different children to get the best out of them	Child change immensely in early years; therefore, six month wait for SLT is too long (why when they know how children develop?)
Aaron (2)	n/a	n/a
Ben (1)	Taking time to proactively think about the needs of each child.	Rate of learning is massive in early years and pre-emptive action is better.
Ben (2)	Need to adapt to support child, and role as a parent to meet that, no child is the same: So I think actually knowing them and knowing what they need, is is definitely part of what I need to be doing.	Importance of early years, want to give child the best possible start they can have.
Christopher (1)	Each child is different and what works for one doesn't work for another	Help early is more beneficial
Christopher (2)	Difficult for SLT to individualise: I don't think they can to be honest cuz every child is different. They can only give you a generic idea of what you should be doing.	Value of early intervention for C: I don't think we'd be here now if he'd had been waited till he was three, I think we'd still be working towards getting him speaking. I think the early intervention has helped.
Daniel (1)	Understanding what works for individual child.	n/a
Daniel (2)	n/a	n/a
Daniel (father)	n/a	n/a
Notes	Understand what works for individual	Early support is better (so why do SLT wait so long)

Appendix J: Pragmatic function and syntax codes of transcribed parent-child interaction samples

Table J1 The frequency of pragmatic function and syntax codes of maternal and Ben's utterances, and their proportion of the total utterances

PCI characteristics	*Maternal utterances*				*Child utterances*			
	t1	*t2*	*t3*	*t4*	*t1*	*t2*	*t3*	*t4*
Request for action	79 (21%)	46 (13%)	27 (10%)	44 (11%)	0	8 (3%)	18 (6%)	20 (6%)
Bid for attention	3 (1%)	6 (2%)	0 (0%)	7 (2%)	38 (14%)	20 (7%)	13 (4%)	12 (3%)
Comment (positive)	155 (42%)	156 (44%)	119 (46%)	144 (36%)	15 (5%)	69 (24%)	135 (46%)	112 (33%)
Comment (negative)	23 (6%)	26 (7%)	30 (11%)	17 (4%)	0	3 (1%)	8 (3%)	20 (6%)
Conversational device	31 (8%)	24 (7%)	14 (5%)	24 (6%)	112 (40%)	72 (25%)	51 (17%)	37 (11%)
Request information	58 (16%)	77 (22%)	55 (21%)	65 (16%)	3 (1%)	1 (3%)	17 (6%)	15 (4%)
Complex	30 (8%)	30 (8%)	20 (8%)	35 (9%)	0	0	1 (0.3%)	6 (2%)
Declarative	67 (18%)	56 (16%)	44 (17%)	90 (22%)	0	0	20 (7%)	34 (10%)
Fragment	99 (27%)	104 (29%)	62 (24%)	90 (22%)	177 (64%)	170 (59%)	187 (63%)	154 (45%)
Imperative	59 (16%)	42 (12%)	18 (7%)	54 (13%)	0	9 (3%)	9 (3%)	10 (3%)
Q: action	10 (3%)	13 (4%)	10 (4%)	11 (3%)	0	0	9 (3%)	4 (1%)
Q: tag	20 (5%)	16 (4%)	33 (13%)	6 (1%)	0	0	0	0
Q: wh-	12 (3%)	14 (4%)	10 (4%)	29 (7%)	0	0	2 (1%)	8 (2%)
Q: yes/no	46 (13%)	47 (13%)	37 (14%)	56 (14%)	1 (0.4%)	0	17 (6%)	7 (2%)
Unclear	9 (2%)	16 (4%)	10 (4%)	15 (4%)	100 (36%)	111 (38%)	44 (15%)	104 (30%)

Table J2 The frequency of pragmatic function and syntax codes of maternal and Christopher's utterances, and their proportion of the total utterances

PCI characteristics	*Maternal utterances*				*Child utterances*			
	t1	*t2*	*t3*	*t4*	*t1*	*t2*	*t3*	*t4*
Request for action	80 (21%)	46 (16%)	74 (21%)	27 (11%)	0	0	5 (3%)	16 (7%)
Bid for attention	9 (2%)	8 (3%)	3 (1%)	0 (0%)	1 (0.4%)	18 (7%)	4 (2%)	14 (7%)
Comment (positive)	123 (32%)	106 (36%)	159 (45%)	105 (42%)	4 (2%)	50 (20%)	53 (28%)	87 (40%)
Comment (negative)	12 (3%)	21 (7%)	20 (6%)	18 (7%)	0	4 (2%)	2 (1%)	17 (8%)
Conversational device	33 (9%)	22 (8%)	29 (8%)	32 (13%)	61 (25%)	53 (21%)	26 (14%)	26 (12%)
Request information	96 (25%)	65 (22%)	52 (15%)	49 (19%)	2 (1%)	0	4 (2%)	10 (5%)
Complex	21 (6%)	41 (14%)	26 (7%)	34 (13%)	0	0	0	1 (0.5%)
Declarative	75 (20%)	56 (19%)	89 (25%)	66 (26%)	0	0	3 (2%)	10 (5%)
Fragment	97 (26%)	87 (30%)	100 (28%)	86 (34%)	69 (29%)	128 (51%)	97 (51%)	124 (58%)
Imperative	52 (14%)	34 (12%)	95 (27%)	17 (7%)	0	0	3 (2%)	15 (7%)
Q: action	23 (6%)	15 (5%)	8 (2%)	7 (3%)	0	0	3 (2%)	2 (1%)
Q: tag	14 (4%)	6 (2%)	5 (1%)	15 (6%)	0	0	0	0
Q: *wh*-	53 (14%)	40 (14%)	24 (7%)	15 (6%)	0	0	1 (1%)	2 (1%)
Q: yes/no	48 (13%)	38 (13%)	27 (8%)	39 (15%)	0	2 (1%)	0	16 (7%)
Unclear	16 (4%)	9 (3%)	11 (3%)	14 (6%)	177 (73%)	117 (47%)	83 (44%)	28 (13%)

Table J3 The frequency of pragmatic function and syntax codes of maternal and Aaron's utterances, and their proportion of the total utterances

PCI characteristics	*Maternal utterances*				*Child utterances*			
	t1	*t2*	*t3*	*t4*	*t1*	*t2*	*t3*	*t4*
Request for action	81 (27%)	115 (31%)	49 (23%)	65 (28%)	29 (9%)	2 (1%)	11 (5%)	29 (9%)
Bid for attention	1 (0.3%)	1 (0.3%)	2 (1%)	1 (0.4%)	16 (5%)	2 (1%)	1 (0.4%)	2 (1%)
Comment (positive)	88 (30%)	154 (41%)	81 (38%)	91 (40%)	70 (22%)	132 (43%)	68 (30%)	146 (47%)
Comment (negative)	20 (7%)	31 (8%)	14 (7%)	16 (7%)	7 (2%)	14 (5%)	16 (7%)	23 (7%)
Conversational device	31 (11%)	24 (6%)	18 (8%)	24 (10%)	53 (17%)	23 (8%)	20 (9%)	27 (9%)
Request information	54 (18%)	40 (11%)	39 (18%)	26 (11%)	8 (2%)	43 (14%)	45 (20%)	44 (14%)
Complex	22 (7%)	28 (7%)	12 (6%)	12 (5%)	0	0	1 (0.4%)	5 (2%)
Declarative	52 (18%)	80 (21%)	41 (19%)	56 (24%)	4 (1%)	67 (22%)	35 (15%)	78 (25%)
Fragment	65 (22%)	82 (22%)	48 (22%)	53 (23%)	154 (48%)	104 (34%)	68 (30%)	107 (34%)
Imperative	69 (23%)	105 (28%)	50 (23%)	56 (24%)	12 (4%)	1 (0.3%)	8 (3%)	23 (7%)
Q: action	4 (1%)	8 (2%)	5 (2%)	6 (3%)	1 (0.3%)	1 (0.3%)	8 (3%)	1 (0.3%)
Q: tag	1 (0.3%)	9 (2%)	8 (4%)	3 (1%)	0	0	0	2 (1%)
Q: *wh*-	27 (9%)	20 (5%)	21 (10%)	10 (4%)	7 (2%)	43 (14%)	36 (16%)	28 (9%)
Q: yes/no	27 (9%)	13 (3%)	13 (6%)	15 (7%)	6 (2%)	2 (1%)	5 (2%)	21 (7%)
Unclear	11 (4%)	6 (2%)	4 (2%)	5 (2%)	136 (42%)	74 (24%)	52 (23%)	26 (8%)

Table J4 The frequency of pragmatic function and syntax codes of maternal and Daniel's utterances, and their proportion of the total utterances

PCI characteristics	*Maternal utterances*				*Child utterances*			
	t1	*t2*	*t3*	*t4*	*t1*	*t2*	*t3*	*t4*
Request for action	44 (26%)	9 (12%)	36 (23%)	26 (13%)	10 (4%)	0	1 (0.4%)	3 (1%)
Bid for attention	4 (2%)	1 (1%)	1 (1%)	0	33 (13%)	23 (16%)	25 (10%)	45 (18%)
Comment (positive)	40 (24%)	26 (33%)	59 (37%)	63 (32%)	13 (5%)	7 (5%)	9 (4%)	24 (9%)
Comment (negative)	10 (6%)	1 (1%)	7 (4%)	16 (8%)	0	2 (1%)	1 (0.4%)	2 (1%)
Conversational device	10 (6%)	3 (4%)	6 (4%)	19 (10%)	31 (13%)	31 (22%)	61 (25%)	79 (31%)
Request information	26 (16%)	11 (14%)	33 (21%)	47 (24%)	1 (0.4%)	1 (1%)	5 (2%)	6 (2%)
Complex	10 (6%)	13 (17%)	5 (3%)	17 (9%)	0	0	0	0
Declarative	25 (15%)	8 (10%)	22 (14%)	34 (17%)	0	0	0	0
Fragment	27 (16%)	24 (31%)	35 (22%)	40 (21%)	94 (38%)	56 (40%)	94 (39%)	132 (51%)
Imperative	49 (29%)	5 (6%)	33 (21%)	24 (12%)	7 (3%)	0	0	0
Q: action	2 (1%)	1 (1%)	5 (3%)	3 (2%)	0	0	5 (2%)	1 (0.3%)
Q: tag	4 (2%)	1 (1%)	10 (6%)	7 (4%)	0	0	0	0
Q: *wh*-	7 (4%)	2 (3%)	13 (8%)	12 (6%)	0	0	0	1 (0.3%)
Q: yes/no	17 (10%)	12 (15%)	20 (13%)	32 (16%)	3 (1%)	14 (10%)	11 (5%)	41 (16%)
Unclear	17 (10%)	10 (13%)	10 (6%)	15 (8%)	143 (58%)	70 (50%)	129 (53%)	82 (32%)