The application and impact of a public health intervention supported by a Speech and Language Therapist in the Early Years Foundation Stage.

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Abstract

Introduction

Prevalence estimates indicate up to 50% of children in areas of social deprivation have speech, language and communication needs (SLCN). Three-tiered service delivery models are widely recommended to support early communication, however there are few studies examining the effectiveness of entire multi-tiered systems of support (MTSS).

This thesis presents a longitudinal evaluation of a locally developed MTSS, with two overarching aims: 1) evaluating the impact of inclusion in this MTSS on vocabulary growth, and 2) exploring how children with differing SLCN move through the MTSS.

Method

Data about SLC skills, EYFS attainment and social deprivation were collected for 409 participants attending a cluster of school-based nurseries over two years. Participants were within the control cohort (n=165), the experimental cohort (n=128), or the control-experimental cohort (n=116). Staff received training and support to implement the MTSS. Data were analysed to explore distinct patterns through the MTSS. Longitudinal multi-level modelling was used to explore vocabulary growth and the impact of the MTSS.

Results

Participants followed three distinct pathways: universal tier only, specialist tier only, or multiple tiers over time. At nursery entry, 100% of participants were below age related expectations for communication (EYFS) and the mean standard score for receptive vocabulary (BPVS) was M = 84.9 (SD = 12.2) (*n*=181). Participants accessing the MTSS gained 2.42 ($p<0.05$) additional standard score points per term completed in the MTSS. Those entering nursery with the lowest vocabulary scores, made the most rapid progress (intercept –slope covariance -0.70).

Discussion

These results indicate that MTSS within schools can have a positive impact on children's vocabulary development. Children entering nursery with the most significant needs can be supported to begin to close the gap and it is crucial that the universal tier of support is more than simply 'business as usual'.

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CHAPTER 1: SPEECH, LANGUAGE AND COMMUNICATION IN A PUBLIC HEALTH CONTEXT

1.1 Introduction

This thesis explores the real-life implementation and impact of a collaboratively designed and delivered multi-tiered system of support, using a longitudinal quasi-stepped wedge design. This system was embedded in a socially deprived context, with high levels of speech, language and communication needs throughout the population, particularly on entry to nursery. The following chapters explore the specific context of the development and design of the MTSS and the study (Chapter 2); evidence of existing MTSS and what this MTSS looks like in practice for the children it supports (Chapter 3); and the impact that the model has on the children's receptive vocabulary development (Chapter 4). How this contributes to the national and international picture of supporting SLC development utilising a collaborative public health informed approach at an institutional level is considered throughout

1.1.1 Overview

The aim of this introductory chapter is to synthesise the evidence that suggests that speech, language and communication needs are a public health issue and should be addressed through the application of public health models of intervention. Current evidence from policy and practice will be presented, alongside a debate about the complexities of evaluating such approaches. The following chapters will then detail the current study and how it adds to the evidence base and discussion around the application and evaluation of these approaches to supporting speech, language and communication.

1.2 Speech, language and communication development

Communication development is complex and rapid. Skills develop quickly in the first five years of life and continue developing throughout the life course. Prior to examining speech, language and communication (SLC) in a public health context it is important to contextualise speech, language and communication development as a whole so that the appropriateness of multi-tiered systems of support (MTSS) or different elements of SLC development can be considered.

1.2.1 Speech development

In the typically developing child, early speech-sound substitutions, or developmental processes, are expected. Over time children's speech sound production becomes more adult-like, resulting in a fully formed phonological system between the ages of six and seven years old (Mcleod, 2002). Thus, speech is a skill that is typically learnt to mastery; we reach a point quite early in life at which our speech sound system is fully developed.

Developing the ability to use speech sounds accurately in words and connected speech is complex and happens in conjunction with language development. Although many children develop their use of speech sounds with no difficulty, there are some children who present with speech sound disorders (SSD). Speech sound disorder is an overarching term for a range of difficulties that children can experience in relation to their speech production. Some SSD occur as a result of a known underlying condition, for example, cerebral palsy, or cleft lip and palate. There are also a number of proposed sub-types of SSD of unknown origin and perhaps the most commonly used model for differential diagnosis clinically is that of (Dodd, 2005). In her model underpinned by the psycholinguistic framework (Stackhouse & Wells, 1997), Dodd proposes four sub-types of SSD, each with different levels of breakdown, resulting in differing surface level presentation. This model has good clinical utility as it provides a clear framework for identification and also a basis for differentiated treatment approaches targeting the different underlying processes (Waring & Knight, 2013). There is also evidence of this classification system's cross-linguistic validity, adding to argument for its use (Clausen & Fox-Boyer, 2017; Fox & Dodd, 2001). Although these children with SSD of unknown origin experience difficulties with speech sounds, they can typically be supported in their development and because the speech system is finite, once they have mastered the skills and are able to apply these, support is no longer required.

1.2.2 Language development

Language development and speech development are inextricably entwined, with speech production relying on the storage of lexical and semantic representations. Language is a complex skill and children make rapid progress in their language learning during the early years of life. Over the decades, different theories of language development have emerged, changing as we discover more. It has been hypothesised that there is an innate language-learning faculty within the brain (Chomsky, 1986). An alternative theory is that more general

learning mechanisms are involved in language learning. These theories explain language development of the child in isolation. However, language develops through interactions with others and with the environments in which a child encounters the world (Bronfenbrenner, 1992; Bronfennbrenner & Morris, 2007). Neuro-constructivist (e.g. Karmiloff-Smith, 1996) and social-pragmatic theories (Tomasello, 2005), as well as the more general development theory proposed by Bronfenbrenner (the bio-ecological systems model)(Bronfennbrenner & Morris, 2007), describe this interactive and relational nature of langauge learning as central to how langauge develops. These theories support the view that language is complex and its learning and application are embedded within and inextricably linked to the systems in which the child operates, be that the family unit, schools, or wider communities. This makes it a complex, relational and multi-faceted process, which has implications for the planning and evaluating of support where difficulties are expereienced.

In contrast to speech, described above, language is not something we can learn to mastery. Rather, it is an on-going journey throughout the life course. For some, although never totally mastered as an entity, language learning is something they do without difficulty. For others however, language learning is not as straightforward and they have difficulties learning, retaining and using language effectively. As language is something that we are constantly learning and developing, it follows that individuals who find the language learning process difficult are likely to require on-going support and strategies to overcome their difficulties.

1.2.3 Social communication and pragmatics

Communication is more than clear speech and linguistic competence. In order to communicate effectively we make a range of choices about the kind of words we use, formality, how directive to be (e.g. 'close the window' versus 'I'm a bit cold' or 'do you think it's cold in here?'), when to talk, whether to accompany our spoken word with gesture, tone of voice, use of sarcasm, the list goes on. This interaction of speech clarity, linguistic competence and these additional elements that make up 'communication' is often termed 'pragmatics'. Perkins (2007) details the elements of pragmatics within four distinct categories – semiotic (relating to signs and symbols), cognitive, motor and sensory. Elements within these include, but are not restricted to, language; gesture; facial expression; inference; memory; attitude; use of the hands, eyes, arms; and hearing and vision. Pragmatics, by its very nature, is contextually dependent and difficulties can arise due to breakdowns at the

level of any of the elements involved. This means that difficulties with speech or language as described above, can have consequences for an individual's pragmatic ability. Some individuals may be able to use their pragmatic skills to compensate for difficulties with an element such as phonology, for example, utilising gestures to support the conveyance of meaning.

1.3 SLCN as a public health issue

It is unsurprising, given the complexity of speech and language development, that not all children develop at the same rate and there is growing concern about the numbers of children entering formal education with speech, language and communication needs (SLCN). The term SLCN was brought to prominence in the review of provision for children with speech and language needs in the UK, led by the MP, John Bercow, in 2008 (Bercow, 2008). In this report Bercow outlines that "SLCN encompasses a wide range of difficulties related to all aspects of communication in children and young people. These can include difficulties with fluency, forming sounds and words, formulating sentences, understanding what others say, and using language socially" (Bercow, 2008; p13). In this thesis, children are included within the umbrella term of SLCN where they are deemed to have a difficulty with speech, language and / or communication that is identified by assessments and / or education staff. The cut off points for the identification of SLCN on assessments used is outlined further in Table 3.1. This has since become a common term, within the UK education system to refer to children with communication difficulties. In the late 1990s Speech and Language Therapists (SLTs) in some areas were extending their roles to provide more preventative, public health services as part of the Sure Start initiative from the then Labour government (Roberts & Hall, 2000). There have been a number of calls for SLCN to be addressed as part of a public health approach. In 2006 Olusanya, Ruben, & Parving (2006) discussed the need to consider communication difficulties as integral to achieving two of the United Nations Millennium Development goals – the eradication of extreme poverty and the achievement of universal primary education. They recommended that those with communication disorders be identified as a target group in order to work towards these wider goals. They focused primarily on communication difficulties as a result of hearing loss, however more recently the idea has been expounded in relation to SLCN more broadly (Bercow, 2018; Law, Levickis, et al., 2017; Law, Mensah,

Westrupp, & Reilly, 2015; Law, Reilly, & Snow, 2013; Snow & Powell, 2004; Wylie, McAllister, Davidson, Marshall, & Law, 2014).

In order to be considered a public health issue Law, Levickis, et al. (2017) state that three specific criteria must be met. These criteria are that the specific issue must:

- place a large burden on society;
- be unfairly distributed within society and
- there must be evidence that preventative strategies can reduce said burden.

The following sections set out the arguments as to why SLCN should be deemed a public health priority and the complexity that this entails.

1.3.1 The burden on society: prevalence

Upon school entry, approximately 7% of children are entering school with speech and/or language difficulties (Bercow, 2008). This estimate is for SLCN, which includes speech, language and communication more broadly.

1.3.1.1 Prevalence of language difficulties

Unpacking this, prevalence estimates for language difficulties in the early years currently range from 2.9 – 20.7% (Law et al., 2017) (Table 1.1), unless focusing specifically on areas of deprivation where this can rise to up to 50% at school entry (Law, McBean, & Rush, 2011; Law, Todd, Clark, Mroz, & Carr, 2013).

Table 1.1 Prevalence of language difficulties in children 5 years and under in representative population or community ascertained samples using direct testing or validated parent report tools

	18 months	24 months	30 months	3 years	4-5 years
Median (%)	11.5	14.3	10.9	7	10.7
Range (%)	8.7 – 14.3	10.7 – 19.7	8.6 – 13.2	5.9 - 8.0	2.9 – 20.7

Note. Reproduced with permission from (Law, Charlton, et al., 2017)

To ascertain prevalence estimates some studies use a strict criteria of ≤2 standard deviations below the mean on standardised tests of language (Law, Rush, Schoon, & Parsons, 2009); whereas others employ a less stringent criteria of between ≤1 and ≤1.5 standard deviations

below the mean on standardised tests of language (Christensen, Zubrick, Lawrence, Mitrou, & Taylor, 2014; Harrison & McLeod, 2010; Law, Rush, Anandan, Cox, & Woods, 2012; McKean et al., 2017; Norbury et al., 2016; Reilly et al., 2010). These less stringent criteria appear to be functionally the most useful when considering SLCN in its broadest sense. Studies that have explored the long term impacts of SLCN have found that there are negative implications for children who are identified using these less stringent criteria (Tomblin, 2008; Young et al., 2002). Therefore, if the aim of ascertaining prevalence data is to inform public health policy and planning, it is important to ensure that those negatively impacted by the condition are included in the net that is cast by the diagnostic criteria. Within this wider prevalence estimate it is likely to be of utility to have local estimates of the prevalence of more significant difficulties that may warrant referral to clinical services in order to help to inform local planning and resource deployment at different tiers of public health approaches.

1.3.1.2 Prevalence of speech sound disorders

There is less data from community or population samples exploring the prevalence of speech sound disorders (SSD). Prevalence estimates for SSD include motor speech disorders, delay and phonological disorders and are between 3.8% and 18% (Eadie et al., 2015; Shriberg, Kwiatkowski, & Mabie, 2019; Shriberg, Tomblin, & McSweeny, 1999; Wren, McLeod, White, Miller, & Roulstone, 2013). These prevalence estimates are not specifically for children in the early years, rather they are for children between four and eight years of age.

1.3.1.3 Prevalence of social communication and pragmatic difficulties

With regards to social communication and pragmatics, there are even fewer studies exploring prevalence data using population or community samples, rather than clinical samples. A Dutch study found that between 7% and 8% of a population sample of four year olds presented with a pragmatic language impairment (Ketelaars, Cuperus, van Daal, Jansonius, & Verhoeven, 2009). In the UK, between 2004 and 2010, estimates for autism spectrum disorder (ASD) were 3.8% for boys and 0.8% for girls at eight years old (Taylor, Jick, & MacLaughlin, 2013); a disorder in which difficulties with social communication are part of a triad of impairments.

1.3.1.4 Comorbidity

These prevalence estimates do not all add up together to make one SLCN prevalence estimate; rather there are known comorbidities between the conditions that fall under the SLCN umbrella. Eadie et al. (2015), in a sample of 1494 four-year olds, found a sample-wide comorbidity of speech and language disorders of 1.4%; within the subgroup of children with speech sound disorder the comorbidity was 40.8% and this was more significant for males (54.1% versus 28% in females). There are also known co-morbidities between speech, language and literacy difficulties. Exact links and estimates of co-morbidity are tentative due to the prevalence of these difficulties being age dependent and varying definitions of caseness. More epidemiological data is needed to fully explore these inter-relationships, however the evidence of comorbidity between speech, language and reading disorders has been summarised by Pennington & Bishop (2009). They find that the most consistent comorbidity is that of all three difficulties; the risk of experiencing reading difficulties (RD) is less if children just present with SSD, and the link is less clear for those experiencing just language impairment (LI). As briefly discussed in section 1.2.3, difficulties with speech and/or language skills can have an impact on an individual's pragmatic functioning, though this does not necessarily mean that there is a resultant pragmatic impairment, as pragmatic skills can be used in a compensatory way.

1.3.2 Unfair distribution of SLCN across society

1.3.2.1 The social gradient of language difficulties

As mentioned above, prevalence rates for language difficulties have been found to be up to 50% in areas of high deprivation. This social gradient in language development is well evidenced (McKean, Law, Morgan, & Reilly, 2018), with children from areas of higher deprivation more frequently experiencing difficulties with language. This is the case for young children (Hart & Risley, 2003; Hoff, 2003) and adolescents (Spencer, Clegg, & Stackhouse, 2012) indicating a persistent nature to the language difficulties of some children from areas of high deprivation. There is also evidence that not only is there are gap in performance between children from areas of the highest and lowest levels of deprivation; that this gap widens over time when focusing on measures of receptive vocabulary (Taylor, Christensen, Lawrence, Mitrou, & Zubrick, 2013).

Understanding the underlying mechanisms of how social disadvantage effects language development is a complex picture, which requires more research (McKean et al., 2018). It is

likely that environmental factors, such as the quantity and quality of language input (Hart & Risley, 1995; 2003; Hoff, 2016), compound genetic factors, such as a family history of language difficulties (Dale et al., 2015) for those growing up in more deprived households and communities. Some theories hypothesise that vocabulary and grammatical learning are inextricably linked in early development (Chiat, 2001; Karmiloff-Smith, 1996; Marchman & Bates, 1994; Tomasello, 2005) indicating that the same processes that result in poorer vocabulary development in children from lower SES backgrounds, would in turn result in poorer grammatical performance (further explored in 4.1.3 and 4.1.4).

It has been postulated that the effect of social disadvantage on language development is cumulative. A longitudinal study of 1910 children in Australia showed that low SES and maternal education explain little of the variation in children's language skills as measured at age two (4% of communication and 7% of expressive vocabulary), however by the age of four these factors linked to social deprivation explain a higher percentage of the variation in receptive and expressive language skills (18.9% receptive and 20.9% expressive) (Reilly et al., 2010). This cumulative impact is supported by data from another longitudinal study in Australia which found that low SES was not associated with children's receptive vocabulary scores at age four, however was the only risk factor in their analysis that had a significant impact on vocabulary growth between four and eight years of age (Taylor, Christensen, Lawrence, Mitrou, & Zubrick, 2013).

This cumulative impact of disadvantage indicates the importance of intervening early in order to manipulate some of the factors associated with disadvantage and therefore ameliorate some level of risk. There is growing evidence to indicate that children's relative position in terms of their language skill is more stable after the age of four (McKean, Wraith, et al., 2017; Norbury et al., 2017), though not set in stone, reinforcing the importance of preventative work to help support children to be in a better relative position by this time. A focus of recent research has been to identify which specific factors would be the most appropriate to target for this kind of intervention or policy (McKean, Reilly, et al., 2017). It was found that 23% of the variability in children's language growth between the ages of four and seven was accounted for by factors within the family environment up to the age of four. This included the number of books in the home when the child was two, the frequency of shared book reading between eight months and four years and TV viewing at age four. All of these factors

are things that have the potential to be manipulated by social policy and preventative interventions.

1.3.2.2 The social gradient of speech and social communication difficulties

As with prevalence data, there is less evidence exploring a possible social gradient for both speech and social communication difficulties. The most recent population study exploring the prevalence of SSD as part of the Early Language in Victoria project (Eadie et al., 2015) found that SES was a significant predictor of SSD, with children from lower SES areas being more likely to experience speech difficulties. This corresponds with findings that low maternal education was a significant risk factor for SSD by Campbell et al. (2003). There is also evidence that children from higher SES homes make greater progress with their phonological awareness skills than their lower SES counterparts (McDowell, Lonigan, & Goldstein, 2007). Phonological awareness skills are important in both the development of the speech sound system and the development of literacy skills.

Due to there being less evidence exploring the social gradient for speech difficulties, the underlying mechanisms of why a social gradient is present are also less well defined. There is evidence that discrepancies in vocabulary and verbal processing speed emerge between SES groups as early as 18 months of age (Fernald, Marchman, & Weisleder, 2013), with those from lower SES homes exhibiting slower lexical processing speeds. This could be hypothesised to lead to children from lower SES backgrounds developing under-specified phonological representations, thus increasing the likelihood of presenting with SSD.

The picture is less clear for social communication difficulties. A recent UK based study (Kelly et al., 2019) found that children of mothers with higher academic qualifications were twice as likely to be diagnosed with ASD than children of mothers who had lower levels of education. When maternal education was controlled for there was no significant association of SES. It was hypothesised that this was not in fact due to a higher prevalence rate in this more educated population, rather an increased ability to access and navigate the systems associated with obtaining a clinical diagnosis.

1.3.2.3 The social gradient associated with access to services

Evidence from the US (Mayer, Skinner, & Slifkin, 2004; Morgan et al., 2016) and Australia (Skeat, Eadie, Ukoumunne, & Reilly, 2010; Skeat et al., 2014) shows that children who present

with a range of environmental risk factors, such as low maternal education, low family income and low SES, are less likely to present to external services. There are no comparable population studies in the UK, however, a report analysing the take-up of early years provision in the UK found that children from larger, lower income families, children from households where there was maternal unemployment, or lower levels of maternal education, were least likely to attend the universal early years provision on offer (Speight, Smith, Coshall, & Lloyd, 2010). These findings reported internationally support positioning SLCN within a public health approach and incorporating the use of MTSS within schools to help to ensure these children still access the support that they need.

1.3.3 The burden on society: long term impacts of SLCN

1.3.3.1 Long term impacts of language difficulties

It is clear from the evidence that there are wide-reaching, severe and long-term effects of language difficulties. The effects include poorer educational outcomes such as literacy difficulties (Clegg, Hollis, Mawhood, & Rutter, 2005; Law et al., 2009) and lower academic success (Feinstein & Duckworth, 2006; Johnson, Beitchman, & Brownlie, 2010; Law et al., 2009) and socio-economic outcomes such as higher rates of unemployment. There is also evidence of poorer psychosocial outcomes such as higher rates of childhood psychiatric disorders (Toppelberg & Shapiro, 2000), increased affective disorders (Armstrong et al., 2017; Botting, Durkin, Toseeb, Pickles, & Conti-Ramsden, 2016; Law et al., 2009) and psychotic disorders (Clegg et al., 2005), increased substance and alcohol misuse (Armstrong et al., 2017) and fewer friendships (Clegg et al., 2005). In addition, there are links between language disorders and a higher rate of arrests and convictions for delinquent and aggressive behaviour in males (Brownlie et al., 2004) and an increased vulnerability to becoming victims of sexual assault in females (Brownlie, Beitchman, Jabbar, & Vida, 2007). These impacts at the individual level also have implications for the wider social and economic context (Field, 2010; Hartshorne, 2006; Marmot, 2010). For example, low language status is associated with both increased service use and substantial costs to healthcare systems (Le et al., 2020).

1.3.3.2 Long term impact of speech and social communication difficulties

Speech difficulties are known to be associated with literacy difficulties (Leitão & Fletcher, 2004; McLeod, Harrison, & Wang, 2019), though this risk is higher when children present with

comorbid speech and language difficulties (Pennington & Bishop, 2009). Other studies have found that speech difficulties are not associated with the range of long term effects seen with language difficulties (Brownlie et al., 2004; Johnson et al., 2010). There are also fewer studies exploring long-term effects of social communication disorders, though they have been shown to overlap with childhood psychiatric disorders (Toppelberg & Shapiro, 2000). With regards to ASD specifically, there have been very few systematic studies of adult outcomes and those which have been done are variable in research quality and consistency (Howlin & Magiati, 2017). There are suggestions of high rates of unemployment, high rates of mental health difficulties and limited social integration.

1.3.4 Evidence that early preventative strategies could substantially reduce the burden of the condition

Early intervention for language difficulties has been a research focus for some time. There are many studies exploring the effectiveness of interventions in the early years to support children's language development, with a view to minimising the long-term effects described above. Law, Charlton et al. (2017) present a summary of intervention studies adopting randomised control or quasi-experimental methodology, published in England since 2000 (45 studies). This summary of robust evidence shows a range of interventions that have modest to high effect sizes. These include an intervention to support teacher responsivity and the impact on children's linguistic productivity and complexity (Cabell et al., 2011) with an effect size of +5.3; the Learning Language and Loving It programme from Hanen shown to have effect sizes over +1.0.

Although SSD are not associated with as many long term negative effects as language difficulties, it is nevertheless important to intervene early in order to maximise the chances of successfully mastering literacy skills such as decoding, spelling and reading comprehension (Eadie et al., 2015). Speech difficulties are linked to phonological awareness (PA) difficulties, a central skill to successful literacy development, and there are a number of studies showing the positive impact of early PA interventions on children's speech and literacy development (Denne, Langdown, Pring, & Roy, 2005; Hesketh, 2004; Kirk & Gillon, 2007).

With regards to social communication many of the interventions that have been evaluated are targeted at children with diagnoses of Autism Spectrum Disorder. A meta-analysis of early intervention studies focusing on developing social communication in children with ASD found

a significant overall positive effect size (Fuller & Kaiser, 2020). Other interventions to support social communication are often implemented at a later stage of development, for example the Social Communication Intervention Project (SCIP)(Adams et al., 2012). This randomized control trial showed significant treatment effects for conversational competence and social communication for a clinical sample of children aged 5;11 to 10;8.

Evidence of some interventions that support SLC development in the early years are presented in more detail in Chapter 3: and Chapter 4: .

1.3.5 SLCN as a public health issue: a summary

In summary, the evidence presented highlights how SLCN meets the three criteria necessary to be considered a public health priority.

Firstly, with prevalence estimates of between 2.9% and 20.9% for language difficulties, 3.18% to 18% for speech difficulties and between 7% and 8% for social communication difficulties, it is clear that SLCN places a large burden on society. These prevalence estimates are similar to those for childhood obesity, a widely recognised public health priority (Law, Levickis, et al., 2017).

Secondly, these difficulties, particularly language difficulties, are subject to a robust social-gradient, with children from areas of higher levels of deprivation being more likely to experience language difficulties. Prevalence estimates increase to up to 50% in areas of deprivation.

Thirdly, the long-term impacts on individuals' academic attainment, employment and mental health outcomes presented reinforce the magnitude of the burden of SLCN on society. Finally, thanks to an on-going focus on the importance of early intervention, there is an ever-growing evidence base of interventions that can be implemented in the early years to support language, speech and social communication. These have effects of varying magnitudes and there is a need for further, larger scale interventions to explore effectiveness, as well as efficacy on a smaller scale.

This evidence indicates that a population approach to supporting speech, language and communication development is a necessity. Within the NHS Constitution it states:

"you have the right to expect your NHS to assess the health requirements of your community and to commission and put in place the services to meet those needs considered necessary and in the case of public health services commissioned by Local Authorities, to take steps to improve the health of the local community" (Department for Health, 2015; p6)

indicating that there is a role for NHS services, as well as those funded by Local Authorities, such as education, to work together to address these pervasive, highly impactful difficulties, paying particular attention to those groups known to be at higher risk of developing SLCN. In order to systematically approach SLCN as a public health priority, there is a desperate need for more robust, consistent, routine national data collection that will enable accurate estimates of prevalence and distribution of need to inform the design of services and the deployment of resources. As suggested above in 1.3.1 it would be important to ensure that the full range of SLCN were captured and thus the less stringent cut-off criteria for any standardised assessments utilised should be employed. Not only would this support planning and deployment of resources, but would provide a rich dataset for further exploration of factors associated with SLCN, comorbidity and the developmental trajectory of SLC skills.

1.4 Public health models for speech, language and communication development

If we subscribe to theories of language development that emphasise the importance of interactions and language learning within a social context (e.g. Tomasello, 2005) then it seems remiss not to approach speech and language support with this as a consideration. Alongside focusing on specific skill deficits, approaching SLC as part of a wider public health approach would aim to support the prevention of SLCN. For those who do experience SLCN, a public health approach would aim to minimise the impacts of SLCN experienced by children who would perhaps not typically present to services.

Speech and Language Therapy has traditionally worked within a medical model of diagnosing specific difficulties and working with individuals or small groups to help to remediate these difficulties. It has long been agreed however that supporting children's speech, language and communication is an education provision and the ultimate responsibility for ensuring that needs are met lies with the Local Authority (IPSEA, n.d.). This makes SLCN an area where joint working is crucial, not only at the level of the individual child, but also in the way that services are funded, designed and delivered.

In the past two to three decades there has been an increased drive for joint working between services to support children with SEN, early intervention, identification of groups at risk of developing SLCN and preventative work by various agencies. After the inception of Sure Start (Roberts & Hall, 2000) in the late 1990s there was a shift in the UK and some services began to extend their role to include preventative work with un-referred populations, in collaboration with Sure Start centres and staff. Since this time, models of provision have evolved and it is now more common to see multi-tiered systems of support for children with SLCN, which are inspired by public health models and education traditions and philosophies.

Public health models traditionally consist of three levels of prevention – primary, for all; secondary, for those at risk; and tertiary, for those already experiencing the condition. This three-tiered model has served as the basis for various iterations of public health models, such as that of Gordon (1983) who introduced the universal, targeted and specialist terminology now often used to describe the tiers of support. He also made a distinction within the targeted tier between targeted-selective and targeted-indicated, a useful way to conceptualise different target groups within this tier. Targeted-selective refers to those people who are members of a particular 'at risk' group, or who possess certain characteristics which mean they are at risk of developing a condition. Using SLCN as an example, this could be being male, living in an area of high deprivation, or a family history of SLCN. Targeted-indicated on the other hand refers to a population who are showing early signs of presenting with the condition, for example, children who are late talkers. These are useful distinctions to be able to make when assessing a population and then planning preventative approaches and workforce deployment.

Mrazek & Haggerty (1994) also utilised the selective and indicated terminology within their interpretation of the public health model. Rather than a tiered model, they proposed more of a radiating continuum of prevention, encompassing universal prevention activities, selective prevention and indicated prevention within a 'prevention' segment. A 'treatment' segment where assessment, case identification and standard treatments are encompassed; and a 'maintenance' segment aiming to reduce the impact of an established disorder and prevent the occurrence of associated comorbid conditions were also part of this continuum of support. They describe how one individual can be receiving support at a range of different levels within the model, though the primary aim will be focused at one of the segments.

Similarly, two different children could be receiving the same input, but with different aims, placing them at different stages on the continuum. For example, one child may be taking part in a phonological awareness intervention because they are experiencing SSD, this is an established difficulty and therefore their intervention sits within the 'treatment' portion of the continuum. Another child may be part of a group receiving the same phonological awareness intervention, but they are included as part of indicated prevention due to emerging difficulties with literacy and therefore the aim is to promote increased progress and prevent literacy difficulties from becoming established. Each of these children would also be benefitting from universal, class-based practices to support speech and literacy development in addition to the supplemental interventions. This idea of a continuum of support and cumulative support is integral to the MTSS model explored in this thesis.

The concept of a continuum of support is also embedded within education. Response to Intervention (RtI) models have been developed in the US over the last two-three decades utilising concepts from prevention science (Schulte, 2016), problem-solving models (Erchul & Ward, 2016) and, to some extent, Applied Behavioural Analysis (Ardoin, Wagner, & Bangs, 2016). The phrase Multi-Tiered Systems of Support (MTSS) is a term that is gaining momentum in the literature and is often used interchangeably with RtI. However, Jimerson, Burns, & VanDerHeyden (2016) in the Handbook of Response to Intervention delineate these terms as two distinct models. They characterise RtI as an assessment-based model that emanated from special education law in America; whereas MTSS is a more general education focused way of providing a continuum of services to meet all children's educational needs. Broadly, the goals of MTSS are to install systems and infrastructure within a school to meet the academic and behavioural needs of all of the children within that setting. At the level of the individual the goals of MTSS are to determine whether a problem behaviour, or poor academic performance, is due to environment or an underlying disability. Typically, these models include a minimum of three tiers of support for children that are accessed depending on the results of universal screening tools. Children access the tiers of intervention progressively; moving up a tier in response to a lack of adequate progress at the preceding tier. Each tier is characterised by increasing intensity and duration of instruction in a reducing group size (e.g. whole class, to small group, to smaller group or one to one). By accessing

intervention in this cumulative way, it helps to identify, and provide adequate support for, those children who are underperforming due to their environmental circumstances.

In the UK education system such structured, rigid models are not routinely utilised, however the Special Educational Needs and Disabilities Code of Practice (Department for Education & Department of Health, 2015) highlights the importance of a graduated response to supporting children with identified needs. This involves identifying SLCN in a timely way, the provision of high-quality universal support, implementing and evaluating targeted interventions and, where deemed appropriate, supporting those whose needs and progress indicate the requirement of more bespoke, specialist support. There is an expectation that schools and professionals work together in order to ensure that there are systems in place to meet these varying levels of need.

In the late 1990s there was a substantially increased drive for integrated working between health and education professionals, which led to a position paper from the Royal College of Speech and Language Therapists (RCSLT). In this position paper, Gascoigne (2006) described a three-tiered model for the prevention and support of SLC development (**Error! Reference s ource not found.**). Within this model, the SLT role was considered at each of the three tiers – the universal tier for all children; the targeted tier for what she termed 'vulnerable' children; and the specialist tier for those with established additional needs. This model is one that we would term a multi-tiered system of support and looks to bridge the gap somewhat between health and education philosophies.

These models require a clear understanding of the population being served in order to judiciously implement evidence-based prevention activities and make decisions as to how to best meet the needs of the population. Due to the high prevalence rates of SLCN, particularly in areas with high levels of deprivation, and the wide-ranging implications of communication difficulties it is essential that there are multiple agencies involved in the planning and delivery of any MTSS to prevent the emergence of SLCN and minimise the impact of existing SLCN.

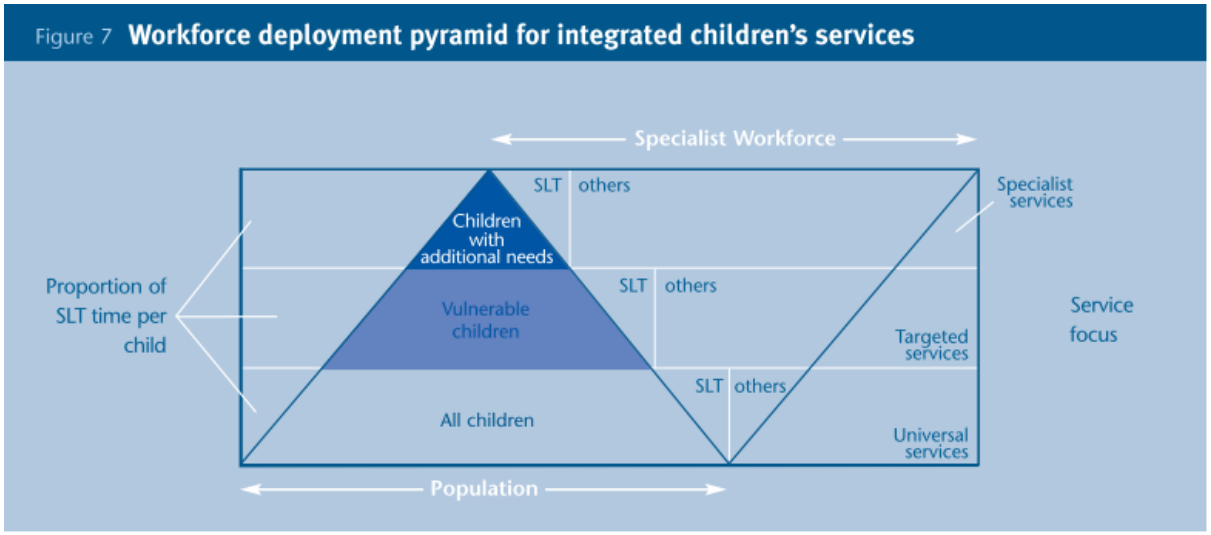

Figure 1.1 Multi-tiered system of support model from "Supporting children with speech needs within integrated children's services: Position Paper" by Gascoigne, 2006. Reproduced with permission.

Despite the frequency of services being conceptualised in this way, there are limited evaluations of public health inspired models supporting SLC. Developing the evidence base here is crucial to facilitate the best possible outcomes for children at risk of and experiencing difficulties with their communication.

1.5 The complexity of evaluating speech and language therapy interventions

1.5.1 Complex interventions

Both public health interventions and SLT interventions are complex in nature. They are often flexible, tailored to different settings and impacted by multiple interacting factors. Most public health interventions aim to change the behaviour of specific populations of people and help to reduce health inequalities. Similarly, SLT interventions aim to facilitate change for children with SLCN, both directly and indirectly through working with others. Both are often complex in the sense that they tend to have multiple components that act independently and inter-dependently. This makes it challenging to identify the active ingredients and to know which components, or combinations of components, are most important. In turn, this makes replication and evaluation difficult (Medical Research Council, 2000).

As well as the interventions themselves being inherently complex, both public health and SLT approaches are typically implemented within complex systems. Systems are complex due to the nature of the relationships within them; relationships between people, practices, policies, all of which are local context dependent. Complex systems include schools, local

communities, healthcare systems; all key areas when it comes to implementing and evaluating public health approaches and specifically those linked to SLCN. There is an argument that if this complexity is not considered, if an intervention is evaluated without consideration of the context, then something important is missed. The idea that something can be 'greater than the sum of its parts' is key here and it is argued that interventions need to be better theorised to reflect just this (Hawe, Shiell, & Riley, 2004; Shiell, Hawe, & Gold, 2008).

A third element of complexity when approaching the evaluation of public health models, or SLT interventions with a public health function, is the complex nature of SLC development itself. As explored above there are many genetic, environmental, social and economic factors that contribute to the successful development of communication skills. Outcomes and implications of difficulties with SLC are cross-domain and there are many risk factors that are shared with other areas, such as mental health difficulties (WHO, 2004) and literacy difficulties (Burgoyne, Lervag, Malone, & Hulme, 2019). Despite this complexity, a compartmentalised approach is often taken to evaluating interventions to support SLC and indeed, other common co-occurring difficulties.

1.5.2 Efficacy vs. effectiveness

When evaluating complex interventions, or interventions with multiple components, it is important that individual components of the models have been evaluated in rigorous efficacy studies, such as randomised control trials (RCTs). These studies in highly controlled conditions indicate the maximum potential of the intervention to facilitate change in the target variables. Effectiveness studies then provide an opportunity to evidence the benefit of the intervention in a real-world context. With complex interventions, such as those focusing on supporting SLC development, there are many factors interacting within the environments that could impact on the effects of the intervention.

It is of the utmost importance to describe and understand the context in which interventions shown to be efficacious in isolation are embedded. This enables others to determine the relevance of the results to their situation. Additionally, this provides a way to begin to understand how different components of interventions and the environment interact to facilitate or hinder SLC development. Each area looking to implement an intervention will vary with regards to the local context. There will be different practices, relationships and social

and economic issues facing different areas, which may result in the standard package being inappropriate or unacceptable in some areas, thus the concept behind an intervention may be promising, but the intervention unsuccessful due to contextual factors. These descriptions as part of effectiveness studies can serve as a basis for the development of locally defined versions of the 'same' interventions, rather than exact replication, which is unlikely to be as effective if context is not considered. It could be that core aspects of an intervention are identified and that fidelity to these core aspects in a range of contexts is what facilitates the effectiveness of the local variations of the same foundation intervention.

1.5.3 Fidelity, standard delivery and manualisation

It may be that quasi-experimental and time-series designs are more appropriate to evaluate these public health approaches, alongside qualitative explorations of facilitating and constraining factors within different contexts (WHO, 2004). However, it may be that standardisation within the RCT design is reconceptualised to encompass the idea that an intervention or approach can be standard in terms of the function it serves and the key underlying concepts, rather standardisation being strictly limited to the form of the intervention, i.e. always being delivered in exactly the same way, using exactly the same resources (Hawe et al., 2004; Rutter et al., 2017; Shiell et al., 2008). In their 2004 paper, Hawe, Shiell and Riley (2004) suggest that standardisation could be of an intervention's 'form' or 'function'. By form they mean the components of an intervention such as the materials, the workshops etc.; by function they mean the key functions of the steps in the change process. They provide a table of examples, which have been adapted below to highlight this idea within the current study (Table 1.2). Utilising this approach to standardisation would allow a balance between fidelity and flexibility to local needs and acceptability.

In the last few years there has been acceleration in work to describe complex methodologies and interventions. Ten years ago, it was rare that SLT was acknowledged as a complex intervention. The vast majority of studies evaluating SLT interventions are grounded in the medical model and their design reflects this. It has also been argued that many studies evaluating SLT interventions are in fact poorly designed. This inadequate design can lead to non-significant outcomes, not because SLT is ineffective but because the questions asked are underspecified, or the scope is too wide (Pring, 2004). New knowledge has emerged which is very relevant to how we now view and evaluate SLT interventions. This work did not

consciously underpin the project from which this thesis emerged but will re-visited in the discussion (Chapter 5:).

1.6 Conclusion

In conclusion, the evidence presented outlines a strong case for speech, language and communication to be addressed as a public health issue. All three of the criteria outlined in Law, Levickis, et al. (2017) can be seen to be met. There are already accepted public health MTSS models being utilised in the area of speech, language and communication support within health and education arenas. Despite some services loosely being based on these models, there is very little evidence of how whole system models to support SLC development are realised and how effective they are. Existing evidence of successful interventions to support SLC development largely emanates from the medical model, despite growing acknowledgement of the importance of the complex systems in which communication develops, and the complexity of communication itself. Evaluating interventions taking these complexities into account is rare and challenging. There is also a need for more routine data at the population and local levels in order to be able to tailor services to local need, on the basis of a range of risk factors, such as deprivation.

Approaching SLC with a focus on the promotion of good communication skills and the prevention of difficulties aligns with the NHS constitution and values (Department for Health, 2015); such as 'designing services to improve, prevent, diagnose and treat both physical and mental health problems with equal regard' (p3), as well as having a 'wider social duty to promote equality through the service it provides and to pay particular attention to groups or sections of society where improvements in health and life expectancy are not keeping pace with the rest of the population' (p3). The collaborative approach necessary to support such a cross-sector issue as SLC development is also aligned with the NHS constitution, as it indicates that 'the NHS is committed to working jointly with other local authority services, other public sector organisations and a whole range of private and voluntary sector organisations to provide and deliver improvements in health and well-being' (p4).

Table 1.2 Table exemplifying how interventions can be standardised by form or function

Principle of intervention	Type of Standardisation	
	By form	By function
To educate staff about speech and language development and the identification of additional needs	Standardised training materials and protocol used with everyone	Key information identified and flexible delivery tailored to local context
Identification of children for the targeted tier of support	Standardised identification tool used to identify children	Information provided about who the intervention is designed for, the intervention aims and support to use existing mechanisms in place for accurate identification
To embed the universal and targeted tiers of intervention in everyday practice	Prescribed curriculum and intervention schedule/content with close monitoring for fidelity	Each site provided with information and materials to implement the intervention and are supported to deliver these in a way that is tailored to their individual context. Opportunities for liaison to share ideas and problem solving.

Note. Adapted from “Complex interventions: how "out of control" can a randomised controlled trial be?” by Hawe, Shiell and Riley, 2004, *British Medical Journal, 328, p 1561.*

1.7 Research Questions

This thesis seeks to further the case for SLCN to be approached utilising a public health model by answering three over-arching research questions. Two of these over-arching research questions are answered by exploring sub-questions with respect to an MTSS supported by an SLT embedded within early years settings serving communities in a coastal region of England with high levels of deprivation:

1. What is the prevalence of SLCN on entry to nursery (Chapter 3:)?
2. What is the nature of the support pathways delivered (Chapter 3:)?
    a. What pathways do participants take?
    b. What are the characteristics of participants in each of the pathways with respect to their pattern of speech, language and communication needs?
    c. How do participants in each of the pathways differ in terms of their speech and language skills?
3. What is the nature of the effects of the MTSS, on children's receptive vocabulary development (Chapter 4:)?
    a. Does the MTSS improve participant's receptive vocabulary development over and above the effects of usual practice in early years provision?
    b. How do the different tiers of the MTSS affect participant's receptive vocabulary development over and above the effects of usual practice in early years provision?

Prior to addressing these research questions, Chapter 2: first details the wider project and context from which this thesis has emanated.

CHAPTER 2: CONTEXT AND METHODOLOGY

2.1 Overview

This chapter details the contextual background for this thesis and the methodology employed in the data collection and analysis. Information about the original collaborative project and the subsequent Knowledge Transfer Partnership (KTP) project (KTP008197) is provided. The chapter then goes on to explain how data have been used to explore the specific research questions outlined in Chapter 1. Details about sub-cohorts of participants included in different elements of the analysis are presented; as well as statistical analyses and the rationale for the choice of these analyses.

2.2 The KTP Background

The Knowledge Transfer Partnership (KTP) project (KTP008197), on which this thesis is based, arose as a result of collaborative working between a local school and the NHS speech and language therapy service that served its population. This provides a background and context for the analysis presented in this thesis. In the UK children attend Nursery from as young as 3 years old, transferring to Reception class at the start of the academic year in which their fifth birthday falls. The Early Years Foundation Stage Curriculum covers both Nursery and Reception years.

2.2.1 Collaborative working: original project

The original collaborative working project was instigated by an NHS SLT in partnership with the head teacher of a school for children aged 3-7 years (known in the UK as a First School) in a coastal village in the North East of England. The number of children that entered the school's nursery with SLCN that impacted on their ability to access the Early Years Curriculum was extremely high. Compared to the expected prevalence of 7-14% (Law et al, 2003), up to 50% of the annual nursery intake was appropriately referred to the NHS SLT service. This level of need was putting exceptional demands on both the school and the SLT service. With the support of the school's senior management, the SLT and nursery staff developed a new model of service delivery. A teaching assistant (TA) was employed, jointly funded by the school and SLT service, to support the delivery of the model. Firstly, the Early Years staff working in the nursery received training from the SLT focusing on how to support speech and language development within the nursery classroom during routine activities (universal intervention). Secondly, the children considered by the TA and the SLT to have speech and language needs

compared to typically developing peers were placed in groups receiving a targeted intervention delivered by the TA with content and on-going support from the SLT. The intervention focused on developing foundation speech and language skills for accessing the curriculum and as a basis for future SLT intervention should it be necessary (e.g. phonological awareness, language structure). During the targeted intervention the children's response to the intervention was monitored. For some of the children with SLCN, being immersed in the language-rich environment, alongside the targeted intervention, was enough to support their speech and language skills to such a level that their needs were met then by the universal tier of the intervention. It was hypothesised that these were children with a transient speech and language delay, possibly due to the home environment not stimulating language development to an adequate extent, as demonstrated in Hart & Risley (2003). The children who took part in the targeted intervention groups who did not make progress as expected were then referred to the NHS SLT service; a decision that was made through frequent liaison between nursery staff and the SLT. It was hypothesised that these were the children with more significant speech and language difficulties that required a more bespoke, specialist intervention.

The SLT attempted to replicate this model in a number of schools in the same local area with varying levels of success. None of the schools embraced the model in the same way as the original school and therefore did not see the same benefits.

2.2.2 Collaborative working: The Knowledge Transfer Partnership

When the pyramid of local schools (the High School and all its feeder schools) merged to form an Academy School [1] for 3-19-year olds there was an opportunity for the SLT to further the model of service delivery. The head teacher of the school in the initial project became a senior manager within the Academy and was also keen to replicate the success of the model across the other first schools (renamed campuses) that were now part of the same organisation. A partnership between Newcastle University, the NHS SLT service and the Academy was formed and a KTP (KTP008197) successfully applied for. This gave the opportunity to establish a research project over two years, to disseminate the model of working to the other school campuses, support its implementation and evaluate its impact on the language skills and

[1] https://en.wikipedia.org/wiki/Academy_(English_school)

school readiness of the children involved. For the Academy School the aim was that this new model of working would be normalised to become their routine model of working in the nursery settings.

2.2.3 The role and contribution of the Author

The author's role in the KTP and the wider evaluation as part of this thesis is outlined in this section. When the author came in to post as the KTP SLT / RA, the KTP project was already planned and externally funded. There was a planned sample, proposed data collection points and the assessment choices were finalised, but operational detail had not been required by the funders. At the launch of the KTP project, the author played a number of key roles including refining the details of the assessment materials and the procedures of data collection. They developed the data collection protocol and managed issues of reliability and fidelity in the data collection, including training teaching staff and SLT students and cross-checking a selection of recordings of transcribed assessments by SLT students. They also conducted a substantial proportion of face to face assessments over the duration of the project. The author also operationalised the roll out of the intervention, leading on the implementation of the MTSS. This included having a lead role in designing and delivering the training to Nursery staff (alongside members of the KTP and local NHS teams) and supporting Nursery staff to implement the intervention, by modelling, advice giving and problem-solving with staff.

With regards to this thesis, which evaluates the KTP project, the author developed the research questions that were to be asked of the data, planned the data analysis approach and analysed and interpreted the data presented.

2.2.4 Ethical Approval

Ethical approval was given by the Newcastle University ethics committee. Parents consenting on behalf of their children were given written and oral information about the evaluation and the opportunity to withdraw from the assessments at any time. As the intervention was being implemented as routine practice within the Academy, if a parent wished to withdraw from the intervention this would mean withdrawing from the school. Parents were given the option to request that their children's data was not used within the evaluation.

2.3 Participants

Four hundred and nine nursery age children (3;0 to 4;11 years) (n=202 boys, n=207 girls) were initially recruited in four cohorts in school terms one, two and three of the project, over two school years (**Error! Reference source not found.**) from the primary campuses of the A cademy School. There were no exclusion criteria employed; all children were given the chance to take part and no parents withdrew consent for the intervention or assessments. Four hundred and eight of the children (99.8%) had English as their first language, a higher proportion than the average in England as a whole (81.9%) (http://www.education.gov.uk/schools/performance/). Table 2.1 shows the characteristics of the participants on entry to the project. Entry to nursery typically occurs during the term following the child's third birthday, but all children start school in the September before their fifth birthday. Therefore, some children progress to school after five terms in nursery while some progress after three terms in nursery.

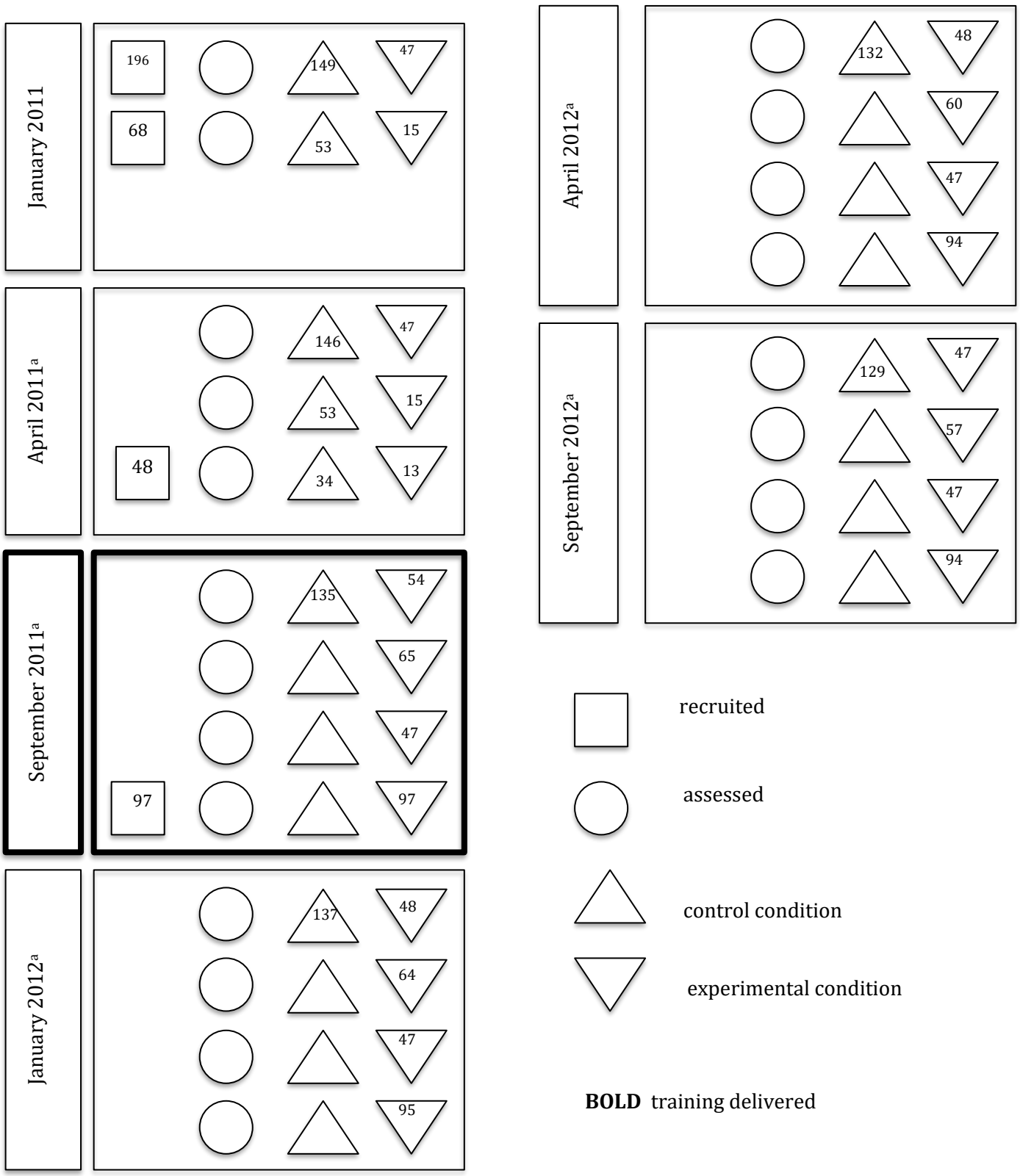

Figure 2.1 Adapted perera diagram of recruitment and movement between control and experimental conditions over the course of the project

[a]missing data due to participants leaving the school over the course of the project

Table 2.1 Characteristics of participants in each cohort at recruitment.

Cohort	Whole			Male			Female		
	n	age in months (SD)	SES decile (SD)	n	age in months (SD)	SES decile (SD)	n	age in months (SD)	SES decile (SD)
1	196	46.70 (3.64)	2.39 (2.20)	98	46.53 (3.65)	2.26 (2.14)	98	46.87 (3.65)	2.52 (2.64)
2	68	38.62 (1.51)	2.14 (2.08)	34	38.76 (1.81)	1.90 (1.80)	34	38.47 (1.13)	2.38 (2.32)
3	48	39.88 (.91)	2.24 (2.10)	28	39.93 (.88)	2.27 (2.34)	20	39.8 (1.01)	2.21 (1.78)
4	97	39.12 (1.58)	2.08 (2.22)	41	39.20 (1.69)	1.82 (1.83)	56	39.07 (1.51)	2.27 (2.48)
Total	409	409	376[a]	201	201	184[a]	208	208	192[a]

Note. SES deciles – http://imd-by-postcode.opendatacommunities.org/ ;

[a]n is lower than the total due to IMD postcode data not being available for all postcodes

Children within the study attended different campuses (previously these had been different schools, see above). At the outset of the study there were seven campuses; over the course of the study merging two sets of two campuses created two larger campuses and therefore for the majority of the evaluation the children were split across five campuses.

This study took place in an area of social deprivation. Total deprivation statistics (http://imd-by-postcode.opendatacommunities.org/) were used to gain the socioeconomic ranking of the children's postcodes; this was done retrospectively in 2019. The index of multiple deprivation is a widely used metric for showing the relative deprivation of small areas in England. The index ranks areas from 1 (the most deprived) to 32844 (the least deprived) and is derived by combining information from seven domains of deprivation, to provide an overall measure. The seven domains from which information are drawn are income deprivation; employment deprivation; education, skills and training deprivation; health deprivation and disability; crime; barriers to housing and services; and living environment deprivation. Each of these domains are weighted depending on their links to poverty and deprivation in the literature and the robustness of the measures used (Department of Communities and Local Government, 2015). The rankings for this cohort are presented as deciles in Figure 2.2 for ease of interpretation. Thirty-three children did not have SES data associated with their postcodes;

therefore, they did not contribute to the SES estimates. The range of the participants' total deprivation statistics was 693-28189 compared to a national range of 1-32,844 (Ministry of Housing, Communities & Local Government, 2019); the standard deviation is 7229.14. Furthermore, the primary campuses had an average of 37.2% of children eligible for free school meals (until 2014 this could be used as a proxy for low SES in England); nearly double the English national average of 19.2% at the time. Parents from low income families could register for free school meals if they met certain criteria, therefore the proportion of children registered for free school meals represented the proportion of families meeting this deprivation criteria. In 2014 the Government introduced free school meals for all children from Reception to Year 2, reducing the need to for parents from the low-income families to register for this, thus nullifying it as a proxy for deprivation in the infant years of school.

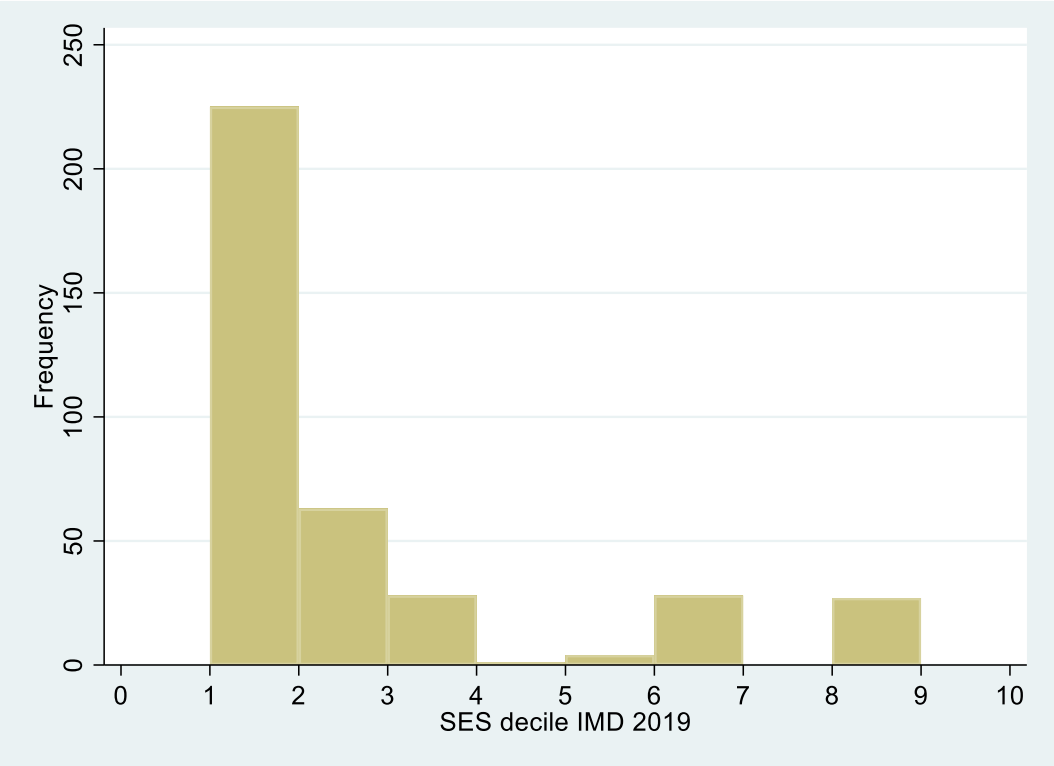

Figure 2.2 SES decile distribution of each participant with an IMD rank - http://imd-by-postcode.opendatacommunities.org/ Whole cohort N=409, n=367 due to missing IMD data for newly built estate

2.3.1 Recruitment over the duration of the project

The study ran over six school terms, spanning two academic years. The intervention was implemented at a single campus from the outset; the remaining campuses being in the control condition at this point. In the control condition participants received the typical nursery curriculum from staff that had received no training linked to the model of

intervention. Participants entered the study in four cohorts (**Error! Reference source not found.**):

- **Cohort one (n = 196):** had already completed one to three terms in nursery at the commencement of the project (January 2011). These participants progressed from nursery to reception class at the end of the second term of the study. Those in the experimental cohort at the first two assessment points attended the original campus. The number of participants in the experimental condition increased at the third assessment point due to one of the Reception classes being part of an EYFS unit with nursery children (n=19). This meant that they were also included in the experimental condition, being taught by staff that had received the training and being included in the targeted tier interventions where appropriate.
- **Cohort two (n = 68):** these participants entered nursery as the study commenced (January 2011) and remained in nursery for five terms. During the first two terms of the project, fifty-one participants were in the control condition and seventeen the experimental (attending the trailblazer campus). Those who began as part of the control condition (n=53) moved into the experimental condition during the third term of the project once the remaining nursery staff received training to implement the intervention.
- **Cohort three (n = 48):** these participants entered nursery at the beginning of the second term of the project. During their first term in the project thirty-three of these participants were in the control condition and fifteen the experimental (attending the original campus). These participants remained in nursery for four terms. Those who began as part of the control condition (n=34) moved into the experimental condition during the third term of the study once the remaining nursery staff received training to implement the intervention.
- **Cohort four (n = 97):** these participants entered nursery at the beginning of the third term of the project and had three terms in nursery. All of these participants were in the experimental condition (n=97) as at this point the remainder of the nursery staff received training to implement the intervention.

2.3.2 Recruitment to the experimental condition

Due to the nature of cohorts, intakes of children and the presence of the trailblazer campus, the picture of recruitment to the experimental condition is a complex one. It is outlined in Figure 2.1 and the movement of children into and out of the experimental condition at each time point is further explained below.

- January 2011 – at this time point, participants attending the trailblazer campus were the only participants that were part of the experimental condition (n = 62), these were children from cohorts one and two.

- April 2011 – a new Nursery intake at this point in time brought 48 new children into the study (cohort three) and some of these entered the trailblazer campus and therefore the experimental condition (n = 13).

- September 2011 onwards – the training was delivered in September 2011, which resulted in all of the Nursery classes becoming part of the experimental condition. This meant that all children starting, or remaining, in Nursery were part of the experimental condition (n = 264) and children who moved on to Reception, where staff had not received the training, were now in the control condition (n = 135). This is with the exception of a small number of children (n = 19) who remained in the experimental condition, as they were taught as part of a Nursery / Reception unit and therefore received the intervention whilst Reception age.

2.4 Assessment Protocol

The participants could be included in six possible assessment points, depending on the time of their recruitment. Each assessment point comprised several short sessions as participants were assessed on one measure per sitting with a maximum of 6 assessments administered (see below). Each campus was visited a number of times during each assessment point in order to ensure participants had the maximum opportunity to be present and willing/able to complete as many of the desired assessments as possible. If a participant failed to cooperate or showed signs of distress they were returned to the classroom. Time permitting, they were offered another chance to complete the assessment in question. Due to resource constraints it was not possible to assess every participant on every measure at all six of the assessment points. The maximum possible number of measures for all participants on all measures at each time point they were included in the study is 13169. In reality the total number of

measures completed was 9270 (70.4%), a shortfall of 3899 (29.6%). In the data a distinction is not made between those participants who have no scores for an assessment due to absence, refusal or time limitations. This could have introduced a sampling bias and is important data to collect if this research is replicated.

2.5 Measures

Table 2.2 details assessments completed over the course of the project.

Table 2.2: Assessments completed during the project

Assessment		Description	Administration points	Administered by
Name	Type			
The British Picture Vocabulary Scale (BPVS 3) (Dunn & Dunn, 2009)	Standardised	A measure of receptive vocabulary knowledge for children aged 3-16. It is standardised on a representative UK sample of 3278 children and has a reliability of 0.91.	T1-6	SLTs, student SLTs, teachers and teaching assistants.
Diagnostic Evaluation of Articulation and Phonology (DEAP) Diagnostic Screen (Dodd, Hua, Crosbie, Holm, & Ozanne, 2006)	Screening Tool	This assessment is the initial screening tool of a larger diagnostic speech sound assessment. The assessment is for children aged 3 - 6;11 and was standardised on a UK sample of 684 children. Where further assessment was recommended, this was carried out (e.g. phonology, inconsistency, articulation assessments).	T1-6	SLTs and student SLTs.

Derbyshire Rapid Screening Test (Knowles & Masidlover, 1987)	Criterion referenced	This is an assessment of receptive language based on children's understanding of information carrying words. It is part of the assessment battery within the Derbyshire Language Scheme. This test had a ceiling score of 22.	T1-6	SLTs, student SLTs, teachers and teaching assistants.
Preschool Inventory of Phonological Awareness (PIPA)(Dodd, Crosbie, McIntosh, Teitzel, & Ozanne, 2000)	Standardised	This assessment is for children aged 3 – 6;11 and has normative data for both UK and Australian populations. The Syllable Segmentation, Alliteration Awareness and Rhyme Awareness sections of this assessment were carried out at all assessment periods for children in cohorts one and two	T1-4[a]	SLTs, student SLTs, teachers and teaching assistants.
Assessment of Phonological Awareness (Version 1) (Stringer, 2012):	Criterion referenced	A dynamic assessment of phonological awareness development in the Early Years developed by Dr Helen Stringer. The first iteration of this newly developed assessment was used from assessment point four during the study as a replacement for the PIPA for children in	T4-6	SLTs and student SLTs.

	cohorts three and four. This assessment provided information about syllable segmentation, syllable deletion, initial and final sound identification and deletion, letter-sound knowledge and rhyme detection and generation. The assessment is based on Rosner's Auditory Analysis Test (Rosner, 1993) and aims to assess the target skills in a transparent and direct way by reducing the memory and language load.		
Early Repetition Battery (ERB) Sentence Repetition (Seeff-Gabriel, Chiat, & Roy, 2008)	This assessment is for children aged 2 to 6 years and was standardised on a nationally stratified UK sample. This assessment is a measure of expressive language ability; children are unable to repeat grammatical constructions that they would be unable to use in their own spontaneous	T1-6	SLTs and student SLTs

	language production (Polišenská, Chiat, & Roy, 2015). This assessment had a ceiling score of 27.		
Early Years Foundation Stage (EYFS) Development Matters (DfE, 2008)**:** Communication, Language and Literacy (CLL) strand and the Personal, Social and Emotional Development (PSED) strand	The data was gathered in the form of the age band that the teachers judged the children to be performing within. This was then converted to a scale score linked to whether this age band was appropriate for the child's chronological age, one below, two below or three bands below. In April 2012 changes were made to the EYFS which meant that from September 2012 the way the school recorded this data also changed (DfE, 2014). The profile was altered to have three prime areas of learning (Communication and Language Development; Physical Development; Personal, Social and Emotional Development) and four specific areas (Literacy;	T1-5	Teachers

	Mathematics; Understanding of the World; Expressive Arts and Design).

Note. SLT = Speech and Language Therapist

[a] Teachers raised the issue that children were not demonstrating knowledge of phonological awareness skills during the assessment that they were easily able to demonstrate in class. Investigation by the research team revealed that this was due to the complexity of the language and the memory load in the assessment. SLTs within the research team agreed that these assessments would therefore not be used with children entering the project part way through (cohorts three and four)

2.5.1 Reliability

Student SLTs, teachers and teaching assistants who administered assessments all received appropriate training from a member of the research team. All assessments were scored by the KTP Research Associate (KTPRA) SLT. For the DEAP, student SLTs were required to audio record their assessments so that a qualified SLT within the research team could check the accuracy of their phonetic transcription for a sub-set of the assessments they completed. Student SLTs were also required to audio record the ERB assessments in order for a sub-section to be checked for accuracy by a member of the research team.

2.6 The Intervention

Over the past decade or more, models of collaborative working have been emerging that are organised into three tiers: a universal tier that caters for all children, a targeted tier that caters for vulnerable or 'at risk' children and a specialist tier which caters for those with additional and specific special educational needs. As mentioned in 1.4 (p21), Gascoigne (2006) outlined an increasing remit for SLT services to be involved at all three of these levels, which was realised in this project. It is important to emphasise that the universal tier of this model was an intervention as staff were provided with training and support to enable them to alter their traditional practice to become more communication supportive and to support their identification of those requiring targeted and specialist levels of support.

2.6.1 Universal Intervention (Tier 1)

This tier of the intervention is characterised by what has subsequently come to be known as quality first teaching and providing a communication supportive environment. This is over and above the routine EYFS curriculum that staff were providing previously as it involves the implementation of a range of language environment enrichment strategies.

The training included information about a range of practice- and evidence-based strategies for supporting vocabulary and wider language development:

- Using visual support – this included the use of visual aids such as pictures/objects to support children's understanding, the use of gesture to accompany language and acting out things for children.

- Focusing on quantity and quality of input - time for conversations, emphasising and elaborating new vocabulary, recasting and extending language (Justice, Mashburn, Hamre, & Pianta, 2008; Walker et al., 2020; Wasik, Bond, & Hindman, 2006).
- Using contingent comments – staff were provided with information about the benefits of utilising a higher ratio of comments to questions and focusing comments on the focus of a child's attention as strategies to support language development (Girolametto, Pearce, & Weitzman, 1996).
- Modelling and explicit teaching
- Conversing with adults so children hear adult conversation
- Songs and rhymes
- Shared book reading (Justice, Meier, & Walpole, 2005; Marulis & Neuman, 2010; Walker et al., 2020)
- Following the child's lead (Cabell et al., 2011; Hoff, 2006; Kim & Yun, 2019; Lieven, 2019)
- Getting down to the child's level

2.6.2 Targeted intervention (Tier 2)

The teacher and/or TA identified children as having difficulties with either speech and/or language that were not improving with the universal intervention. These children were included in the targeted tier of the intervention. Children could also be placed in the targeted tier of the intervention immediately if deemed necessary. This tier involved small group work focusing on phonological awareness skills, listening and attention, turn-taking, understanding and use of language using an Information Carrying Words (ICW) framework (Frizelle, Harte, O'Sullivan, Fletcher, & Gibbon, 2017). The groups delivered were:

- **The speech programme:** A rolling 16-week programme with content provided by the SLT and activities developed by the TA in the original collaborative project. Skills targeted in this programme include listening and attention, turn-taking, phonological awareness skills (including syllable and phoneme level skills as appropriate), and auditory discrimination work on developmentally appropriate speech sounds. The programme comprised a weekly session plan and a corpus of additional activities to reinforce the content, from which staff delivering the intervention could choose. There were typically between 4-6 children in each group and the frequency and

duration of the groups was flexible. This enabled each campus to embed the groups in a way that fitted with their cohort and timetable; it also gave the staff some ownership over the decision making rather than this being dictated to them and contributed to the normalisation process (May et al., 2007).

- **The language programme:** Adapted session plans from Language Steps (Armstrong, 1999) were used as a basis for the this programme which also included some structured symbolic play to support generalisation of the language structures outside of the session plan activities and into play activities. Language Steps is based on the Derbyshire Language Scheme, using Information Carrying Words (ICW) as a framework for developing receptive and expressive language. Skills targeted in these groups include listening and attention; turn taking, symbolic play skills, receptive and expressive vocabulary, and understanding and use of increasing numbers of ICW. Groups typically comprised 3-5 children and the frequency and duration of the groups was left flexible for the reasons stated above.

Children in the targeted tier could be assigned to either or both of the targeted groups, as well as benefitting from the enhanced communication environment provided by the universal tier of the intervention.

2.6.3 Specialist Intervention (Tier 3)

Children who were already under the care of the local NHS SLT Service on entry to nursery and children who were subsequently referred to the NHS SLT Service sit at this level of the model. SLTs delivered the interventions in partnership with Early Years staff, who were supported to deliver the interventions through additional training and modelling. NHS SLTs assessed the children and school-based TAs delivered intervention programmes with specialist oversight from the SLTs. These intervention plans focused on individual children's areas of need. Children at this level were also benefitting from the enhanced communication environment at the universal tier. Children whose needs were obviously very significant were referred to the NHS SLT service soon after entering nursery; whilst they waited for their initial assessment and intervention plan they were usually placed into the targeted interventions to ensure they were receiving some support to develop their speech and language skills.

2.6.4 Inclusion and movement between tiers

All participants in the experimental condition of the project were included in the universal tier of the intervention. Participants who were identified as having speech and/or language delay were also selected for inclusion in the targeted tier of the intervention. Those with significant difficulties (that met referral criteria) were referred to the NHS SLT service in the first instance, as well as being included in targeted groups.

The responsibility for the identification of participants to be included in the targeted interventions lay with the teacher and the TAs working in the nursery settings. They were well supported in this decision-making process and were able to seek further advice from SLTs where they were unsure. No formal measure was used to determine inclusion, rather observations as part of the EYFS, interactions with the participants, reference to local NHS SLT referral guidelines[2] and liaison with the SLTs (NHS and the KTPRA) were used, in conjunction with their own professional knowledge, to identify participants. Although this increased the risk of variation between campuses due to subjectivity, it had already proved to be an appropriate method in the original school and would contribute to normalisation of the process (May et al., 2007). For the duration of the project, where staff sought extra support identifying participants, the assessment scores were used to support the decision-making. Where staff continued to have concerns and the assessment scores were inconclusive or apparently not reflecting the presentation in class, participants were included in the targeted groups as a means of further assessing their language skills. In these circumstances the smaller group afforded the opportunity to communicate in a quieter situation, which then allowed the staff to determine whether their continued inclusion was necessary.

As previously mentioned, it was possible for participants to enter the targeted groups at any stage of their time in nursery. Some participants were identified as requiring extra support quite soon after entry to nursery; others were monitored to ascertain whether exposure to the communication friendly environment of the universal tier would be sufficient to improve their skills before a decision was made about their inclusion in the targeted tier. Similarly, participants could be referred to the NHS SLT (specialist tier) quite soon after entry to nursery

[2] Local SLT referral guidelines are used by all settings accessing the service and are accompanied by guidance for use.

where their difficulties were significant. On other occasions participant's response to the targeted tier of the intervention was monitored and used as a decision-making tool about the necessity of referral on to specialist services.

Consequently, participants could be benefiting from multiple tiers of the intervention at any one time (between one and three tiers). The flow of participants through the tiers of intervention is explored in detail in Chapter 3: and the implications of this complex movement through tiers on the statistical analysis is explored further in Chapter 4: .

2.6.5 Training

The training for teachers and TAs was devised over a four-month period. The initial stage involved information gathering from a range of sources:

- Discussions with the SLT service about what was in place in the example school versus the other school sites;
- Observations of typical nursery practice in both the original school and the other school sites. This focused on identifying strategies being employed to support speech and language development, as well as targeted support in place to support children with identified needs;
- Video analysis of interactions in both the example school and the other school sites. A modified version of The Self Evaluation of Teacher Talk (SETT) tool (Walsh, 2003) was used as a basis for analysing these videoed interactions. Interactions were compared across sites to ascertain whether staff members on the example site were employing different communication support strategies, an increased range or volume of communication support strategies, and what strategies needed to be promoted within the training.
- Structured conversations with nursery staff from all school sites and with senior leadership within the Academy. This aimed to establish what they perceived they were already doing to support speech and language development; how they identified children with speech and language needs; and how they supported children with identified speech and language needs.

The information gathered was then used to identify areas to cover in the training package. The project team then decided the structure of the training package collaboratively. This was:

a training day (training session one), to be attended by all staff working in the nursery classes (teachers and TAs); a further half day training session (training session two) for the same staff, to be delivered after one term for the staff to discuss how they were implementing the model in their settings, to share positive experiences and to support each other to troubleshoot any difficulties, to provide further information about supporting vocabulary development and understanding information carrying words (ICW). Throughout the project informal support from the RA was provided to facilitate the set-up of targeted groups and identification of children and to provide positive feedback about the implementation of strategies suggested in the training days.

The structure of the training and support within the project was such so that it corresponded with behaviour change theory (Davis, Campbell, Hildon, Hobbs, & Michie, 2015). The organisation of the training and support aimed to ensure that staff were given opportunities to develop their capability in the target areas; to ensure that they were provided with ample opportunities to put the specific strategies and ways of working in to practice and reflect on this; and to support their continued motivation to embed the model into their practice. Not only did the structure of the training and subsequent support aim to utilise the principles of behaviour change, it also drew heavily on the concept of social capital (Forbes, 2006; Forbes & McCartney, 2010; McKean et al., 2017)

Fidelity to the principles of the MTSS, the implementation of the universal tier strategies and the group interventions was supported by the design of the training and subsequent support for teachers and TAs. Although elements of the model were flexible in nature to support normalisation within each campus, it was also important that key principles were adhered to with a high level of fidelity across campuses. These key principles included:

- The level of support provided being responsive to children's needs and progress;
- That the universal tier of the model was an intervention and included additions/changes to their previous practice;
- The content of the targeted tier interventions;
- The importance of communication and liaison between professionals.

Supporting adherence to these key principles was something that was explicitly planned into the project and was approached utilising the concept of social capital (Forbes & McCartney,

2010; Halpern, 2005; McKean et al., 2017) and normalisation process theory (Murray et al., 2010).

Normalisation is “the process by which an intervention becomes so embedded into routine practice that it disappears from view” (Murray et al., 2010, page 2) and there are four suggested components to this process: coherence work (or sense-making); engagement; collective action to enable the intervention to happen; and reflexive monitoring (reflection). How best to build reciprocity and trust, how to understand and build upon the norms within the school and individual campuses and how to build productive relationships with the staff, key components of social capital, were all considered.

The KTPRA SLT was located within the school campuses for large portions of the working week. Much of the time prior to the delivery of the training was spent building relationships with staff across each of the campuses; learning about their priorities and pressures; helping out in the classrooms whilst observing existing practice and ensuring staff felt engaged and included in the development of the training and intervention. This process helped to create solid relationships and a shared understanding of the context; during this time a culture of trust and reciprocity developed and this provided a key foundation for the understanding of, acceptance and engagement in the implementation of the intervention. This presence then continued once the training had been delivered, to provide problem solving opportunities (reflexive monitoring, Murray et al., 2010), to keep the project and the intervention front and centre in people’s priorities, to informally model elements of the universal tier of the intervention and to maintain that vitally important feeling of trust and shared understanding.

2.6.5.1 Teacher and TA Training Sessions

Training session one was delivered as one full training day at the start of the academic year in September 2011, after two terms of the KTP. Training session two was delivered at the start of the Spring term in January 2012, after all staff had delivered the universal and targeted sessions for one term. Training was delivered by the KTPRA, local NHS SLTs and the KTP project lead; see Table 2.3 for details of the content. The senior leadership that resided over all of the Primary campuses of the Academy were also present (Executive Head and Deputy), though the leaders of each individual campus were not present. The training

Table 2.3 Outline of the content of the training sessions for classroom staff

Training Session One	Training Session Two
Overview of typical language development: what is 'language'?; overview of typical development; what do language difficulties look like?	*Feedback from each nursery:* how have the groups being going, recording progress, troubleshooting.
Communication friendly environments: to demonstrate the importance of physical and linguistic environments; supporting children who are struggling; stretching children who are typically developing; developing vocabulary in the environment; teacher talk	*Vocabulary recap*: enhancing the environment to support vocabulary developing; what recommendations have you put into place to support vocabulary; how do you choose specific vocabulary.
Identifying and supporting children with language difficulties: ways to identify children with language difficulties; when to refer to NHS SLT services; case examples; what to do in the meantime.	*Language steps*: recap information carrying words; discussion about any groups that have been running; thoughts about transferring this to the classroom.
Overview of typical speech development, identifying and supporting children with speech difficulties: sound production and typical error processes; links with phonological awareness; different types of speech difficulty; universal, targeted and specialist levels of support.	
The Speech Programme (outlined above) – content, skills targeted, tips for running the groups, when to refer to SLT.	

package was subsequently converted into an e-format with a workbook that new members of staff in the Early Years including Reception Class staff were encouraged to undertake after the completion of the project to ensure further embedding and normalisation of the new model of working. This was followed up with a contact session to discuss any queries, the interactive tasks and how to put some of the strategies into practice. Staff members who joined to teach nursery classes during the KTP were also asked to complete this.

2.7 KTP Outcome

At the end of the KTP project a final report was submitted to the school and to the Technology Strategy Board who administer the KTP programme. The project received a rating of 'Outstanding' from a panel of independent assessors appointed by the Technology Strategy Board and was considered a success by the Academy School. Subsequently, the Academy School employed a full-time SLT to continue with this higher level of input, extending the additional SLT support throughout the Primary Years. This model of intervention has been taken forward by the local NHS SLT service as the **N**ewcastle University-**N**orthumbria Healthcare NHS Foundation Trust **U**niversal, **T**argeted and **S**pecialist SLT service delivery model (NNUTS).

CHAPTER 3: A MULTI-TIERED SYSTEM OF SUPPORT IN PRACTICE; WHAT DOES THIS LOOK LIKE FOR CHILDREN IN NURSERY?

3.1 Introduction

Whilst tiered models are now seen as best practice (Bercow, 2008, 2018; Department for Education & Department of Health, 2015; Gascoigne, 2006) it is unclear how such models are implemented. In this chapter the **N**ewcastle University-**N**orthumbria Healthcare NHS Foundation Trust **U**niversal, **T**argeted and **S**pecialist SLT service delivery model (NNUTS) model is used as a case study to describe how children access tiers of intervention flexibly over time in a MTSS model implemented across a number of nursery settings.

The NNUTS model was implemented in an area of deprivation (Figure 2.2) and this has important implications for a multi-tiered system of support. As discussed in 1.3.3, there is a robust social gradient when it comes to language difficulties and this results in up to 50% of children in areas of social deprivation being identified as having language difficulties in their pre-school years (Law, McBean, & Rush, 2011; Law, Todd, Clark, Mroz, & Carr, 2013). Deprivation is also a predictor of speech sound disorders (Eadie et al., 2015) and thus in areas of social deprivation it would be expected that higher numbers of children are entering early education with speech sound disorders.

3.1.1 Considerations in areas of deprivation

The provision at each of the three tiers of a public health inspired MTSS may vary depending upon the granularity of the population – for example, what is considered a targeted tier approach at a local authority level, may in fact be implemented as universal provision in a setting in an area with high levels of deprivation. Living in an area with a high level of deprivation is known to increase children's risk of experiencing SLCN (Eadie et al., 2015; Law et al., 2011; Law, Todd, et al., 2013; Marmot, Allen, Boyce, Goldblatt, & Morrison, 2020; McKean et al., 2018; McKean, Reilly, et al., 2017) and up to 50% of children in these areas are entering school with SLCN.

It is important to consider whether business-as-usual classroom practices are sufficient to support children entering nursery with SLCN to develop their SLC skills and also whether they are supported to close the gap with their peers. Pre-school attendance has been shown to be particularly important for the language development of children from areas with higher levels of deprivation and from homes where mothers have attained lower levels of qualification

(Becker, 2011). Where children from deprived areas had attended pre-school, their expressive vocabulary development progressed at a rate commensurate to their less deprived peers, in comparison to those who had not attended pre-school. This indicates that pre-school attendance for these children was vital to prevent the vocabulary gap present on entry to nursery from widening further. Disappointingly, there was no evidence that children from more deprived backgrounds were able to begin to close this gap (Becker, 2011). This study did not explore specific characteristics of the early education classrooms and no overt focus on language development was described, therefore these findings could be considered representative of business-as-usual classroom practice. Considering the specific language supportive practice and instruction in the EY, studies find substantial variation in the quantity and quality of language support (Dockrell, Bakopoulou, Law, Spencer, & Lindsay, 2015; Dwyer & Harbaugh, 2020; Justice et al., 2008; Melhuish & Gardiner, 2017; Pelatti, Piasta, Justice, & O'Connell, 2014). There is evidence of the positive impacts of nursery attendance on language development, in comparison to no nursery attendance (Becker, 2011; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004) and more substantial improvement in classrooms where there are more language enriching strategies being utilised (Cabell et al., 2011; Justice et al., 2010; Piasta et al., 2012). It is clear that high quality communication supporting classrooms have the potential to support children's language development. However, what is also clear is that these characteristics are not necessarily present in all early year's classrooms.

At the level of the institution, i.e. an individual or group of schools, if up to 50% of children are entering school with SLCN and many others are considered at high risk of developing SLCN, it is important that universal provision is altered to meet those needs and could in fact be termed a targeted-selective intervention. This is the concept of proportionate universalism (Marmot, 2010), in that the scale and intensity of universal support should be proportionate to the level of disadvantage in order to help to close the gap between the most and least deprived within society. A number of studies have focused on implementing class-based interventions or curricula in areas of deprivation with varying results and are included in the evidence base discussion in section 3.1.3 (e.g. Snow et al., 2014; Wasik & Hindman, 2020; Xu, Chin, Reed, & Hutchinson, 2014; Zucker, Solari, Landry, & Swank, 2013).

3.1.2 Collaboration within an MTSS and the role of the SLT

The unfair distribution of SLCN across the population is an integral factor to the drive for public health approaches to support children to develop effective communication skills. Public health approaches to supporting SLCN are necessarily a multi-agency, multi-sector responsibility. Language learning is on-going throughout infancy into adulthood and occurs within the multiple contexts children experience on a day-to-day basis. This means that professionals working to promote better outcomes for children at the different life stages and within the different contexts should be able to work in a 'joined up' way to support language development for all. This means that success rides heavily on productive collaboration at national policy, local and institutional levels.

Historically, SLT services worked largely at the specialist tier of support, following a predominantly medical approach. After the inception of Sure Start in the late 1990s there was a shift in the UK and some SLT services began to extend their role to include some work at the targeted and universal tiers. This was further recognised in the RCSLT's position paper in 2006 (Gascoigne, 2006). Increasingly it has been recognised that SLTs have a valid contribution to make at each of the universal and targeted tiers, as well as the traditional involvement at the specialist tier (Bercow, 2018; Law, Reilly, et al., 2013). This could be at a meso-level within a school or at a wider, macro-level in terms of having a 'public health' remit in prevention and education (Law, Levickis, et al., 2017). The role of the SLT at the universal and targeted tiers could involve supporting the identification of need and implementation of interventions at the targeted level with a population identified as 'at risk' and the more traditional assessment and intervention at the specialist level with children with more significant and long lasting SLCN (Bercow, 2008; Gascoigne, 2012; Gross, 2008). This is not a universally held belief and there are some within the SLT profession that believe the role of the SLT should remain more firmly positioned within the targeted indicated and specialist tiers of the model (Ebbels, McCartney, Slonims, Dockrell, & Norbury, 2017).

It can be argued, however, that in order to maximise the impact for children with the most significant needs, there must be a culture of co-practice at each of the tiers of a preventative model, particularly in areas of deprivation where prevalence of SLCN is so high. There is evidence to suggest that teaching staff value the contribution of the SLT at all tiers of prevention (White & Spencer, 2018) and that they often feel that additional training and

support is required to adequately support and identify children with SLCN (Glover, McCormack, & Smith-Tamaray, 2015; Mroz, 2006). Working together more closely within the education environment would also support SLT knowledge of the curriculum, an area SLTs identified as an area for development (Glover, McCormack, & Smith-Tamaray, 2015). In order for successful collaboration it is important that professionals are able to build relationships in which social capital is high (Forbes & McCartney, 2010; Forbes et al., 2018; McKean, Law, et al., 2017) with a shared understanding of roles, reciprocal trust and shared values, such as having the child at the centre of the partnership. This social captial is important at all levels: the systems level, an organisational level and at the level of individual practitioners. Shared reposnsibility, with clearly delineated roles at each of the tiers of a MTSS for SLCN would support this.

In the following sections the evidence at each of the tiers of a MTSS in an education context will be outlined. Firstly, universal interventions; in this context these are whole class interventions, designed to support the language development of all children. Then targeted-selective interventions; interventions to support children who have certain characteristics which place them at higher risk of SLCN (e.g. low SES). Finally, evidence of targeted indicated interventions will be outlined. These are interventions for children who have been identified as having SLCN which aim to limit the impact and close the gap between them and their peers.

3.1.3 Evidence of effectiveness of universal and targeted-selective education-based SLT interventions

Interventions to support all learners in an early years classroom can either be characterised as universal interventions, or targeted-selective interventions depending upon the population being served and the motives behind the provision. As described above, where an intervention 'sits' within a public health framework for SLC development universal, targeted or specialist is likely to vary depending on the level at which the population in question is defined and the level of deprivation of the area. This section explores the evidence of the effects of whole-class interventions to support SLC development, paying particular attention to those implemented in areas of deprivation and with high-risk populations.

Whole-class interventions primarily focus on opportunities for language learning and the language environment. Part of the rationale for this is to compensate for a lack of exposure

to a rich and stimulating language environment often experienced by children from areas of deprivation. Early disparities in language skill that emerges for children from low SES households are, in part, hypothesised to be linked, at least in part, to exposure to a supportive language-learning environment, or the lack of. In their seminal study of child-directed speech in the homes of children from welfare, working class and professional families, Hart & Risley (1995; 2003) found that children from professional families were hearing more than three times the amount of words per hour than those within welfare households (2153 compared to 616). They also found differences in the type of language that children were exposed to, with children from those families receiving welfare hearing five affirmations to 11 prohibitions every hour in comparison to 32 affirmations and five prohibitions in the professional households. This higher frequency of directive language is a finding that has been replicated in other studies (Hoff, 2006). Other aspects of the home language environment, such as the availability of books and frequency of shared reading activities have been positively related to language development, and shown to be less readily available for/experienced by children in lower SES households (Ermisch, 2008; Taylor et al., 2013). It is important to note however, that although differences across deprivation levels emerge with regards to the home language environment, there is also variability within levels of deprivation. Such that many children living with social disadvantage experience language-rich home learning environments. Also we must note that inequalities in language environments and outcomes may in part be genetically determined (Dale, Tosto, Hayiou-Thomas, & Plomin, 2015). However environmental factors such as language rich home and pre-school environments are mutable to change and therefore ideal for targeting as part of public health approaches to supporting SLC development.

In order to implement these kinds of interventions teachers are typically provided with professional development (see Markussen-Brown et al. (2017) for a meta-analysis) and on some occasions, curricula to adhere to (Assel, Landry, Swank, & Gunnewig, 2007; Justice, Mashburn, Pence, & Wiggins, 2008; Justice et al., 2010; Wilcox, Gray, & Reiser, 2020).

When reviewing the evidence of effectiveness of these whole class interventions, there are indications that the quality and quantity of language that children are exposed to in in this context are important (Farrow, Wasik, & Hindman, 2020; Hoff, 2006; Rowe, 2012). Additionally, there is evidence to show that the responsiveness of adults in their interactions

with children is also important (Justice, Mashburn, Pence, & Wiggins, 2008; Piasta et al., 2012). Supporting early education staff to utilise communication enhancing interaction strategies is often a core component of professional development programmes. These interaction behaviours prove challenging to alter (Justice et al., 2008; Markussen-Brown et al., 2017), though there are some examples of increasing teacher's language enhancing strategy use during whole class and small group interactions (Cabell et al., 2011; Piasta et al., 2012). Environmental alterations to support speech and language development are also often core components of professional development; an area which is shown to be more malleable to change (Markussen-Brown et al., 2017). This is perhaps a reflection of the complexity of changing such engrained and individualised behaviours such as communication styles.

When evaluating class-based interventions that seek to facilitate change in the physical and linguistic environment in which the children are learning, it is important to evaluate changes to teaching practices and also the impact that these changes have on child language outcomes. It is largely assumed that if treatment fidelity is high and those who received the training implement the strategies they have been trained to use, then this will have a positive impact on child language development. There is however a relative paucity of evidence evaluating both educator and child outcomes following professional development for staff (Markussen-Brown et al., 2017). The prevailing evidence focuses on a variety of outcomes. A number of interventions effect improvements for children on measures of receptive vocabulary (Landry, Swank, Smith, Assel, & Gunnewig, 2006; Wasik & Hindman, 2011; Wilcox et al., 2020); expressive vocabulary (Bleses, Jensen, Slot, & Justice, 2020; Hadley, Dickinson, Hirsh-Pasek, Golinkoff, & Nesbitt, 2016; Justice et al., 2010; Landry, Anthony, Swank, & Monseque-Bailey, 2009; Landry, Swank, Anthony, & Assel, 2011; Landry et al., 2006; Piasta et al., 2012; Wilcox et al., 2020); comprehension (Assel et al., 2007; Landry et al., 2006; Snow et al., 2014); language use (Bleses et al., 2020; Girolametto, Weitzman, & Greenberg, 2003); syntactic complexity (Justice et al., 2010; Landry et al., 2011; Piasta et al., 2012) and phonological awareness (Assel et al., 2007; Girolametto, Weitzman, & Greenberg, 2012; Landry et al., 2011, 2006; Wasik & Hindman, 2011). Conversely, some evaluations find no significant effects on child language outcomes in comparison to a control group (Cabell et al., 2011; Justice, McGinty, Piasta, Kaderavek, & Fan, 2010; Nicolopoulou, Cortina, Ilgaz, Cates, & de Sá, 2015; Pollard-Durodola et al., 2011) and Wilcox et al. (2020) found no significant impact

of the intervention studied on phonological awareness skills. The studies above were a mixture of universal interventions (Assel et al., 2007; Bleses et al., 2020; Cabell et al., 2011; Girolametto et al., 2003, 2012; Hadley et al., 2016; Justice et al., 2010; Landry et al., 2009, 2011, 2006; Snow et al., 2014; Wasik & Hindman, 2011; Wilcox et al., 2020) and targeted-selective interventions (Justice et al., 2010; Nicolopoulou et al., 2015; Piasta et al., 2012; Pollard-Durodola et al., 2011). These studies were mostly based in areas of high levels of deprivation and could therefore be considered targeted-selective interventions. They were all delivered as whole class interventions and therefore could also be considered universal interventions. They were predominantly based in the US.

When delivered to a whole class an intervention is likely to be differentially effective for different children. There is a risk that when delivered to all children, an intervention can serve to benefit those with the highest initial language levels more than those with SLCN. This would result in a widening gap, often described as a 'Matthew Effect' in which effectively 'the rich get richer and the poor get poorer'. Although this is a notion that is often mentioned, there is conflicting evidence about the presence of such an effect. Studies exploring a Matthew Effect for language development have largely been conducted with older students than are the focus here (e.g. Luyten & Bruggencate, 2011). Bleses et al. (2020) measured SES by maternal education in their study of a low-cost teacher-implemented intervention to improve language and maths skills for toddlers (18-36 months). They found that children with the highest educated mothers benefitted the most from the intervention, showing improvement on all four of the measures (vocabulary, language use, math vocabulary and numeracy); children of mothers with low-mid and mid-high levels of education showed improvements on measures of vocabulary, mathematical vocabulary and numeracy; and children with mothers who had the lowest level of education only made significant gains in mathematical language and numeracy. Positively, this same study found that, at the school level, those schools with the lowest starting scores made the most progress. This kind of evidence resonates with the idea of proportionate universalism, in that those children presenting with wider risk factors appear to need their 'business as usual' to be somewhat enhanced to facilitate progress and to overcome barriers often associated with social determinants of health.

Speech clarity is rarely a focus of universal or targeted-indicated whole class support. This is perhaps due to a perception that fewer children present with difficulties that have a

significant impact on a child's functioning; or perceptions that intervening to support speech clarity is a more specialist area and thus these children are referred to SLT services. It could also be down to a lack of understanding of speech production and links to later outcomes, such as literacy development. Despite this, a number of studies focus on developing phonological awareness (PA) skills due to their explicit focus on early reading instruction. It could be hypothesised that whole class interventions focusing on PA will have beneficial effects for children presenting with some SSD, specifically phonological delay or consistent phonological disorder (Denne et al., 2005; Hesketh, Adams, Nightingale, & Hall, 2000; Smith, Downs, & Mogford-Bevan, 1998).

Similarly, there is a paucity of evidence focusing on whole-class interventions to specifically support the more social elements of communication such as verbal reasoning, inference and social skills. Interventions focusing on social communication tend to be more targeted at individuals or small groups, rather than delivered as whole-class interventions, (e.g. Adams et al. (2012).

3.1.4 The importance of supporting accurate and timely identification for support

An integral part of the universal tier of MTSS models within early education is the identification of those children who require additional support. To facilitate accurate and timely identification of children with emerging or established SLCN it is crucial that education staff have a solid understanding of typical early SLC development. One way to identify children requiring additional support is through the use of screening tools, however we know that elements of language development are particularly unstable in the early years; between two and four years of age (Reilly et al., 2010), between four and five years of age (Eadie et al., 2014; Zambrana, Pons, Eadie, & Ystrom, 2014) and between four and seven-ten years of age (McKean, Reilly, et al., 2017; Taylor et al., 2013; Zubrick, Taylor, & Christensen, 2015). This means that, should staff utilise a one-time screening tool to identify children for inclusion at the targeted tier of a MTSS, there is a risk that some children who would have followed an improving langauge trajectory (i.e. low-language at age 3 but resolved by age 5) would receive support unecessarily. Conversely, there is also a risk that children presenting with no apparent language difficulties at the point of the screen would follow a declining trajectory would be precluded from receiving necessary support. This is why the flexible nature of a MTSS and capitalising on classroom staff's detailed, holistic knowledge of children's functional

communication skills, are important. If staff can be supported to have the knowledge, confidence and tools to identify children who are having difficulty with SLC skills throughout the school year and the autonomy within a MTSS to flexibly allocate children to interventions as required, this can be a responsive way to support children's language development. This also enables the judicious allocation of resources and small-group intervention time to those children who need it, rather than those who, over time have progressed and will be well supported through the implementation of high-quality universal tier provision. More thorough, specialist assessment of children's SLC is vitally important for those children presenting with significant and/or persisting difficulties and this highlights the importance of the relationships between education and SLT professionals that enable frequent discussions and collaborative decision-making about those requiring more specialist support.

There is mixed evidence as to whether teaching staff are accurately able to identify children with SLCN. A number of studies have shown that teachers identify children with SLCN with some agreement with other, more standardised methods. For example, Early Years Foundation Stage Profile (EYFSP) data (a tool used by teachers in England to determine whether children are meeting age related expectations at the end of Reception year), indicated 18.4% of children were not meeting age-related expectations for their Communication, Language and Literacy skills in 2016 (Jimerson et al., 2016) which is comparable to prevalence estimates towards the higher end of the range generated from research studies. When exploring the sensitivity and specificity of agreement between teacher judgements of children who present with SLC difficulties which place them 'at risk' for later literacy difficulties, Williams (2006) found 86% sensitivity (true positives) and 68.2% specificity (true negatives). This estimate increased markedly when the youngest children in the sample were removed (Kindergarten – 5-6) indicating that it is perhaps more difficult for teachers to identify children in the earliest years of schooling. This increased difficulty identifying younger children presenting with language difficulties is mirrored in Seager & Abbot-Smith (2017) who found the EYFS communication measure to have just 40% sensitivity in identifying the same children with language difficulties as the PLS-4 (Zimmerman, 2009). Looking specifically at SSD and teacher agreement with the Diagnostic Evaluation of Articulation and Phonology (Dodd et al., 2006), agreement ranged between 63-80% (Harrison, McLeod, McAllister, & McCormack, 2017). For this study, the measure for teacher judgement

of SSD was a single question from the Parent Evaluation of Developmental Status Measure (Glascoe, 2000), asking 'Do you have any concerns about how your/this child talks and makes speech sounds?'.

This evidence indicates that teachers are perhaps likely to over-estimate the number of children with language difficulties in comparison with standardised language assessments and underestimate the number of children with SSD. In order to decide which children are presenting with SLCN teachers synthesise the wide range of knowledge they have about the child and their functional communication skills, as well as any more formalised data they may have gathered (Williams, 2006). There are a number of tools available for education staff designed to support them to identify children requiring additional support, often linked with targeted interventions (ICAN, 2016), government initiatives (DCSF, 2008a, 2008b) or local services (Northumberland Care Trust & Northumberland County Council, 2009). The use of data and knowledge of the child's functional communication skills aligns with the more holistic view of SLCN embraced widely by SLTs and based on the International Classification of Functioning (WHO, 2001). This framework not only considers the child's impairment but also their ability to engage in everyday activities, their personal well-being and the settings and partners they engage. This more holistic view could explain the possible over (language) and under (SSD) identification of children with SLCN by teachers. Children with language skills that fall marginally past the arbitrary standard score cut off for language difficulties may present with functional difficulties utilising their language skills in the demanding classroom and social environment. On the other hand, some children with SSD may be very adept at communicating successfully despite their speech clarity not being age appropriate. Despite this evidence indicating teachers are adept at identifying SLCN, there is additional evidence that indicates teachers feel under-confident, or desire additional training in the area of SLC development and SLCN identification (Mroz, 2006; Williams, 2006). This reinforces the important role for the SLT to foster this knowledge and confidence within the teaching profession and to empower teaching staff to ensure the most positive outcomes for children in MTSS.

Evaluations of early years-based interventions to support SLC development are varied in terms of how children are identified for inclusion. In some studies identification is researcher led (Fricke, Bowyer-Crane, Haley, Hulme, & Snowling, 2013; Haley, Hulme, Bowyer-Crane,

Snowling, & Fricke, 2016) and in some identification is teacher led (Hutchinson & Clegg, 2011; Reeves et al., 2018; Zucker et al., 2013). It is important to evaluate interventions both with tightly controlled participant identification and then to extend evaluation and increase ecological validity by evaluating the same intervention when teachers identify participants, thus representing real world application. It is important in terms of representing effectiveness, but also in acknowledging the importance of the role of teaching staff and empowering them within the process.

The current evidence for a range of whole class interventions paints a complex picture. On the face of it, it seems that this tier encompasses interventions delivered by teaching staff for nursery/school aged children and therefore is relatively 'light-touch' for SLT services. However, the evidence presented shows a very different picture. Supporting staff to make changes to their practice requires significant investment in time. Further research is needed to explore the most effective ways to facilitate and maintain changes, particularly when attempting to change interaction styles and strategies. The variable evidence of resultant improvements in children's language skills also highlights the need for further exploration of the mechanisms that facilitate language development and how these can be manipulated to produce desired results, building on existing studies such as McKean et al. (2015).

3.1.5 Evidence of effectiveness of education-based targeted-indicated interventions

As discussed above, some targeted-selective interventions are delivered as whole-class interventions. Targeted-indicated interventions are typically delivered for small groups of children with identified SLCN; as are some targeted-selective interventions. Evidence shows that these small group interventions focused on developing SLC skills can be effective in supporting improvements in a range of different areas. Receptive and expressive vocabulary knowledge are the most widely reported positive outcomes; some studies showing improvements on standardised measures (Gallagher & Chiat, 2009; Haley et al., 2016; Lonigan, Purpura, Wilson, Walker, & Clancy-Menchetti, 2013; Sibieta, Kotecha, & Skipp, 2016; Van Kleeck, Vander Woude, & Hammett, 2006), others solely show a positive impact for vocabulary knowledge for the specific items addressed in the intervention (Motsch & Ulrich, 2012). There are also interventions that have been shown to have positive impacts on language comprehension and overall language scores in comparison to controls (Dimova et al., 2020; Fricke et al., 2013; Gallagher & Chiat, 2009; Reeves et al., 2018; Sibieta et al., 2016);

as well as narrative and spoken language skills (Fricke et al., 2013; Lee & Pring, 2016; Reeves et al., 2018; Spencer, Peterson, & Adams, 2015). Phonological awareness has also been targeted with some success (Fricke et al., 2013; Koutsoftas, Harmon, & Gray, 2009; Lonigan et al., 2013; O'Connor, Bocian, Beebe-Frankenberger, & Linklater, 2010).

Of the studies stated above, some of the interventions are delivered by the authors, 'interventionists' or part of the research team (Lonigan et al., 2013; Spencer et al., 2015; Van Kleeck et al., 2006) meaning the results, though positive, may not be representative of real-life implementation. Other studies evaluate the impact of manualised interventions that setting staff were trained and supported to administer, such as Talk Boost (Lee & Pring, 2016), Early Talk Boost (Reeves et al., 2018) and the Nuffield Early Language Intervention (NELI) (Dimova et al., 2020; Fricke et al., 2013; Haley et al., 2016; Sibieta et al., 2016). These UK based studies are more closely aligned with everyday practice and therefore results are more likely to be representative of what may be expected in a real-life setting. The NELI, in particular, has undergone rigorous evaluation, initially as pilot studies (Fricke et al., 2013; Haley et al., 2016), then up-scaled to an efficacy study comparing the two piloted versions (30 week and 20 week)(Sibieta et al., 2016) and most recently an effectiveness trial (Dimova et al., 2020). Both the efficacy and effectiveness studies were funded through the Education Endowment Fund (EEF), which has a specific focus on breaking the link between poverty and poor educational outcomes. Both large-scale studies were conducted in schools with high free school meal (FSM) eligibility, however when analysing the results Sibieta et al. (2016) found that the intervention was much less effective for the children included who were in receipt of FSM. In the following effectiveness study (Dimova et al., 2020) this was not explored due to limited data, though subsequent analysis is planned. This is an interesting finding and perhaps has implications for how children are identified for inclusion in the group intervention, or what additional support needs to be considered for those children with multiple risk factors, such as low language and FSM status.

3.1.6 Evaluations of multi-tiered SLC interventions in education

It is crucial that individual interventions and approaches are evaluated in isolation to explore viability, effectiveness and efficacy. What is also important, but under-researched, is how these interventions and approaches interface within a multi-tiered system of support. As discussed in Chapter 1, MTSS for SLT services are widely advocated, as well as a graduated

approach within schools to support SLCN. It is recognised that multiple approaches and interventions are likely to be more effective than a single approach (EEF, 2016), however there is little evidence to empirically support this assumption.

The examples of studies exploring multiple tiers of a tiered MTSS within the early years are largely motivated by minimising risk for/ameliorating early literacy difficulties and emanate from the US (Loftus, Coyne, McCoach, Zipoli, & Pullen, 2010; Pullen, Tuckwiller, Konold, Maynard, & Coyne, 2010; Schuele et al., 2008; Zucker et al., 2013). These studies either had vocabulary knowledge or phonological awareness as the target area and success was variable. There is evidence that supplemental targeted level interventions support improved word learning for children with identified vocabulary difficulties in comparison to whole-class universal interventions (Loftus et al., 2010; Pullen et al., 2010; Zucker et al., 2013). The positive impacts tended to be isolated to targeted vocabulary and children's understanding of this vocabulary and improvements were not always maintained at delayed post-test (Pullen et al., 2010).

Moving away from peer-reviewed literature, a report from the Stoke Speaks Out programme provides descriptive evidence from a local authority-wide approach to supporting SLC development in an area of social deprivation and high levels of SLCN (MWB Consultancy Ltd, 2006). Using a locally designed screening measure, they showed reductions of children identified as 'amber' or 'red' on the screen, indicating 'at risk' and 'significant needs' respectively, over a ten-month period. Settings (including nurseries, school nurseries, school reception classes) benefitted from training and support from the School Ready Team at the universal tier. At the targeted tier there was a suite of progressive, targeted interventions that could be used, which were delivered with 27% of children (not including children on the SLT caseload). Their data showed that this tiered approach was supporting children with English as an Additional Language to close the gap with their monolingual peers. For children in receipt of Pupil Premium (allocated funding from the government aimed to support children eligible for free school meals) and those in receipt of 2-year-old funding (government childcare funding to support low-income parents to stay in work) there was no evidence of the gap between them and their peers closing, though they did appear to make commensurate progress, thus the gap was not widening. The evaluation for this study was purely a comparison of percentages scoring within each of categories identified by the

screening tool ('on track', 'at risk', 'significant needs') at baseline and follow-up ten months later. Claims of gaps closing 'significantly' and 'strong correlations' are made within the report, however no statistical analyses were conducted to come to these conclusions. There is little detail included about the research design and therefore it is unclear whether there are issues with blinding or selective reporting that could result in biased interpretations of the results. There is also limited information about fidelity to the interventions conducted, though this is acknowledged within the report.

There are no peer-reviewed, UK-based studies that explore the implementation and impact of a whole three-tiered system of support within an education setting. It is important to consider how interventions and approaches work in combination, within a system of support, particularly when attempting to address the language gap for children from areas of high deprivation. For approaches found to have efficacy in research contexts to be implemented in such a way so to be effective in the real-world additional research is needed. Exploring the acceptability with teaching staff, how children move through the tiers of the intervention and how allocation to the tiers work in practice all contribute to the overall effectiveness of interventions to support children's SLC development. When a new, targeted level intervention is implemented in a school, it is likely that this will run alongside existing interventions, or approaches, therefore evaluating the impact when 'in situ' and delivered in a less controlled manner is an important next step in the evaluation process. As well as the need to describe and evaluate the impact of MTSS for children with SLCN, it is therefore also important to explore what access to a MTSS looks like over time for children with SLCN.

3.1.7 Further consideration of the importance of supporting accurate and timely identification for support

Speech, language and communication are complex as individual skills, made increasingly so by their interpersonal nature. Children utilise their communication skills in interactions with others and therefore their communicative success is not solely a function of their underlying ability. In certain contexts, and with familiar, responsive communication partners, children with SLCN can function well. This can change if cognitive demands are increased, causing a cognitive overload and therefore difficulties have more immediate impact (Bishop, 1994). This cognitive overload could be due to changes in compensatory strategies in the environment such as the removal of visual supports, an increase in background noise, an

increased pace of lesson or a less skilled communication partner unable to scaffold the child's contributions to the interaction. Children who were perceived to be communicating well and not presenting with notable SLCN, as they get older can begin to struggle more overtly as demands, such as teacher expectations for more complex language and reasoning increase. Additionally, children who manage well in structured situations can find it more challenging in less structured contexts, or social situations, when they have only a surface knowledge of certain vocabulary and language structures. These fluctuations in how well children appear to be coping in terms of the language and communication demands within the classroom, have implications for which children are likely to be identified as requiring additional support and when.

It is also known that language development is characterised by significant instability in the early years. Some children are identified as late talkers but exhibit typical skills by age four, whereas some children who are deemed to be developing language typically at age two are presenting with language difficulties by age four (Dale, Price, Bishop, & Plomin, 2003; Ukoumunne et al., 2011). There is also a similar picture of changing profiles between age four and five; Eadie et al. (2014) found that 36% of five-year olds identified with language difficulties were classified as having typically developing language skills at age four. These studies used a range of methods to identify whether children were classified as presenting with language difficulties or typically developing language. Dale et al. (2003) used parent reported measures of vocabulary, grammar and use of abstract language; Eadie et al. (2014) utilised the core language score from the Clinical Evaluation of Language Fundamentals – Pre-School 2 (Wiig, Secord, & Semel, 2006) and Ukoummunne et al. (2011) used the Communication and Symbolic Behaviour Scales – Infant Toddler Checklist (Wetherby & Prizard, 2002) at eight and 12 months, sections of the MacArthur Bates CDI (Fenson, Dale, & Reznick, 1993) at 24 and 36 months and the core language score of the CELF-PS2 (Wiig, Secord, & Semel, 2006) at age four. The fact that this unpredictability is seen across measures shows that language development generally during this period is highly variable, not just specific components such as vocabulary. This changing profile of whether children are identified as being typically developing or presenting with language difficulties is thought to be due to individual variation over time, the use of arbitrary cut-points to define 'caseness'

and limitations in measures used (Eadie et al., 2014). What this changing profile of need looks like in practice, and implications of this on how support is structured, is under-explored.

Addressing the paucity of research of these MTSS is vital in beginning to develop understanding about how these systems work in practice, The Education Endowment Foundation (EEF) states, "Combining a range of communication and language approaches is likely to be more effective than a single approach." Logically, this seems like it would be true, however there is little empirical evidence to back up this assumption. Many questions are yet to be tested empirically. For example: does accessing multiple approaches and interventions within a MTSS result in a cumulative effect for these children, whether they are experiencing speech, language or social communication difficulties? Do strategies and approaches, consistently implemented at the universal tier of an intervention boost the impact of supplemental, targeted interventions and therefore?

In Chapter 4 the overall effects of the MTSS and the effects of inclusion at the different tiers of support are evaluated. Here the focus is on describing the real pathways that children take through the MTSS and the profiles of children accessing the different elements of the intervention. This real-life description of the intervention delivery and the different profiles of need within this, provide a foundation for understanding the mechanisms of action of the MTSS on a population as a whole.

3.2 Research questions and hypotheses

The following sections provide an exploratory analysis of the tiers of support that children access during their nursery year, whether and how they change over time (i.e. pathways through the tiers) and whether there are common profiles of need within these pathways.

3.2.1 Research questions

With respect to an MTSS supported by an SLT embedded within early years settings serving communities in a coastal region of England with high levels of deprivation:

1. What is the prevalence of SLCN on entry to nursery?
2. What is the nature of the support pathways delivered?
    a. What pathways do participants take?
    b. What are the characteristics of participants in each of the pathways with respect to their pattern of speech, language and communication needs?

c. How do participants in each of the pathways differ in terms of their speech and language skills?

3.2.2 Pathway Predictions (hypotheses)

Predictions were made using theoretical knowledge of language development and influencing factors discussed above, as well as drawing on local expertise about how children presented and progressed in terms of their language skills in this area. The following four pathways were predicted (see Figure 3.1):

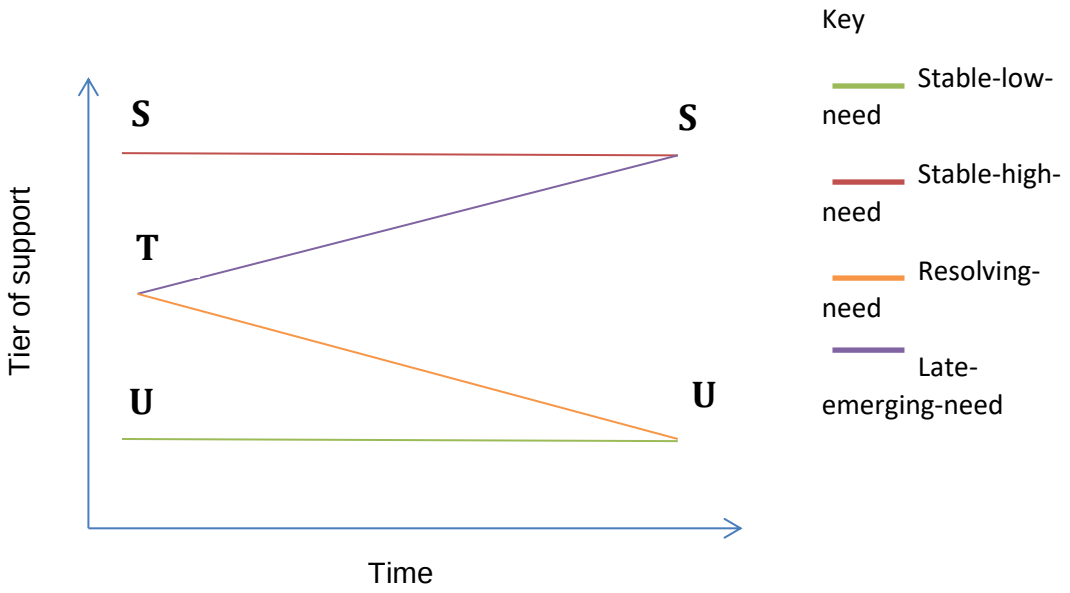

Figure 3.1 Graphic representation of the pathways children are predicted to follow through the multi-tiered system of support. U = universal, T = targeted, S = specialist

1. **Stable-low-need:** It is hypothesised that there will be a group of children who have speech and/or language skills that are age appropriate, or staff think can be supported through the universal tier of provision. It is not expected that all these children will be presenting with age appropriate skills. Prior knowledge of the population indicated that there are a large number of children entering nursery with SLCN, as expected in an area with such high levels of deprivation. The expectation is that being immersed in the language rich environment of the universal tier of support will support their SLC

development adequately so they will not need further intervention to develop appropriate speech and language skills.

2. **Stable-high-need:** It is hypothesised that there will be a group of children who enter nursery with significant SLCN that has already been identified prior to commencing nursery. These children will already have been referred for external support from the local NHS department and therefore will be accessing the specialist tier of provision upon entry to nursery. These children are expected to have the most impactful difficulties, namely a multi-deficit profile with difficulties in a number of the domains assessed. It is hypothesised that this profile will be associated with more long-standing difficulties and require long-term access to SLT specialist services.

3. **Resolving-need:** It is hypothesised that there will be children who enter nursery with speech difficulties that, once accessing the enhanced universal intervention and targeted interventions focusing on developing phonological awareness skills, will improve over time. It is also hypothesised that there will be children who enter nursery with a level of language delay that requires a higher level of support than simply being exposed to the universal tier of intervention. The expectation is that they will make progress in response to the cumulative intervention at the universal and the targeted tiers of provision within the MTSS. This group of children is expected to be large due to many children historically entering the nurseries with difficulties resulting in referral who appeared to progress rapidly once in this enhanced environment. It is hypothesised that with this new model of working in place, these children will cease to require referral to external services and thus mean that the specialist services are then able to be more effectively used to address the needs of those children with less transient difficulties with speech and language.

4. **Late-emerging need:** It is hypothesised that there will be another group of children who enter nursery with some level of SLCN who will react differently (when compared to the children in pathways one and three) to being exposed to the universal and targeted tiers of the MTSS. It is predicted that there will be a group of

children who do not progress rapidly despite being immersed in a rich language environment and receiving targeted support. It is this difference in response to the intervention that is expected to differentiate children with more long-standing speech and/or language difficulties from those with a more transient delay.

3.3 Methodology

3.3.1 Participants

A sub-cohort of participants was chosen to address the above research questions as they were solely within the experimental condition throughout their time in the study. This sub-sample included ninety-one participants (n=53 girls, n=38 boys). These participants were from cohort four (N = 97): those entering the study in September 2011. Six participants from the cohort were not included in the analysis due to leaving the study before completion.

On entry to the study the participant's mean age was 39 months (sd. 1.67) and ranged from 36 – 44 months. The range of the participants' total deprivation statistics was 1138-29815 compared to a national range of 1-32,844 (Ministry of Housing Communities & Local Government, 2019); the median was 1643 and the standard deviation 7648.60. **Error! Reference source not found.** shows the distribution of the cohort's total deprivation statistics as measured by the decile rankings across the English population.

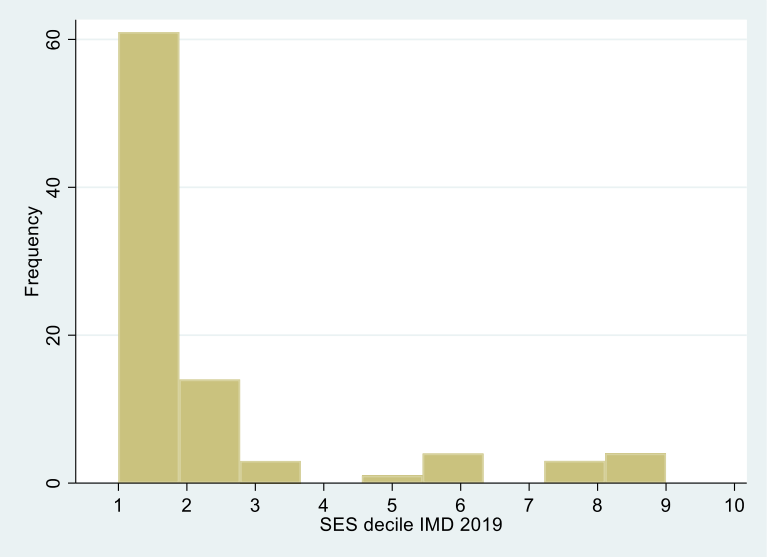

Figure 3.2 Histogram of sub-cohort of participants' SES decile distribution. Total deprivation statistics (https://imd-by-postcode.opendatacommunities.org/) were used to gain the socioeconomic rankings of the postcodes

3.3.2 Assessments

Detailed information about the assessments used in the entire project is outlined in Table 2.2. Assessment data used in the analyses for these research questions include:

- **The British Picture Vocabulary Scale (BPVS 3)** (Dunn & Dunn, 2009)
- **Early Repetition Battery (ERB) Sentence Repetition** (Seeff-Gabriel et al., 2008)
- **Derbyshire Rapid Screening Test** (Knowles & Masidlover, 1987)
- **Diagnostic Evaluation of Articulation and Phonology (DEAP) Diagnostic Screen Matters** (Dodd et al., 2006)
- **EYFS Development Matters** (Department for Children, Schools and Families, 2008)

Participants were assessed on four occasions using the speech and language assessments (**Error! Reference source not found.**). EYFS data was available for three occasions (baseline in September 2011, January 2012 and April 2012). In this section 'assessment point 1' refers to September 2011, 'assessment point 2' to January 2012, 'assessment point 3' to April 2012 and 'assessment point 4' to September 2012.

Data from the speech and language assessments were coded at each assessment occasion to identify those participants whose performance indicated an increased risk for/the presence of SLC difficulties. This information was used to explore how those identified as at risk for SLC difficulties were represented at each of the tiers of the NNUTS MTSS model and how the

levels of identified risk changed over time. The cut-points used to identify which participants were classed as ‘at risk’ are described in Table 3.1.

Table 3.1 Cut points for determining participants' risk status for speech, language and communication difficulties

Assessment	'At risk' cut point				Rationale
	A1	A2	A3	A4	
BPVS SS	<1s.d. below the mean				A cut point of greater than one standard deviation below the mean was used in order to ensure children who were not presenting with clinically significant language difficulties, but were struggling with language in relation to typically developing peers were included in the 'at risk' category.
ERB SS	<1s.d. below the mean				
RST RS	<15		<18		At A1 and A2 the cut off indicates three ICW understanding not emerging between 36-48months; at A3 and A4 the cut off indicates four ICW understanding not emerging at age four.
Speech	Further assessment indicated				A further assessment is indicated when a child's expressive phonology is characterised by errors that indicate delayed or disordered phonology, or an articulation disorder.
CLL	<CA band				If children are not performing at age expected levels in the EYFS areas, this indicates that they are experiencing some level of difficulty with their language/communication.
PSED	<CA band				

Note. A = assessment point; BPVS = British Picture Vocabulary Scale 3; ERB = Early Repetition Battery sentence repetition; SS = standard score; RST = Derbyshire Rapid Screening Test; RS = raw score; ICW = information carrying words; CLL = Communication, Language and Literacy strand of the Early Years Foundation Stage; PSED = Personal, Social and Emotional Development strand of the Early Years Foundation Stage; CA = chronological age.

3.3.3 MTSS data

The tier of support within the NNUTS model that the participants accessed was recorded at each assessment occasion; this could have been 'universal', 'targeted' or 'specialist'. Participants were allocated to the tiers by the classroom staff and their allocation at each tier was flexible over time in order to be responsive to their presentation 2.6.4. The number of terms completed in the experimental condition was also recorded at each assessment occasion.

3.3.4 Data Analysis

3.3.4.1 Testing normal distribution

Prior to grouping participants based on the pathways they took through the multi-tiered intervention the SLC assessment and demographic variables of interest were tested to establish whether they had a normal distribution. These were age, SES, BPVS raw scores, BPVS standard scores, ERB raw scores, ERB standard scores and RST. This was completed in order to ascertain whether parametric or non-parametric statistical analyses should be conducted when exploring differences between groups of participants. This was established by exploring measures of kurtosis, skewness, the similarity between the mean and median and histograms to visually analyse the distribution, all completed using Excel. Both the raw and standard scores of the BPVS and ERB were examined due to a number of participants not achieving the lowest raw score required to reach the lowest standard score presented in the manuals. This meant that a focus only on standard scores risked losing data and/or losing sensitivity with regards to important characteristics associated with the lowest scoring children: a group of particular interest here (**Error! Reference source not found.**).

Table 3.2 Percentage of participants who completed the BPVS and ERB assessments who did not reach the standardisation threshold at each assessment point in cohort four (N=97)

Assessment	Assessment point (n)			
	1	2	3	4
BPVS	18.82 (16)	3.45 (3)	0 (0)	0 (0)
ERB	20.29 (14)	10.34 (6)	2.86 (2)	3.75 (3)

Note: BPVS = British Picture Vocabulary Scale (3rd Edition); ERB = Early Repetition Battery sentence repetition assessment; SLN = Stable-low-needs; CN = Changing-needs; SHN = Stable-high-needs. N = 97. Missing data are due to time constraints, absence or refusal

3.3.4.2 RQ1: What is the prevalence of SLCN on entry to nursery?

The ID codes of participants judged 'at risk' on each of the speech and language measures at assessment point one was tabulated. These were then visually analysed in order to identify the number of unique ID numbers judged at risk on any one of the measures. This total was then used to calculate the percentage of children with SLCN on entry to nursery.

3.3.4.3 RQ 2a: What pathways do participants take?

The data were visually analysed to establish the unique pathways through universal, targeted and/or specialist interventions that the participants were allocated to over the four assessment points and the frequency of each of these. These combinations or pathways through the multi-tiered intervention were then grouped depending on the trend that they showed. For example, a stable trend within one tier, a trend for requiring increasing support over time, or a trend for requiring reducing support over time.

To ensure that distinct groups had been identified, analyses were completed to assess if there were significant differences between the groups for at least one of the variables (age, gender, SES, BPVS SS, BPVS RS, ERB SS, ERB RS, RST, Speech). Chi squared analysis was used to explore gender differences across the groups as the independent variable of 'group' has five, unordered, unrelated conditions (each group contains different participants) and the dependent variable of gender is categorical. Kruskal Wallis analysis was used to explore difference in age, SES, BPVS, ERB, RST and speech performance due to the dependent variables being rankable. This analysis was conducted in STATA v15 (StataCorp, 2017). These comparisons resulted in the identification of grouped pathways that were significantly

distinct from one another; these grouped pathways were then used as a basis for exploring the characteristics of participants accessing the MTSS in different ways.

3.3.4.4 RQ2b: What are the characteristics of the participants in each of the pathways with respect to their speech, language and communication needs?

For each grouped pathway participants performance over time on each assessment were visualised. The mean standard scores on the ERB and BPVS at each assessment point were plotted on a line graph with a super-imposed population mean line for comparison. The mean RST scores at each assessment point were plotted on a line graph with a super-imposed line indicating the ceiling score. The percentage of participants presenting with a difficulty, without a difficulty and who were not assessed on the DEAP screen were collated into a stacked bar chart. These were presented in the following order: DEAP screen, ERB, BPVS, RST. The rationale for this is linked to the hypothesis that language disorder is a unitary disorder in which different elements of language are differentially vulnerable to impairment; expressive phonology being the most vulnerable (and therefore the area in which we would expect to see the highest prevalence of difficulty), followed by syntax and morphology, semantics and finally receptive language (Bishop, 1987). Presenting the data in this way for each grouped pathway enabled a comparison of the characteristics of participants and their performance over time.

Proportions of the participants who completed assessments deemed 'at risk' at each assessment point was also graphically displayed in clustered bar charts. In order to identify children who were 'at risk' of SLCN thresholds were identified for each assessment and these are outlined in Table 3.1. At each assessment point there is missing data and the data were missing for one of the following reasons: time constraints meaning not all assessments were completed in the time frame, absence, or refusal. Specific reasons for each individual were not recorded.

3.3.4.5 RQ2c: How do participants in each of the pathways differ in terms of their speech and language skills?

Where the Kruskal Wallis analysis used to establish distinct groups in RQ1 identified a significant difference between the groups, a further Dunn's test with Bonferroni corrections was used to establish which groups were significantly different to each other. This analysis was conducted in STATA v15 (StataCorp, 2017). The proportions of each group who did not

meet the standardisation threshold (i.e. completed the assessment but their raw score was too low to achieve the lowest standard score in the assessment manual) for the BPVS and ERB were graphically presented for comparison over time. This enabled a comparison of the proportion of children with the most significant difficulties with receptive vocabulary and sentence repetition within each grouped pathway over time.

3.4 Results

3.4.1 Testing normal distribution

The mean, median, skewness and kurtosis statistics for the BPVS, ERB, RST and SES data at assessment point one are displayed in Table 3.3. The kurtosis figures for the RST and SES in indicate that these variables are not normally distributed and non-parametric tests should be used for further exploration.

As the skewness and kurtosis statistics indicated that the BPVS and ERB data was normally distributed (Table 3.3). It was deemed appropriate to visually explore the data to clarify these findings. The normal distribution of the BPVS standard scores and raw scores and of the ERB standard scores and raw scores were therefore further explored by examining histograms of the data (Figure 3.2, Figure 3.3, Figure 3.4, Figure 3.5, Figure 3.6). Each of these indicates that the data are negatively skewed and not normally distributed; further analysis using these variables will be conducted using non-parametric statistics to account for this.

Table 3.3 Descriptive statistics exploring the normal distribution of the BPVS, ERB, RST and SES data at assessment point 3 (cohort four entry point)

	BPVS		ERB			
Measure	RS (n = 80)	SS (n = 66)	RS (n = 66)	SS (n = 53)	RST (n = 81)	SES[a] (n = 87)
Mean	32.8	87.4	5.6	88.8	17.8	6039.8
Median	30.5	87	3.5	86	18.0	3822.0
Kurtosis	0.1	0.6	-0.0	0.7	2.4	3.9
Skewness	0.5	0.8	1.0	0.8	-1.3	2.2

Note. BPVS = British Picture Vocabulary Scale; ERB = Early Repetition Battery Sentence repetition; RST = Rapid Screening Test; SES = socio-economic status; RS = raw score; SS = standard score. N=91.

[a]SES measured using total deprivation statistics (http://imd-by-postcode.opendatacommunities.org/)

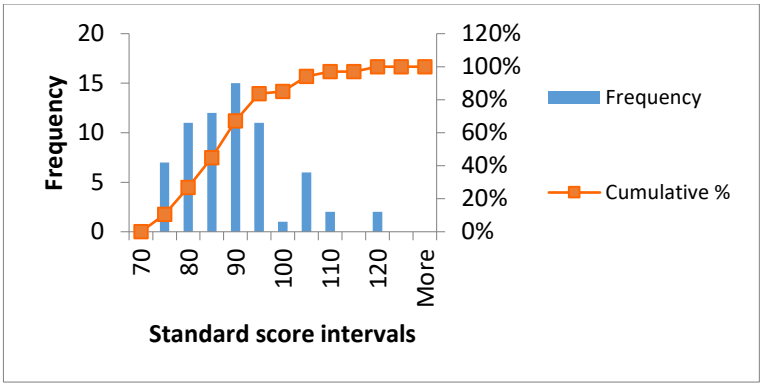

Figure 3.3 Histogram to explore the distribution of British Picture Vocabulary Scale 3 standard scores at assessment point 1

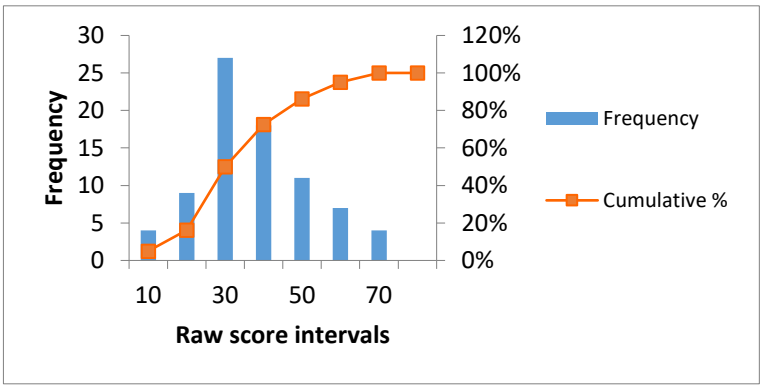

Figure 3.4 Histogram to explore British Picture Vocabulary Scale raw scores at assessment period 1

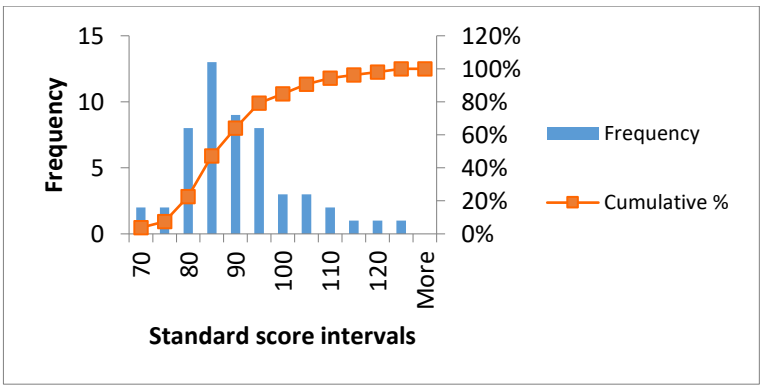

Figure 3.5 Histogram to explore the distribution of Early Repetition Battery Sentence Repetition standard scores at assessment point 1

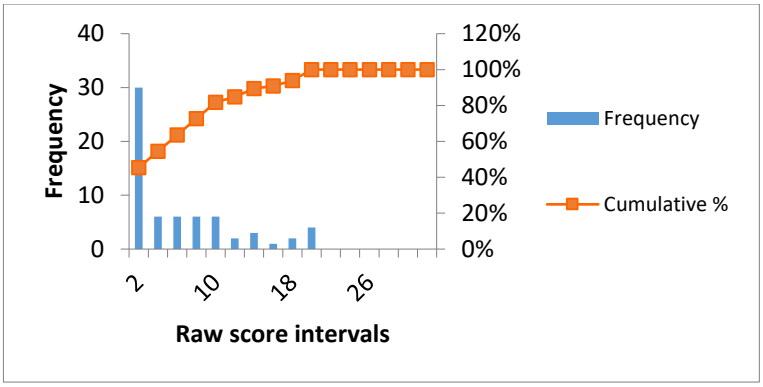

Figure 3.6 Histogram to explore the distribution of Early Repetition Battery Sentence Repetition raw scores at assessment point 1

3.4.2 RQ1: What is the prevalence of SLCN on entry to nursery?

The percentage of participants deemed 'at risk' of SLCN within each group is shown in **Figure 3.14**, **Figure 3.19** and **Figure 3.24**. Figure 3.7 shows the percentage of children identified as 'at risk' as part of the whole cohort at each assessment point. The data was further interrogated to identify the prevalence of language difficulties on entry to nursery. To do this each ID code identified as 'at risk' on the BPVS, ERB and RST were recorded and a prevalence estimate derived by dividing the number of unique ID codes by 91 (cohort size when leavers removed, see 3.3.1). This resulted in a prevalence estimate of 56% - 51 of the 91 participants entering nursery were identified as 'at risk' on at least one of the language measures.

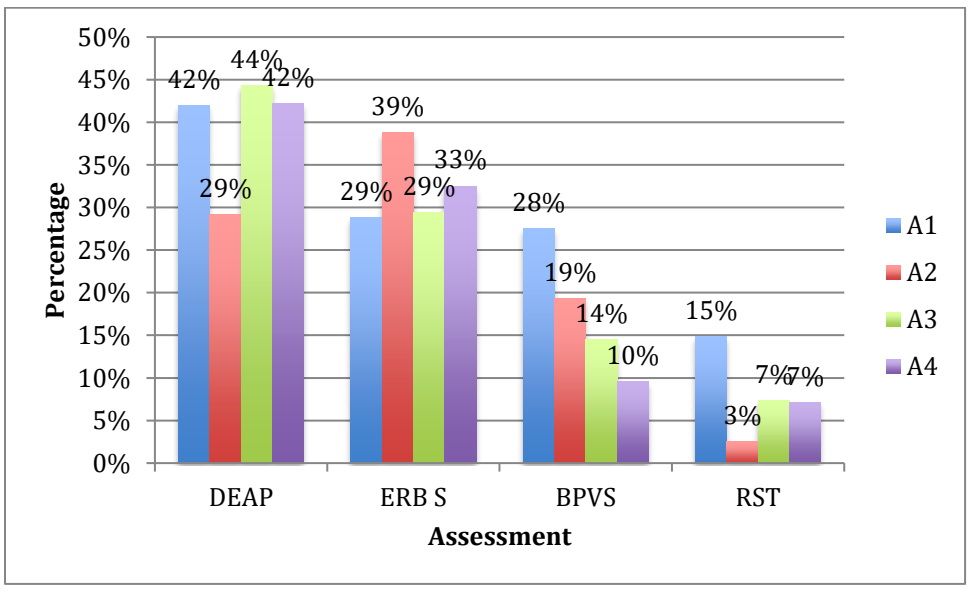

Figure 3.7 Percentage of participants deemed 'at risk' at each assessment point. ERB = Early Repetition Battery sentence repetition. BPVS = British Picture Vocabulary Scale 3. DEAP = Diagnostic Evaluation

of Articulation and Phonology. RST = Derbyshire Rapid Screening Test. Participants scores were deemed 'at risk' if they were more than 1s.d. below the mean on the ERB and the BPVS, if a further assessment was indicated on the DEAP screen for speech, if the score was less than 15 at assessment points 1 and 2 or below 18 at assessment points 3 and 4 on the RST.

3.4.3 RQ2a: What pathways do participants take?

Each of the unique pathways followed by participants in this cohort were identified. These are shown in Figure 3.8. There were 15 different pathways that participants followed; trends across these pathways were established and five overarching grouped pathways were formed. Table 3.4 outlines how these pathways were grouped by trend. Figure 3.9Figure 3.10 shows the proportions of participants within each grouped pathway.

These groups were than analysed using Chi Squared, Kruskal Wallis and Dunn's tests (as described above) to establish whether the groups were significantly different from each other on any of the assessment measures. Following this analysis, it became clear that the Resolving Needs, Late Emerging Needs and Fluctuating Needs groups did not differ significantly from each other at any of the time points, on any of the measures (Appendix A - Table A1, Table A2, Table A3, Table A4, Table A5, Table A6, Table A7). This resulted in the amalgamation of these groups to form a group called 'Changing Needs' (Figure 3.10). These three distinct pathways were then explored to look at the characteristics of children in each pathway and how they differed.

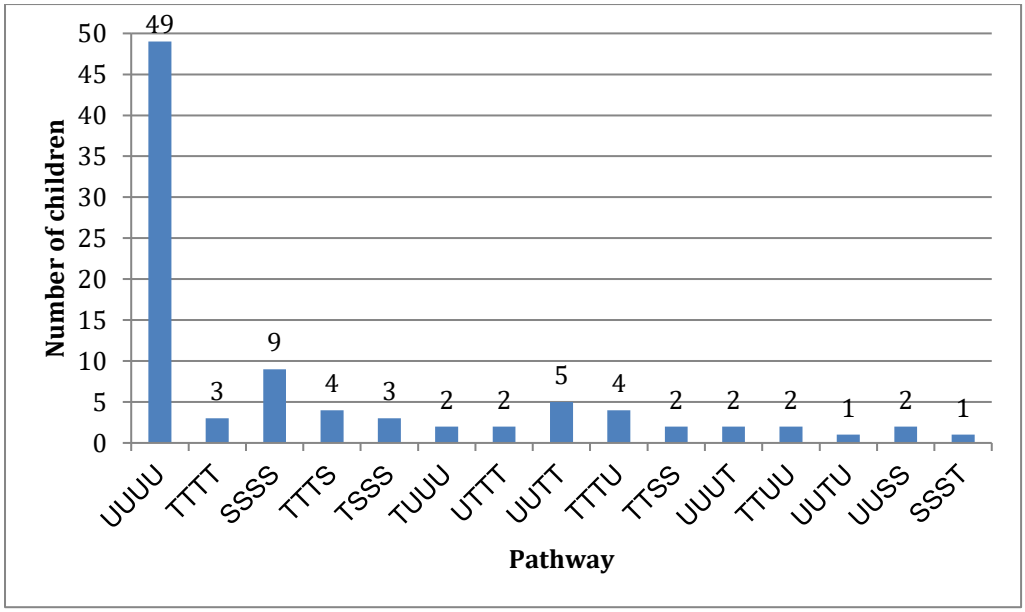

Figure 3.8 Pathways participants followed through the tiers of the MTSS and their frequency. U = universal. T = targeted. S = specialist. MTSS = multi-tiered system of support.

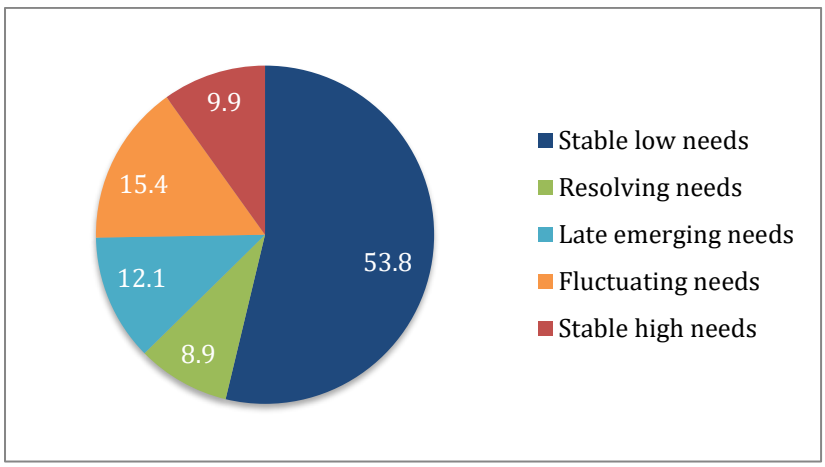

Figure 3.9 Pie chart showing the percentage of the cohort in each of the five grouped pathways through the MTSS

Table 3.4 Grouping of unique pathways into overarching pathways through the NNUTS model

Pathway name	Tier allocation	n	% of cohort
Stable low needs	UUUU	49	53.8
Resolving needs	TUUU	2	
	TTTU	4	8.9
	TTUU	2	
Late emerging needs	TTTS	4	
	TSSS	3	12.1
	TTSS	2	
	UUSS	2	
Fluctuating needs	TTTT	3	
	UTTT	2	
	UUTT	5	15.4
	UUUT	2	
	UUTU	1	
	SSST	1	
Stable high needs	SSSS	9	9.9
Total		91	100

Note. U = universal; T = targeted; S = specialist

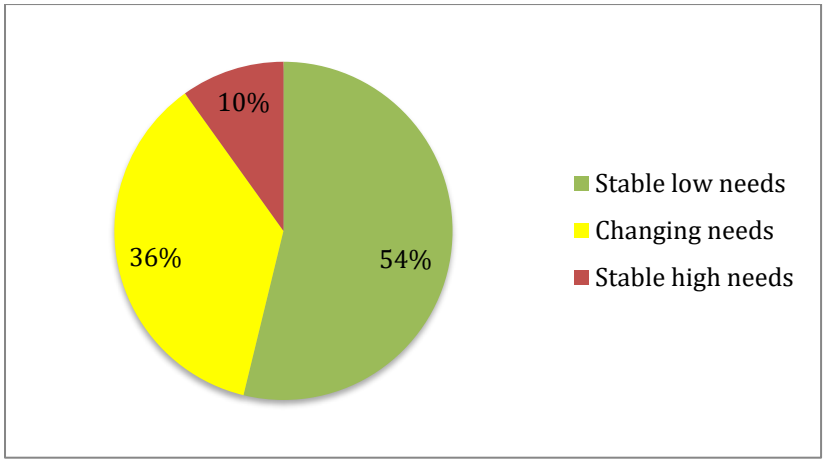

Figure 3.10 Pie chart showing the percentage of the cohort in each of the three grouped pathways through the MTSS model

3.4.4 RQ2b: What are the characteristics of participants in each of the pathways with respect to their pattern of speech, language and communication needs?

The performance of participants in the stable-low-needs pathway on each of the speech and language assessments are shown in and **Figure 3.11**, Figure 3.12, Figure **3.13**, Figure 3.15 . **Figure 3.14** shows the percentage of participants in the stable-low-needs pathway that are deemed 'at risk' at each assessment point. The cut points for what is deemed 'at risk' can be found in Table 3.1.

The performance of participants in the changing-needs pathway is shown in Figure 3.16, Figure 3.17, Figure 3.18, Figure 3.20. Figure 3.19 shows the percentage of participants at each assessment point that are deemed 'at risk' on each assessment in the changing-needs pathway.

The performance of participants in the stable-high-needs pathway is shown in Figure 3.21, Figure 3.22, Figure 3.23, Figure 3.25. Figure 3.24 shows the percentage of participants at each assessment point that are deemed 'at risk' on each assessment in the stable-high-needs pathway.

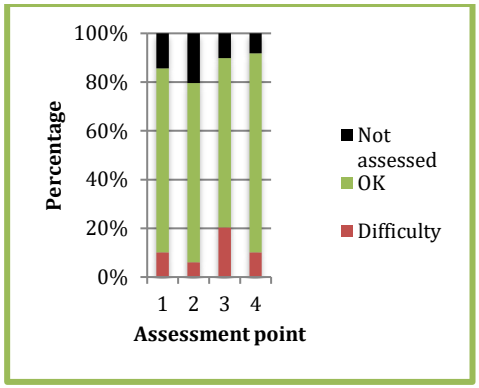

Figure 3.11 Participants in the STABLE-LOW-NEEDS pathway DEAP screen performance at each assessment point. N=49 for Stable low needs pathway, n=42 at assessment point 1, n=39 at assessment point 2, n=44 at assessment point 3, n=45 at assessment point 4. Missing data due to time constraints, absence, or refusal.

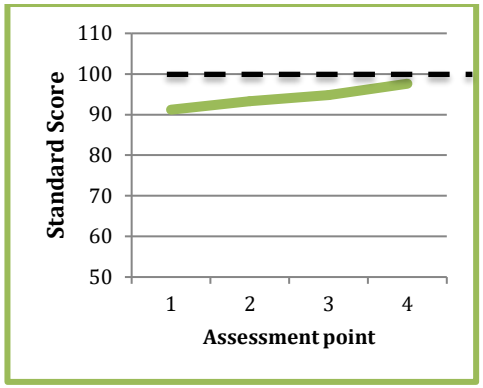

Figure 3.12 Mean ERB standard score for participants in the STABLE-LOW-NEEDS pathway at each assessment point. Dashed line represents the population average of the standardisation sample. ERB = Early Repetition Battery sentence repetition assessment. N=49 for Stable low needs pathway, n=35 at assessment point 1, n=32 at assessment point 2, n=37 at assessment point 3, n=45 at assessment point 4. Missing data due to time constraints, absence, or refusal.

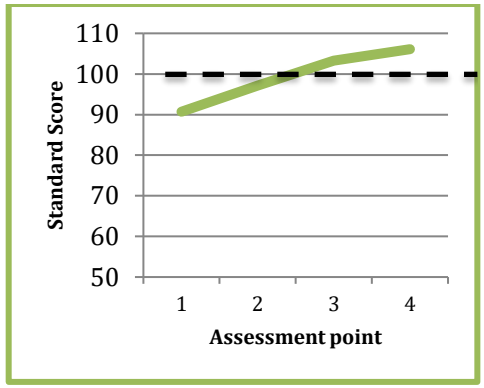

Figure 3.13 Mean BPVS standard score for participants in the STABLE-LOW-NEEDS pathway at each assessment point. Dashed line represents the population average of the standardisation sample. BPVS = British Picture Vocabulary Scale 3rd Edition. N=49 for Stable low needs pathway, n=42 at assessment point 1, n=47 at assessment point 2, n=45 at assessment point 3, n=47 at assessment point 4. Missing data due to time constraints, absence or refusal.

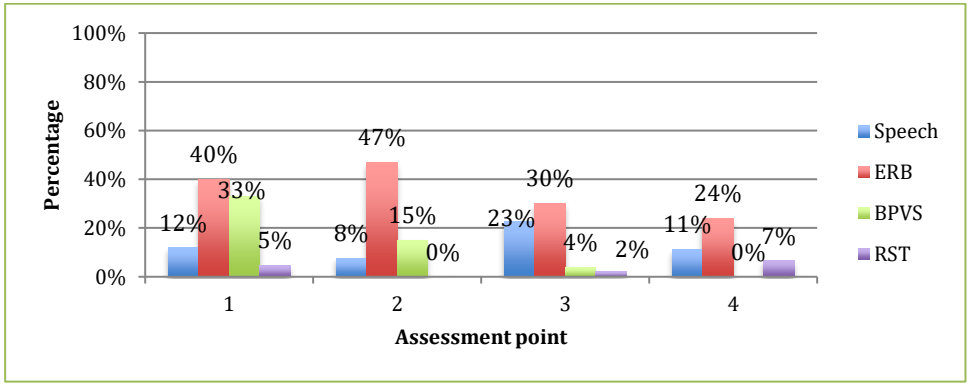

Figure 3.14 Percentage of participants in the STABLE-LOW-NEEDS pathway that completed the assessment deemed as 'at risk' of speech and language difficulties at each assessment point. ERB = Early Repetition Battery sentence repetition assessment, BPVS = British Picture Vocabulary Scale 3rd Edition, RST = Derbyshire Rapid Screening Test. Participants scores were deemed 'at risk' if they were more than 1s.d. below the mean on the ERB and the BPVS, if a further assessment was indicated on the DEAP screen for speech, if the score was less than 15 at assessment points 1 and 2 or below 18 at assessment points 3 and 4 on the RST.

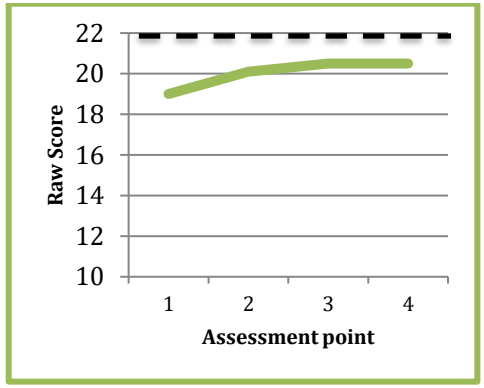

Figure 3.15 Mean RST raw score for participants in the STABLE-LOW-NEEDS pathway at each assessment point. Dashed line represents the ceiling score of 22. RST = Derbyshire Rapid Screening Test. N=49 for Stable low needs pathway, n= 43 at assessment points 1 and 2, n= 44 at assessment point 3, n=46 at assessment point 4. Missing data due to time constraints, absence or refusal.

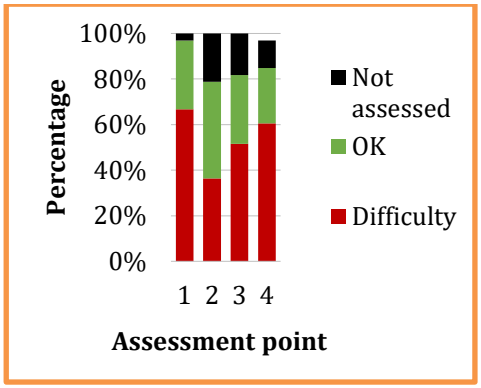

Figure 3.16 Participants in the **CHANGING-NEEDS** pathway **DEAP screen** performance at each assessment point. N=33 for Changing needs pathway, n=32 at assessment point 1, n=26 at assessment point 2, n=27 at assessment point 3, n=28 at assessment point 4. Missing data due to time constrains, absence or refusal.

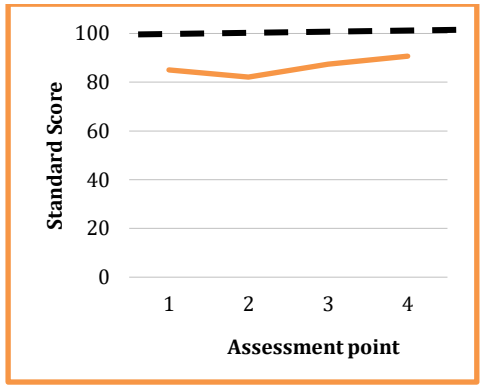

Figure 3.17 Mean **ERB standard score** for participants in the **CHANGING-NEEDS** pathway at each assessment point. The dashed line represents the population average of the standardisation sample. ERB = Early Repetition Battery sentence repetition assessment. N=33 for Changing needs pathway, n=17 at assessment point 1, n=19 at assessment point 2, n= 26 at assessment point 3 and 4. Missing data due to time constrains, absence or refusal.

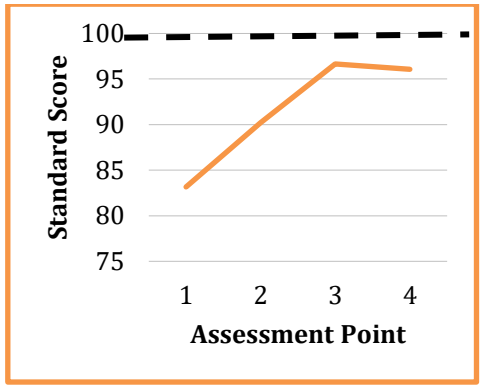

Figure 3.18 Mean **BPVS standard score** for participants in the **CHANGING-NEEDS** pathway at each assessment point. The dashed line represents the population average of the standardisation sample. BPVS = British Picture Vocabulary Scale 3rd Edition. N=33 for Changing needs pathway, n = 25 at assessment point 1, n = 29 at assessment point 2 and 3, n=27 at assessment point 4. Missing data due to time constraints, absence or refusal.

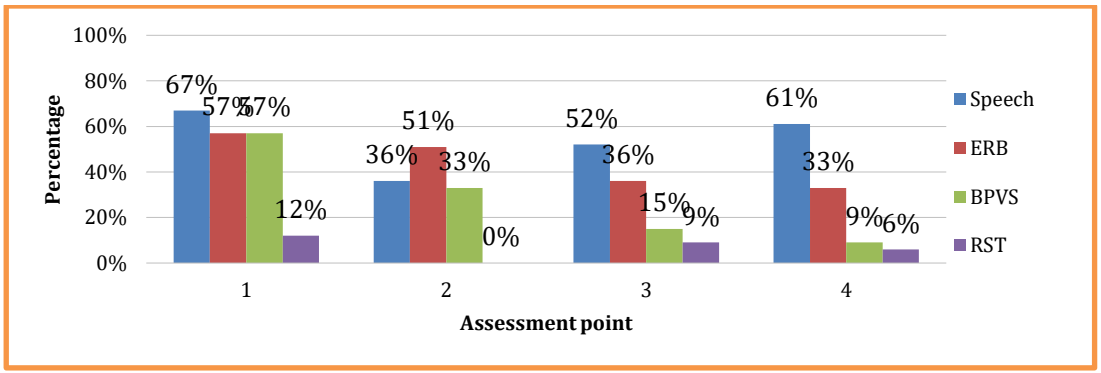

Figure 3.19 Percentage of participants in the **CHANGING-NEEDS** pathway that completed the assessment deemed as 'at risk' of speech and language difficulties at each assessment point. ERB = Early Repetition Battery sentence repetition assessment, BPVS = British Picture Vocabulary Scale 3rd Edition, RST = Derbyshire Rapid Screening Test. Participants scores were deemed 'at risk' if they were more than 1s.d. below the mean on the ERB and the BPVS, if a further assessment was indicated on the DEAP screen for speech, if the score was less than 15 at assessment points 1 and 2 or below 18 at assessment points 3 and 4 on the RST.

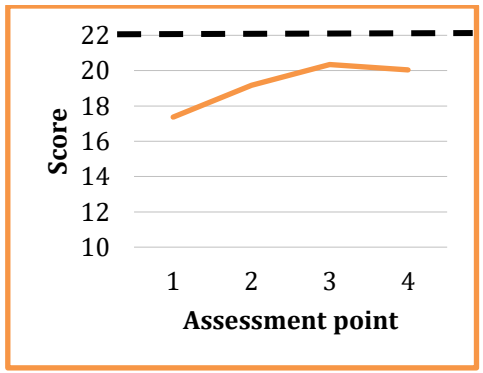

Figure 3.20 Mean **RST raw score** for participants in the **CHANGING-NEEDS** pathway at each assessment point. The dashed line represents the ceiling score of 22. RST = Derbyshire Rapid Screening Test. N=33 for Changing needs pathway, n= 30 at assessment point 1, n = 29 at assessment point 2 and 3, n= 30 at assessment point 4. Missing data due to time constraints, absence or refusal.

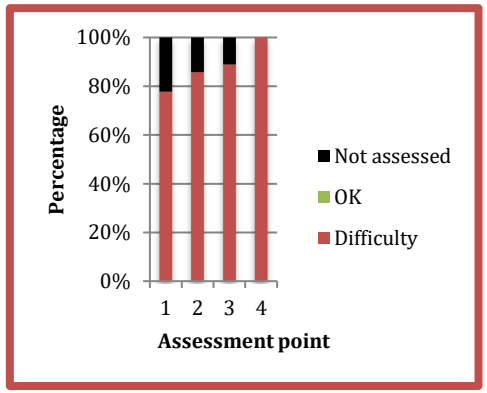

Figure 3.21 Participants in the **STABLE-HIGH-NEEDS** pathway DEAP screen performance at each assessment point. N=9 for Stable high needs pathway, n=7 at assessment points 1 and 2, n=8 at assessment point 3, n=9 at assessment point 4. Missing data due to time constraints, absence or refusal.

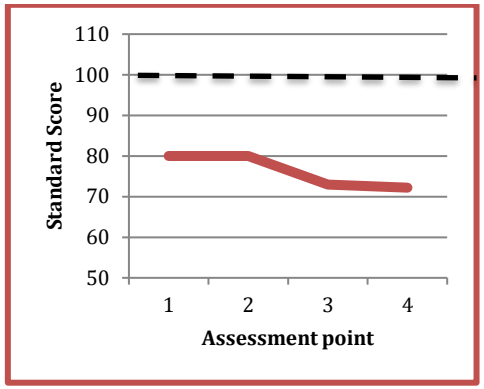

Figure 3.22 Mean **ERB standard score** for participants in the **STABLE-HIGH-NEEDS** pathway at each assessment point. The dashed line represents the population average of the standardisation sample. ERB = Early Repetition Battery sentence repetition assessment. N=9 for Stable high needs pathway, n=2 at assessment point 1, n=1 at assessment point 2, n= 3 at assessment point 3, n = 7 at assessment point 4. Missing data due to time constrains, absence or refusal.

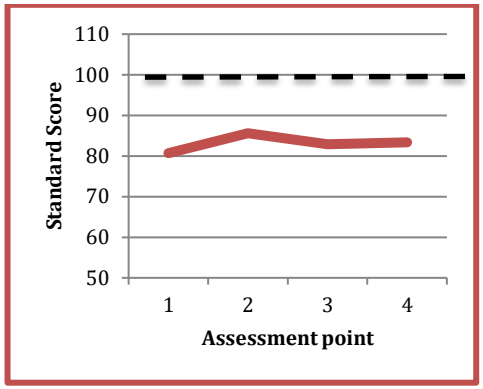

Figure 3.23 Mean **BPVS standard score** for participants in the **STABLE-HIGH-NEEDS** pathway at each assessment point. The dashed line represents the population average of the standardisation sample. BPVS = British Picture Vocabulary Scale 3rd Edition. N=9 for Stable high needs pathway, n = 3 at assessment point 1, n = 7 at assessment point 2, n=9 at assessment points 3 and 4. Missing data due to time constraints, absence or refusal.

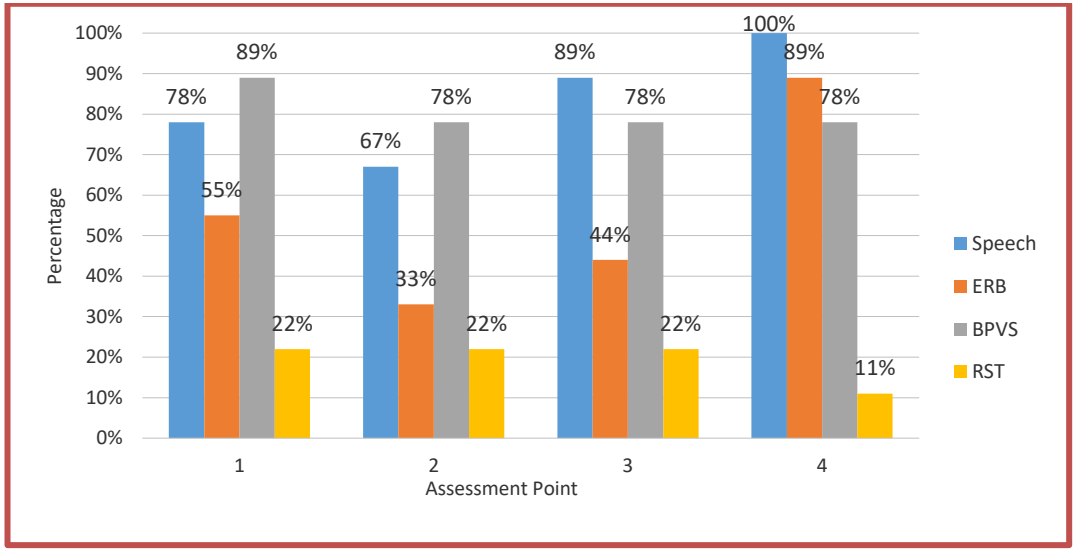

Figure 3.24 Percentage of participants in the **STABLE-HIGH-NEEDS** pathway that completed the assessment deemed as **'at risk'** of speech and language difficulties at each assessment point. ERB = Early Repetition Battery sentence repetition assessment, BPVS = British Picture Vocabulary Scale 3rd Edition, RST = Derbyshire Rapid Screening Test. Participants scores were deemed 'at risk' if they

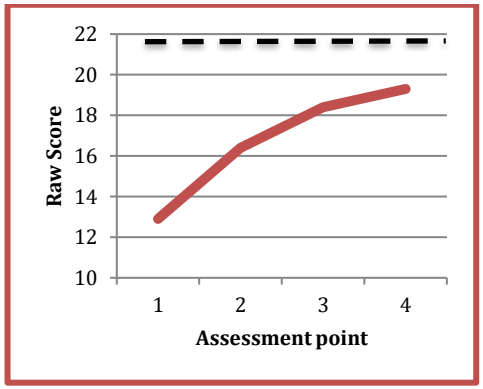

Figure 3.25 Mean **RST raw score** for participants in the **STABLE-HIGH-NEEDS** pathway at each assessment point. The dashed line represents the ceiling score of 22. RST = Derbyshire Rapid Screening Test. N=9 for Stable high needs pathway, n= 8 at assessment points 1, 2 and 4, n = 9 at assessment point 3. Missing data due to time constraints, absence or refusal.

were more than 1s.d. below the mean on the ERB and the BPVS, if a further assessment was indicated on the DEAP screen for speech, if the score was less than 15 at assessment points 1 and 2 or below 18 at assessment points 3 and 4 on the RST.

3.4.5 RQ2c: How do participants in each of the pathways differ in terms of their speech and language skills?

3.4.5.1 Age

A Kruskal Wallis test was conducted to evaluate whether the participants in each group differed in terms of their age. The test, which was corrected for tied ranks was not significant, χ^2 (2, N – 91) = 2.91, p = .23. This indicates that the participants in each group did not differ significantly in terms of their age.

3.4.5.2 Gender

A Chi squared analysis was conducted to examine the relationship between gender and group. The result was not significant, X^2 (2, N- 91) = 0.39, p = .82.

3.4.5.3 Socio Economic Status

A Kruskal Wallis test was conducted to evaluate the differences between the three groups in their socio-economic status. The test, which was corrected for tied ranks, was not significant, χ^2 (2, N – 87) = 1.25, p = .54. When looking at the distribution of the total deprivation statistics for this cohort (Figure 3.2) it is unsurprising that there is no significant difference between the groups as there is a lack of variability in the sample as a whole.

3.4.5.4 Speech

In order to determine whether the groups differed significantly in their performance on the DEAP (expressive phonology), a Kruskal Wallis test was administered for the data at each assessment point. At assessment points one, two, three and four the groups were shown to be significantly different in the proportion of children identified as having a speech difficulty; χ^2 (2, N – 81) = 34.26, p = .00, χ^2 (2, N – 72) = 22.85, p = .00; χ^2 (2, N – 79) = 21.89, p = .00; χ^2 (2, N – 83) = 40.53, p = .00 respectively. This was then explored further using Dunn's Test (with Bonferroni corrections to control for Type 1 errors) to establish which of the groups were significantly different to each other (Table 3.5). The stable-low-needs group differed significantly from the changing-needs group and from the stable-high-needs group at each assessment point. These groups had significantly more children with identified difficulties than the stable-low-needs group. The changing-needs group and the stable-high-needs group did not differ significantly from each other at any assessment point. There was a trend

towards higher proportions of identified need in the stable-high-needs group. A visual representation of the performance of the groups at each time point is shown in Figure 3.11, Figure 3.16 and Figure 3.21.

Table 3.5: Dunn's post hoc comparison at each assessment point for the Diagnostic Evaluation of Articulation and Phonology assessment

Groups	Assessment point 1			Assessment point 2			Assessment point 3			Assessment point 4		
	Dunn's post hoc test											
	n	SLN	CN	n	SLN	CN	n	SLN	CN	n	SLN	CN
SLN	43			40			45			46		
CN	32	.00*		26	.00*		27	.00*		29	.00*	
SHN	6	.00*	.20	6	.00*	.06	7	.00*	.10	8	.00*	.22

Note: SLN = stable-low-needs; CN = changing-needs; SHN = stable-high-needs. SLN N=49; CN N = 33; SHN N = 9. Missing data due to time constraints, absence or refusal.

*significant after Bonferroni corrections

3.4.5.5 Early Repetition Battery

Both the raw and standard were explored separately for this assessment and the mean scores for each group at each assessment point are shown in Figure 3.26 and Figure 3.27. Kruskal-Wallis tests were conducted for both standard and raw scores at each assessment point to establish whether there were significant differences between any of the groups (Table 3.6). Where there was a significant difference, Dunn's tests with Bonferroni corrections were carried out to establish where the differences lay (Table 3.7 and Table 3.8).

Table 3.6: Kruskal Wallis results for ERB standard and raw scores at each assessment point.

Assessment point	ERB standard score			ERB raw score		
	n	χ^2	p	n	χ^2	p
1	53	5.77	.06	66	18.08	.00*
2	51	7.65	.02*	57	11.11	.00*
3	66	10.44	.01*	68	14.06	.00*
4	77	14.52	.00*	80	19.67	.00*

Note: ERB = Early Repetition Battery sentence repetition; N = 91 and missing data are due to time constraints, absence or refusal.

*p < .05

Table 3.7: Dunn's post hoc comparison at each assessment point for the Early Repetition Battery sentence repetition assessment raw scores

Group	Assessment point 1				Assessment point 2				Assessment point 3				Assessment point 4			
	Dunn's post hoc test															
	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN
SLN	35	8			32	13			37	16			45	17		
CN	26	3.2	.00*		22	7.2	.01*		27	12.1	.03		27	14	.05	
SHN	5	1	.00*	.29	3	2	.02*	.33	4	3	.01*	.05	8	4	.00*	.01*

Note: SLN = stable-low-needs; CN = changing-needs; SHN = stable-high-needs. SLN N=49; CN N = 33; SHN N = 9. Missing data due to time constraints, absence or refusal.

*significant after Bonferroni corrections

Table 3.8: Dunn's post hoc comparison at each assessment point for the Early Repetition Battery sentence repetition assessment standard scores

Group	Assessment point 1				Assessment point 2				Assessment point 3				Assessment point 4			
			Dunn's post hoc test													
	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN
SLN	34	91.2			31	93.3			37	94.8			45	97.6		
CN	17	85.1	.07		19	82.1	.01*		26	87.5	.06		26	90.7	.07	
SHN	2	80	.15	.63	1	80	.055	1.00	3	73	.01*	.09	6	72.2	.00*	.03

Note: SLN = stable-low-needs; CN = changing-needs; SHN = stable-high-needs. SLN N=49; CN N = 33; SHN N = 9. Missing data due to time constraints, absence or refusal.

*significant after Bonferroni corrections

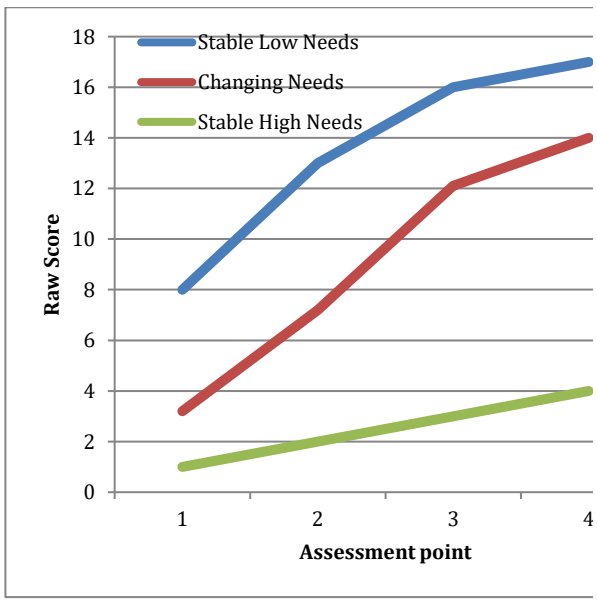

Figure 3.26 Participants' raw scores on the Early Repetition Battery sentence repetition assessment at each assessment point. Stable-low-needs group (N=49) n=35 at assessment point 1, n = 32 at assessment point 2, n = 37 at assessment point 3, n = 45 at assessment point 4; changing-needs (N = 33), n = 26 at assessment point 1, n = 22 at assessment point 2, n = 27 at assessment point 3, n = 27 at assessment point 4; stable-high-needs (N = 9) n = 5 at assessment point 1, n = 3 at assessment point 2, n = 4 at assessment point 3, n = 8 at assessment point 4. Missing data due to time constrains, absence or refusal.

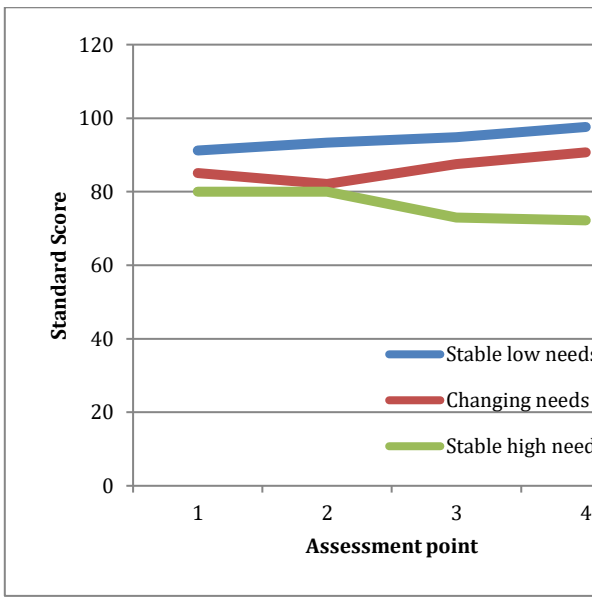

Figure 3.27 Participants' standard scores on the Early Repetition Battery sentence repetition assessment at each assessment point. Stable-low-needs group (N=49) n=34 at assessment point 1, n = 31 at assessment point 2, n = 37 at assessment point 3, n = 45 at assessment point 4; changing-needs (N = 33), n = 17 at assessment point 1, n = 19 at assessment point 2, n = 26 at assessment point 3, n = 26 at assessment point 4; stable-high-needs (N = 9) n = 2 at assessment point 1, n = 1 at assessment point 2, n = 3 at assessment point 3, n = 6 at assessment point 4. Missing data due to time constrains, absence or refusal.

3.4.5.6 British Picture Vocabulary Scales

Both the raw and standard scores were explored separately for this assessment and the mean scores for each group at each assessment point are shown in Figure 3.28 and Figure 3.29. Initially Kruskal Wallis tests were carried out to establish if there were significant differences in the standard scores and raw scores at each assessment point (Table 3.9). Where there was a significant difference, Dunn's tests with Bonferroni corrections were carried out to establish where the differences lay (Table 3.10 and Table 3.11).

Table 3.9: Kruskal-Wallis results for the BPVS standard and raw scores at each assessment point.

Assessment point	BPVS standard score			BPVS raw score		
	n	χ^2	p	n	χ^2	p
1	66	11.32	.00*	80	19.84	.00*
2	80	10.86	.00*	83	16.17	.00*
3	83	19.75	.00*	83	21.53	.00*
4	84	27.17	.00*	84	29.46	.00*

Note: BPVS = British Picture Vocabulary Scale (3rd Edition).; N = 91 and missing data are due to time constraints, absence or refusal. Discrepancy between standard score and raw score n is due to some participants completing the assessments but not achieving a standard score as their raw score was too low.

*p < .05

Table 3.10: Dunn's post hoc comparisons of groups at each assessment point for the British Picture Vocabulary Scale 3rd Edition raw scores

Group	Assessment point 1				Assessment point 2				Assessment point 3				Assessment point 4			
			Dunn's post hoc test													
	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN
SLN	42	39			47	49			45	58			47	63		
CN	30	28.6	.00*		30	39.2	.01*		29	49.6	.02*		27	51	.00*	
SHN	8	18	.00*	.07	9	30	.00*	.18	9	32	.00*	.01*	9	35	.00*	.05

Note: SLN = stable-low-needs; CN = changing-needs; SHN = stable-high-needs.. SLN N=49; CN N = 33; SHN N = 9. Missing data due to time constraints, absence or refusal.

*significant after Bonferroni corrections

Table 3.11: Dunn's post hoc comparisons of groups at each assessment point for the British Picture Vocabulary Scale 3rd Edition standard scores

Group	Assessment point 1				Assessment point 2				Assessment point 3				Assessment point 4			
			Dunn's post hoc test													
	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN
SLN	39	90.7			44	97.1			45	103.3			47	106.1		
CN	25	83.2	.00*		29	90.2	.01*		29	96.7	.03		27	96.1	.00*	
SHN	3	80.7	.09	.87	7	85.6	.01*	.46	9	82.9	.00*	.01*	9	83.4	.00*	.05

Note: SLN = stable-low-needs; CN = changing-needs; SHN = stable-high-needs. SLN N=49; CN N = 33; SHN N = 9. Missing data due to time constraints, absence or refusal.

*significant after Bonferroni corrections

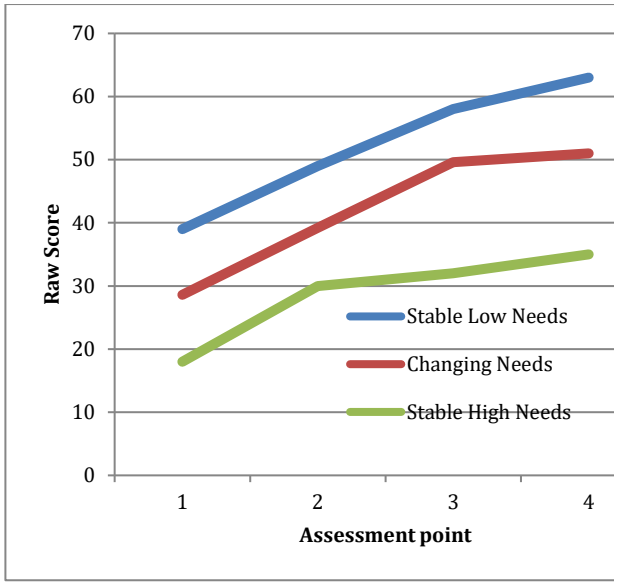

Figure 3.28 Participants' mean raw scores on the British Picture Vocabulary Scale (3rd Edition) assessment at each assessment point. Stable-low-needs group (N=49) n=42 at assessment point 1, n = 47 at assessment point 2, n = 45 at assessment point 3, n = 47 at assessment point 4; changing-needs (N = 33), n = 30 at assessment point 1 and 2, n = 29 at assessment point 3, n = 27 at assessment point 4; stable-high-needs (N = 9) n = 8 at assessment point 1, n = 9 at assessment point 2, 3 and 4. Missing data due to time constrains, absence or refusal.

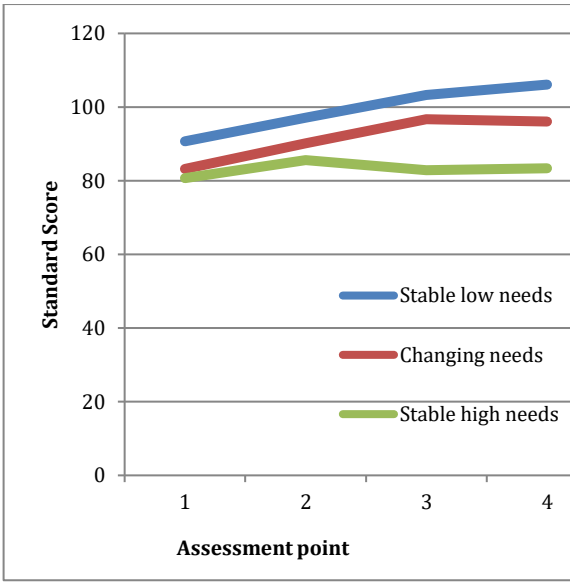

Figure 3.29 Participants' mean standard scores on the British Picture Vocabulary Scale (3rd Edition) assessment at each assessment point. Stable-low-needs group (N=49) n=39 at assessment point 1, n = 44 at assessment point 2, n = 45 at assessment point 3, n = 47 at assessment point 4; changing-needs (N = 33), n = 25 at assessment point 1, n = 29 at assessment point 2, n = 29 at assessment point 3, n = 27 at assessment point 4; stable-high-needs (N = 9) n = 3 at assessment point 1, n = 7 at assessment point 2, n = 9 at assessment points 3, and 4. Missing data due to time constrains, absence or refusal.

3.4.5.7 Rapid Screening Test

Figure 3.30 shows the mean RST scores of each group and how they compare over time. As the graph shows, the lines converge as the assessment points progress due to most children reaching the ceiling score of 22. This is a limitation of this assessment choice.

Initially Kruskal Wallis tests were carried out to establish if there were significant differences in the scores at each assessment point (Table 3.12). Where there was a significant difference, Dunn's tests with Bonferroni corrections were carried out to establish where the differences lay (Table 3.13). By the time assessment four is reached the Kruskal Wallis does not identify any significant differences between the groups; likely due to the ceiling effect rather than there not being a difference in the children's language comprehension.

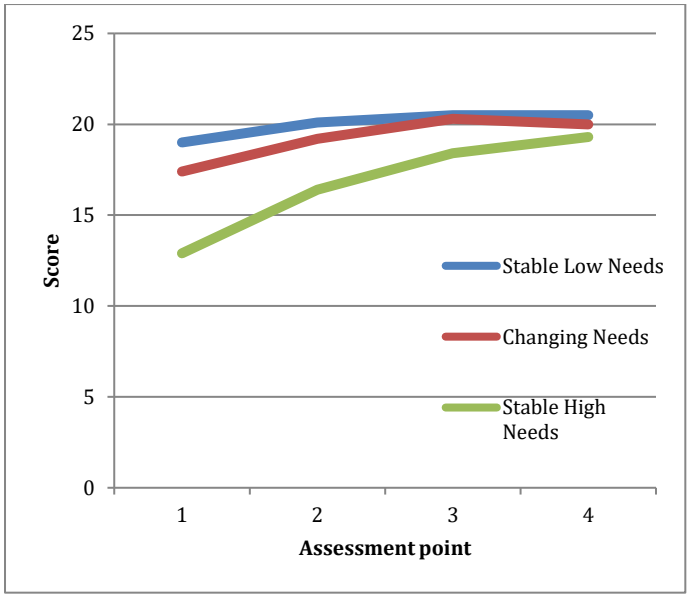

Figure 3.30 Participants' mean scores on the Derbyshire Rapid Screening Test at each assessment point. Stable-low-needs group (N=49) n=43 at assessment point 1 and 2, n = 44 at assessment point 3, n = 46 at assessment point 4; changing-needs (N = 33), n = 30 at assessment point 4; stable-high-needs (N = 9) n = 4 at assessment point 1, n = 8 at assessment point 2, n = 9 at assessment points 3, n = 8 at assessment point 4. Missing data due to time constrains, absence or refusal.

Table 3.12: Kruskal-Wallis results for the Derbyshire Rapid Screening Test results at each assessment point.

Assessment point	RST score		
	n	χ^2	p
1	81	20.12	.00*
2	80	12.83	.00*
3	82	10.41	.01*
4	84	5.72	.06

Note: RST = Derbyshire Rapid Screening Test.; N = 91 and missing data are due to time constraints, absence or refusal.

*p < .05

Table 3.13: Dunn's post hoc comparisons of groups at each assessment point for the Derbyshire Rapid Screening Test

Group	Assessment point 1				Assessment point 2				Assessment point 3				Assessment point 4			
			Dunn's post hoc test													
	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN	n	mean	SLN	CN
SLN	43	19			43	20.1			44	20.5			46	20.5		
CN	30	17.4	.01*		29	19.2	.21		29	20.3	1.00		30	20	.24	
SHN	4	12.9	.00*	.03	8	16.4	.00*	.02*	9	18.4	.00*	.00*	8	19.3	.04	.28

Note: SLN = stable-low-needs; CN = changing-needs; SHN = stable-high-needs SLN N=49; CN N = 33; SHN N = 9. Missing data due to time constraints, absence or refusal.

*significant after Bonferroni corrections

3.4.6 Below Standardisation Threshold

At each assessment period there were a number of participants who completed the assessment but whose scores did not meet the threshold to receive a standard score in the assessment manuals. The percentages within each group, at each time point on both the BPVS and ERB are shown in Table 3.2.

3.4.7 Early Years Foundation Stage judgements

Teacher judgements of which age band within the Development Matters framework (Department for Children Schools and Families, 2008) children were performing was recorded at assessment points 1-3. After this, the framework used altered and therefore no direct comparison of judgements could be made. These are presented for each group in Figure 3.31, Figure 3.32 and Figure 3.33 as proportions of children judged to be in the age commensurate band, one, two, or three age bands below their chronological age.

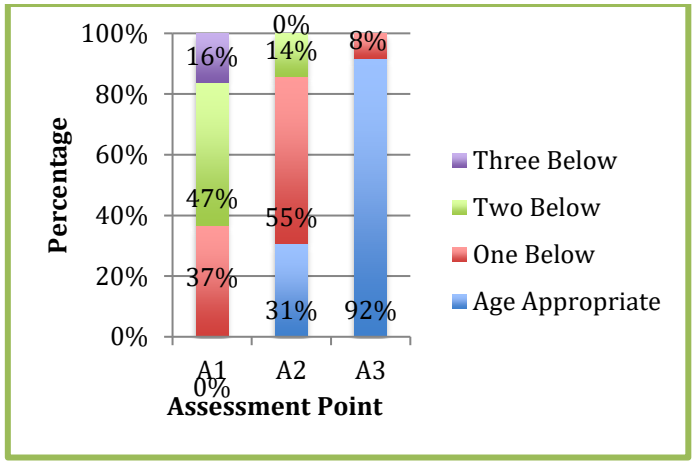

Figure 3.31 Development Matters age band judgements for children in the stable-low-needs pathway for the Communication, Language and Literacy strand of the Early Years Foundation Stage.

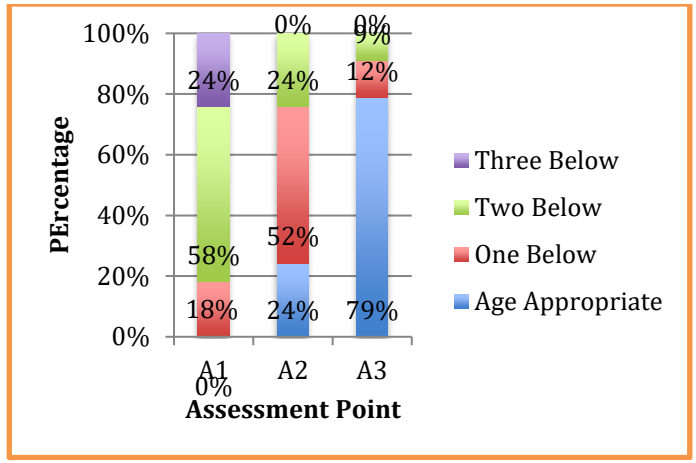

Figure 3.32 Development Matters age band judgements for children in the changing-needs pathway for the Communication, Language and Literacy strand of the Early Years Foundation Stage.

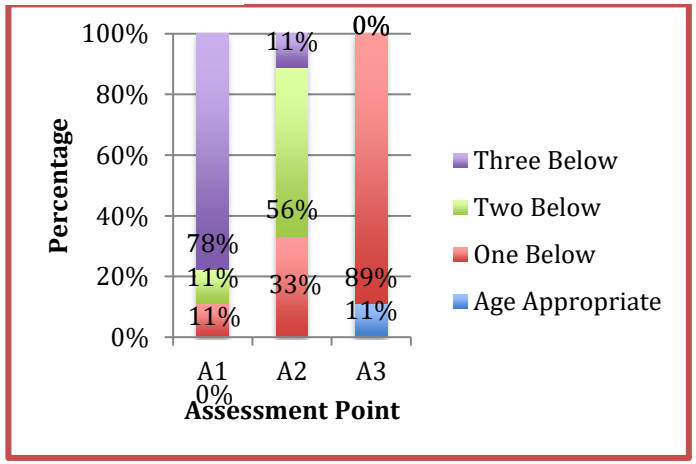

Figure 3.33 Development Matters age band judgements for children in the stable-high-needs pathway for the Communication, Language and Literacy strand of the Early Years Foundation Stage.

3.5 Discussion

This chapter has explored the different pathways that children take through this multi-tiered system of support and what characterises children in each pathway. The key difference between the three pathways that emerged appeared to be the consistency of level of need; with one group's needs fluctuating more over time compared to the other two groups in which children's level of need was more consistent over the course of the project. The fact that the cohort was not normally distributed on any of the standardised language measures is interesting and reflective of the high deprivation population, showing a negative skew. This is not a surprising finding, but nonetheless an important one. It has implications for the content of different tiers of intervention and the importance of the universal tier being an intervention in itself, rather than just business as usual.

The discussion first explores prevalence data arising from this analysis. The profiles of need and implications for MTSS in areas of deprivation are then considered. This is followed by discussion of the pathways that children take through this MTSS; the role of teacher judgement and the role of the SLT in the implementation of the MTSS. Strengths and limitations are discussed in Chapter 5:

3.5.1 Prevalence

On entry to nursery the proportion of children judged to be at risk on each of the specific measures of language on entry were as follows:

- Twenty-nine per cent of the children were at risk on the sentence repetition assessment (Seeff-Gabriel et al., 2008);
- Twenty-eight per cent were at risk on the receptive vocabulary measure (Dunn & Dunn, 2009)
- Fifteen per cent were at risk on the measure of receptive language (Knowles & Masidlover, 1987).

The cut points for the standardised measures were <1SD below the mean and for the comprehension measure these were criterion referenced and are outlined in Table 3.1. These prevalence estimates are slightly higher than those outlined by Law, Todd, et al. (2013) (Table 3.14).

Table 3.14 Prevalence of language difficulties (%) at five years at each quintile of social disadvantage with a threshold of one standard deviation below the mean (reproduced with permission from J.Law)

Cohort	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Millennium Cohort Study	18	10	7	5	3
Growing up in Scotland	23	18	15	11	10
Early Language in Victoria Study	21	16	7	12	6

The prevalence of children entering nursery with any kind of language difficulty (i.e. the number of unique ID codes identified as 'at risk' on one or more of the language measures) was 51%. This is in line with the upper estimate for SLCN within other areas of deprivation outlined by Law, Todd, et al. (2013).

Speech difficulties were the most prevalent individual difficulty identified within the cohort, with 42% of the cohort experiencing difficulties as measured by the DEAP screen (Dodd et al., 2006). This is a stark contrast to the prevalence estimates of between 3.8% and 18% (Eadie et al., 2015; Shriberg et al., 2019, 1999; Wren et al., 2013). This vast difference in prevalence of SSD could be due to the different age of the cohort, the estimates of between 3.8% and 18% were for children between the ages of four and eight years of age, whereas this cohort had a mean age of 39 (SD 1.67) months. Alternatively, this could be due to the under-representation of lower SES children within the cited studies. This proportion of children with SSD fluctuated across the four assessment points, remaining high.

3.5.2 Pathways

Four distinct pathways through the provision were hypothesised – stable-low-need; stable-high-need; resolving-need and late-emerging-need. These hypotheses were derived from substantial evidence about individual variability in children's language development (Eadie et al., 2014; Law et al., 2012; McKean, Wraith, et al., 2017; Reilly et al., 2010; Tomblin, Zhang, Buckwalter, & O'Brien, 2003; Zambrana, Pons, Eadie, & Ystrom, 2014; Zubrick et al., 2015),

although the pathways represented the perceived level of support children required with their SLC development, rather than the children's language trajectories per se. This means that the pathways followed, as they are determined by teacher judgement, likely reflect children's functioning. As such these pathways are reliant on the children's SLC skills *and* the environment in which they are communicating, including the physical space and the interaction partners. The predictions were also made primarily based on knowledge about language trajectories, however teacher judgements for the level of support required were made on the child's speech, language and communication competence, therefore this discrepancy could also have contributed to differences in predicted and observed pathways.

Descriptively it appeared there were five pathways that children took through the MTSS during their nursery year; the four hypothesised pathways and one pathway characterised by instability in the perceived level of support required over time. Statistically however, there was no significant difference in scores on any measure for the three, non-stable pathways and therefore further investigation was conducted on the characteristics of the three distinct pathways of stable-low-needs, changing-needs and stable-high-needs. This lack of statistical distinction between the groups could in part be due to the low numbers in these non-stable pathways, rather than there being no real differences between the profiles of the children.

The presence of the changing-needs pathway highlights the importance of a MTSS being flexible and responsive to children's needs over time. This is perhaps of increased importance in the early years when language in particular is known to be subject to high levels of individual variation. Children do not all make linear progress in different areas of language and this reinforces the importance of MTSS being used in a flexible way to ensure children are receiving the most appropriate level of support at any one time. This has implications for service planning, practice and future research. It is important to further understand MTSS in practice and the effectiveness for children with different profiles of speech, language and communication skills at different tiers of the models.

3.5.3 Profiles of need and implications for MTSS in areas of deprivation

The profiles of children in the three distinct pathways are interesting and highly representative of the area of deprivation in which this study was conducted. Perhaps the starkest finding is that 100% of the children were performing below age related expectations

for communication, language and literacy (CLL) (EYFS Development Matters judgement) on entry to nursery. Every single child that started nursery in September 2011 was deemed to be presenting with some functional level of SLCN as judged by teaching staff. The proportion of children judged to be at risk on each of the specific measures of speech and language on entry was lower than this as outlined above (3.5.1).

This finding strongly supports the need for the universal tier of a MTSS, specifically those implemented in areas with high levels of deprivation, to be more than simply business as usual. Evidence highlights the variability in how well language is supported within early years' classrooms (Dockrell, Bakopoulou, Law, Spencer, & Lindsay, 2015; Dwyer & Harbaugh, 2020; Justice et al., 2008; Melhuish & Gardiner, 2017; Pelatti, Piasta, Justice, & O'Connell, 2014); alongside the benefits when language-promoting strategies are readily used (Cabell et al., 2011; Justice et al., 2010; Piasta et al., 2012). In order to support this to happen more consistently, there is a clear role for the SLT in supporting teachers to alter this universal tier of their practice to be as supportive as possible for children presenting with SLCN. Evidence has shown that facilitating changes in the physical environment to support communication tends to be more successful than facilitating change in interaction strategies and styles (Marulis & Neuman, 2010). This indicates that careful consideration needs to be given to how this kind of professional development is delivered; with evidence that intensity and duration of courses or coaching are related to effect sizes in child outcomes, as well as the strongest predictor of changes in interaction techniques being the number of different components to professional development (Marulis & Neuman, 2010). For this kind of support at the universal, or targeted-indicated tiers, to be effective, there are serious considerations to be made in terms of service provision and the proportions of time devoted to this facet of an SLT service, in order to provide a sound basis for more specific, direct work, as well as to provide the best chances for children from disadvantaged backgrounds to begin to catch up with their peers in the early years.

The stable-low-needs group consistently scored higher than those in each of the other groups for their receptive vocabulary, starting with a mean standard score of 90.7 at time one, increasing to a mean of 106.1 at time four. The universal tier of intervention really seemed to support these children to develop their vocabulary skills at a somewhat accelerated rate in comparison to expected progress (i.e. their standard scores were improving rather than

children maintaining their relative position). This inference is tested empirically in Chapter 4: . This group also continued to make progress with their vocabulary scores between time three and time four, over the summer holidays, indicating a possible increase in their vocabulary learning skills as they were the only group who showed this pattern. Both the changing-needs and stable-high-needs groups showed very little standard score progress for receptive vocabulary between time three and four, in the case of the changing-needs group there was in fact a regression in their mean standard score over this period. This difference could be due to the children in the changing-needs and stable-high-needs groups having a lower initial vocabulary levels to build upon. Additionally, only small numbers of the children in the stable-low-needs pathway were identified as having speech sound difficulties (10.2% at times one and four). This could indicate that superior phonological processing skills to children in the other groups, thus contributing to more successful word learning.

Sentence repetition was the area in which children appeared to consistently have the most difficulty across all three groups, with 89% of the stable-high-needs, 33% of the changing-needs and 24% of the stable-low-needs groups still being considered at risk on this measure at time four. Sentence repetition has been shown to assess morphosyntax and lexical phonology skills (Polišenská et al., 2015) and thus relies on lexical processing skills which have been shown to be less efficient in children from low SES backgrounds (Fernald, Marchman, & Weisleder, 2013). This persistent difficulty across the cohort could therefore be linked to deficits in lexical processing skills in this largely low SES cohort, alongside more limited syntactic knowledge.

Children in the changing-needs group initially appeared to present with multi-domain difficulties, though there were notable improvements in their receptive vocabulary and sentence repetition over time. As stated previously, there were three sub-groups within this larger group which, had the numbers been higher, may have been statistically distinct. There was one sub-group whose assessment performance remained relatively stable over time (fluctuating-need); one whose assessment performance steadily improved over time in most domains (resolving-need); and one whose use of developmental speech processes did not resolve over time and therefore became classified as presenting with speech sound difficulties as time went on (late-emerging-need). This late-emerging-needs group appeared to make slow steady progress with their receptive vocabulary over time, but minimal progress

with their sentence repetition score. In contrast, the stable-high-needs group appeared to present with persistent, multi-domain difficulties that were resistant to change in terms of 'risk' and standard score. This group did however make progress with their raw scores over time for both sentence repetition and receptive vocabulary. Despite this improvement, the progress was not enough to close the gap with their peers, or indeed maintain the gap, with their standard scores actually decreasing over time for sentence repetition. This is in contrast to the findings of other studies which show that children appear to maintain their relative standing over time, with children with significant language needs exhibiting similar rates of growth to their peers (Bornstein, Hahn, Putnick, & Pearson, 2018; Norbury et al., 2017; Putnick, Bornstein, Eryigit-Madzwamuse, & Wolke, 2017). In the case of Norbury et al. (2017), this could be linked to the differing age ranges of the studies. Norbury et al. (2017) studied children between ages five and eight years of age, and the relatively more stable language development between these ages. However, studies by Bornstein and colleagues evaluated the stability of language performance from a very early age (as early as five months) and found high levels of stability from age one year (Bornstein et al., 2018). In future studies describing and evaluating in more detail the cumulative support received by children these children with consistently high levels of need could help to identify ways to maximise improvement in this group in these important early years. Looking at the profiles of need, it seems clear that these children are likely to present with persistent SLCN and as 10% of the cohort studied, this is in line with the prevalence estimate for the wider population.

It is important to ensure that children in areas of deprivation are not overlooked for services because they do not stand out within their cohort as having poor language skills. For example, the children in the stable-low-needs pathway identified as at-risk on speech and language assessments (Figure 3.14). The higher numbers of children with SLCN require a different approach to support from specialist services, such as supporting the implementation of such MTSS models in conjunction with more traditional methods of 1:1 therapy and providing support plans for staff to carry out. Interestingly, in the ten year review of the Marmot review (Marmot et al., 2020) evidence was presented that children living in and attending schools in low SES areas perform better than children living in low SES areas but attending schools in less deprived areas. It could be that in the schools in lower SES areas, where there were arguably more children presenting with SLCN and other academic difficulties, there is more

likely to be a more robust MTSS in place in which the universal tier is tailored to the increased level of need. Thus, in these lower SES schools, children are able to access cumulative support through a MTSS such as this, rather than solely being supported through interventions, which may be more the picture in schools where there is a lower level of need. This again reinforces the importance of evaluating MTSS as a whole to explore the possibility of these cumulative effects and how multiple interventions interact.

3.5.4 Teacher judgement and the role of the SLT

Although there were only three statistically distinct pathways, descriptive analysis showed some similarities between the three sub-groups combined to form the changing-need group, but also some stark contrasts (Figure A1-A12, Appendix A). This descriptive analysis provides some interesting information about how teachers may assign children to different tiers of support.

Within the changing-need group children in the three sub-groups appeared to show different patterns of need for speech. The late-emerging-need group entered nursery with 0% of children presenting with SSD. By assessment point four this had increased to 100%. In contrast, 100% of the children in the resolving-need group entered nursery with a SSD, as identified by the DEAP screen. The fluctuating-need group presented with a relatively stable proportion of children identified as having a SSD (42.9% at time one, 35.7% at time two, 28.6% at time three and 42.9% at time four).

From this we propose three different hypotheses about what guides teachers' judgements of the level of support required:

1) The saliency of speech difficulties means that it is easier to identify children with SSD quickly in contrast to those with language difficulties.
2) Another explanation may be that teachers perceive children with speech difficulties to need more targeted, specific support than can be provided within the whole class environment and therefore place these children more readily into targeted provisions.
3) The enhanced universal tier of provision may support/scaffold the functioning of children with language difficulties more readily than for those children presenting with difficulties primarily characterised by their speech clarity, or lack thereof.

This third hypothesis may also provide some explanation for the proportions of children in the stable low need group who were identified as having language difficulties but not allocated to receive additional targeted interventions (Figure 3.12, Figure 3.13, Figure 3.15). Children's ability to communicate effectively is not only determined by the child's communicative competence, but also the physical environment and the interaction partners with whom they are communicating. The adaptations made to the communication environment as part of the universal tier of the MTSS were designed to promote not only SLC development, but also to facilitate communicative success for children. For example, utilising visuals to support comprehension, not only supports children to enhance their understanding of the language being used in terms of helping them to form a long-term representation, but also minimise the immediate processing load by giving them additional visual information to support the verbal information. By reducing this immediate processing load, children are better able to utilise the skills that they have. There is evidence to suggest that language difficulties (and associated literacy difficulties) can be the result of cognitive overload, rather than always a specific competence deficit (Bishop, 1994; Perkins, 2007; Zourou, Ecalle, Magnan, & Sanchez, 2010). Consequently, children with language difficulties may be supported to function well within the universal tier of provision, up to a point at which the demands outweigh the capacity and their difficulties begin to have more of a functional impact. This could help to explain why some children's perceived level of support varied over time and also why some children, despite presenting with SLCN, were deemed to be adequately supported within the universal tier of intervention.

It is clear from section 3.4.7 that teachers were not under the impression that children in the stable low need pathway were all presenting with age appropriate language skills and therefore did not require any additional support. This is evidence by their EYFS Development Matters judgements (Department for Education, 2012) for the children (Figure 3.31, Figure 3.32, Figure 3.33) and is an important indicator of the clear need for the universal tier of the provision to be highly attuned to developing and supporting communication skills. The fact that teachers appeared able to accurately identify the high numbers of children in their nurseries with SLCN is in line with evidence presented in 3.1.3 about teacher reported prevalence of speech and language difficulties. Anecdotally, teachers found it extremely useful to be able to discuss children's needs with the KTPRA (a qualified SLT) who was

embedded within the nursery settings to support their decision making around which children required inclusion in the targeted tier of intervention. Judgements here were often made taking a wide range of factors into consideration, including functional ability, listening and attention, family history and temperament. Information about this decision-making process, the amount of support given by the KTPRA, how this occurred (incidentally when on-site in the nurseries/requested discussions/assessment feedback meetings) and the value of these discussions was not formally recorded, a limitation of this study design and a key area for further investigation in similar MTSS. The relationship between the SLT and teaching staff in this model, and other similar models of provision, is integral to success and normalisation of new practices and exploring the way that positive, productive social capital is developed and maintained within such models should be an integral part of the research design.

3.6 Conclusions

In conclusion, this chapter provides a detailed description of the pathways through an MTSS intervention in the nursery year and how these relate to profiles of need. With regard to the children, although three pathways were deemed statistically distinct, qualitatively there appeared to be five different pathways and profiles of need within the nursery. These were somewhat in-line with the predicted pathways, though with the addition of a less stable, fluctuating pathway. Children were making improvements in their skills (as evidenced by increasing raw scores), however for some this was not sufficient to begin to be able to close the gap between them and the expected norms, or indeed to prevent the gap from widening in the case of those children with the most significant needs. The presence of the stable high need pathway appears to support the hypothesis that persistence of language difficulties over time may be the best predictor of which children are likely to have long-term SLCN, with this group largely falling further behind their peers over time. There is also a query of the acceptability of some of the standardised assessments for use with such cohorts when such proportions of children failed to meet the threshold for the standardisation on both the BPVS and the ERB.

The striking finding that 100% of children were deemed at risk on the EYFS measure upon entry to nursery paints a clear picture of the extreme levels of SLCN in some areas where there are high levels of deprivation. Prevalence estimates from the specific speech and language measures reinforce existing estimates of around 10% of children with persistent,

significant SLCN, but up to almost 50% with less severe SLCN. The evidence here clearly supports the need for the universal tier of support to be more than simply 'business as usual' for populations such as this, where the social gradient of SLC skills is so pronounced. The high level of need and children's inclusion solely at the universal tier point to the need for SLTs to have a role at each tier in this kind of MTSS, serving this kind of population. In the next chapter we test the effects of this approach across the tiers.

The novel exploration of the whole MTSS model provides much needed description of the implementation of a MTSS in practice in order to begin to understand findings regarding the relative effectiveness of such interventions for children at different tiers, embedded in different MTSS services and or in differing contexts (e.g. higher SES overall). It is essential that we improve our understanding of these models in practice and begin to explore the possible cumulative and interactive effects of support at different tiers of the model. Comparison of such models in areas with a wider range of deprivation will integral to understanding this; when attending schools with lower levels of SLCN, do children with identified needs miss out on a more purposeful, rich universal tier of support? Exploring these MTSS models as a whole entity will also provide increased opportunity to further the understanding of how they can be successfully embedded into practice, the characteristics of the professional relationships supportive to success, as well as barriers to success. Opportunity for flexibility within the models, responsivity to children's functional needs, embedded support, plus professional trust and agency to act appear integral to the implementation; though further detail about the processes involved needs to be gathered.

CHAPTER 4: A MULTI-TIERED SYSTEM OF SUPPORT IN PRACTICE; WHAT IS THE IMPACT ON CHILDREN'S VOCABULARY DEVELOPMENT?

4.1 Introduction

Chapter three sought to describe the implementation of the MTSS in practice for children with differing profiles of speech, language and communication skills. The following chapter takes this further to explore the effectiveness of this MTSS in supporting children's SLC development, specifically focusing on receptive vocabulary. The rationale for the focus on vocabulary is detailed in the following introductory section.

4.1.1 The importance of early vocabulary development

To demonstrate the importance of vocabulary development we turn to longitudinal research from non-clinical samples. Studies exploring data from cohorts such as the British Cohort Study 70 (BCS70), the Millennium Cohort Study, (MCS) the Avon Longitudinal Study of Parents and Children (ALSPAC), the Early Language in Victoria Study (ELVS), the Longitudinal Study of Australian Children (LSAC) and the Ottowa-Carlton cohort have shown the multifarious implications of poor vocabulary skills in the early years. Children's early vocabulary development has been shown to be associated with school readiness (Roulstone, Law, Rush, Clegg, & Peters, 2011), literacy development (Duff, Reen, Plunkett, & Nation, 2015; Law et al., 2009; Russell, Ukoumunne, Ryder, Golding, & Norwich, 2018; Song et al., 2015; Young et al., 2002; Zubrick et al., 2015); socio-emotional and behaviour development (Brownlie et al., 2004; Clegg, Law, Rush, Peters, & Roulstone, 2015; Forrest, Gibson, Halligan, & St Clair, 2018; Hartas, 2011) and employment (Armstrong et al., 2017; Law et al., 2009).

Receptive vocabulary skills at five were used as a determinant of language difficulties in the 1970 Birth Cohort Study (BCS-70). Evidence from this cohort indicates that receptive vocabulary at age five is associated with life satisfaction and agency (Law et al., 2009); those with more well developed vocabulary knowledge at age five go on to be more satisfied with their lives and to feel more in control. Additionally, children with better vocabulary skills at age five were also shown to have better mental health at age thirty (Schoon, Parsons, Rush, & Law, 2010). Educationally and economically, within a subgroup of this cohort (all of the twins plus 10% of the remaining sample), children with poorer receptive vocabulary at age five were shown to have poorer academic outcomes and lower income at age thirty (Feinstein & Duckworth, 2006). On the other hand, 61% of the children identified with poor receptive

vocabulary skills at five were shown to develop into competent readers by the age of ten (Parsons, Schoon, Rush, & Law, 2011), in some ways a positive finding. This finding is of similar magnitude to that found by Zubrick et al. (2015), who found that although low receptive vocabulary at age four resulted in increased risk of literacy difficulties at age 10, the majority of children with low receptive vocabulary scores at age four went on to perform in the middle to high range for literacy at age 10. In contrast to the evidence from clinical cohorts, within the BCS-70 cohort, boys presented with higher receptive vocabulary scores at age five than girls (Law, Rush, Parsons, & Schoon, 2013).

The Millennium Cohort Study, a study of children born at the turn of the century, utilised measures of expressive and receptive vocabulary at differing time points within the study. Expressive vocabulary at age five was shown to be associated with poorer word reading skills at age seven (Russell et al., 2018), in addition to increased emotional difficulties up to age eleven (Forrest et al., 2018; St Clair, Forrest, Yew, & Gibson, 2019). A measure of receptive vocabulary was also used within the longitudinal Ottowa-Carlton Cohort. The children were recruited at age five in 1982; data from the second round of follow up assessments found that children who had performed poorly on the measure of receptive vocabulary at age five, had significantly lower levels of academic achievement at age 18-19 (Young et al., 2002). Twenty-year follow up of this cohort found that the children with poorer receptive vocabulary skills at age five also showed poorer outcomes in terms of their occupational status, in addition to their academic achievement and language skills at age 25 (Johnson et al., 2010).

In sum these studies show that early vocabulary development is a critical contributing factor to later language, academic, socio-emotional and economic outcomes. It is therefore important to consider how early vocabulary development can be supported in order to ameliorate these difficulties and prevent the associated negative consequences.

4.1.2 Vocabulary development trajectories

In order to design interventions that serve to support children with vocabulary difficulties to close the gap with their peers, it is important to consider what is known about typical vocabulary development and factors that influence this. Children begin to develop their receptive and expressive vocabulary skills very early in development and these are subject to rapid growth during the early years. Children as young as 11 months have begun to develop

their receptive vocabulary knowledge, with a median reported receptive vocabulary of 54 words, with a sharp increase to 169 at 16 months (Fenson et al., 1994). With both receptive and expressive vocabulary, substantial variability becomes apparent as early as 12 months and dramatically increasing up to 24 and 30 months (Fenson et al., 1994; Reilly et al., 2009). Cross-sectional studies have shown at 16 months the top 10% of a cohort understands around 321 words compared to 92 words in the lowest 10% (Fenson et al., 1994). A more recent longitudinal study found that, at two years of age, the mean expressive vocabulary of the almost 2000 strong cohort was 260 words (SD 162, range 0 – 679) (Reilly et al., 2009).

Understanding the factors that lead to such vast variability in children's vocabulary development is integral in understanding how to support those children who are struggling to acquire vocabulary at the rate of their peers. Factors related to the child and their environment have been found to influence vocabulary development, such as gender (Reilly et al., 2010; Schoon et al., 2010); SES (Farkas & Beron, 2004; Reilly et al., 2010); home learning environment (Rowe, 2012; Sénéchal & LeFevre, 2002); maternal characteristics such as mental health, age, employment and education (Becker, 2011; Reilly et al., 2010); and race and non-English speaking background (NESB)(Farkas & Beron, 2004; Reilly et al., 2010). These factors do not occur in isolation and it is important that we begin to understand how exposure to different and multiple risk factors cumulatively impacts on children's vocabulary development and growth. In their 2013 analysis of children's receptive vocabulary performance and growth between the ages of four and eight, Taylor et al. (2013) found that NESB, school readiness, reading with children, sibship size, income, birth weight and maternal education all contributed to children's receptive vocabulary at age four when included in a multivariate model. NESB and school readiness were also associated with differential rates of vocabulary growth, with those from a NESB and those who showed lower levels of school readiness, demonstrating more rapid growth and thus beginning to close the initial vocabulary gap with their peers. The area measure of SES, when included in the multivariate model, did not have a significant effect on the children's vocabulary at age four, however there was a negative slope effect, meaning that children from the areas with the highest levels of neighbourhood deprivation exhibited slower rates of vocabulary growth over time, thus widening the gap in receptive vocabulary performance between them and their peers between the ages of four and eight. These risk factors explained only a small proportion of

the observed variation in vocabulary performance and rate of growth, a similar finding to other studies of vocabulary development (Fernald & Marchman, 2012; Rowe, Raudenbush, & Goldin-Meadow, 2012).

4.1.3 The impact of deprivation of vocabulary development

Of the risk factors shown to impact vocabulary development and growth, SES is perhaps one of the most widely reported and pertinent to this study. There is much interest and focus on discrepancies between children growing up in affluent areas and those growing up experiencing varying degrees of poverty and deprivation. This interest spans many domains as researchers and policy makers strive to tackle inequalities linked to social determinants of health, wellbeing, and social mobility. As discussed in Chapter One, there is a robustly evidenced social gradient for language development and language skills across the life-course. Vocabulary is a specific component of language development that has received much attention in the research exploring links between poverty and language. In fact, discrepancies in children's vocabulary and verbal processing speed (known to be predictive of vocabulary development) have been shown to emerge as early as 18 months between socio-economic groups (Fernald et al., 2013).

It has been shown that the children's early language environment and experiences influence their vocabulary development. Econometric measures of SES, parental (usually maternal) education and household income are often used as a proxy for the child's home language environment in studies exploring the link between deprivation and vocabulary development. Although linked, studies have shown that this over-simplifies the complex relationship between deprivation, the language environment and children's vocabulary development (Law, Clegg, Rush, Roulstone, & Peters, 2019; Roulstone et al., 2011). Many studies show that deprivation is associated with poorer vocabulary outcomes (Becker, 2011; Christensen et al., 2014; Fernald et al., 2013; Hart & Risley, 1995, 2003; Henrichs et al., 2011; Levine et al., 2020; Taylor et al., 2013; Zubrick et al., 2015), though some studies do not arrive at the same conclusions (Reilly et al., 2009). This variation could be due to variation in the way that deprivation is measured, the age of the children when the relationship was explored, or the representativeness of the samples.

Encompassed within the home language environment are the kinds of language and the amount of interaction that the child is engaged in in the home, which have been found to be robustly linked to children's vocabulary size at a variety of ages. In their seminal study, Hart and Risley (1995, 2003) compared the vocabulary growth of children from welfare, working class and professional class families in the US. They found that children from lower SES households (welfare and working class) exhibited a slower rate of vocabulary growth than those children growing up in less deprived homes. They were also exposed to considerably less vocabulary and parental interaction styles were significantly different between the parents in the welfare group and the parents in the professional group. When exploring the data, they found that it was actually the measures of the type and frequency of the input that were stronger predictors of children's vocabulary skills than the measures of SES itself. This suggests that it is the types of things that occur within the home that is the important factor associated with language development, rather than SES per se. However, they found that SES scores served as a relatively reliable proxy for this language environment; more of the behaviours and activities positively associated with language development were found in families with higher SES, and this finding has been replicated (Hoff, 2006; Miser & Hupp, 2012).

This evidence indicates that it is, at least partially, a difference in language experience rather than a difference in underlying for language learning that results in children from lower SES backgrounds having poorer vocabulary skills. These differences in language experience are, in part, due to genetic differences, as shown by Dale et al. (2015), as well as environmental characteristics. This language experience also includes the aspects of the home environment such as exposure to books, regular reading and household routines. These are also aspects which have been linked to vocabulary development; the presence of more books, more frequent reading, more robust routines are all linked to more well developed vocabulary skills (Becker, 2011; Law et al., 2019). This evidence supports the argument that environmental characteristics such as SES, have an indirect impact on children's vocabulary development as a result of the impact on more proximal processes such as those described above (Bronfennbrenner & Morris, 2007). It could be that parents within less deprived households hold different values; have a different understanding about language promoting practices; or are able to make different decisions about how they utilise their resources to support

children's development. For example, in a household with lower income, priorities for resource allocation, be that monetary in the buying of books, or be that time based in terms of time interacting, may need to be focused on different areas of need, such as ensuring safety and that children in the household have enough food to eat. Perkins, Finegood, & Swain (2013) discuss the way that low SES is linked to language development using two theoretical models, the family stress model and the parental investment model. The family stress model links parenting with the emotional distress that can occur as a result of living in poverty and the parental investment model outlines parents focusing on meeting basic needs rather than parenting behaviours that are facilitative of language development. The importance of early vocabulary skill for subsequent outcomes, alongside the unfair distribution across society, has positioned vocabulary as a prime area for intervention in the early years.

4.1.4 Targeting vocabulary development as part of preventative interventions

Supporting early vocabulary development has long been an area of focus for intervention studies, particularly as the evidence of the 'word gap' between social classes has grown. The relevant evidence includes a plethora of intervention studies aiming to support vocabulary development (receptive and/or expressive) with a mixed picture of success. Some studies find improvements on standardised measures of vocabulary (Hargrave & Sénéchal, 2000; Justice et al., 2010; Wasik & Hindman, 2011; Motsch & Ulrich, 2012). Others find that children make improvements on researcher-developed measures (Coyne, McCoach, & Kapp, 2007; Coyne, Simmons, Kame'enui, & Stoolmiller, 2004) but do not utilise standardised assessment. Some studies show improvements on researcher-developed measures, but the intervention does not facilitate enough generalised improvement in vocabulary learning that the improvement is evident on standardised measures (Haley et al., 2016; Lorio & Woods, 2020; Neuman, Newman, & Dwyer, 2011; Pollard-Durodola et al., 2011). There are also some studies that find no improvement on the measures used (Cabell et al., 2011; Justice et al., 2010; Nicolopoulou et al., 2015). Although all aiming to improve children's receptive/expressive vocabulary skills, the aforementioned studies are varied in their approaches and designs. Those showing no significant improvement on vocabulary measures have a more explicit focus on other domains; Cabell et al. (2011) focus on teacher responsivity and the impact this has on children's language development; Justice et al. (2010) focus predominantly on improving print knowledge with vocabulary as an additional consideration and Nicopoulou et al. (2015)

focus on story-telling and story acting, hypothesising that this will impact vocabulary development. The less explicit focus on vocabulary perhaps explains the lack of significant improvement in vocabulary in these studies. Of particular relevance to this thesis are studies that explore whether interventions can support children with poorer vocabulary, or increased risk factors (e.g. low SES) to begin to close the gap between them and their peers. This appears to be a challenging feat, with a number of studies showing that intervention can support children to keep pace with their non-delayed peers (Coyne et al., 2004; Dockrell, Stuart, & King, 2010; Goodson et al., 2011; Pollard-Durodola et al., 2011; Pullen et al., 2010); but there is very little evidence of them beginning to close this gap.

A meta-analysis in 2010 (Marulis & Neuman, 2010) showed evidence that children from mid to high income backgrounds benefitted from vocabulary intervention to a greater degree than those from a lower income background. They found that the gap between the lowest SES children and those from mid to high-income backgrounds increased. This finding was also shown when looking at the effect of nursery attendance on expressive vocabulary (Becker, 2011). Using parental education to represent social background, Becker (2011) found that the difference between the expressive vocabulary performance of children of higher and lower educated parents increased between the ages of three and five years of age. This increase was not attributed to nursery attendance, however. In fact, there was a positive differential impact of nursery attendance on vocabulary performance for children with lower educated parents. Those children from lower educated households who attended nursery settings, showed commensurate expressive vocabulary progress with their peers whose parents had higher levels of education. Conversely, without nursery attendance children from low education families made significantly less progress, serving to widen the vocabulary gap. This shows the importance of nursery attendance, and interventions within these settings, to at least prevent children from more deprived backgrounds from falling further behind with their vocabulary knowledge.

Although vocabulary has been shown to be predictive of a range of important long-term outcomes, it is often included in large-scale studies to represent language development more generally. This is due to the relative speed and ease of testing when compared to other aspects of language development, as well as its high levels of correlations with other language tests. Could it be that this has led to a disproportionate focus on specifically targeting

vocabulary development in interventions to prevent the related long-term consequences of poor 'language' development, as measured by vocabulary? That is, could vocabulary be a proxy for wider language development and hence should the response be for broader language focussed interventions.

To answer this question, we must turn to theories of language acquisition. Some theorists propose an innate grammar module, or domain-specific systems for language learning (Chomsky, 2000; Pinker, 2007; Van Der Lely, 2005; Van Der Lely & Pinker, 2014). From this perspective it could be argued that to facilitate grammatical progress grammatical constructions would need to be an explicit focus of intervention. However, a number of other theories of language acquisition argue that distinct, modular processes do not govern vocabulary and grammatical development; rather they are governed by related mechanisms that are inextricably linked over development (Chiat, 2001; Karmiloff-Smith, 1996; Marchman & Bates, 1994; Tomasello, 2005).

A number of theoretical perspectives suggest that the development of lexical knowledge in turn facilitates grammatical learning. The Competition Model theorised by Marchman & Bates (1994) expounds a critical mass hypothesis which states that "the learning of lexical items triggers the organisation of lexical information in such a way as to allow the abstraction of general patterns and subsequent productive usage" (p360). In other words, the more words a child learns, the easier it is for them to identify different morphological and grammatical patterns within their language. The Mapping Theory of language acquisition (Chiat, 2001) describes how phonological processing and semantic cues work together to enable children to map meaning onto distinct phonological units recognised as words. This mapping process also extends to identifying morphological and syntactic features with the speech streams and this builds upon earlier established lexical meanings and common phonological forms. In this instance increased vocabulary knowledge means more well specified phonological representations, leading to more efficient processing of not only additional vocabulary items, but also grammatical information as well. The usage-based theory of language acquisition (Tomasello, 2005), a social-pragmatic theory, explains vocabulary and grammatical learning within the social context. Children use the whole communicative situation to interpret the speakers' communicative intent. Tomasello hypothesises that word learning and grammatical learning share the same fundamental

learning processes, pre-requisite process (speech processing, conceptualising referents), foundational processes (joint attention and intention reading), and facilitative processes (lexical contrasts and linguistic context).

Two large scale studies exploring the dimensionality of language development between the ages of four and eight years of age show that the relationship is not as static over the course of development as could be construed from the evidence presented above (Language and Reading Research Consortium, 2015; Tomblin & Zhang, 2006). Rather, that there is a developmental relationship over time between vocabulary and other aspects of language. These studies explored whether vocabulary and grammar, and in the case of the Language and Reading Research Consortium (2015) discourse, were governed by uni-dimensional processes, or separate processes. Their findings support an emergent dimensionality of language, rather than distinct, innate processes governing different aspects of language development from the beginning. In the earliest grades (Kindergarten to Grade 2) there was no clear evidence that vocabulary and grammar were developing separately. However, by the time the children reached Grade 3 (age 8), when vocabulary and grammar were the two dimensions studied there was a clear dimensionality between the domains at this stage. When discourse was investigated, as a third dimension of language development, there was evidence of three separate dimensions, however vocabulary and grammar were highly correlated. This evidence could be utilised to support an argument for a robust focus on vocabulary development over grammatical development in the early years, or to counter the same argument. The evidence of dissociation between vocabulary and grammar could indicate that neglecting to focus specifically on grammar in early intervention could hinder grammatical development. However, the clear uni-dimensional nature of vocabulary and grammar in the early years perhaps indicates that in the early stages of language development, both vocabulary and grammatical learning are governed by the same processes and support one another.

When considering both theoretical hypotheses about language acquisition and the extant evidence base of vocabulary interventions, it is clear that there is a real risk that, if not carefully designed, interventions could service to widen inequalities between high and low performers. As the evidence presented shows, many interventions to support vocabulary development, and close the gap, are implemented within the classroom. This highlights the

caution that must be exercised when planning and implementing interventions designed to support vocabulary development of all, when one of the aims of these interventions is to support those with the least secure vocabulary foundations to close the gap.

This uneven starting point is one of the reasons that MTSS are widely recommended. It is vital to not only support all children's vocabulary development, but also to supplement this high-quality instruction with additional support for those with less secure foundations. This is supported by findings such as those of Loftus et al. (2010). In their study, children identified as at risk of vocabulary difficulties that received tier two interventions kept pace with their typically developing peers receiving tier one, only when getting the additional support. There is a real need to evaluate interventions in this way, considering the cumulative and interactive effects of universal approaches and targeted interventions being delivered in conjunction.

The evidence reviewed above leads us to the question of, can we ameliorate the effects of cumulative exposure to multiple risk factors once the children enter nursery at age 3? If we provide children with supportive language environments, focussed child-directed speech (CDS) and timely interventions can we help them to develop larger vocabularies and begin to close the gap between them and children entering nursery with age-appropriate vocabularies?

4.2 Research questions and hypotheses

With respect to an MTSS supported by an SLT embedded within early years settings serving communities in a coastal region of England with high levels of deprivation:

3. What is the nature of the effects of the MTSS, on children's receptive vocabulary development?
    a. Does the MTSS improve participants' receptive vocabulary development over and above the effects of usual practice in early years provision?
    b. How do the different tiers of the MTSS affect participants' receptive vocabulary development over and above the effects of usual practice in early years provision?

Considering the evidence presented above it is hypothesised that inclusion in the NNUTS MTSS will positively impact the vocabulary development trajectory of participants included. It is hypothesised that the enhanced universal environment will enable those children

accessing the universal tier of the intervention to accelerate their vocabulary growth in comparison to those in the control group. This is particularly important when, as shown in Chapter Three, large portions of the nursery cohort are presenting with SLCN and being primarily supported through the universal tier of the intervention. The targeted tier is hypothesised to further enhance the vocabulary growth of the children included in order to help them to close the gap with their peers, or at least to keep pace. These children are those that have been identified by teaching staff as having SLCN that are more impactful on their everyday interactions, who require additional support. For those children with the most significant level of need, those accessing the specialist tier, it is hypothesised that they may make real-terms gains in their vocabulary skills, but that this may not be reflected in standard score gains. In other words, the gap between them and their peers may widen over time, despite progress being made. This is due to these children having the most significant and multi-domain difficulties that are persisting over time (Chapter 3).

4.3 Methodology

4.3.1 Participants

Full details about the participants can be found in 2.3. All participants were included in this section of the analysis. Details of participants' age and SES deciles on recruitment to the project (entry to nursery for cohorts 2-4) are shown in Table 4.1. A portion of cohort one, those in the experimental condition in January 2011, are referred to as the 'Reception' group after the training delivery in September 2011 (Figure 2.1). These children were part of the trailblazer campus, so were receiving the MTSS intervention in the first two terms. Once they moved to Reception however, they were no longer in receipt of the MTSS support.

4.3.2 Measures

For a full description of the variables within the study see chapter (2 2.5). Variables specifically included in these analyses are outlined below.

Table 4.1 Characteristics of participants in each cohort at recruitment

Cohort	Whole			Male			Female		
	n	age in months (SD)	SES decile (SD)	n	age in months (SD)	SES decile (SD)	n	age in months (SD)	SES decile (SD)
1	196	46.70 (3.64)	2.39 (2.20)	98	46.53 (3.65)	2.26 (2.14)	98	46.87 (3.65)	2.52 (2.64)
2	68	38.62 (1.51)	2.14 (2.08)	34	38.76 (1.81)	1.90 (1.80)	34	38.47 (1.13)	2.38 (2.32)
3	48	39.88 (.91)	2.24 (2.10)	28	39.93 (.88)	2.27 (2.34)	20	39.80 (1.01)	2.21 (1.78)
4	97	29.12 (1.58)	2.08 (2.22)	41	39.20 (1.69)	1.82 (1.83)	56	39.07 (1.51)	2.27 (2.48)
Total	409	409	376[a]	201	201	184[a]	208	208	192[a]

Note. SES deciles – http://imd-by-postcode.opendatacommunities.org/

[a]missing data for SES deciles due to no postcode data available on http://imd-by-postcode.opendatacommunities.org/

4.3.2.1 Response variable

The participant's standard scores on the British Picture Vocabulary Scale – 3rd Edition (Dunn & Dunn, 2009) is the main response variable explored in this chapter. The Theoretical rationale for exploring the developmental trajectories of receptive vocabulary is outlined 4.1. Alongside the theoretical rationale, there were also practical reasons why participants' results on the other measures within the project were not utilised here. Firstly, there was a ceiling effect for both the Rapid Screening Test (Knowles & Masidlover, 1987) and the Early Repetition Battery – Sentence Imitation Test (Seeff-Gabriel et al., 2008). Secondly, not all participants were assessed using a full subtest of the Diagnostic Evaluation of Articulation and Phonology (Dodd et al., 2006), rather only those who were indicated as having difficulties. Thirdly, it was important to use a robustly validated assessment and the BPVS met this

criterion. The ERB is also robustly validated, however there were fewer responses throughout the project for this assessment. Although reasons for missing data were not routinely recorded, researcher feedback noted that a number of participants refused to complete this assessment; it was possible that the expressive nature of the task made some children feel under pressure, particularly with examiners with whom they were not routinely familiar. Table 4.2 presents an overview of the missing data for the ERB and a comparison between the whole sample, the sample with ERB scores and those without ERB scores. This reveals ERB data was more likely to be missing when language skills, as measured by the BPVS and the RST, were lower. With this in mind, utilising the ERB data as the main response variable would result in the presentation of biased results and would not give a robust indication of how those with the most significant SLCN respond to inclusion in the MTSS.

We therefore consider the vocabulary trajectories as representing the least biased estimated of the effects of the intervention on language trajectories. For comparison purposes we also ran the final model developed here using ERB scores. However, the vocabulary measure remains our primary outcome for the reasons given above and in the introduction.

4.3.2.2 Child internal and environmental variables

Participants' age in months (centred at 43.3 months – mean age at assessment point one), gender, SES decile and speech assessment performance were child and environmental factors considered in the analysis. These were included to adjust for their potential effects on language trajectories, which may act as confounds in the analysis. By including them in the analysis statistically controls for their effects. The measure of time used was the participants' age in months rather than the specific point within the project timeline. Age as the metric of time allows a more functional analysis of growth over time and enables the comparison of children at different ages, rather than just different stages within the project.

Table 4.2 Comparison of sample characteristics of those with and without ERB scores.

Mean (unless otherwise stated)	Entire dataset N=2454	Missing ERB n=701	With ERB n=1753
Age (months)	50.8	45.3	53.0
SES decile	2.3	2.0	2.2
BPVS SS	97.3	93.3	97.9
Below BPVS SS (%)	4.2	14.8	1.9
RST	19.9	18.6	20.2
Gender (% male)	49.1	51.6	48.0

Notes. ERB = Early Repetition Battery, sentence repetition subtest. BPVS SS = British Picture Vocabulary Scale Standard Score. Below BPVS SS = those completing the assessment but not achieving the lowest standardised score. RST = Derbyshire Rapid Screening Test.

Total deprivation statistics (http://imd-by-postcode.opendatacommunities.org/) were used to gain the socioeconomic ranking of the children's postcodes; this was done retrospectively in 2019. These rankings are presented as deciles in Figure 2.2 for ease of interpretation. Thirty-three participants did not have their postcodes linked to the indices of deprivation; therefore, they did not contribute to the SES estimates. When models were run with the SES variable included, these participants were omitted. The small number meant that this did not bias the results. The range of the participants' total deprivation statistics was 693-28189 compared to a national range of 1-32,844; the standard deviation is 7229.14.

Each participant's gender was also recorded. Participants' performance on the DEAP Diagnostic Screen was also used as a predictor variable to explore whether potential phonological difficulties significantly impact on receptive vocabulary growth in this cohort.

4.3.3 Data analysis

4.3.3.1 Data sets

For a substantial minority of the participants (54 participants, 79 assessments) it was not possible to assign a standard score on the BPVS due to their raw scores falling below the

minimum required for a standard score as described in the BPVS manual (Dunn & Dunn, 2009). In order to best represent the true performance of the participants, two iterations of the data are used in the analysis; the true standard score dataset (TSS) and the below standardisation threshold dataset (BST). These datasets are described below:

- TSS – this dataset includes all participants who achieved at least one standard score on the BPVS over the duration of the project. Any instances where a participant completed the BPVS but their raw score did not reach the standardisation threshold were treated as missing data and this measurement was omitted from the estimations.
- BST – in this dataset, those instances where participants completed the BPVS without achieving a standard score were all notionally assigned a standard score of 60. This score was utilised to represent the fact that the standard score was lower than 70, the lowest standard score that could be assigned as per the BPVS manual. Thus, this dataset incorporates all of the BPVS data gathered, albeit with a notional value to represent those participants with the most significant vocabulary difficulties.

The rational for analysing the data using these two iterations of the dataset was to ensure that the impact of the intervention on those participants with the most significant receptive vocabulary needs could be captured. There are limitations to this approach in that the notionally assigned standard score of 60 does not capture the variation of those participants below that standardisation threshold and that this was not their 'true' standard score.

4.3.3.2 Analytic methods

Growth curve models with a three-level structure were used to analyse the data for a number of reasons. Traditional approaches to analysing longitudinal data presume that repeated measures are not correlated and that the variability over time is homogenous (Fitzmaurice and Ravichandran, 2008). It was hypothesised that the data in this study were likely to be correlated within individuals (i.e. each measure from the same participant would be correlated to each other in some way) and also across campuses (i.e. performance of children on the same campus may be correlated in some way). It was necessary to utilise a statistical approach which could test these assumptions and account for correlation at several levels. Growth curve models with a nested structure estimate the intercept and slope effects of child

internal and environmental variables, as well as the inclusion in the experimental condition. A three-level nested structure accounted for the fact that responses at each measurement occasion (level one) are nested within individual children (level two). The third level allows for the impact of children nested in campuses to be accounted for. This structure is visualised in Figure 4.1. By taking this correlation, that may account for differences in performance over time, into account, estimates are more conservative than those using more traditional methods, making the conclusions that can be drawn more robust.

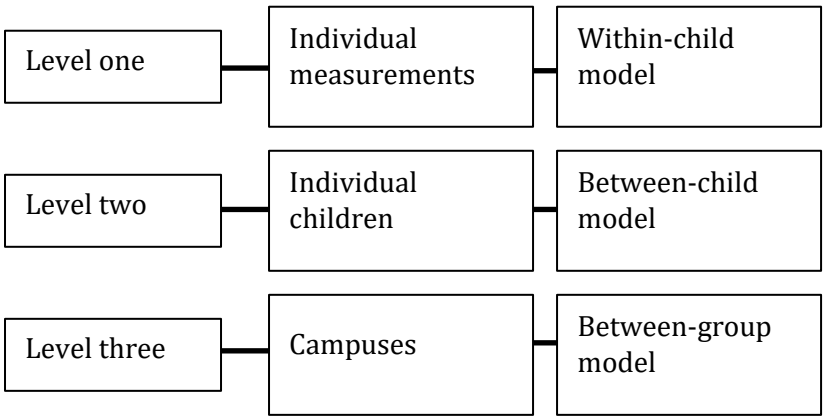

Figure 4.1 Three-level structure of the data

Another rationale for using this approach was that participants entered the study at several different time points, meaning that cohorts were included for an unequal number of assessment periods. More traditional methods, such as repeated measures ANOVA, require balanced datasets, whereas the use of multilevel models allows for unevenly spaced measurements and imbalanced data sets (Singer & Willett, 2003). Within this analysis, the fixed effects are the primary focus in the analysis. With regards to the random effects, an unstructured covariance matrix was applied to the models; this allows the covariance matrix to be freely estimated from the data. Subsequently this provides the best possible model fit and is also an effective way to estimate the covariance matrix where there is unequal spacing between measurements (Singer & Willett, 2003).

The analyses were completed in sequential steps. The first step was to estimate unconditional means and growth models with two and three levels to establish which best fit the data, i.e. to identify whether there was 'true' nesting within campuses (level three), or solely of measurements within children (level two). The models were compared using a likelihood ratio test to establish which model was the better fit, using a threshold of $p<0.005$. The three-level

model was estimated in two forms, both with and without a random slope at the third level. The hypothesis was that vocabulary growth might vary between campuses, in which case a random slope would be necessary at this level, though due to small numbers in some of the campuses this may not be possible to include in the analyses. A likelihood ratio test was used to establish whether random effects were necessary at this third level.

In the unconditional growth models, the single variable of age was included. This was parameterized as the participants' age in months, centred at 43.3 months (the mean age at assessment point one). The rationale for centring the age is to aid interpretation of the intercept value; this ensures that the intercept value represents a child at the mean age, not a child at age 0, which would be the case without centring.

Following the guidance in Singer & Willett (2003), as well as the traditions within healthcare and education research, a systematic sequence of univariate models were then fitted to establish the impact of each individual predictor. This approach establishes whether each individual predictor has a significant impact on receptive vocabulary. If so, it is then carried forward into a covariate model.

This stage univariate model building stage was completed using both the TSS dataset and the BST dataset. In order to ascertain the impact of individual predictors on vocabulary growth, interaction variables were created for gender, SES decile, speech screen performance and campus. These were then individually included in univariate models and carried forward to the covariate model if significant. Utilising this approach, of first establishing univariate models to ascertain whether predictors have a significant impact on receptive vocabulary, introduces the chance that sources of variation may be missed where a predictor variable does not make an individual contribution, but could interact with other variables to produce a meaningful impact.

Table 4.3 Predictor variables added into univariate models

Predictor Variable	Fixed/random effect	Continuous/factorial	Time variant/time invariant
Age (centred)	Random (between individual)	Continuous	Variant
Gender	Fixed	Factorial: Male (reference), Female	Invariant
SES decile	Fixed	Factorial: D1 (reference), D2, D3, D4, D5, D6, D7, D8, D9, D10	Invariant
Speech performance	Fixed	Factorial: No difficulty (reference), Difficulty	Variant
Campus	Fixed	Factorial: C1 (reference – trailblazer), C2, C3, C4, C5	Invariant
Gender-Age interaction	Fixed		
SES decile -Age interaction	Fixed		
Speech -Age interaction	Fixed		

Campus-Age interaction	Fixed		
Experimental condition	Fixed	Factorial: 0 terms (reference), 1 term, 2 terms, 3 terms, 4 terms, 5 terms	Variant
Provision	Fixed	Factorial: Control (reference), Universal tier, Targeted tier, Specialist tier, Reception	Variant

4.3.3.3 Missing data

The use of the growth curve models with a three-level nested structure allows for unevenly spaced measurements and imbalanced data sets (Singer & Willett, 2003). There was some planned imbalance within this dataset (waves within the study). There was also unplanned imbalance, due to participants not completing every assessment at every wave in which they were present, or data being unavailable (e.g. SES data). There was no distinction made in the data collection between those participants who have no scores for an assessment due to absence, refusal or time limitations. Levels of missing data at each time point are outlined in Table 4.4.

Table 4.4 Assessments completed at each assessment point

	Assessment point (%)					
	1	2	3	4	5	6
Participants	264	312	409	409	409	409
BPVS RS	234 (88.6%)	247 (79.2%)	362 (88.5%)	351 (85.8%)	348 (85.1%)	338 (82.6%)
BPVS SS	211 (79.9%)	234 (75.0%)	338 (82.6%)	341 (83.4%)	344 (84.1%)	333 (81.4%)
ERB	220 (83.3%)	238 (76.3%)	301 (73.6%)	297 (72.6%)	321 (78.5%)	316 (77.3%)
RST	249 (94.3%)	271 (86.9%)	191 (46.7%)	343 (83.9%)	353 (86.3%)	331 (80.9%)
Speech screen	247 (93.6%)	281 (90.1%)	374 (91.4%)	331 (80.9%)	348 (85.1%)	335 (81.9%)

Notes. ERB = Early Repetition Battery, sentence repetition subtest standard score. BPVS SS = British Picture Vocabulary Scale Standard Score. BPVS RS = British Picture Vocabulary Scale Raw Score. RST = Derbyshire Rapid Screening Test.

4.4 Results

4.4.1 Model building – determining the model structure

The repeated measures nature of the data dictates that a minimum of a two-level model be required to take into account the fact that two measurements from the same participant at different time points will be more highly correlated than two measures from two different participants. The first phase of the model building explored whether this two-level structure was sufficient to account for clustering within the data, or whether a third level was required in order to capture similarities between participants who attend the same campus. Unconditional means models were initially fitted using a two and three level structure; estimates from these empty models were then compared using a likelihood ratio test, LR = 14.42, $p < .001$ indicating that the null hypothesis that vocabulary scores for participants within the same campus are not correlated can be rejected, and the three-level model utilised in the next stages of model building.

Unconditional growth models were then estimated comparing the model fit when random slopes at level two, the between-child level, and level three, the between-campus level were

included. The likelihood ratio test, LR = 1.90, p = .39, indicated that the three-level model including a random slope at level two better fit the data than the three-level model including a random slope at both levels two and three. In this instance the null hypothesis that participant's vocabulary growth does not vary across campuses can be accepted. The three-level model containing a random slope at the between-child level is utilised in the next stages of model building. Fixed and random effects for all of these empty models are presented in Table B1 (Appendix B). Several findings stand out from these models; the negative correlation in the 'random slope level 2' model indicates that those participants with lower vocabulary performance initially, begin to catch up with their peers over time. Additionally, the correlation of the between-campus residuals is estimated as 1.0, which implies that the data does not provide sufficient information on this correlation, which could be due to the small number of campuses.

4.4.2 Which variables need to be controlled for in the covariate model exploring the impact of the intervention?

4.4.2.1 True standard score dataset

Gender, SES decile, speech performance and the campus variable, and their interaction terms with age, were each included in bivariate models to establish their individual contributions to children's receptive vocabulary intercept and slope. Gender, with male as the reference category, made a significant contribution to the participants' intercepts. Female participants were estimated to have higher intercept scores by 3.61, $p < .001$ standard score points. There was no significant effect of gender on slope. Due to this significant impact on intercept, gender, but not the interaction term with age, was included in the subsequent covariate model.

Participants' level of deprivation, as measured by the IMD decile ranking (decile 1 as the reference category), only showed a significant effect for intercept when participants were living in a household ranked within the 3rd or 6th decile. These participants scored significantly higher than those in decile 1, 5.00, $p < .05$ and 6.06, $p < .05$ respectively. The interaction effect was significant for those living in the 6th decile and they progressed significantly slower, -.37, $p < .05$. No other SES decile approached significance. Due to only two of the ten-decile rankings significantly contributing to receptive vocabulary development, and the limited SES variation within the cohort, this variable was not included in subsequent covariate models.

However, it is an important variable to consider in any future similar evaluations, particularly those with a broader SES representation within the cohort.

Participants' speech assessment performance was parameterised as a dichotomous variable of 'no difficulty' (reference value) versus 'difficulty'. The results show that having a speech difficulty had a significant impact on receptive vocabulary intercept but not slope estimates. Participants with speech difficulties intercept scores were 2.54, $p < .01$ standard score points lower than those with no difficulty. Due to the significant impact on intercept values, the speech variable was included in subsequent covariate models. The intercept term was not taken forward.

The campus attended by participants was included in a bivariate model to ascertain whether participant's vocabulary scores and slope varied across campuses. The bivariate model showed a significant effect positive effect on intercept values for those participants attending campus 2 and campus 3, in comparison to those attending campus 1 (the trailblazer site), 4.67, $p < .01$ and 7.16, $p < .001$ respectively. There was however no significant effect on the participants' slopes. This indicates that the vocabulary gap between the different campuses does not widen; on the other hand, it does not appear to reduce over and above the wider catch up effect described below.

In the bivariate models the negative correlation within the random portion of the models indicate that as participants' intercept scores increase, their rate of vocabulary growth decreases. This shows a catch-up effect for those participants entering nursery with lower vocabulary scores. This estimate for the bivariate gender model was -.49 [SD -.60, -.36]; for the SES decile bivariate model was -.47 [SD -.59, -.33]; the speech bivariate model was -.50 [SD -.62, -.37]; and the bivariate campus model was -.49 [SD -.60, -.36]. These correlation estimates are relatively stable, with small standard deviations. A correlation of between .4 and .6 is generally regarded as representing a moderate relationship between variables, indicating that participants with lower receptive vocabulary scores initially, make greater gains than those with higher receptive vocabulary scores. In effect, they begin to 'close the gap'.

Gender, speech and campus variables were then included in a covariate model to ascertain whether they continued to make statistically significant unique contributions to the intercept

values. Each variable remained significant. Female participants are estimated to have significantly higher intercept scores than males; those with speech difficulties significantly lower intercept scores than those with no identified difficulties; and participants attending campus 2 and campus 3 significantly higher intercept scores than those attending campus 1 (the trailblazer campus). The negative correlation between mean receptive vocabulary score and age also remained, -.52 [SD -.63, -.40].

4.4.2.2 Below standardisation threshold dataset

Gender, SES decile, speech performance and the campus variable, and their interaction terms with age, were each included in bivariate models to establish their individual contributions to children's receptive vocabulary intercept and slope. Gender, with male as the reference category, made a significant contribution to the participants' intercepts. Female participants were estimated to have higher intercept scores by 5.08, $p < .001$ standard score points. There was no significant effect of gender on slope. Due to this significant impact on intercept, gender, but not the interaction term with age, was included in the subsequent covariate model.

Participants' level of deprivation, as measured by the IMD decile ranking (decile 1 as the reference category), had no significant effect on intercept. Those participants living in areas within the 6th decile rank improved significantly slower than those in decile 1, -.40, $p < .05$. No other SES decile approached significance. Due to only one of the ten decile rankings significantly contributing to receptive vocabulary development, and the limited SES variation within the cohort, this variable was not included in subsequent covariate models. However, it is an important variable to consider in any future similar evaluations, particularly those with a broader SES representation within the cohort.

Participants' speech assessment performance was parameterised as a dichotomous variable of 'no difficulty' (reference value) versus 'difficulty'. The results show that having a speech difficulty had a significant impact on receptive vocabulary intercept and slope estimates when these lower performing participants were included in the analysis. Participants with speech difficulties intercept scores were 3.06, $p < .001$ standard scores lower than those with no difficulty. Participants with speech difficulties receptive vocabulary standard scores increased by .18, $p < .05$, points per month more than those with no speech difficulty, indicating some

reduction in the initial gap in scores. Due to the significant impact on intercept and slope values, the speech variable and the interaction term were included in subsequent covariate models.

The campus attended by participants was included in a bivariate model to ascertain whether participant's vocabulary scores and slope varied across campuses. The bivariate model showed a significant effect positive effect on intercept values for those participants attending campus 2 and campus 3, in comparison to those attending campus 1 (trailblazer campus). When exploring the effect on slope, there was only one campus significantly different to campus 1 (trailblazer campus). Participants attending campus 5 experienced slower growth, evidenced by the negative interaction term. Each month these participants' rate of growth was .32, $p < .05$, standard score points slower than those in campus one. Due to the effect on both intercept and slope, this variable is included in the subsequent covariate model.

In the bivariate models the negative correlation within the random portion of the models indicate that as participants' intercept scores increase, their rate of vocabulary growth decreases. This shows a catch-up effect for those participants entering nursery with lower vocabulary scores. This estimate for the bivariate gender model was -.56 [SD -.65, -.46]; for the SES decile bivariate model was -.56 [SD -.65, -.46]; the speech bivariate model was -.57 [SD -.66, -.46]; and the bivariate campus model was -.57 [SD -.65, -.46]. These correlation estimates are relatively stable, with small standard deviations. A correlation of between .4 and .6 is generally regarded as representing a moderate relationship between variables, indicating that participants with lower receptive vocabulary scores initially, make greater gains than those with higher receptive vocabulary scores. In effect, they begin to 'close the gap'.

Variables making a significant contribution to intercept and/or slope were then included in a covariate model to ascertain whether they continued to make statistically significant unique contributions to the intercept values. Gender, speech performance and campus continued to make a unique contribution to receptive vocabulary intercept. The effect of both slope and campus (campus 5) on slope also remained significant; though this was only marginally so for the campus variable, -.31, $p = .048$. Each of these variables and their interactions making a

significant contribution to receptive vocabulary intercepts and slopes were taken forward into the models exploring the impact of inclusion in the MTSS.

Table 4.5 Bivariate model estimates for the True Standard Score dataset and the Below Standardisation Threshold dataset

Fixed Effects n	TSS		BST	
	Intercept Coefficient (95% CI)	Slope Coefficient (95% CI)	Intercept Coefficient (95% CI)	Slope Coefficient (95% CI)
Gender (ref. male)				
Female	3.69** [1.33, 6.04]	-.06 [-.21, .09]	5.08*** [2.34, 7.81]	-.16 [-.33, .01]
SES decile (ref. D1)				
D2	1.13 [-2.28, 4.54]	.17 [-.04, .38]	1.69 [-2.31, 5.68]	.09 [-.16, .33]
D3	5.00* [.29, 9.72]	-.09 [-.38, .19]	4.81 [-.72, 10.35]	-.14 [-.47, .19]
D4	-6.12 [-28.30, 16.07]	.63 [-.66, 1.93]	-4.03 [-30.44, 22.38]	.47 [-1.07, 2.01]
D5	.81 [-10.86, 12.47]	-.01 [-.76, .74]	-.43 [-13.98, 13.12]	.04 [-.82, .89]
D6	6.06* [1.07, 11.05]	-.37* [-.66, -.08]	5.41 [.29, 11.11]	-.40* [-.73, -.08]
D7	-	-	-	-
D8	5.76* [.32, 11.21]	-.03 [-.35, .29]	6.26 [-.14, 12.66]	-.10 [-.47, .27]
D9	4.92 [-4.54, 14.38]	.12 [-.58, .81]	7.05 [-4.17, 18.27]	-.03 [-.83, .78]
D10	-	-		
Campus (ref. C1 trailblazer)				
C2	4.67** [1.73, 7.62]	.06 [-.13, .25]	5.84** [2.39, 9.29]	-.05 [-.26, .17]

C3	7.16*** [3.31, 11.01]	.08 [-.16, .33]		6.97** [2.50, 11.45]	.02 [-.26, .30]
C4	-.24 [-4.20, 3.73]	.10 [-.15, .36]		-2.46 [-6.99, 2.08]	.23 [-.06, .51]
C5	1.22 [-2.99, 5.43]	-.25 [-.52, .02]		2.05 [-2.87, 6.97]	-.32* [-.62, -.01]
Speech (ref. no difficulty)					
difficulty	-2.54** [-3.98, -1.11]	.11 [-.02, .24]		-3.06*** [-4.56, -1.55]	.18* [.04, .32]

Note: SES = socio-economic status. D = decile. C = campus. ***p<0.001, **p<0.005, *p<0.05. Highlighted = statistically significant.

The impact of inclusion in the NNUTS MTSS was explored in two different ways. Firstly, by adding the 'experimental' variable into the adjusted model. This variable quantified the number of terms participants had completed in the intervention condition and thus was time-varying. In order to then ascertain the impact of the different tiers of the intervention on vocabulary development, the 'provision' variable was included in the adjusted model. This variable indicated the tier of the model at which the participants were receiving intervention at each time point. This was typically cumulative, i.e. if a participant was recorded as being placed at the targeted tier, they were also receiving intervention at the universal tier. There were some instances where this may not have been the case for the specialist tier. For instance, some children were recorded as receiving specialist tier support, i.e. being under the care of the local NHS SLT team, due to experiencing a stammer. In cases such as this, children may not have been receiving input at each of the previous tiers. This is not something that was routinely recorded during data collection.

4.4.3 Does the MTSS improve participants' receptive vocabulary development over and above the effects of usual practice in early years provision?

For both the TSS and BST datasets inclusion in the intervention was shown to have a significant, positive impact on participants' receptive vocabulary growth (Table 4.6). When the lowest scores were omitted (TSS model) the impact of the intervention was only significant when three or four terms were completed. Participants completing three terms in the MTSS could be expected to improve by .82, $p < .001$ of a standard score each month over and above those in the control condition. Participants completing four terms in the MTSS .95,

p < .001 more than those in the control condition each month. Significant impact of inclusion in the MTSS was seen after much less time when those children with the lowest receptive vocabulary scores were included (BST). A significant improvement of 2.10, p < .05 standard score points per month over and above those in the control condition was shown after just one term in the MTSS. This rate of progress slowed somewhat over time over time, but still remained significant.

Table 4.6 Impact of inclusion in the MTSS; fixed effects from the adjusted model

	TSS		BST	
	Intercept Coefficient (95% CI)	Slope Coefficient (95% CI)	Intercept Coefficient (95% CI)	Linear Slope Coefficient (95% CI)
Age[a] (ref. 43.3 months)	-.18** [-.29, -.08]		-.26** [-.43, -.09]	
Gender (ref. male)				
Female	3.25** [1.31, 5.20]		3.72** [1.54, 5.89]	
Speech (ref. no difficulties)				
Speech difficulties	-1.88** [-2.96, -.80]		-2.91*** [-4.34, -1.49]	.12* [.02, .27]
Campus (ref. C1 trailblazer)				
C2	5.27*** [2.72, 7.82]		5.30** [2.94, 8.67]	.11 [-.07, .30]
C3	8.32*** [5.01, 11.64]		8.85*** [4.56, 13.13]	.02 [-.21, .27]
C4	.92 [-2.42, 4.26]		-1.06 [-5.38, 3.27]	.26* [.02, .50]
C5	-2.26 [-5.87, 1.35]		4.11 [-.60, 8.82]	-.72***[-.99, -.46]
Experimental condition (ref. 0 terms				
1	-.95 [-17.06, 15.16]	1.70 [–.13, 3.53]	-1.90 [-20.12, 16.35]	2.10* [.11, 4.10]

2	-3.29 [-13.02, 6.45]	.49 [-.166, 1.14]	-6.73 [-.17.49, 4.03]	.85* [.19, 1.52]
3	-6.89*** [-9.41, -4.38]	.82*** [.67, .96]	-7.83*** [-10.64, -5.02]	1.08*** [.93, 1.24]
4	-4.17 (-12.10, 3.76]	.95*** [.44, 1.47]	-2.55 [-11.57, 6.47]	.97** [.42, 1.52]
5	-1.42 [-7.86, 5.03]	.26 [-.06, .59]	-2.16 [-9.45, 5.13]	.45* [.09, .81]

Note. ***p<0.001, **p<0.005, *p<0.05. Highlighted = statistically significant results linked to the research question.

An effect of note within the BST model here is that the interaction term of the campus variable and age shows slightly different findings than in the previous model not including the intervention variable. Now, the rate of improvement for campuses four and five differ significantly from that at the trailblazer campus (campus one). Participants at campus four are shown to improve significantly more each month, albeit a small amount, .26, $p < .05$ and those in campus five are shown to improve significantly less each month, -.72, $p < .00$.

It is unclear why three terms in the MTSS is associated with a significantly lower intercept. There is no hypothesised impact of inclusion in the MTSS on the vocabulary intercept. It is possible that this is linked to the participants in the model that were included in the MTSS for three terms largely being those children who are the youngest in the school year (i.e. birthdays between April and August). This may mean that they have lower vocabulary scores at their entry point to the project, thus skewing this estimate. Age at entry to nursery was considered for entry to the model as a possible confound; however, due to the complex nature of the sample this data was only available for 213 of the 409 participants.

Interestingly, in these models, entering nursery with a higher age in months is associated with a lower intercept score. This could support existing findings about the cumulative impact of SES on vocabulary development.

4.4.4 How do the different tiers of the MTSS affect participants' receptive vocabulary development over and above the effects of usual practice in early years provision?

The impact of inclusion in individual tiers of the intervention utilising both the TSS and BST datasets is shown in Table 4.7 and the results from the TSS model are graphically presented in Figure 4.1. For each dataset the impact of inclusion in the universal and targeted tiers of

the intervention resulted in a significantly higher rate of progress than in the control condition. This improvement was greater for the BST dataset where the participants with the lowest BPVS scores were included in the model. This was evident at both the universal and targeted tiers. Using the BST dataset, for each month in the universal tier participants improved by .63, $p < .001$ more standard score points than those in the control condition. Over the course of a year, this equates to 7.56 standard score points. Using the TSS dataset, for each month in the universal tier participants improved by .40, $p<0.001$ more standard score points than those in the control condition, this small, but significant difference in trajectory is difficult to see clearly in Figure 4.1. The impact for those in the targeted tier was higher, .55, $p < .001$ and .89, $p < .001$ in the TSS and BST datasets respectively. This is represented clearly in Figure 4.1. Over the course of a year this equates to 6.6 standard score points for the TSS dataset and 10.68 for those in the BST dataset. This implies that there is a cumulative impact of inclusion in the universal and targeted tiers, over and above inclusion solely in the universal tier. Smaller, but significant improvements over and above those in the control condition were observed for the children receiving support at the specialist tier; .32, $p<0.05$ and .53, $p<0.001$ for the TSS and BST datasets respectively. Again, this is difficult to see in clearly in Figure 4.1.

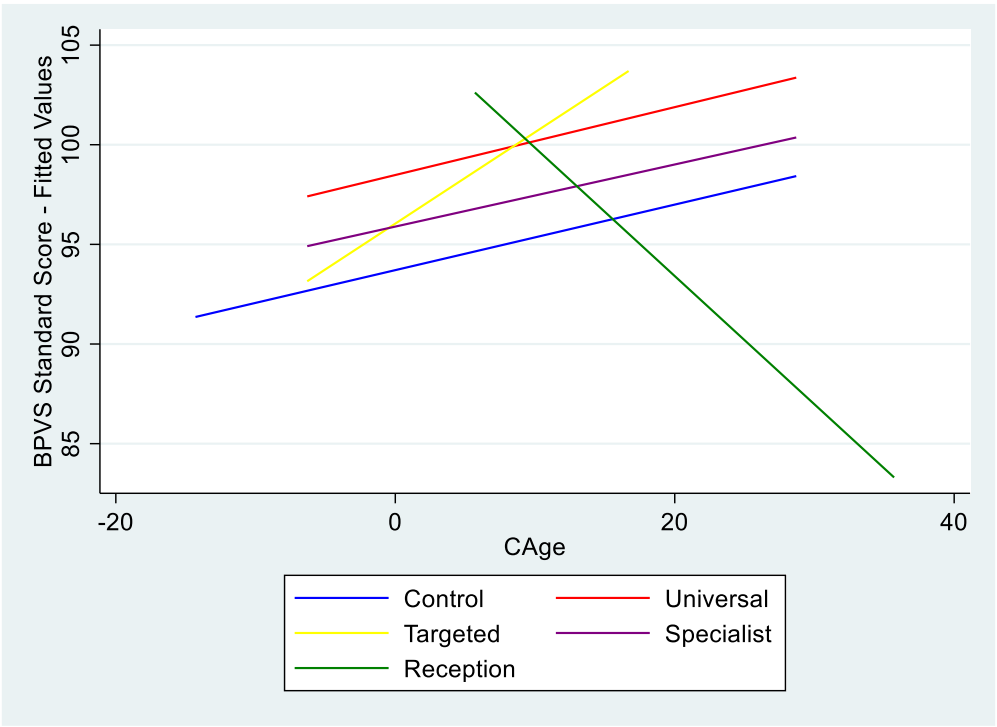

Figure 4.1 Graph to show fitted BPVS trajectories for each of the tiers of MTSS provision

Table 4.7 Impact of inclusion at different tiers of the MTSS; fixed effects from the adjusted models

	TSS		BST	
	Intercept Coefficient (95% CI)	Slope Coefficient (95% CI)	Intercept Coefficient (95% CI)	Linear Slope Coefficient (95% CI)
Age[a] (ref. 43.3 months)	.09* [.02, .20]		.25** [.09, .42]	
Gender (ref. male)				
Female	2.54* [.61, 4.45]		2.82* [.66, 4.98]	
Speech (ref. no difficulties)				
Speech difficulties			-2.21** [-3.70, -.73]	.10 [- .03, .23]
Campus (ref. C1 trailblazer)				
C2	5.16*** [2.71, 7.61]		7.96*** [4.41, 11.52]	-.21* [-.39, -.03]
C3	7.37*** [4.16, 10.56]		9.90*** [5.34, 14.47]	-.23 [-.46, .00]
C4	1.45 [-1.76, 4.70]		.78 [-3.86, 5.42]	.00 [-.23, .24]
C5	-3.91* [-7.37, -.45]		6.26* [1.22, 11.30]	-1.03*** [-1.30, -.77]
Provision (ref. control)				
Universal tier	3.59*** [1.93, 5.25]	.40*** [.26, .55]	4.20*** [2.33, 6.07]	.63*** [.46, .79]
Targeted tier	.70 [-1.61, 3.00]	.55*** [.27, .83]	2.84* [.40, 5.28]	.89*** [.60, 1.19]
Specialist tier	-2.13 [-5.40, 1.14]	.32* [.05, .58]	2.40 [-.91, 5.70]	.53*** [.25, .81]
Reception[a]	11.42*** [5.75, 17.09]	-.48** [-.80, -.16]	13.49*** [7.28, 19.69]	-.61** [-.96, -.26]

Note. ***p<0.001, **p<0.005, *p<0.05. Highlighted = statistically significant results linked to the research question.

The Reception group within this provision variable is an interesting group. Small in number (n=27), this group represents children who attended the trailblazer site (campus one) and

were included in the intervention prior to the commencement of the project. These children then moved into Reception class where teaching staff had not received the training in September 2011, thus moving into the control condition (intervention-control). This group showed significantly slower progress than the control group. This was perhaps influenced by rate of progress being accelerated during inclusion in the intervention, but then slowing once they were not receiving this structured support.

The significantly higher intercept for this Reception group is unexpected. This could perhaps be explained again by the presence of those children who had been included in the intervention prior to the project and thus had elevated scores. Also, this group does contain children who were under the care of the NHS SLT service (the criteria for inclusion in the specialist tier) who were presenting with difficulties such as a stammer, as well as children who may solely have been experiencing speech difficulties with no concomitant language needs. These children could contribute to the higher estimate for the intercept in this group, in comparison to the control group that included children across the spectrum of vocabulary ability. The Reception group being a higher estimate could also be explained by them being the oldest children in the cohort and their ages at the start of the project being higher, so the model is extrapolating down from there and perhaps mis-estimating in this instance. This is a limitation of the complex sample arising from the embedded nature of the study.

In Figure 4.1, the lower intercept for the control group could be seen as anomalous. However, this group contains children who, in the MTSS, would have been in the universal, targeted and specialist tiers. With this in mind, we would expect that their intercept would be approximately an average of the three universal, targeted and specialist intercepts and therefore have a value closer to that of the targeted tier, which is what we do see.

An additional finding of note, from the BST dataset model that included the campus interaction with age, is the significantly slower rate of progress for participants on campus 5 (the smallest campus).

4.4.5 A comparative model for sentence repetition scores

As a form of triangulation, and mindful of the potential biases in the available ERB data, the final linear models utilising both the TSS and BST datasets were also run using sentence

repetition scores as the dependent variable. These results are presented in Table B2 and Table B3 (Appendix B).

4.4.5.1 Impact of inclusion in the intervention on sentence repetition

Inclusion in the intervention had a less notable impact on participant's sentence repetition development in comparison to vocabulary development. Significant improvement over time was only present for the first term of inclusion in the MTSS when utilising the TSS dataset. The BST dataset showed a more widespread improvement with participants showing greater than control improvement in one, three and four intervention terms. Within this BST dataset, those children completing the ERB assessment, but not reaching the threshold to receive a standard score (as per the manual) were allocated a notional standard score of 50. This was lower than the assigned score of 60 for the BPVS, due to the lowest standard score within the ERB manual being 54.

4.4.5.2 Impact of the different tiers of the intervention on sentence repetition

When exploring the impact of the different tiers of the MTSS on sentence repetition, the universal and targeted tiers were shown to facilitate more rapid development with the BST dataset. That is, children in the universal tier improved by .34, $p < .001$ standard score points more than the control group each month and participants in the targeted tier improved by .71, $p < .001$ more than the control group each month. When those lowest scoring children were not included, the effect at the universal and targeted tiers was no longer significant.

4.5 Discussion

This chapter aimed to explore the impact of the NNUTS MTSS on children's receptive vocabulary development, looking both at the impact of inclusion in the intervention and the impact of the different tiers of the intervention. Two iterations of the data were explored due to a substantial minority of children completing the BPVS assessment, but not achieving scores high enough to be assigned a standard score. The true standard score dataset did not include results where no standard score was assigned. The below standardisation threshold dataset contained a uniform standard score of 60 for all of the instances when the assessment was completed, but the scores were not high enough to achieve a standard score.

4.5.1 Does the MTSS improve participants' receptive vocabulary development over and above the effects of usual practice in early years provision?

Encouragingly, both datasets showed the intervention to have a significant positive impact on children's receptive vocabulary development measured using a standardised measure. This adds to the evidence that interventions with at least a partial focus on vocabulary development can result in generalised receptive vocabulary improvement (Coyne et al., 2007, 2004; Gibbard, 2004; Goodson et al., 2011; Hargrave & Sénéchal, 2000; Wasik & Hindman, 2011). In this study, the impact was more pronounced when the children presenting with the most significant receptive vocabulary difficulties were included within the models (BST dataset). There was an initial sharp increase of 2.10, $p < .05$ standard score points per month over and above the control group in the first term in the intervention This could be due to the standard score of 60 that was assigned to those lowest performing children being too low for some children. This rate slowed over time, but remained significant. A worked example in Table 4.8 shows that over the course of a school year, a child in the NNUTS MTSS can be expected to make 15.04 standard score points of improvement over and above that of a similar child in the control condition. This magnitude of improvement is enough to bring a child scoring 2s.d. below the mean to just within the typical range when utilising commonly used cut-points based on a normal distribution.

Not all children have three terms in nursery. Children are entitled to begin nursery the school term after their third birthday. Children with birthdays between September and December are entitled to five terms; those with birthdays falling between January and April are entitled to four terms and the youngest children in the school year are only entitled to three terms in nursery. Children's enhanced vocabulary development trajectories continued in the fourth (TSS and BST datasets) and fifth (BST dataset) terms they are accessing the MTSS. These improvements are .97, $p < .01$ and .45, $p < .05$ for term four and five with the BST dataset and .95, $p< .001$ with the TSS dataset in term four. This indicates, as we would expect, that longer within the MTSS is associated with higher levels of improvement, thus disadvantaging those youngest children in the school year somewhat.

Table 4.8 The impact of inclusion in the intervention over a school year

Term one and term two in school are approximately four months long and term three is approximately three months long. Applying the estimates from the models exploring the impact of inclusion in the intervention indicates the following improvement for a 'reference group child' included in the NNUTS MTSS over and above a 'reference group child' in the control condition.

Conservative projection using TSS dataset:

Term 1 = no significant improvement over and above control

Term 2 = no significant improvement over and above control

Term 3 = .82 standard score points X 3 months = 2.46 standard score points

Less conservative projection using BST dataset:

Term 1 = 2.10 standard score points X 4 months = 8.4 standard score points

Term 2 = .85 standard score points X 4 months = 3.4 standard score points

Term 3 = 1.08 standard score points X 3 months = 3.24 standard score points

Overall improvement = 15.04 standard score points

[reference group = male, 43.3 months at intercept, no SSD, campus 1 (trailblazer)]

However, the fixed effect of age in the TSS and BST models exploring the impact of inclusion in the intervention (Table 4.6) is negative. This indicates that those children that enter nursery older than the mean sample age of 43.3 months are entering nursery with lower standard scores. This could be due to prolonged exposure to home environments in which language promoting activities are limited, as evidenced in a number of studies of the home language environment in areas of social deprivation (Hart & Risley, 1995, 2003; Hoff, 2006; Miser & Hupp, 2012). This hypothesis is in line with findings from the ELVS study that the impact of deprivation on children's language development is cumulative (Reilly et al., 2010).

4.5.2 How do the different tiers of the MTSS affect participants' receptive vocabulary development over and above the effects of usual practice in early years provision?

This cohort had a high level of SLCN, including a large number of children with low receptive vocabulary scores. This high level of need was one of the reasons that the universal tier of the MTSS needed to be an intervention, rather than business as usual. It was hypothesised that inclusion in the universal tier of the intervention would result in more rapid receptive vocabulary growth than the control group. The results of both the TSS and BST models confirmed this hypothesis. Slope estimates of .40, < .001 and .63, $p < .001$ respectively, once again showing an effect of greater magnitude when the lowest scoring children were included in the analysis. This indicates that all children are likely to be benefitting from the strategies and communication supportive practices within the classroom, rather than solely those with no identified SLCN.

There is some evidence to show that inclusion in a targeted tier intervention supports children who are more at risk of language difficulties to keep pace with their peers (Loftus et al., 2010). These results echo those findings, with children in the targeted tier making .55, $p < .001$ and .89, $p < .001$ standard score points more progress each month than those in the control condition for the TSS and BST datasets respectively. In fact, the children in our targeted tier begin to close the gap between them and their peers in the universal tier over time, although this would be very gradual. However, as evidenced in Chapter Three, children in the targeted tier do not always have lower receptive vocabulary scores than those in the universal tier. The judgements about which tier of support is most appropriate for the children is more complex than solely their BPVS scores. It would be interesting to replicate this MTSS model with cohorts with a broader range of SES and SLCN to ascertain whether this catch up was still apparent when the initial receptive vocabulary gaps are perhaps more substantial.

For both datasets the specialist tier of intervention also had a significant impact on children's receptive vocabulary scores over and above that of the control condition (.32, $p< .05$ and .53, $p< .001$ standard score points per month for TSS and BST respectively). The fact that the children with the most complex, often multi-domain SLCN (Figure 3.21, Figure 3.22, Figure 3.23, Figure 3.25) are being supported to make additional progress within this model is a promising finding about the effectiveness of MTSS for all children. Children could be allocated to the specialist tier as a result of SSD or dysfluency, as well as significant language needs.

This will confound the estimates at this tier. A larger study could further categorise the specialist tier cohort as those with and without language difficulties to explore the differential effects for different profiles of children. The sample size in this study was not large enough to allow this depth of analysis.

The Reception cohort included those from the 'trailblazer' campus (campus one) who received the intervention and then moved in to the control condition. Tentative conclusions can be drawn from the fact that there are negative slope estimates for this tier. This is indicative of the importance of on-going support, rather than intervening in nursery and expecting this to have somehow kick-started a new, more rapid developmental trajectory for vocabulary development which will continue without explicit on-going support. It is likely that the children who were initially receiving the MTSS had accelerated their vocabulary growth, but then when this structured system of support was no longer in place, this increased rate of growth was not maintained. This may reflect underlying difficulties with vocabulary learning, which are supported by the environmental adaptations of the MTSS, but without these in place, difficulties remain.

4.5.3 A comparison of the impact on vocabulary with the impact on sentence repetition

The main focus of this chapter has been exploring the impact of the MTSS on receptive vocabulary development (rationale for this detailed in 4.1 and 4.4.2.1). A comparative model was explored to ascertain whether the intervention had an impact on language skills more broadly. This model included the children's sentence repetition scores and showed that there were also positive effects in this domain (Table B2 and Table B3, Appendix B). As the intervention is not solely focused on developing receptive vocabulary, we would hypothesise improvements in children's use of language alongside improvements in vocabulary. The universal tier of the intervention focuses on creating a language-enhancing environment, with some focus on vocabulary development strategies, but also modelling and extending language (2.6.1 and 2.6.2). Additionally, it would be expected that increasing receptive vocabulary would in turn facilitate improvements in morphology, syntax and grammar (Chiat, 2001; Language and Reading Research Consortium, 2015; Marchman & Bates, 1994; Tomasello, 2005; Tomblin & Zhang, 2006). This indicates that a MTSS consisting of a language-rich universal tier and flexible allocation to targeted interventions to support listening and attention, phonological awareness, receptive vocabulary, comprehension, expressive

language and symbolic play skills has the potential to facilitate broad improvements in language skills. Not only that, but inclusion in the universal and targeted tiers can support those children judged to need additional support to keep pace with their peers receiving support at the universal tier and begin to close the gap.

4.5.4 A consideration about fidelity

As outlined in chapter 2 (2.6.5), fidelity to the NNUTS MTSS was facilitated by close co-practice between the KTPRA (SLT) and staff. There were high levels of trust and collaborative working which supported the normalisation of the model as part of the everyday practice within the setting, it was important that there was an element of flexibility in the delivery. An acknowledgement of the different contexts across campuses, different strengths, challenges and cohorts of children gave staff some autonomy and control over the delivery. This helped to build trust and shared understanding, as well as strong relationship between professionals, enabling discussions, problem solving, and productive challenge. The models show similar rates of progress across campuses with no significant interaction of campus and age in the TSS models. For the BST models, the impact of inclusion in the MTSS model (Table 4.6) showed two campuses had a significantly different slope to the trailblazer campus (one negative and one positive) and the model exploring the impact of the different tiers showed one campus to have a significantly different slope to the trailblazer campus (negative). This relative uniformity in progress has positive connotations for the fidelity to the key principles across the campuses, although data was not formally gathered.

In their 2011 study, McCartney, Boyle, Ellis, Bannatyne, & Turnbull (2011) compared how efficacious a manualised intervention was when delivered by SLT staff (SLTs or assistant SLTs) versus when delivered by school staff. They found that there was significantly less improvement on the language measures when school staff delivered the interventions. They hypothesised that this was linked to the amount of intervention provided and adherence to the therapy programme, concluding that interventions delivered in this way should be subject to careful monitoring by SLT staff. In this study, the SLT was present across the campuses for the majority of the working week enabling high levels of informal support. This study also differed from the McCartney study in that it was evaluating a MTSS, rather than a standalone targeted/specialist tier intervention. This may mean that some of the key active ingredients from the targeted tier intervention are well embedded into the universal classroom provision

as well. Additional exposure to language learning opportunities in this way may help to mitigate some of the negative effects of things such as sessions of the targeted group intervention being missed or perhaps not adhered to with consistency. The 'load' for providing the intervention and support is shared across contexts (e.g. classroom and small group), as well as between a number of staff within the classroom rather than one specific person.

This reinforces the importance of considering targeted interventions within the wider classroom context, rather than as a standalone intervention. Evidence here suggests that the universal tier of this MTSS plays a vital role in supporting all children's SLC development and the targeted tier intervention builds on this for those children identified as requiring additional support. When presented as a standalone intervention to staff, it is easy for them to see the SLC support as contained within those sessions. We have clear evidence that the communication environment as a whole supports children's SLC development when thoughtfully curated and tailored to children's needs by trained staff. To portray to staff that a targeted intervention is where SLC support is best placed would be missing an excellent opportunity. An opportunity to ensure that staff are aware of the central role of the universal tier of support and to empower them to feel that they can make a meaningful difference to children's communication skills through their everyday interactions and environmental choices.

4.6 Conclusions

In conclusion, this study provides evidence of the positive impact of a MTSS on children's receptive vocabulary development and their sentence repetition skills. This progress is seen on standardised measures of language and therefore indicates a generalised improvement, rather than improvement only on vocabulary and sentence structures specifically targeted in the interventions. There is evidence that inclusion in the targeted tier of the intervention supports those children identified by classroom staff as needing additional support to make progress over and above that of the children included in the universal tier. Cumulative impacts of the tiers in this way, as well as improvement over and above that of children in the control condition, highlight the importance of the universal tier of support being an intervention, rather than business as usual. This is particularly the case for cohorts such as this with high proportions of children with SLCN within the setting. Further exploration of how

the characteristics of the universal tier of intervention interact with the targeted tier of intervention is essential in understanding the synergy between the tiers. It is important to consider whether there are certain characteristics of the universal tier of support that facilitate greater improvement for the children requiring targeted and specialist tiers of support.

The findings presented here that the universal tier of the MTSS facilitates greater receptive vocabulary and expressive language improvement than the control condition provides strong evidence of the importance of the universal tier as more than simply 'business-as-usual'. This has implications for the role of the SLT at this tier to support the implementation and normalisation of the changed classroom practice, as well as the embedding of appropriate targeted tier interventions. In this instance the SLT was an integral part of the staff team spanning all campuses. There were regular informal opportunities for modelling, discussions, prompting and time to build reciprocal, respectful, trusting relationships. Exploring this as a key component to the success of MTSS models in schools/settings will be an important area for future research.

CHAPTER 5: MTSS IN THE EYFS: DISCUSSION AND FUTURE DIRECTIONS

5.1 Introduction

This study explored the practical implementation and impact of a specific multi-tiered system of support (MTSS) for speech, language and communication development, delivered in an education setting with SLT involvement at each of the universal, targeted and specialist tiers. The education setting, an academy trust, served a coastal community in a region of England with high levels of deprivation. To date, very few studies have explored the detail and impact of a whole MTSS, despite this approach being widely recommended (Bercow, 2008; Department for Education & Department of Health, 2015; Gascoigne, 2006; Gascoigne, 2008). As a result, there is little evidence to quantify the assumed benefit of supporting SLC in this way.

This study sought to answer the following research questions with respect to an MTSS supported by an SLT embedded within early years settings serving communities in a coastal region of England with high levels of deprivation:

1. What is the prevalence of SLCN on entry to nursery (Chapter 3:)?
2. What is the nature of the support pathways delivered (Chapter 3:)?
    a. What pathways do participants take?
    b. What are the characteristics of participants in each of the pathways with respect to their pattern of speech, language and communication needs?
    c. How do participants in each of the pathways differ in terms of their speech and language skills?
4. What is the nature of the effects of the MTSS, on children's receptive vocabulary development (Chapter 4:)?
    a. Does the MTSS improve participants' receptive vocabulary development over and above the effects of usual practice in early years provision?
    b. How do the different tiers of the MTSS affect participants' receptive vocabulary development over and above the effects of usual practice in early years provision?

This chapter will recap the answer to each research question in turn. The findings are then discussed collectively in the context of current literature, and directions for future research

are outlined. Strengths and limitations of the current evaluation and the Knowledge Transfer Partnership (KTP) project from which it emanated are detailed. Finally, how this study has contributed to the argument that speech, language and communication needs (SLCN) should be considered a public health issue and the importance of the SLT role across the different tiers of prevention and intervention is outlined.

5.2 What is the prevalence of SLCN on entry to nursery?

The prevalence of children entering nursery with any kind of language difficulty within early years settings across an Academy Trust serving communities in a coastal region of England with high levels of deprivation (i.e. the number of unique ID codes identified as 'at risk' on one or more of the language measures) was 51%. This is in line with the upper estimate for SLCN within other areas of deprivation outlined by Law, Todd, et al. (2013).

With regards to specific areas of need, speech difficulties were the most prevalent individual difficulty identified within the cohort, with 42% of the cohort experiencing difficulties as measured by the DEAP screen (Dodd et al., 2006). This is startlingly higher prevalence than the 3.8% - 18% outlined in the extant literature (Eadie et al., 2015; Shriberg, Kwiatkowski, & Mabie, 2019; Shriberg, Tomblin, & McSweeny, 1999; Wren, McLeod, White, Miller, & Roulstone, 2013) is somewhat surprising. There are multiple possible explanations for this. Firstly, the methods used to identify children with speech difficulties differ across all of the studies, i.e. Eadie et al., (2015) used the Goldman-Fristoe Test of Articulation, Shriberg, Kwiatowski & Mabie (2019) used the Word Articulation subtest of the Test of Language Development – 2 and Wren, McLeod, White, Miller and Roulstone (2013) used no specific speech assessment, rather the secondary analysis of language measures used within their study. Secondly, the thresholds that were adopted to identify speech difficulties vary, with this study identifying children who presented with difficulties on the DEAP screening tool, in comparison to Eadie et al., (2015) who identified the lowest 10% of their sample as those with SSD; or Wren, McLeod, White, Miller and Roulstone (2013) who excluded children with common clinical distortions (e.g. using /w/ in place of /ɹ/) from their estimates. There is also the matter of SES representation. The other studies included children from a range of SES backgrounds, and the McLeod study's participants had limited representation from lower SES families. In comparison, the SES distribution in this study was heavily weighted towards the most deprived, supporting the presence of an SES effect on the presence of speech

difficulties. As hypothesised in Chapter 1, this could be due to children from low SES homes exhibiting slower lexical processing speeds, leading to under-specified phonological representations, thus increasing the likelihood of presenting with SSD age (Fernald, Marchman, & Weisleder, 2013).

Twenty-nine per cent of the children were at risk on the sentence repetition assessment (Seeff-Gabriel et al., 2008) and 28% were at risk on the receptive vocabulary measure (Dunn & Dunn, 2009). These similar prevalence figures could be seen to support the theory that during early language development, vocabulary and grammatical development are inextricably linked and governed by the same processes (Language and Reading Research Consortium, 2015; Tomblin & Zhang, 2006). Finally, 15% were at risk on the measure of receptive language (Knowles & Masidlover, 1987). Poor receptive language skills have been shown to be a risk factor for persisting difficulties (Zambrana et al., 2014) and it is interesting that this prevalence estimate should be so close to the estimate in the extant literature of 10%. The cut points for the standardised measures were <1SD below the mean and for the comprehension measure the cut points were criterion referenced and are outlined in Table 3.1.

5.3 What is the nature of the support pathways delivered?

This research question, again relating to the MTSS with embedded SLT delivered within early years settings serving communities in a coastal region of England with high levels of deprivation was addressed by answering two sub-questions. The analysis was completed on a sub-cohort of 91 children who entered nursery at assessment point three, as the training was delivered (Figure 3.2). This sub-cohort was used because they were the cohort that were accessing the MTSS for their whole nursery year and were solely within the experimental cohort.

5.3.1 What pathways do participants take?

There were fifteen unique support pathways that the children accessed over their time in nursery (Figure 3.8). When statistically analysed, three statistically distinct support pathways emerged: a stable-low-needs pathway (n=49), a changing-needs pathway (n=33) and a stable-high-needs pathway (n=9). The children within the stable-low-needs pathway accessed the universal tier of the intervention throughout their time in nursery. The children in the stable-

high-needs pathway were supported at the specialist tier of the MTSS throughout their time in nursery, i.e. they were on the NHS SLT caseload. The children in the changing-needs pathway appeared to show three different trends in terms of their level of support over the course of the nursery year (Table 3.4**Error! Reference source not found.**). One sub-group showed a pattern of fluctuating-needs (n=14), one a pattern of resolving-needs (n=8) and the third, a pattern of late-emerging-needs (n=11) (Figure A1 – A12, Appendix A).

5.3.2 What are the characteristics of participants in each of the pathways with respect to their pattern of speech, language and communication needs?

5.3.2.1 Characteristics of children within the stable-low-need pathway

The children within the stable-low-need pathway were not characterised by age-appropriate communication skills as may be suggested by the pathway name and provision they received (i.e. entirely within the universal tier). In fact, on entry to nursery 10.2% of children were identified as having a SSD, 40% were at-risk on the ERB assessment, 33% were at-risk on the BPVS assessment and 5% on the Derbyshire Rapid Screening Test. There were also 16% of the children in this pathway identified by teaching staff as performing three age-bands below their chronological age on the EYFS profile, using the development matters age-bands.

With regards to progress over time, group means for this pathway indicate steady improvement on the standardised language measures – increasing from 91.2 to 97.6 for the ERB and from 90.7 to 106.1 for the BPVS. Proportions of children identified as at-risk on these measures also reduced from 40% for the ERB to 24% and from 33% on the BPVS to 0%. The proportion of children identified as at-risk for SSD fluctuated across the assessment points changing from 10.2% to 6.1% to 20.4% and then returning to 10.2% at the final assessment point. This could be related to children performing close to the cut-off that indicated further assessment was needed and therefore slight changes in performance resulted in them moving either side of the cut-off over time. More likely, these children's speech performance stayed quite stable over time and was perceived to fluctuate due to the arbitrary nature of assessment criteria. The proportion of children deemed at-risk on the general comprehension measure rose from 5% to 7% by the final assessment point. This assessment was criterion referenced and many children reached the ceiling score of 22 by the final assessment point limiting its interpretability, as the children got older.

The EYFS measure also shows improvement for this pathway. By the third assessment point for this sub-group of children (assessment point five out of six for the wider cohort) 92% of them were deemed to be exhibiting skills appropriate to their chronological age, when teachers used benchmarks provided in the EYFS Development Matters (Department for Education, 2012).

In summary, the stable-low-needs pathway was characterised by a substantial proportion of children with expressive language and receptive vocabulary difficulties on entry to nursery and below average mean standard scores (91.2 and 90.7 respectively). Children typically made progress over time, improving both their raw and standard scores on the standardised assessments. This progress was more notable for receptive vocabulary than expressive language, with the mean standard score for receptive vocabulary exceeding the average standard score of 100 (106.1) and the mean standard score for expressive language only approaching this (97.6). Teachers largely deemed children within this pathway age-appropriate on the EYFS measure by the time they finished their nursery year (92%). This suggests that the enhanced language environment of the universal tier of intervention, supported children to make accelerated progress, perhaps compensating for the lower quantity and differing quality of language that is more common in households in areas with high levels of social deprivation (Hart & Risley, 1995, 2003; Hoff, 2006; Miser & Hupp, 2012).

5.3.2.2 Characteristics of children within the changing-needs pathway

The changing-needs pathway was characterised by high proportions of children with speech, expressive language and receptive vocabulary difficulties on entry to nursery. In addition to this there was a smaller, but notable, proportion of children experiencing broader language comprehension difficulties as measured by the Derbyshire RST (12%). Mean scores for the standardised measure were 1SD or more below the mean when children entered nursery, with a mean standard score of 85 for the ERB and 83 for the BPVS, with neither of these reaching the population mean of 100 by the final assessment point (96.1 for the BPVS and 90.7 for the ERB). This indicates that although progress was seen for this pathway, support provided had not enabled them to close that gap between their low starting point and the population average. Children within this cohort were less likely to be perceived by teaching staff as age appropriate on the EYFS measure by the end of their nursery year, with 12% of

children still judged to be one age band below their chronological age and 9% judged to be two age bands below their chronological age on this measure.

Descriptively, this pathway appeared to contain three different trends, as described above in 5.3.1. Descriptively, one trend within this pathway was for children's SLCN to resolve over time (resolving-need); one trend was for children to emerge as having SLCN as they progressed through nursery (late-emerging-need); and the final trend was one of fluctuating-need that did not resolve over the course of nursery. The children showing the late-emerging-need trend within this pathway has implications for the interpretation of the mean ERB and BPVS scores at the final assessment point.

The three trends within this group are interesting and align somewhat with the predicted pathways, as well as the trajectories identified in a number of longitudinal studies of language development over the primary school years (McKean et al., 2017; Zambrana et al., 2014; Snowling et al., 2016). The children within the resolving needs group, could be hypothesised to be those children whose communication difficulties are predominantly as a result of environmental risk factors, such as SES and the home communication environment. This aligns with the 'low-improving' group that emerge from the data in McKean et al. (2017). Also, the fact that 100% of this resolving group entered nursery with speech sound difficulties, draws some parallels with the work of Zambrana et al., (2014), who found that one of the predictors for children presenting with a transient language difficulties between the age of three and five, was a family history of SSD. It would be interesting to explore this further with a larger cohort and a broader range of variables linked to biological risk factors, such as family history, and environmental risk factors, such as books in the home, in addition to the IMD measure of SES in this study.

The late-emerging group within this changing-needs pathway is an important group to consider. These children evidently begin to present with SLCN which have a more notable functional impact as time progresses. Their vocabulary comprehension steadily improves, but their sentence repetition scores show minimal improvement. Within the literature there appears to be a consistent small, but notable cohort of children who present in this way, with language difficulties emerging later. These children tend not to have had as notable comprehension difficulties as those with earlier emerging needs (Zambrana et al., 2014); and

risk factors for later emerging needs are low birth weight, attention and behaviour difficulties, a history of family literacy difficulties and limited access to books in the home (10-20 children's books) (McKean et al., 2017). It has been suggested that the difficulties experienced by these children, could be influenced by genetic mechanisms, such as low family literacy (McKean et al., 2017; Snowling et al., 2016; Zambrana et al., 2014).

5.3.2.3 Characteristics of children within the stable-high-needs pathway

The children in the stable-high-needs pathway presented with multi-domain difficulties that persisted over time. For both the speech measure and the ERB the proportions of children deemed at-risk within this pathway increased over time, from 78% to 100% and 55% to 89% respectively. This indicates that their progress was slower than would be anticipated by their age and therefore their standard score (with regards to the ERB) dropped over time. Progress was seen for these children on their raw scores for both the ERB and BPVS and they were able to improve their mean standard score for the BPVS from 80.7 to 83.4 over the course of the nursery year. Progress was much slower for the ERB and standard scores decreased over time, falling from 80 to 72.2, indicating significant difficulties in the area of expressive language for children in this pathway. The mean score of 12.9 on the RST on entry to nursery shows a proportion of these children to have significant comprehension difficulties (100% score would be a score of 22, with 12.9 representing two-information-carrying-word level is still developing), with 22% deemed at-risk in line with the criterion cut-off points identified. This remained stable until the final assessment point where it halved to 11%. The low number within this pathway (n=9) and the limitations of the RST in terms of ceiling effects limits the conclusions that can be drawn for this group of children. Those children reaching the ceiling score may still have comprehension difficulties that this assessment was not sensitive enough to identify. There has been little research exploring how information-carrying-word (ICW) understanding correlates with more general measures of receptive language, however, Frizelle, Harte, O'Sullivan, Fletcher & Gibbon (2017) found that there was a very strong correlation (.73) between children's ICW scores and their scores on the receptive language subtests of the Clinical Evaluation of Language Fundamentals (CELF-4). The study used a more extensive measure of ICW understanding, extending up to six information carrying words and containing a wider range of linguistic concepts than the measure used in the current study.

With this in mind, it seems pertinent to be cautious about the conclusions that can be drawn from this more restricted measure of ICW understanding for this cohort.

5.4 What is the nature of the effects of the MTSS on children's receptive vocabulary development?

This research question was addressed by posing two sub-questions. First overall effects of inclusion in the MTSS on receptive vocabulary development were evaluated; second the effect of inclusion in the different tiers of the MTSS on receptive vocabulary development was explored. The relevant analyses were carried out on two iterations of the dataset in order to ensure that the effects of the intervention for those children with the most significant vocabulary difficulties were captured. One dataset, the true standard score (TSS) excluded children who completed the BPVS assessment, but achieved raw scores that did not reach the threshold to be allocated a standard score as determined by the BPVS user manual (54 participants, 79 assessments). Clearly the trajectories of the lowest scoring children are of central interest to this study and of evaluations of MTSS. A 'below standardisation threshold (BST)' dataset was therefore created including these children by assigning a standard score of 60 to those who completed the assessment without achieving a high enough score to be given a standard score. The lowest standard score that a child could achieve on the BPVS was 70.

5.4.1 Does the MTSS, improve participant's receptive vocabulary development over and above usual practice in early years provision?

Children who received support as part of the MTSS made significantly greater progress than the children receiving the usual classroom practice (Table 4.6 and Table 4.7). This finding was evident for both the TSS and BST datasets, though was greater and more immediate and more sustained for the BST dataset, which included those children with the lowest BPVS scores. When considering the BST results, inclusion in the MTSS resulted in significant greater receptive vocabulary gains whether included for one, two, three, four or five terms in the intervention. The greatest gains were seen in the initial term, 2.10 ($p < .05$), although the magnitude of this increase could be artificially inflated due to the standard score of 60 potentially being too low for those who did not reach standardisation threshold. The TSS results were more conservative, only showing significantly greater receptive vocabulary improvement than the usual classroom provision after three and four terms in the MTSS, .82 ($p < 0.001$) and .95 ($p < .001$) standard score points each month respectively. Overall, for

children attending nursery for three terms, the mean improvement in standard score over the course of the year as per the TSS dataset is 2.46 standard score points and 15.04 standard score point over the course of the year as per the BST dataset.

5.4.2 How do the different tiers of the MTSS, affect participant's receptive vocabulary development over and above usual practice in early years provision?

Support at the universal tier of the MTSS resulted in receptive vocabulary improvement over and above that of support in the usual classroom practice. This was the case for both the TSS and BST datasets, .40, $p < .001$ and .63, $p < .001$ standard score points each month respectively. Over the course of a year, this is 4.44 standard score points for the TSS dataset and 6.48 for the BST dataset. The improvement for children receiving support at the targeted tier of the MTSS is greater still, .52, $p < .001$ for the TSS dataset and .69, $p < .001$ for the BST. This shows the additional benefit, over and above the universal tier, of inclusion in the targeted tier for children requiring additional support. The improvement is once again greater when the lowest scoring children are included in the analysis.

Support at the specialist tier of the model also resulted in improvement over an above that of the control group, .32, $p< .05$ and .53, $p< .001$ standard score points per month for the TSS and BST datasets respectively. This is an exciting finding, that those with the most significant needs are also supported by teaching staff and SLTs working together to implement a broader, tiered model of support. This is in contrast to SLTs providing bespoke targets for school staff to focus on for this referred population.

The 'reception' sub-cohort of children (n=27) began the study in the trailblazer campus and were therefore benefitting from the MTSS. At the point at which the training was delivered for the nursery staff, these children then moved into Reception, where staff had not received the training. These children were shown to have a negative slope, indicating that their rate of growth was slower than that of a child receiving usual nursery classroom practice. The negative slope could be seen to indicate the need for on-going support to maintain the increased rate of progress that can be seen as a result of the MTSS inclusion. This idea is supported by findings in McKean et al. (2017), who explored subgroups in language trajectories between age four and eleven. They found that a 'low-improving' group emerged in their data, comprising of children from EAL backgrounds, low SES backgrounds and homes

with less than ten children's books. They found that by the time the children were age seven, their language scores were indistinguishable from the 'stable' group in their cohort and by age eleven their scores were largely within the typical range. They hypothesised of the children from EAL homes, that these children required "prolonged exposure to the language of instruction in preschool and school to consolidate skills in both languages" (p1088). It could be that the same is true for the children for whom English is their only language, but that come from more deprived households, with less language promoting resources and interactions within the home environment. There could also be an increase in children experiencing difficulties during this Reception year, due to children presenting with language difficulties that begin to emerge as they reach more advanced language milestones, such as those identified by Snowling et al. (2016). This late-emerging group that has been identified in the literature also indicates the need for MTSS to continue beyond the nursery and EYFS years, to ensure that these children are identified and adequately supported.

5.5 Understanding the nature of MTSS pathways for children with differing profiles of speech, language and communication skills

The exploration of the nature of the support pathways and the characteristics of the children within these, help us to understand this intervention in more detail and which children benefit from which elements of the MTSS. Perhaps the most important finding from this aspect of the evaluation is the importance of the universal tier of support having a more explicit focus on developing communication skills than usual classroom practice. The evaluation outlined above shows that children in the universal tier of provision make progress over and above that of children receiving business as usual nursery practice. With 56% of children in cohort four (Table 2.1) deemed at risk on at least one of the speech and language measures on entry to nursery it is imperative that classroom interactions and opportunities in early years settings with high prevalence, such as this, are tailored to facilitate speech and language development. The importance of this is highlighted further by the proportions of children receiving support solely at the universal tier identified as at risk on the speech assessment (10.2%), the expressive language assessment (40%) and the receptive vocabulary assessment (33%) when they entered nursery. Studies investigating language-focused instruction and language supportive practice in early years classrooms find substantial variability in the amount and quality of language support (Dockrell, Bakopoulou, Law, Spencer, & Lindsay, 2015; Dwyer &

Harbaugh, 2020; Justice et al., 2008; Melhuish & Gardiner, 2017; Pelatti, Piasta, Justice, & O'Connell, 2014). In cohorts with high levels of deprivation and associated high levels of SLCN, supporting positive communication supportive practices and teachers' knowledge and confidence to provide these is critical if there is to be a chance for these children to begin to close the gap.

The description of the variety of support pathways within the MTSS also highlights the complexity of this type of model. In designing robustly controlled intervention evaluations, children are selected for inclusion in different arms of an intervention using strict criteria such as assessment scores. This is in order to establish the effectiveness of an intervention in tightly controlled conditions. This KTP study was an effectiveness study, seeking to describe and evaluate the NNUTS MTSS in an ecologically valid context, rather than in a controlled context. When a MTSS is implemented in practice teaching staff judge the level of support children require at different stages of their academic journey, sometimes this is supplemented or guided by screening tools (Reeves et al, 2018; Zucker et al., 2013), but this is not always the case (Hutchinson & Clegg, 2011).

This study provided the opportunity to explore the profiles of children that teaching staff perceive to require different levels of support. As explored in Chapter Three staff appear to make this judgement based on a holistic view of the child, rather than just on speech or language skills in isolation. This is evidenced by some of the similarities in performance on speech and language assessments of children in different grouped pathways. For instance, in the stable-low-needs group there are children who assessments identify as 'at risk'; based on this measure alone these children may be allocated to the targeted tier of support. It is not the case, however, that staff are unaware these children's language skills are not age appropriate, as evidenced by the EYFS judgements (Figure 3.31) showing 100% of children judged to be performing below age related expectations at the point of the training delivery. Rather, it appears that staff use a combination of their knowledge about the children's speech and language skills, coupled with their knowledge of how they are functioning within the classroom and their individual personalities. It is difficult to conclude whether this is the most appropriate or effective way to identify children for support, as there is no direct comparison of the same children receiving different levels of support. However, it can be concluded that the children who were identified as at risk by the speech and language measures made

significantly more progress than children with similar levels of need in the control group, whether they received support at the universal or targeted tier of the MTSS. Within the different pathways, 92% of those in the stable-low-need pathway, 79% of those in the changing-need pathway and 11% of those in the stable-high-need pathway were judged as age appropriate on the EYFS measure by the end of nursery. This could indicate that teachers are somewhat sensitive to indicators of prognosis not necessarily captured by the speech and language measures, such as attention, executive function and temperament. It could also be the case that the breadth of areas in which children are experiencing difficulties is more important than the severity, as suggested by (Hayiou-Thomas, Smith-Woolley, & Dale, 2020). Looking at the graphs identifying proportions of each grouped pathway at risk on each of the assessments (Figure 3.14, Figure 3.19, Figure 3.24) this could have factored into teachers' decision making. There are smaller percentages of children at risk on each of the measures in the stable-low-need group, therefore indicating a low number of children with multiple areas of risk. This is in comparison to higher proportions at risk on each assessment in the changing-need group and higher again in the stable-high-need group.

5.6 The effects of MTSS for SLCN

The results in Chapter Four show that the NNUTS MTSS resulted in significant improvements in both receptive vocabulary and sentence repetition, a proxy for expressive language. The sizes of these significant improvements, particularly looking at the results from the BST dataset, have real clinical significance as well (Table 4.8). This improvement was over and above that of the children in the control condition and was evident on standardised measures and standard score. This generalised improvement is in line with studies such as Justice et al. (2010) and Wasik & Hindman (2011) and in contrast to studies that find no improvement on standard measures such as Haley et al. (2006), Lorio & Woods (2020) and Neuman, Newman & Dwyer (2011). The studies by Justice et al. (2010), Wasik & Hindman (2011), Lorio & Woods (2020) and Neuman, Newman & Dwyer (2011) focused specifically on developing vocabulary skills, whereas the NNUTS MTSS study had a broader focus on SLC development, generating some interesting insights into possible mechanisms of impact of MTSS. The study by Haley et al. (2016) study also focused more broadly than solely vocabulary, targeting narrative and listening skills as well, though in contrast to the MTSS this was a stand-alone, 15-week

intervention, delivered by teaching assistants which could account for the difference in results due to the hypotheses detailed below.

The first hypothesised mechanism of impact is the public health style structure of the intervention. By approaching SLC support as part of a multi-professional, shared approach and a continuum of support in this way, rather than the traditional standalone intervention, a range of additional opportunities is created. Opportunities such as some of the key active ingredients from the targeted tier intervention being embedded into the universal classroom provision; or additional exposure to language learning opportunities might mitigate potential negative effects if targeted group interventions or perhaps not delivered with high levels of fidelity or consistency. Furthermore, it is possible that the MTSS might have an effect on staff confidence through empowering them to feel that they can make a meaningful difference to children's communication skills through their everyday interactions and environmental choices. This is in contrast to a more traditional, medical model of withdrawal from the classroom for a time-limited intervention in which the same opportunities do not arise.

The second hypothesised mechanism of impact is the flexible, broad focus of the intervention. As described in Chapter 2, the intervention across the universal and targeted tiers focused on facilitative processes such as visual support and interaction strategies; creating opportunities for communication in the classroom; developing listening and attention and turn-taking skills; receptive and expressive vocabulary; symbolic play and phonological awareness. One of the key principles of the intervention is responsiveness to children's needs. Responsiveness in the context of the everyday interactions – following the child's lead, recasting and extending their utterances, using comments and open-ended questions linked to the child's focus of attention; and responsiveness with respect to inclusion in the different tiers of the intervention. That is, children could be included in the universal tier, as well as one or more of the targeted interventions (2.6.2). All children receive support focusing on a range of domains as part of the universal tier of the intervention; additionally, children are then allocated to receive support via 'The speech programme' and/or 'The language programme'. Focusing on a broad range of speech and language domains in this flexible way is hypothesised to have facilitated more generalised improvements than interventions focusing solely on vocabulary development. For example, by supporting children's lexical knowledge

this then acts as a foundation for syntactic development (Chiat, 2001; Marchman & Bates, 1994; Tomasello, 2005).

The hypotheses above lead to the conclusion that if we are to broaden our understanding of how to facilitate significant and generalised improvements in children's SLC skills it is important to consider interventions in the context of MTSS. Examining the effectiveness of interventions in highly controlled efficacy studies is an important step in the process. The evidence presented here indicates that for effectiveness studies that context is also crucial. Effectiveness studies that do not take in to consideration the support within the contexts wherein interventions are being evaluated risk missing important information and opportunities with respect to methods to maximise impact.

5.7 The importance of MTSS for SLCN in areas with high levels of deprivation

A critical finding in this study is that the dataset containing the lowest scoring children showed the strongest gains in both vocabulary and sentence repetition scores. Although this could be argued to be regression to the mean, the fact that this improvement is over and above the gains made by children in the control cohort indicates that this is not the case. This is somewhat contradictory to other evidence in the field which shows children with higher entry level scores benefit more from support within early education settings and interventions (Becker, 2011; Marulis & Neuman, 2010). Becker examined the impact of pre-school attendance for children of parents with high and low education levels. The results represent improvements in expressive vocabulary (measured by the naming vocabulary subtest of the British Ability Scales) (Elliott, Smith, & McCulloch, 2004) as a result of usual classroom practice. No children in Becker (2011) were identified as achieving a raw score below the standardisation threshold and the group means for the low educated and high educated parents' groups were -.42 and .01 respectively (z-scores, mean = 0, SD1). This indicates that both the low-educated parent and high-educated parent groups had higher relative starting points than the children within this study. This difference between the findings of Becker's study of typical classroom practice and the current study is further evidence of the importance of the universal tier of support being different to business-as-usual provision.

There is also evidence that children from 'working-poor' households have lower vocabulary scores than those from 'environmentally-enabled' households at four, and that this gap is

maintained over the subsequent four years (Christensen et al., 2017). Christensen et al. (2017) examined a wide range of information about children's exposure to a range of risk factors, of which SES was one. The evidence that children within the current study are beginning to close the gap is promising, however this could be due to the study being conducted in an area with a relatively limited range of socio-economic status (SES) and children with high levels of SLCN on entry to nursery. These high levels of SLCN may mean that the changes to usual classroom practice to create the universal tier of the intervention may have been more easily accepted and embedded by staff, as the need was clear. In a setting with lower levels of SLCN, implementing the universal tier of the intervention may not be seen as a necessary adaptation and therefore less acceptable to staff.

Looking more broadly than children with SLCN, it has been shown that children from areas of poverty perform better in schools in lower income areas, than when they attend schools in higher income areas (Marmot et al., 2020). The current study has no information about children's exposure to other risks, or protective factors, such as maternal education, shared book reading in the home and employment. It is important to consider the utility of gathering a broader range of data about risk and protective factors in subsequent evaluations of MTSS. This information would provide further important information to describe and facilitate a greater understanding of different profiles of children accessing different pathways of support. In turn, this is would allow us to build a picture of how the effects of MTSS change for children with differing profiles of SLCN and risk.

The mean size of the effect of inclusion in the MTSS, in comparison to those in the control condition, is large enough to enable children to move from far below the mean to within the average range by the time they start formal schooling (Table 4.8). Research exploring the impact of language difficulties in the early years has found that those with significant impairments remaining at age 5;6 are significantly more likely to have impairments in both the spoken and written domains at age 15-16 (Bird, Bishop, & Freeman, 1995; Snowling, Adams, Bishop, & Stothard, 2001; Stothard, Snowling, Chipchase, & Kaplan, 1998). As such, the findings from this study provide promising evidence that it is possible to support children to develop their language skills to such an extent that they are no longer identified as 'at risk' by this critical age. Whether they will require on-going support after this age, given the potential biological and environmental risks they likely face is moot. The results for the

children who received the intervention and then moved in to reception with no access to the MTSS had negative slope values, i.e. their rate of improvement was slower than children in the control condition. This could indicate that the gains made by children in their vocabulary skills are reliant on the supportive environment of the MTSS. In other words, the MTSS supported them to increase their rate of vocabulary development, however this slowed once in reception, in comparison to the control group who had consistently slower gains over the course of the project. Receiving support through the MTSS has a significant benefit for children's rate of vocabulary learning. However, once they are no longer being taught in an environment with such a specific language focus the gains in their rate of vocabulary development are not maintained. This highlights the importance of maintaining a language focus throughout a child's education and cautions against seeing early intervention as the panacea for reducing children's language difficulties. It also supports the argument that the SLCN experienced by children in areas of deprivation is likely in part due to early language experience, but also in part due to difficulties with the underlying propensity for language learning (Bishop, 1994) and/or gene environment interactions (Dale et al., 2015).

5.8 Strengths and limitations

5.8.1 Strengths

The large overall cohort size and homogeneity of SES are strengths of this study. The sample size gives power to the statistical analysis and allows more robust conclusions to be drawn. The fact that this cohort represents children in the second and third deciles of social disadvantage means that this study clearly represents the prevalence of SLCN in the most disadvantaged of our society. Many schools across the country are catering for children in poverty and as such these findings have positive implications for how SLCN can be supported within these similar populations. The area of England studied also has a highly stable population, thus supporting longitudinal data collection with limited dropout providing the opportunity to make a unique contribution to the evidence base. The cohort has low numbers of children who speak languages other than English. This means that the effects of a MTSS on language acquisition can be examined without the complicating factors of the influence of EAL on the validity of language measures.

Another strength of the current study is the inclusive nature of the sample and the implementation in the everyday context of school life. All children attending the school

campuses over the duration of the study were included in the analyses where data permitted. This included children with diagnosed conditions such as ASD, Di George Syndrome and Down syndrome. This inclusivity and limited control of the context enhances the ecological validity of this study by being truly representative of how a MTSS could be implemented with the whole Early Years Foundation Stage cohort.

5.8.2 Limitations

The homogeneity of SES within the sample limits the applicability of the results to other geographical areas and populations with more heterogeneous SES.

Although the study has a large overall cohort size, the pattern of recruitment into the experimental and control arms led to some of the grouped pathways having small numbers of children. This led to the statistical analysis defining only three groups, rather than the five initially identified. Due to the seemingly different characteristics within the changing-needs groups, it is possible that in a larger sample the three groups merged to form the changing-need group would be statistically distinct.

Positioning the study firmly within the everyday context of school life provides credibility from an effectiveness standpoint. However, with regard to analysis of the data, the complex intakes of children and the changes within the context over the course of the study led to significant complexity for the statistical analysis. Changes over the course of the study include the initial seven campuses merging to form five and national changes to the EYFS measure in September 2012.

Although the cohort having low numbers of children who speak languages other than English is considered a strength (above), this can also be seen as a weakness in terms of the generalisability of the findings to more ethnically and linguistically diverse populations.

5.8.3 Strengths and Limitations of the overarching KTP project

Normalisation is “the process by which an intervention becomes so embedded into routine practice that it disappears from view” (Murray et al., 2010, page 2) and there are four suggested components to this process: coherence work (or sense-making); engagement; collective action to enable the intervention to happen; and reflexive monitoring (reflection). An aim of the wider project was for the MTSS to become normalised into the practice of the

nursery staff. There were a number of ways that this was hypothesised to be faciliated; these are viewed as strengths of the wider project and are outlined below.

- Training development - Much of the time prior to the delivery of the training was spent building relationships with staff across each of the campuses; learning about their priorities and pressures; helping out in the classrooms whilst observing existing practice and ensuring staff felt engaged and included in the development of the training and intervention. This process helped to create solid relationships and a shared understanding of the purpose of the intervention. During this time a culture of trust and reciprocity developed and this provided a key foundation for the understanding of, acceptance and engagement in the implementation of the intervention. These features incorporate the coherence work and engagement elements of normalisation process theory.
- Key principles – key principles ran through the MTSS, session plans were provided by the KTPRA SLT for the targeted interventions together with supplementary activities to tailor around these. This supported the staff to understand the intervention (coherence work), whilst allowing some flexibility to meet the varying needs of the children (engagement and collective action). Incidental feedback throughout the project indicated that the flexibility empowered staff teams to make the MTSS work within their individual settings, contributing to their willingness to implement the model over a sustained period of time. On reflection, this flexibility, alongside the KTPRA SLT being a member of the school team are hypothesised to have been key to the success of implementation and on-going culture shift within the organisation. This flexibility and the KTPRA SLT placement are considered strengths due to the contribution to the normalisation of the MTSS.
- On-going KTPRA SLT presence – After the training had been delivered the KTPRA SLT continued to be based on site for the majority of the working week. This served to provide problem solving opportunities (reflexive monitoring), to keep the project and the intervention front and centre in people's priorities (coherence work), to informally model elements of the universal tier of the intervention (collective action) and to maintain that vitally important feeling of trust and shared understanding.

Limitations of the of the wider project include the fact that it was not possible to keep detailed records of the content of the intervention on each campus because this would have placed an unreasonable burden on the teaching staff. It is therefore not possible to assess whether some of the variation between campuses is due to small differences in implementation. It was also outside of the scope of the project to collect the data to test the assumptions about the processes contributing to the acceptance and normalisation of the intervention, but these factors were explicitly considered in the design.

Additionally, the assessment choices could be seen as a limitation due to the ceiling effect on the RST and the proportion of children completing the BPVS and ERB who did not reach the standardisation threshold. This could also be seen as a limitation of the BPVS and ERB assessments themselves, the representativeness of their standardisation samples of the breadth of society and their utility for low SES populations.

The study received ethical approval from the University of Newcastle, which approved the process of including all children across the schools, giving parents the option to 'opt out' of the study. This would either involve their children moving school, or requesting for their children's data not to be utilised within the evaluation, as interventions were implemented at the universal level, so it was not possible for children to be excluded from the intervention entirely. This 'opt-out', or passive consent process is common within educational research (Felzmann, 2009). Using the 'opt out' process requires parents to explicitly inform researchers that they do not wish they children to be part of the research and there could be doubt that parents have made a well-informed decision not to raise objections if no contact is received. To counter this somewhat, there is the additional safety net of the consent of school-management that is in place in education-based research, which supplements parent / carer consent (Felzmann, 2009). Although using opt-out consent does have some ethical implications (i.e. parents not reading information provided and making fully-informed decisions), there are benefits in terms of higher response rates and reducing the risk of selection-bias within the setting. It is also typically perceived that education-based research carries very little risk for participants (Feltzmann, 2009).

5.9 Directions for future research

Future research should focus on describing and evaluating MTSS in more detail. The existing evidence base shows that standalone interventions to support vocabulary development can result in significant improvements for children's vocabulary skills (Haley et al., 2016; Lorio & Woods, 2020; Motsch & Ulrich, 2012; Neuman, Newman, & Dwyer, 2011; Pollard-Durodola et al., 2011), though these findings are inconsistent (Cabell et al., 2011; Justice et al., 2010; Nicolopoulou et al., 2015). There are no other existing studies that describe and evaluate a MTSS in the Early Years Foundation Stage. Studies mapping the universal, targeted and specialist provision within education and childcare establishments would help to build this picture more clearly. As well as needing a clearer picture of the nature of the support provided by MTSS, there is a need to more robustly theorise and evaluate how these models impact on children's SLC development. Children experience support in their immediate environment, which includes specific interventions delivered, but also their everyday interactions with classroom staff. It is likely that there is a multi-directional impact of support and experiences at each tier of a MTSS, with children's experiences at the universal tier impacting on how they benefit from targeted tier interventions, and vice versa. There is an argument that if this complexity is not taken into account, then something important is missed (Hawe et al., 2004; Shiell et al., 2008). When designing future evaluations, it is important to explicitly theorise how interventions are hypothesised to facilitate change for children with SLCN and how the various elements of their environment may interact to facilitate or hinder this progress.

When introducing a MTSS, factors that will facilitate the successful implementation and normalisation of the model need to be considered. Positive social capital is known to be facilitative of joint working practices (Forbes & McCartney, 2010; Halpern, 2005; McKean et al., 2017). A number of strategies were used within this study to foster this and the embedding of the KTPRA in the teaching environment was the lynchpin of these strategies. Regular liaison with familiar SLTs and embedding SLTs as part of the school workforce has been shown to be desirable and have positive effects for both SLT and education staff and how they work together to implement recommendations (Dimova et al., 2020; Gallagher, Murphy, Conway, & Perry, 2019; White & Spencer, 2018). Further evaluations of similar models should seek to describe in more detail the 'softer' elements contributing to the

model's success such as those described above. Building this understanding will help to unpick key elements that may support successful implementation across a variety of contexts, such as those outlined in social capital theory (Forbes & McCartney, 2010; Halpern, 2005; McKean et al., 2017), normalisation theory (May et al., 2007; Murray et al., 2010) and behaviour change theory (Davis, Campbell, Hildon, Hobbs, & Michie, 2015). These are all areas which are highlighted as integral to the succesful implementation of complex interventions. Guidance from the National Institute of Clinical Excellence recommends that studies such as this, aiming to change behaviour as part of a public health intervention, should include information about process as well as outcome data; should take account of social and cultural contexts, including the role of support networks, relationships that help to build resilience and also social processes that support the implementation and impact of the intervention (NICE, 2007).

This study has shown that MTSS can support significant improvements in children's vocabulary and expressive language skills, over and above that of usual classroom practice. We do not know if there are certain characteristics of the universal tier of support that facilitate greater improvement for children requiring targeted and specialist tiers of support or whether the action of each alone would be sufficient to bring about these changes. Future research should explore in more detail the context in which interventions are delivered to find common contextual facilitators and barriers to progress in specific interventions and in the wider communication environment.

Multi-tiered systems of support for SLCN such as this are examples of complex interventions, embedded into complex systems. Interventions are typically standardised by form (i.e. always being delivered in the same way, using the same resources), however it has been considered that complex interventions are more suited to standardisation by function and underlying concept (Hawe et al., 2004; Rutter et al., 2017; Shiell et al., 2008). Standardising by function, rather than form, allows for flexibility to adapt the intervention to the local context, whilst maintaining the integrity of core, integral components and theoretical underpinnings. This was the approach taken in this study and children across each of the campuses improved at very similar rates, tentatively indicating high levels of fidelity to the key components of the model. This is not something that was explicitly explored within this project and these findings

indicate that it is an area that would merit further, explicit investigation for interventions targeting SLCN.

Finally, the finding here that the children entering nursery with the lowest BPVS scores were able to begin to close the gap with their higher performing peers is promising. It is important to explore whether this finding is replicated if the model is implemented in contexts with greater variations in SES and a lower prevalence of SLCN. However, if only successful in the most deprived areas, this in itself is an informative and practical finding.

5.10 SLCN as a public health issue

In order to be considered a public health issue Law, Levickis, et al. (2017) state that three specific criteria must be met. These criteria are that the specific issue must:

- place a large burden on society;
- be unfairly distributed within society and
- there must be evidence that preventative strategies can reduce said burden.

Existing evidence to support SLCN being considered a public health issue was outlined in Chapter 1: . This study provides additional evidence that SLCN places a large burden on society, that the need is unfairly distributed and that preventative strategies can reduce said burden. These claims are expanded in the following sections.

5.10.1 SLCN as a large burden on society and the unfair distribution

Existing prevalence estimates indicate approximately 7%-10% of children enter school with some level of SLCN (Bercow, 2008) in comparison to 56% entering nursery with SLCN in this cohort with high levels of deprivation. On entry to nursery in this study 42% of children presented with a SSD, 29% with expressive language difficulties, 28% receptive vocabulary difficulties and 15% with comprehension difficulties (Figure 3.7, page 76). These prevalence rates in this area of high deprivation align with the estimates outlined in Table 3.14 (page 100) for children in the lowest quintile of deprivation. Perhaps the most surprising finding is the high proportion of children presenting with SSD on entry to nursery. This is much higher than the 3.8% - 18% estimate from previous studies (Eadie et al., 2015; Shriberg et al., 2019, 1999; Wren et al., 2013) and is perhaps reflective of the limited representation from low SES areas in those studies. The effect of SES on SSD is rarely reported. This could be due to their being

a more biological model of causation and therefore studies have largely overlooked the impact of SES on speech development.

Previous studies have found that the impact of SES on children's language development is cumulative (Reilly et al., 2010). Within this study, children who are older when they start nursery are estimated to have lower receptive vocabulary scores than those entering at a younger age (Table 4.6, page 100). As this sample is characterised by high levels of deprivation, this provides additional evidence of this cumulative impact of deprivation on language development, in this case specifically receptive vocabulary development.

5.10.2 Evidence that preventative strategies can reduce the burden on society

This study adds to the existing evidence that preventative strategies have the potential to reduce the burden of SLCN on society. Table 4.8 (page 140) shows that over the course of the nursery year, the mean improvement when included in the MTSS is 15 standard score points of progress when included in the MTSS in comparison to usual classroom practice. This magnitude of improvement has the potential to move children from 'at risk' categories into the typical range before the age of five; a key milestone in terms of future implications and outcomes (Bird et al., 1995; Snowling et al., 2001; Stothard et al., 1998).

5.11 Addressing SLCN as part of a public health model

Through reviewing existing accepted and applied models of public health approaches in SLCN, exploring the data within this thesis and practical experience from the wider project, the following model of SLCN as part of a public health model was developed (Figure 5.1). Models of public health approaches and tiered systems of support are often presented in isolation, rather than as a complex network of models at different scales that all contribute to the wider picture. This model seeks to bring these together to reinforce the importance of collaboration not only within tiered systems of support, but between and across the different contexts, i.e. institutions, local areas, nationally, in order to build a more robust evidence base for meeting SLCN in this way.

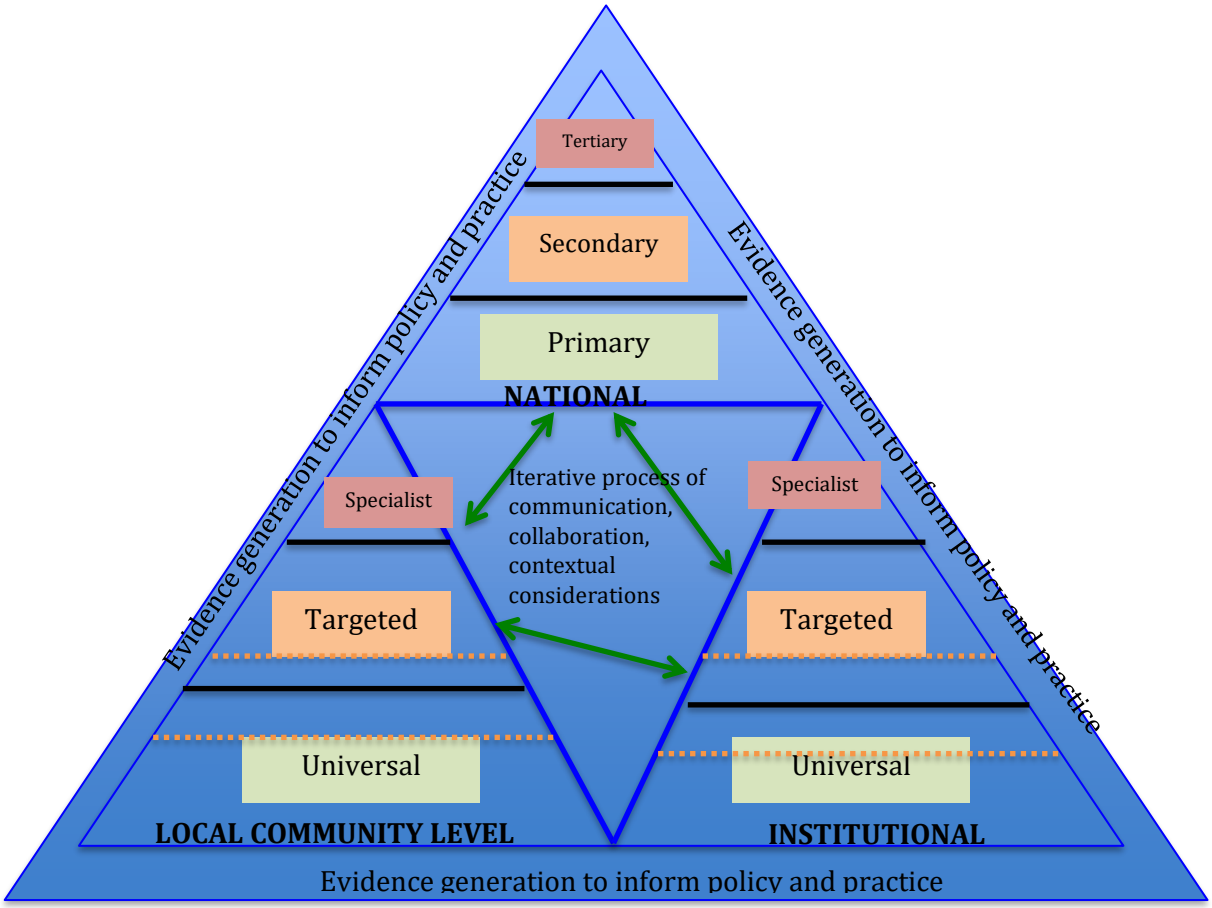

Figure 5.1 A visualisation of a public health MTSS for SLCN

This model is a visualisation of SLCN support in the context of public health and tiered models of provision. Each of the three triangles represents either the institutional, local community or national context. Each encompasses three levels of prevention/intervention. The public health terminology of primary, secondary and tertiary prevention has been retained at the national level, but the more intervention-based terminology of universal, targeted and specialist tiers of provision have been utilised at the local and institutional levels. This is to indicate the focus on provision and practicality rather than policy. There is some discrepancy with regards to the terminology used in practice; the universal/targeted/specialist terminology is often used by SLTs and to some extent in the education system, however there are other terms such as 'quality first teaching' or 'wave 1' or 'tier 1' to describe the universal tier; 'wave 2' or 'tier 2' for targeted levels and 'wave 3' or 'tier 3' for more individualised targeted work or specialist level support. The whole system is encompassed in an outer layer of evidence generation to inform policy and practice to emphasise the shared responsibility and on-going importance of evidence generation at all levels and collaboration in the vision

and priorities for this. This would help to facilitate the co-production of interventions and evidence that are rooted in theory, but able to vary locally and institutionally to ensure acceptability and relevance. This flexibility is hypothesised to promote normalisation and sustained impact of successful approaches (May et al., 2007; Murray et al., 2010). The inner triangle represents the complex nature of the relationships and interactions within and between these contexts; as well as the importance of an iterative process of communication, collaboration and contextual consideration within and between levels. Each level can then be extracted and positioned into a model such as that in Gascoigne (2006) which extrapolates the possible portion of SLT time/responsibility at each of the tiers. It is entirely possible that this varies at each level, for example there would perhaps be a higher portion of SLT representation at the primary prevention tier nationally than at the local and institutional levels in order to ensure that the over-arching policy, advice, strategies and messages are well informed; however, the delivery and dissemination of these elements may be appropriately and effectively delivered by other trained and supported professionals or community members.

The inclusion of the dashed orange lines on the local and institutional triangle denotes that there will be local and institutional variation in the proportions of children requiring support at each of these levels. This is linked to differing prevalence estimates for populations in areas of disadvantage and the concept of proportionate universalism also comes in to play here (1.2.4). This could be exemplified by a certain local authority falling within the targeted tier of prevention as determined at the national level due to level of deprivation and therefore being classed as an area that is at risk of having a higher prevalence of SLCN. Within that local authority there could then be institutions (schools, nurseries, children's centres etc.) that fall in to the universal/targeted/ specialist tiers depending on local characteristics; and then within that a school that is at the targeted tier locally would also then be implementing its own tiered provision in response to the needs of its pupils and hyper-local context.

This study has evaluated a MTSS at the institutional level of the model. The findings are applicable to other institutions serving similar populations and are also relevant at the local level of the model, particularly in areas with high levels of deprivation.

5.12 Conclusion

In conclusion, MTSS such as this can have a positive impact on children's language skills, over and above that of business as usual classroom practice. With such high prevalence estimates in areas of social deprivation, MTSS are required in order to adequately meet the high levels of need in a flexible and responsive way. When planning and implementing a MTSS within education it is vital that contextual factors are considered in order to aid normalisation into everyday practice. This can be done by allowing flexibility in some aspects of the MTSS, though supporting fidelity to core principles across settings. Exactly what these core principles should be needs to be further, systematically evaluated.

With the universal tier of the intervention playing an integral role to children's progress, the collaborative nature of the MTSS and the role of the SLT at all tiers are essential. This evaluation shows that although this role is vital, one SLT can support change across five campuses. The mechanisms and detail of this support is an important area for further study. Particularly as it appears that support may be needed into the school years in order to maintain the progress made. This does not invalidate the impact of this intervention; rather provides evidence of the complexity involved in supporting children in these areas and the on-going challenges faced by children living in deprivation.

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APPENDICES

7.1 Appendix A

Table A1: Kruskal Wallis results for each assessment at every assessment period (five groups)

Assessment period	DEAP			ERB standard score			ERB raw score			BPVS standard score			BPVS raw score			RST	
	n	χ^2	p	n	χ^2	p	n	χ^2	p	n	χ^2	p	n	χ^2	p	n	χ^2	p
1	81	41.75	.00*	52	6.25	.18	66		.00*	67	12.40	.01*	80		.00*	81	20.17	.00*
2	72	30.42	.00*	51	13.84	.01*	57		.00*	80	11.86	.02*	83		.00*	80	12.95	.01*
3	79	27.02	.00*	66	11.72	.02*	68		.00*	83	20.17	.00*	83		.00*	82	11.50	.02*
4	83	46.17	.00*	77	16.56	.00*	80		.00*	84	28.28	.00*	84		.00*	84	9.07	.06

Note: DEAP = Diagnostic Evaluation of Articulation and Phonology; ERB = Early Repetition Battery sentence repetition; BPVS = British Picture Vocabulary Scale (3rd Ed.); RST = Derbyshire Rapid Screening Test. N=91.

Missing data due to time constrains, absence or refusal.

Table A2: Dunn's post hoc comparisons of groups at each assessment point for the British Picture Vocabulary Scale 3rd Edition standard score

Note: SLN = Stable low needs; RN = Resolving needs; LEN = Late emerging needs; FN = Fluctuating needs; SHN = Stable high needs. SLN N=49; RN N = 8; LEN N = 11; FN N = 14; SHN N = 9. Missing data due to time constrains, absence or refusal.

	Assessment point 1						Assessment point 2						Assessment point 3						Assessment point 4					
			Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test			
Group	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN
SLN	41	90.72					44	97.14					45	103.31					48	106.6				
RN	8	84.13	.68				8	87.50	.14				8	93.88	.27				6	100.83	.27			
LEN	11	85.20	1.00	1.00			9	90.22	.27	1.00			9	97.67	1.00	1.00			9	96.56	1.00	1.00		
FN	14	81.67	.01*	1.00	1.00		12	92.00	1.00	1.00	1.00		12	97.75	0 71	1.00	1.00		12	93.33	.71	1.00	1.00	
SHN	9	80.67	.30	1.00	1.00	1.00	7	85.57	.05	1.00	1.00	p=0.87	9	82.89	.00*	.47	.10	.07	9	83.44	.00*	.47	.10	.07

*significant after Bonferroni corrections

Table A3: Dunn's post hoc comparisons of groups at each assessment period for the British Picture Vocabulary Scale 3rd Edition raw scores

	Assessment point 1						Assessment point 2						Assessment point 3						Assessment point 4					
			Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test					
Group	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN
SLN	42	39					44	49					45	58					48	63				
RN	8	33	1.00				8	36	.11				8	47	.20				6	57	1.00			
LEN	9	27	.07	1.00			9	39	.28	1.00			9	51	.75	1.00			9	51	.04	1.00		
FN	13	27	.06	1.00	1.00		13	41	.42	1.00	1.00		12	51	.69	1.00	1.00		12	48	.01*	1.00	1.00	
SHN	8	18	.00*	.14	1.00	.056	9	30	.00*	1.00	1.00	.47	9	32	.00*	.43	.10	.05	9	35	.00*	.12	.53	.65

Note: SLN = Stable low needs; RN = Resolving needs; LEN = Late emerging needs; FN = Fluctuating needs; SHN = Stable high needs. SLN N=49; RN N = 8; LEN N = 11; FN N = 14; SHN N = 9. Missing data due to time constrains, absence or refusal.

*significant after Bonferroni corrections

Table A4: Dunn's post hoc comparisons of groups at each assessment period for the Early Repetition Battery sentence repetition assessment standard scores

	Assessment point 2						Assessment point 3						Assessment point 4					
			Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test			
Group	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN
SLN	31	93.3					37	94.8					45	97.6				
RN	6	93.2	1.00				8	91.9	1.00				7	97.3	1.00			
LEN	4	77.8	.15	.31			9	85.3	.36	1.00			10	88.1	.29	.98		
FN	9	76.7	.01*	.09	1.00		9	85.7	.31	1.00	1.00		9	88.4	.38	1.00	1.00	
SHN	1	80.0	1.00	1.00	1.00	1.00	3	73.0	.03	.15	.65	.70	6	72.2	.00*	.03	.40	.40

Note: SLN = Stable low needs; RN = Resolving needs; LEN = Late emerging needs; FN = Fluctuating needs; SHN = Stable high needs. SLN N=49; RN N = 8; LEN N = 11; FN N = 14; SHN N = 9. Missing data due to time constrains, absence or refusal. No results for assessment period 1 as no significant difference between the groups was identified in the Kruskal Wallis analysis

*significant after Bonferroni corrections

Table A5: Dunn's post hoc comparison of groups at each assessment point for the Early Repetition Battery sentence repetition assessment raw scores

	Assessment point 1						Assessment point 2						Assessment point 3						Assessment point 4					
			Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test					
Group	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN
SLN	35	8					32	13					37	16					45	17				
RN	6	4	.48				6	14	1.00				8	15	1.00				7	17	1.00			
LEN	8	4	.08	1.00			6	4	.03	.07			9	11	.28	1.00			10	13	.33	1.00		
FN	12	3	.02*	1.00	1.00		10	5	.03	.09	1.00		10	11	.10	.91	1.00		10	12	.23	1.00	1,00	
SHN	5	1	.01*	.95	1.00	1.00	3	2	.07	.08	1.00	1.00	4	3	.00*	.56	.42	.60	8	4	.00*	.01*	.17	.22

Note: SLN = Stable low needs; RN = Resolving needs; LEN = Late emerging needs; FN = Fluctuating needs; SHN = Stable high needs. SLN N=49; RN N = 8; LEN N = 11; FN N = 14; SHN N = 9. Missing data due to time constrains, absence or refusal.

*significant after Bonferroni corrections

Table A6: Dunn's post hoc comparisons of groups at each assessment period for the Diagnostic Evaluation of Articulation and Phonology

	Assessment period 1					Assessment period 2					Assessment period 3					Assessment period 4				
		Dunn's post hoc test					Dunn's post hoc test					Dunn's post hoc test					Dunn's post hoc test			
Group	n	SLN	RN	LEN	FN	n	SLN	RN	LEN	FN	n	SLN	RN	LEN	FN	n	SLN	RN	LEN	FN
SLN	42					39					44					45				
RN	8	.00*				8	1.00				7	.45				8	.21			
LEN	10	.00*	1.00			8	.00*	.03			10	.00*	.91			11	.00*	.15		
FN	14	.27	.05	.35		10	.05	.42	1.00		10	1.00	1.00	.13		1	.02*	1.00	.33	
SHN	7	.00*	1.00	1.00	.07	7	.00*	.01/8	1.00	.57	8	.00*	.49	1.00	.06	9	.00*	.19	1.00	.40

Note: SLN = Stable low needs; RN = Resolving needs; LEN = Late emerging needs; FN = Fluctuating needs; SHN = Stable high needs. SLN N=49; RN N = 8; LEN N = 11; FN N = 14; SHN N = 9. Missing data due to time constrains, absence or refusal.

*significant after Bonferroni corrections

Table A7: Dunn's post hoc comparisons of groups at each assessment period for the Derbyshire Rapid Screening Test

	Assessment point 1						Assessment point 2						Assessment point 3					
			Dunn's post hoc test						Dunn's post hoc test						Dunn's post hoc test					
Group	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN	n	Mean	SLN	RN	LEN	FN
SLN	43	19.05					43	20.12					44	20.50				
RN	8	17.13	.30				8	19.13	1.00				7	19.71	1.00			
LEN	10	17.60	.37	1.00			8	19.13	1.00	1.00			10	20.40	1.00	1.00		
FN	12	17.33	.27	1.00	1.00		13	19.23	1.00	1.00	1.00		12	20.67	1.00	1.00	1.00	
SHN	8	12.88	.00*	.42	.21	.18	8	16.38	.00*	.19	.36	.10	9	18.44	.01*	.48	.02*	.04

Note: SLN = Stable low needs; RN = Resolving needs; LEN = Late emerging needs; FN = Fluctuating needs; SHN = Stable high needs. SLN N=49; RN N = 8; LEN N = 11; FN N = 14; SHN N = 9. Missing data due to time constrains, absence or refusal. No results for assessment period 4 as no significant difference between the groups was identified in the Kruskal Wallis analsysis

*significant after Bonferroni corrections

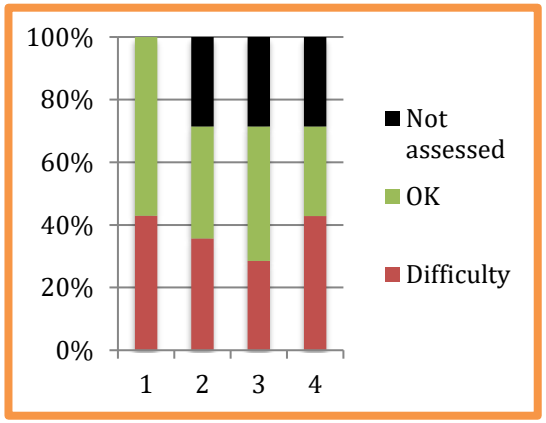

Figure A1 Speech performance of the **fluctuating-need** pathway at each assessment point. N=14 for fluctuating-need pathway.

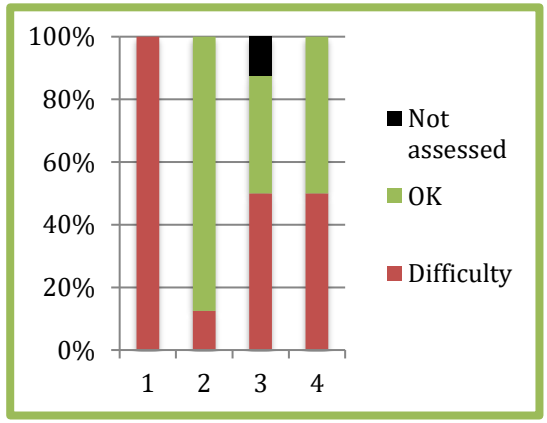

Figure A2 Speech performance of the **resolving-need** pathway at each assessment point. N=8 for resolving-need pathway

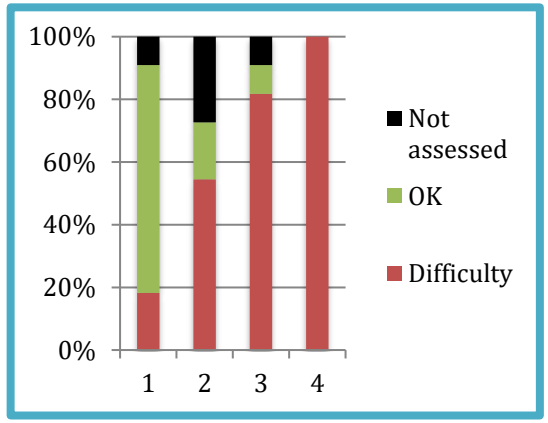

Figure A3 Speech performance of the **late-emerging-need** pathway at each assessment point. N=11 for late-emerging-need pathway.

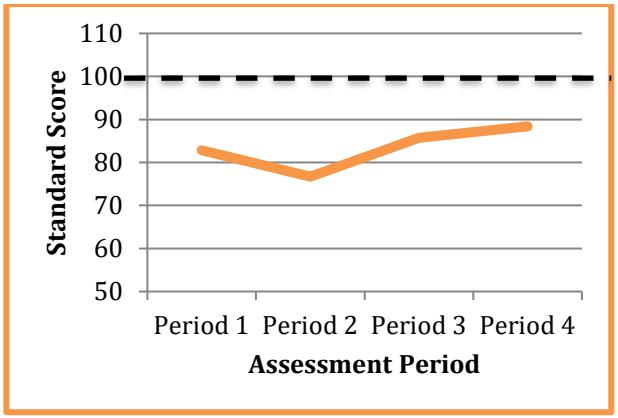

Figure A4 ERB standard score performance of the **fluctuating-need** pathway at each assessment point. N=14 for fluctuating-need pathway. ERB = Early Repetition Battery sentence repetition assessment.

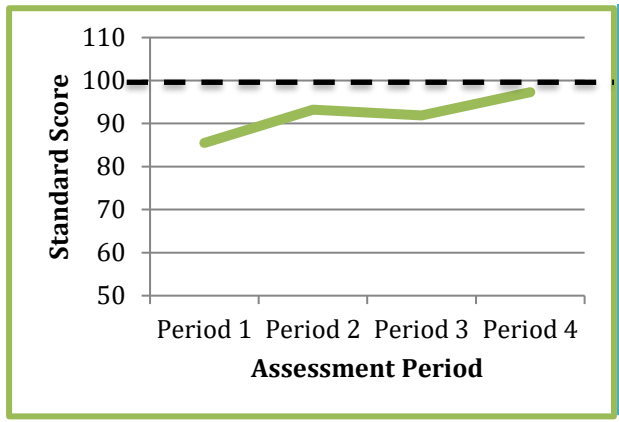

Figure A5 ERB standard score performance of the **resolving-need** pathway at each assessment point. N=8 for resolving-need pathway. ERB = Early Repetition Battery sentence repetition assessment.

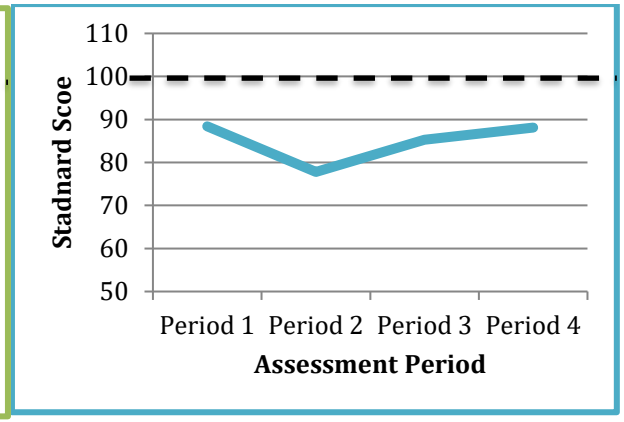

Figure A6 ERB standard score performance of the **late-emerging-need** pathway at each assessment point. N=11 for late-emerging-need pathway. ERB = Early Repetition Battery sentence repetition assessment.

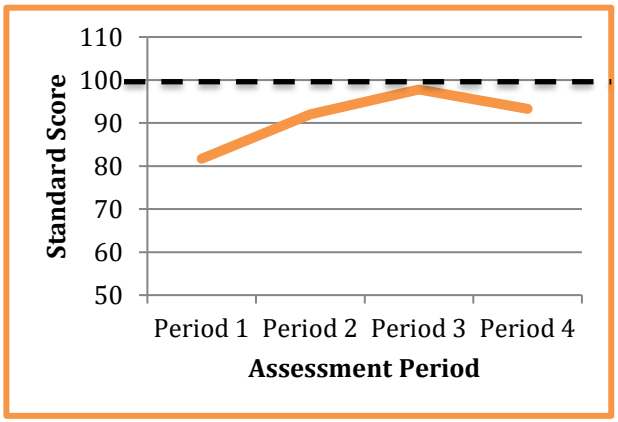

Figure A7 BPVS standard score performance of the **fluctuating-need** pathway at each assessment point. N=14 for fluctuating-need pathway. BPVS = British Picture Vocabulary Scale 3rd Edition.

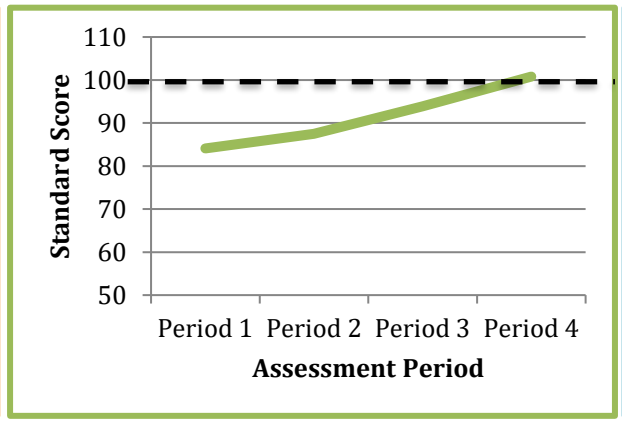

Figure A8 BPVS standard score of the **resolving-need** pathway at each assessment point. N=8 for resolving-need pathway. BPVS = British Picture Vocabulary Scale 3rd Edition.

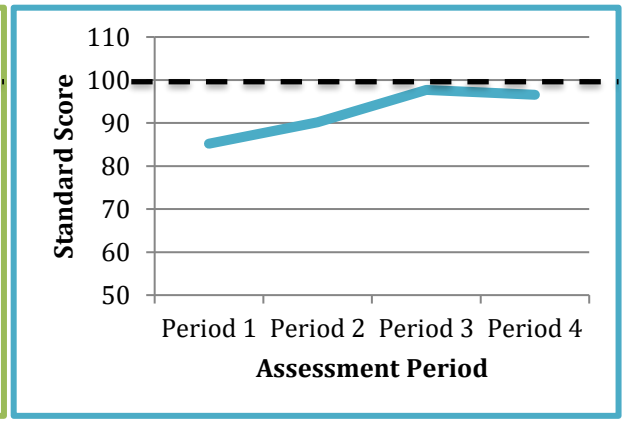

Figure A9 BPVS standard score of the **late-emerging**-need pathway at each assessment point. N=11 for late-emerging-need pathway. BPVS = British Picture Vocabulary Scale 3rd Edition.

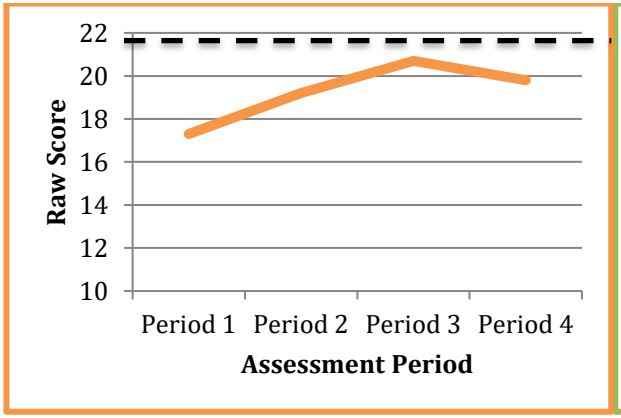

Figure A10 RST raw score of the **fluctuating-need** pathway at each assessment point. N=14 for fluctuating-need pathway. RST = Derbyshire Rapid Screening Test.

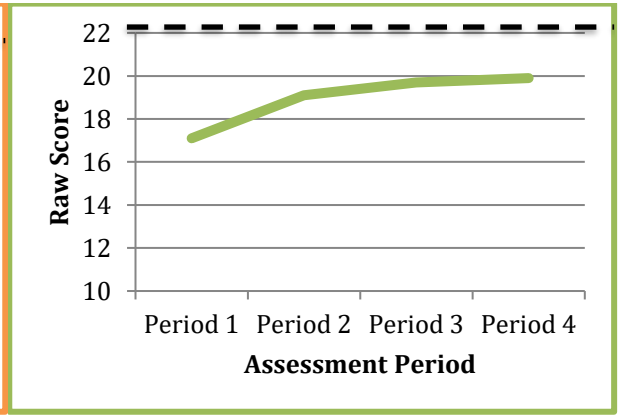

Figure A11 RST raw score of the **resolving-need** pathway at each assessment point. N=8 for resolving-need pathway. RST = Derbyshire Rapid Screening Test.

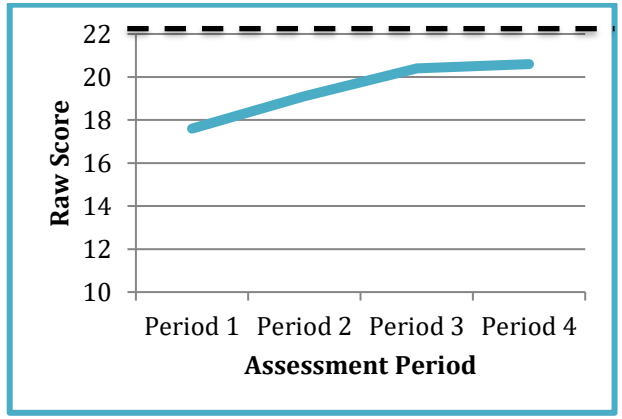

Figure A12 RST raw score of the **late-emerging-need** pathway at each assessment point. N=11 for late-emerging-need pathway. RST = Derbyshire Rapid Screening Test.

7.2 Appendix B

Table B1 Empty multilevel models to establish the need for a two- or three-level structure: fixed and random effects

Parameters	Unconditional Means Model		Unconditional Growth Model		
	Two-level	Three-level	Random intercept	**Random slope level 2**	Random slope levels 2 and 3
			Fixed effects		
Constant	96.64	96.60	93.32	**93.62**	93.63
Age			.20*	**.28***	.28*
			Random effects		
Between-campus intercept		2.56	2.69	**3.02**	2.12
Between-campus slope					.06
Between-campus covariance					1.0
Between-individual intercept	9.30	8.97	8.98	**13.37**	13.35
Between-individual slope				**.53**	.53
Between-individual covariance				**- .71**	- .71
Within-individual	7.79	7.79	7.64	**6.52**	6.52

* $p<0.05$

Table B2 Impact of inclusion in the MTSS; fixed effects for the Early Repetition Battery standard scores model

ERB	TSS		BST	
	Intercept Coefficient (95% CI)	Slope Coefficient (95% CI)	Intercept Coefficient (95% CI)	Linear Slope Coefficient (95% CI)
Age[a] (ref. 43.3 months)	.28***[.18, .38]		.42*** [.26, .57]	
Gender (ref. male)				
Female	6.06*** [3.47, 8.66]		6.67*** [3.81, 9.54]	
Speech (ref. no difficulties)				
Speech difficulties	-3.02***[-4.34, -1.69]		-3.76*** [-5.45, -2.08]	.13 [-.00, .27]
Campus (ref. C1)				
C2	3.95*[.58, 7.32]		5.06* [.89, 9.27]	-.06 [-.23, .11]
C3	4.59*[.16, 9.01]		10.45*** [4.98, 15.92]	.57*** [-.80, -.35]
C4	-.96 [-5.49, 3.57]		-.82 [-6.28, 4.63]	-.17 [-.39, .05]
C5	2.69 [-2.14, 7.52]		8.57** [2.64, 14.50]	-.77***[-1.01, -.52]
Experimental condition (ref. 0 terms				
1	-1.36 [-30.37, 27.65]	3.42*[.57, 6.28]	-4.56 [-37.59, 28.46]	4.05** [1.12, 6.99]
2	-1.58 [-12.99, 9.83]	..13 [-.53, 6.28]	-2.80 [-15.73, 10.12]	.35 [-.27, .98]
3	-3.65*[-6.74, -.55]	.00 [-.13, .15]	-5.39** [-8.88, -1.91]	.21** [.07, .36]
4	-7.16 [-16.63, 2.32]	.47 [-.06, 1.00]	-8.16 [-18.90, 2.59]	.63* [.13, 1.12]
5	-3.58 [-11.53, 4.36]	.10 [-.21, .41]	-.96 [-10.09, 8.18]	-.06 [-.38, .27]

Table B3 Impact of inclusion at different tiers of the MTSS; fixed effects for the Early Repetition Battery standard scores model

ERB	TSS		BST	
	Intercept Coefficient (95% CI)	Slope Coefficient (95% CI)	Intercept Coefficient (95% CI)	Linear Slope Coefficient (95% CI)
Age[a] (ref. 43.3 months)	.32***[.23, .41]		.40***[.25, .56]	
Gender (ref. male)				
Female	6.14***[3.51, 8.77]		6.30***[3.50, 9.11]	
Speech (ref. no difficulties)				
Speech difficulties			-3.65***[-5.40, -1.90]	.13 [-.02, .27]
Campus (ref. C1)				
C2	3.80*[.49, 7.10]		3.96*[.04, 7.88]	-.02 [-.20, .16]
C3	4.55*[.16, 8.94]		9.07**[3.85, 14.29]	-.52***[-.75, -.29]
C4	-1.10 [-5.60, 3.41]		-2.22 [-7.44, 3.00]	-.08 [-.31, .15]
C5	1.88 [-2.86, 6.61]		5.61 [-.02, 11.24]	-.59***[-.86, -.32]
Provision (ref. control)				
Universal tier	-3.81***[-5.85, -1.77]	.15 [-.02, .32]	-4.37***[-6.57, -2.16]	.34***[.16, .52]
Targeted tier	-7.46***[-10.33, -4.59]	.34 [-.01, .70]	-7.57***[-10.50, -4.63]	.71***[.35, .1.07]
Specialist tier	-7.02**[-11.38, -2.65]	-.14 [-.48, .21]	-6.48**[-10.48, -2.49]	.11 [-.21, .43]
Reception[a]	-7.40*[-14.19, -.61]	.31 [-.05, .66]	-8.18*[-15.27, -1.09]	.31 [-.07, .68]