

AN EXPLORATION OF EVIDENCE OF
DEFICITS AND THEORIES OF THERAPY FOR
SPECIFIC-RECEPTIVE LANGUAGE
IMPAIRMENT IN CHILDREN

LYDIA MORGAN

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CHAPTER 1 Introduction

This chapter provides background information on specific receptive language impairment (SRLI), in terms of the issues around defining it (1.1), its prevalence and incidence (1.2) and its suggested etiology (1.3). The importance of extending research on this population is then established; the negative outcomes for children with receptive language difficulties are described (1.4) and it is suggested that SRLI is under-identified (1.5). The lack of evidence for the effectiveness of interventions for children with SRLI is then presented (1.6). Finally, the chapter finishes with an outline of this thesis (1.7).

1.1 Defining specific receptive language impairment

Specific receptive language impairment is a language problem in children, affecting their ability to comprehend both written and spoken language. The International Statistical Classification of Diseases and Related Health Problems (ICD-10), developed by the World Health Organisation (WHO 2003) classifies specific language disorders into two types; receptive language disorder and expressive language disorder. The definition they provide for receptive language disorder is as follows:

“A specific developmental disorder in which the child’s understanding of language is below the appropriate level for its mental age. In virtually all cases expressive language will also be markedly affected and abnormalities in word-sound production are common.”

(WHO 2003, F80.2)

It should be noted that this definition acknowledges that there are likely to be associated expressive language impairments. In contrast, expressive language disorder is described by the ICD-10 as expressive spoken language being markedly below the appropriate level, but where language comprehension is within normal limits. The Diagnostic and Statistical Manual of Mental Disorders-IV-TR (DSM-IV-TR, American Psychiatric Association 2000), draws the same distinction between mixed receptive-expressive language disorder (315.23) and expressive language disorder (315.31).

Among teachers and academics, children with specific-receptive language impairment are often referred to as having specific language impairment (SLI), which incorporates both receptive and expressive subtypes. To add further confusion, other terms used for SLI include primary language impairment, developmental dysphasia and developmental language disorder.

The ICD-10 notes that receptive language disorder might also be referred to as mixed receptive/expressive disorder. Receptive language disorder is referred to throughout the thesis as specific receptive language impairment. The decision to use this term rather than

receptive language disorder or impairment (RLI), as referred to by the ICD-10, was taken because RLI appears to be viewed to encompass both specific and general receptive language difficulties:

“It (RLI) is associated with both general language learning difficulties and specific language impairment.”
(Law et al 2008, p.246)

Among SLTs the term RLI appears to have connotations of learning difficulties, as well as pragmatic or autistic spectrum disorders (ASD), perhaps because it tends to be written about in association with these issues (Howlin et al 2000; Mawhood et al 2000; Clegg et al 2005). The term SRLI, is intended to denote the specific nature of the impairment, where language difficulties are not thought to be associated with low non-verbal intelligence or other underlying disorders.

There appear to be conceptual issues for many different terms in speech and language therapy (SLT) (Wren et al 2009). It is therefore important to operationalise the definition of receptive language disorder given by WHO (2003) in terms of what ‘below appropriate level for its (the child’s) mental age’ means, in measurable terms. The WHO developed diagnostic criteria for research purposes (ICD-10) and gives the following criteria for receptive language disorder (under code F84):

- A. Language comprehension, as assessed on standardized tests, below the two standard deviations limit for the child's age
- B. Receptive language skills at least one standard deviation below non-verbal IQ as assessed on a standardized test
- C. Absence of neurological, sensory, or physical impairments that directly affect receptive language, nor is there a pervasive developmental disorder
- D. Most commonly used exclusion criterion: Nonverbal IQ below 70 on a standardized test

These criteria are important to consider for research purposes, though clinically speech and language therapists may not define specific-receptive language impairment in these terms. Non-verbal intelligence quotients (IQ) for instance, require assessment from a psychologist, but SLTs may not have this information available to them. This is demonstrated in a study by Bishop and Edmundson (1987). SLTs were asked to refer language impaired children to the study, excluding those of low nonverbal ability, yet 22% of the referred sample scored more than two standard deviations (SD) below the mean on a nonverbal test. Although SLTs may use norm-referenced scores to diagnose clients, decisions about when speech-language therapy is or is not appropriate are more likely to be based on the functionality of the child’s

language, not just standardised test scores. SLTs are therefore perhaps more concerned with these issues than with labelling disorder types, preferring instead to see children on a continuum with individuals having different profiles of difficulty. In clinical practice such a perspective is pragmatic but it is at odds with research where patterns of deficit, the efficacy of therapy and long term outcomes can only be examined if participants are grouped by their having certain features in common.

1.2 Prevalence and incidence of specific receptive language impairment

A number of studies have examined the prevalence (those who currently have the condition) of SLI rather than SRLI; fewer have examined the incidence (the number of new people with a condition in a specific time frame). Prevalence of SRLI has only been examined in more recent years, Tomblin et al (1997) for instance note that:

“Although it is generally believed that the majority of children with SLI will present expressive language problems...the proportion of children with receptive language problems is not known.”
(Tomblin et al 1997, p. 1247)

Precise estimates of prevalence for SLI are difficult to ascertain owing to studies adopting different diagnostic systems for SLI. Silva (1980) and Silva et al (1983) studied over 1,000 three-year-old children in a four-year longitudinal study. Language impairment was found to occur in 7.6% of the three-year-old children and 10.4% of the children two years later when they were five-year-olds. Similar prevalence rates were reported by Beitchman et al (1986), with 12.6% of five-year-old children being found to have language impairment. By contrast, lower rates of language impairment have been reported elsewhere (Stevenson and Richman 1976; Fundudis et al 1979), particularly where more specific language criteria have been adopted. For example, Stevenson and Richman (1976) reported a 3.1% prevalence of expressive language impairments in a sample of 705 three-year-olds. However, when a specific language impairment criterion was employed, using non-verbal IQ discrepancy, prevalence dropped to 1.42%. Similarly in a cohort study, of 3,300 children, Fundudis et al (1979) found specific speech and language disorder in only 2.5% of seven-year-olds. It should be noted that in both these studies the language impaired groups do not fulfill the criteria for SRLI, since the former only examined expressive language, and the latter included those who had only speech difficulties.

The DSM-IV (American Psychiatric Association 1994) estimates the prevalence rate for specific expressive language impairment (SELI) to be between three and five percent and SRLI to be three percent, putting overall prevalence for SLI between six and eight percent. Though it does not provide any supporting evidence for this, this estimate has been upheld

in a subsequent large scale study of over 6000 children (Tomblin et al 1997), where the estimated overall prevalence rate for SLI was found to be 7.4% among five-year-olds. Tomblin et al (1997) adopted a -1.25 standard SD discrepancy from the norm criteria, on two of five composite scores, to diagnose SLI. They report that had they adopted a two SD discrepancy (as recommended by WHO in the ICD-10) the prevalence estimate would be only 1.12%. This perhaps explains the higher prevalence estimate by Tomblin et al (1997) compared with previous language impairment studies, for example, Stevenson and Richman (1976) adopted more restrictive diagnostic criteria for SLI, of two and a half years below the child's age level expectations.

More recently, authors have explored the prevalence of expressive and receptive subgroups. Archibald and Gathercole (2006) examined the prevalence of SLI in language units, estimating it to be 13%. About three quarters of those with SLI were found to have receptive impairments, the remaining having expressive impairments only. A larger proportion of SLI children presenting with SRLI, rather than SELI, has also been found elsewhere; in an urban primary care trust (PCT) Clark and Collins (2007) for example, reported 64% of children with SLI, to have receptive difficulties while the remaining children had just expressive difficulties.

The only recent incidence study for primary speech and language impairments (Broomfield and Dodd 2004) found an incidence rate of 14.6% based on new referrals to a speech and language therapy service in the northeast of England. A larger proportion of new referrals (20.4%) were found to be receptive language impaired compared with expressive language difficulties (16.9%). The proportion of children recorded as having profound levels of severity was also high for receptive language disorder but low for children with speech disorders.

It is evident that the issue of prevalence and incidence is not an exact science. Establishing prevalence and incidence based on children meeting standard deviation discrepancy criteria is further complicated by its inherent circularity. Standard scores are based on normal distribution, thus the percentage of cases should be predetermined by the standard deviation criteria used. For instance, a criteria of two SD below the mean for language impairment, should equate to two percent of the population, and one SD below the mean to 16%. The prevalence studies demonstrate, however, the relative commonality of language impairments and that the majority of those with language impairments have receptive language difficulties.

1.3 Etiology of language impairments

For years there was very little known about the etiology of SLI, and there is still considerable uncertainty (Bishop 2008). There also appears to be no attempt to separately address

etiology of SRLI compared to SELI. It is likely that in most cases of language impairment there is not a single causative factor, but rather a complex combination of risk factors.

Genetics have been found to play an important role in SLI. Twin studies of school-aged children have found genetic effects on SLI (Bishop et al 1995; Lewis and Thompson 1992; Tomblin and Buckwalter 1998). However, there is not a single gene or even combined influence of genes that are likely to be the sole cause of SLI, but rather there are numerous genetic variants that increase the risk of disorder. SLI can be described as having a "complex multifactorial etiology" (Bishop 2008, p.72) where a combination of genetics and environmental risk factors contribute to the disorder.

It is noteworthy that speech and language delays are more common in males than females. Varied gender ratios have been found within language disability, but the majority of studies have found a 2:1 ratio of boys to girls having language impairments. There are, however, a few studies that found exceptions to this (Law et al 2000). The most recent study examining this issue found a gender ratio within language disability of 3:1 boys to girls (Broomfield and Dodd 2004). However, Tomblin et al. (1997) is the only study that examines gender in relation to SLI, and found that while boys are slightly more likely to present with SLI, the ratio was nearly 1:1 boys to girls. This suggests more research is needed into gender differences for SLI, before firm conclusions can be drawn.

Brain physiology has also been examined in those with language impairment (LI). Structural imaging studies have been used to establish the neuronatomical and functional brain characteristics of children with language impairments. Among those with LI, regions of abnormal asymmetry in brain structure have been found, particularly in the planum temporale, an area involved in processing acoustic and speech information (Griffiths and Warren 2002). A number of other studies have noted variations in the planum temporale, though there are inconsistencies across studies in the type of differences that have emerged (Plante et al 1991; Gauger et al 1997; Herbert et al 2005), suggesting more research is necessary in this area. There is also some evidence that LI children have enlarged white matter (Herbert et al 2004), which might indicate alteration in neurodevelopmental processes. It is noteworthy, however, that these types of structural differences are subtle and based on small sample sizes. Furthermore, the extent that these structural differences relate to the cause of language impairment, or are a consequence of years of different language use by children with LI is difficult to determine.

1.4 Outcomes for children with receptive language difficulties

Children with receptive language impairments appear to be at greater risk of a persisting problem than those with speech impairments or expressive only language impairments. In a systematic review, by Law et al (2000), collating 12 natural history studies of speech and language delays, it was found that participants classified as having both expressive and receptive impairments had greater persistence of their difficulties (median 75.6%) than those with just an expressive impairment (median 40%). Bishop and Edmundson (1987) also found comprehension impairments to be a factor predicting persistence of language difficulties. In a longitudinal study examining 87 children with language impairments, from four-years-old to five-and-a-half years old, it was concluded that:

“...a child whose language is limited in content as well as structure has a poorer outlook, especially if comprehension is also impaired”
(Bishop and Edmundson, 1987 p.169)

Botting and Conti-Ramsden (2000) examined secondary social and behavioural difficulties of a large cohort of children attending language units in England. It was found that although children did not generally have clinical-level behavioural problems, the scores were significantly different by subgroup. Children who exhibited mainly expressive difficulties showed the least secondary behavioural problems, whereas children with complex receptive language impairments were the most likely to score over the clinical threshold and were rated as having more marked social difficulties with peers than the other subgroups. Broomfield and Dodd (2004) reported similar findings: behaviour was found to be an issue for 43% of children with receptive language disability, but for only 21% of children with speech disability.

There is some evidence that children with receptive language impairment are at greater risk of psychiatric disorders, (Baker and Cantwell 1987; Beitchman et al 1994). Beitchman et al (1994) conducted a seven year follow up study, with children initially assessed at five years (n=202), finding children with a receptive impairment more likely to have a diagnosis at the 12.5 year follow-up (64.7%) than children with expressive only impairment (40%), though this difference did not reach significance. There is evidence to suggest that such difficulties also extend into adulthood. The same children, with both expressive or receptive impairments, were examined again at 19 years (Beitchman et al 2001) when it was found they had significantly higher rates of anxiety disorder compared with non-impaired children.

In another cohort study, children with SRLI were found to have significant social adaptation problems and difficulty with peer relationships. Howlin et al (2000) followed a cohort of children with SRLI from childhood into their early twenties, finding that over half of the SRLI

group had some problems in establishing relationships and over a third had no particular friends. This group was then followed up again in a study by Clegg et al (2005) in their early thirties where they were found to have significantly worse social adaptation, including prolonged unemployment, compared with their siblings and adults matched to the cohort on age and performance IQ.

Social difficulties in those with receptive and expressive language difficulties have also been found elsewhere. Snowling et al (2006) examined 71 young people, aged 15-16 years old, with a preschool history of speech and language impairment and found that, for those whose language difficulties persisted to school age, there was a raised incidence of attention and social difficulties. These difficulties were associated with different language profiles; the group with attention problems showed a profile of specific expressive language difficulties, where as the group with social difficulties had receptive and expressive language difficulties.

The link between emotional and behavioural disorders and language impairments also seems to be upheld in studies of children with emotional behavioural disorders (EBD). Benner et al (2002) conducted a systematic review on the language abilities of children with EBD. It was found that a large proportion of children identified in EBD studies had clinically significant language difficulties. On average, based on prevalence information provided by authors, over half of those identified as having language impairment were found to have receptive language deficits.

Other studies have looked at language impairments more broadly, not differentiating receptive and expressive groups, and found negative outcomes (Catts et al 2002; Johnson et al 1999; Stothard et al 1998,). In a 14-year prospective longitudinal study (Johnson et al 1999), children with early language impairments (at five years old) showed long-term deficits in language, cognitive, and academic domains compared with controls. A further example of language impairments resulting in poor academic attainment can be found in a study by Catts et al (2002), who found language impairments to have a detrimental effect on reading and literacy outcomes. Children with SLI that persists to school age appear to have a particularly poor prognosis for spoken and written language functioning (Stothard et al 1998). The cohort study by Clegg et al (2005) of receptive language impaired children, also found them to have severe literacy difficulties as adults. These findings, of a range of negative outcomes for children with SRLI, demonstrate the importance of effective interventions for this population.

1.5 Under-identification of receptive language difficulties

It seems a feature of receptive difficulties that they can go unrecognised or misinterpreted as inappropriate behaviour (Clarke and Collins 2007). This is supported by evidence that

identification of speech and language difficulties by SLT services seems to often be determined by expressive, rather than receptive, difficulties.

Cohen (1993) conducted a large scale study of the language abilities of those with emotional behavioural disorders. Those children with unidentified language impairments (34%) had similar profiles to the previously identified language impairments (25%), in terms of the severity of their receptive language impairments. By contrast, the previously identified group scored comparatively poorly on expressive and pragmatic tests. Similar findings were gained in a large scale prevalence study by Tomblin et al (1997); it was found that of the 216 children participating, only 29% of their parents had previously been informed that their child had a speech or language problem. Support for their identification appeared to be largely determined by expressive rather than receptive skills. Scores obtained on the word articulation and expressive language composite score could accurately predict 80% of those children who had had previous contact with SLT services. In a more recent population based study, Bishop and Hayiou-Thomas (2008) also found SLI children with speech problems were more common among those referred to SLT services, than those who had SLI but who did not have speech problems.

It has been suggested that therapists believe it is sufficient to solely focus intervention on expressive difficulties when treating those with specific-receptive language impairment:

“Very often the presenting symptoms of expressive and receptive disorder are conflated and it is assumed that working on the former has a direct effect on the latter.”

(Law et al 2008, p. 246)

1.6 Interventions for specific receptive language impairment

Concern for those with SRLI is compounded when evidence for the efficacy of speech and language interventions for children with receptive language difficulties is considered. A systematic review for the Cochrane Collaboration (Law et al 2004; 2010) found intervention literature for speech and language therapy to point overall to positive results for expressive language impairments, however, there was insufficient evidence to draw the same conclusions for receptive language difficulties. It was also noted that there were a limited number of intervention studies examining receptive language outcomes; only five studies (Cole et al 1986; Law et al 1999; Glogowska et al 2000; Dixon et al 2001) met inclusion criteria for interventions targeting receptive language, two of which did not categorise therapy aims in terms of expressive and receptive language (Cole et al 1986; Barratt et al 1992).

The intervention studies have different foci; Glogowska et al (2000) and Law et al (1999) compare speech and language therapy intervention to no therapy. Dixon et al (2001) compares traditional speech and language therapy with a technique called Visualising and Verbalising® and Cole et al (1986) compares direct and interactive treatment programmes. These four studies failed to find statistically significant differences between treatment and control conditions on standardised measures of receptive syntax. The study by Barratt et al (1992) was not included in the meta-analysis by Law et al (2010), however, in a comparison of intensive intervention to weekly intervention delivered in a nursery setting, a greater improvement was reported in expressive scores, compared with receptive scores. These studies indicate the lack of evidence for the efficacy of interventions for SRLI. It is perhaps a culture of focus on expressive language impairments that has left receptive language interventions underdeveloped and untested.

1.7 The current research project

Given the relatively high prevalence of SRLI, coupled with the vulnerability of children with receptive language difficulties to negative outcomes, it is felt that receptive language interventions should be considered a priority. Yet the research evidence seems to indicate this population has often been overlooked. More recent years have seen an increased focus on receptive language (Law et al 2008; Clarke and Collins 2007), following the findings from the systematic review by Law et al (2004; 2010). However, there remains little evidence for the efficacy of interventions for children with SRLI. Time spent on the development of receptive language interventions should be time saved trialing non-theoretically sound interventions, perhaps less likely to bring positive findings.

1.7.1 Thesis outline

This thesis focuses on the identification and development of evidence and theory for interventions for SRLI. In Chapter 2 frameworks for developing interventions for SRLI are considered. Complex intervention guidance (Campbell et al 2000) is concluded to be valuable for informing interventions for SRLI, and the Medical Research Council's updated guidance (MRC 2008) is used to inform the research in this thesis. Chapter 3 considers advice from the MRC on identifying and developing theory for interventions for SRLI. The importance of establishing the areas of deficit to be changed in interventions are discussed and models of language comprehension are considered. Chapter 4 then examines, in a systematic literature review, the evidence for the cognitive and linguistic deficits of children with SRLI, to help inform where comprehension might fail in this population. Existing interventions published in the literature for children with SRLI are subsequently examined in Chapter 5 and are reviewed in light of the areas of deficit identified in the systematic literature review in Chapter 4. The theory underpinning interventions and the evidence of their efficacy is also explored. In order to further develop an understanding of interventions

for SRLI, as well as their theoretical basis, focus groups with expert speech and language therapists were then conducted. The background and methods for these are described in Chapter 6. The results of the focus groups are then presented in Chapter 7; intervention themes are described and core intervention approaches and influences on target selections are identified. Finally, in Chapter 8, the findings from the thesis are considered in relation to the research aims, a model of interventions for SRLI is presented, and directions for future research are suggested. The strengths and limitations of the research as a whole are also discussed.

1.7.2 Aims and objectives of thesis

Although the aims, objectives and methods are developed inductively throughout the thesis, they are presented here for clarity. The overarching aim of the research is to develop a model of SRLI that can generate hypotheses for interventions. The objectives within this are:

- To identify the evidence on the nature of cognitive and linguistic deficits in children with SRLI
- To examine and explore theories that link the evidence of deficit in children with SRLI to intervention approaches which target these areas of deficit
- To identify and explore components of interventions that are used to address common deficits in SRLI

The specific objectives for the systematic review of the literature, in Chapter 4, are:

- To identify the receptive cognitive and linguistic deficits in children with specific receptive language impairment
- To explore if there are areas of deficit that have particularly strong research evidence

The specific objectives for searching the intervention literature in Chapter 5 are:

- To examine the extent to which existing interventions are targeting the deficits that emerged from the systematic literature review (SLR Chapter 4)
- To explore the theoretical basis for the approaches provided in SRLI intervention studies
- To examine the evidence for the efficacy of SRLI interventions

The specific objectives for the focus groups in Chapter 6 are:

- To explore the therapies/activities that therapists use for children with SRLI in

relation to the deficits identified in the SLR

- To identify whether SLTs have common therapeutic approaches for interventions for children with SRLI
- To examine the rationale and underlying theory for the interventions that speech and language therapists (SLTs) use with children with SRLI

CHAPTER 2 Developing interventions for children with specific receptive language impairment

The following chapter considers frameworks for treatment development (2.1). The Medical Research Council (MRC) guidance for complex interventions is identified as appropriate for the development of interventions in SRLI (2.2) and the importance of identifying evidence and theory in developing complex interventions, as proposed by the guidance, is discussed. How evidence and theory might be developed in creating interventions for children with SRLI is then considered. Finally, the aims and objectives of the research project are presented (2.3).

2.1 Frameworks for treatment development

There are two different types of framework that identify stages in the development and evaluation of the evidence base for treatments. These are those that focus on relatively simple interventions (Pocock 1996), and those that focus on more complex interventions (Campbell et al 2000). In both models the final phase of the framework suggests investigation of the efficacy of the treatment in context, preferably in randomised controlled trials.

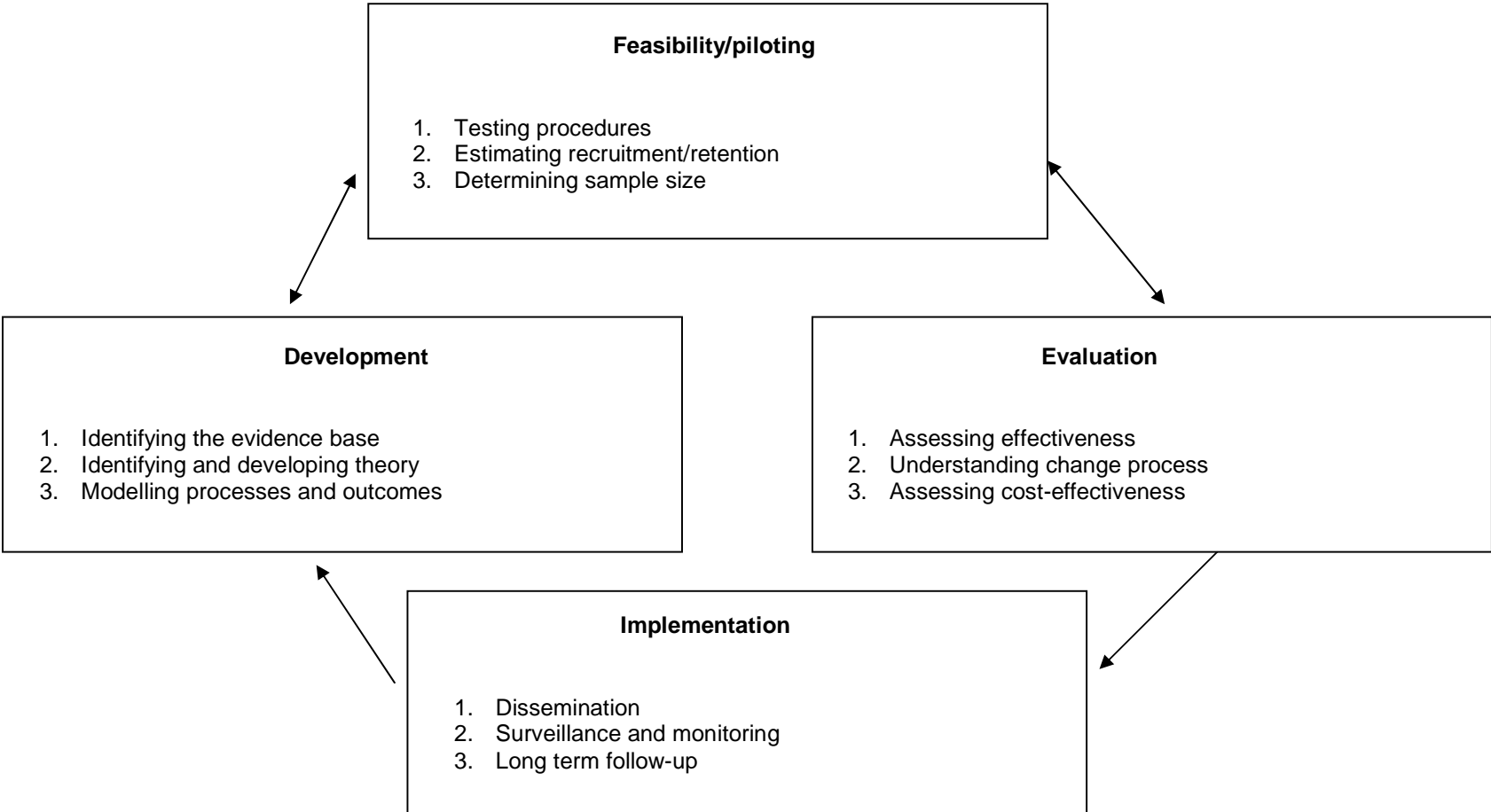
2.1.1 Simple interventions

Simple interventions are likely to have a key component to the intervention, with theoretical reasoning which relates symptom(s) to treatment, and in turn to outcomes. Phased models for simple interventions are based in a positivist approach used in pharmacology, where quantitative methods are adopted. There have been numerous versions, with some featuring three (e.g. Ensign et al 1994), four (e.g. Pocock 1996) and others five phases (e.g. Greenwald and Cullen 1985). The principles of the models follow structured steps, for example, in a five phase model; from developing a research hypothesis for testing (Phase I), developing specific procedures (Phase II), testing the efficacy of these (Phase III), further efficacy testing with sub populations (Phase IV), and efficacy when implemented into practice, as well as cost-effectiveness (Phase V). Common to all models within this framework is that knowledge gained at each phase feeds into the following stage, with progress being made in a linear fashion. It is noteworthy that attempts have been made to modify the Greenwald and Cullen (1985) five phase model to suit an SLT context, focusing on research into treatments for aphasia (Robey and Shulz 1998). Robey and Shulz (1998) suggest the use of case studies and small-group experiments to inform the development phases.

2.1.2 Complex interventions

A separate model has been developed for complex interventions by the Medical Research Council (MRC) (Campbell et al 2000) to help inform “specific difficulties in defining, developing, documenting, and reproducing complex interventions” (p. 694). Complex interventions are described as those that consist of a number of components that may act independently as well as inter-dependently (MRC 2000). The model for complex interventions has similarities to ‘simple’ intervention models, however, a fundamental difference is its emphasis on the use of both qualitative and quantitative evidence to inform development of interventions. The complex intervention framework has since been extended and updated (MRC 2008) re-emphasising some of the key messages, but also attempting to address the limitations identified, by providing a more flexible, less linear, model of the process. The framework focuses on four key stages; development, feasibility/piloting, evaluation and implementation. It places more emphasis on establishing which components of an intervention are crucial for inducing change (i.e. development). The complex intervention framework posits the process of developing and evaluating an intervention as an iterative one, since knowledge gained in one phase may link with other stages. Figure 1 displays key elements of the development and evaluation process suggested by the MRC (2008).

Figure 1 Key elements in the development and evaluation process (adapted from MRC 2008)



2.1.3 Appropriateness of MRC complex intervention guidance in speech and language therapy

Many interventions in SLT are complex, and thus would be fit for complex intervention guidance. These interventions are far removed from the simple treatment frameworks initially developed for pharmacology trials (where the intervention is a specific drug). SLTs can be seen to subscribe to different paradigms of disability that influence intervention approaches and add to their complexity. Interventions for language impairments in particular are argued to feature many components, and therefore to be suitable for complex intervention guidance.

SLT can be seen to ascribe to different paradigms or 'models' of disability that influence practice. It is an allied health profession and as a result, historically, SLT practice has always been influenced by the medical model. An early definition of the medical model describes it as a scientific process that moves from the recognition of symptoms (of a disease) to etiology and pathology and consequently rational and specific treatment (Kety 1974). The medical model is based on the premise of impairment; it aims to find treatments for diagnosed symptoms and syndromes. The medical model has received criticism both for being reductionist (Engel 1977) as well as focusing too heavily on the idea of deficiency among those with disability, and a need for normalisation. In response to criticisms of the medical model, the social model of disability arose in the 1970s, developed by activists in the Union of the Physically Impaired Against Segregation (UPIAS). The social model of disability, a phrase coined by Oliver (1983), advocates that disability is caused by the barriers that exist within society and the way society is organised rather than impairment. Since then the debate has developed further and it has been argued that, taken on its own, the social model also provides an inadequate view of disability. Instead an 'embodied ontology' is called for (Shakespeare and Watson 2002). Such an ontology has been adopted by the International Classification of Functioning, Disability and Health (ICF) framework, which was developed and approved in 2001 by the World Health Organisation (WHO). WHO (2002) propose that neither the social nor the medical model are adequate, although both are partially valid (p.9). The ICF was therefore developed to encompass both social and medical models and is described as a biopsychosocial model. In a position paper of children's services, the Royal College of Speech and Language Therapists (RCSLT, Gascoigne 2006) suggest that they endorse both medical and social models of disability. SLT interventions might therefore target both surface and/ or underlying difficulties, or their application in a social context.

Among the range of interventions adopted in SLT practice, language (as distinct from speech) interventions are particularly complex. This is because language impairments present with variability in terms of whether comprehension and/or production is affected, as

well as whether they co-exist with speech impairments (American Psychiatric Association 2000). The children's profiles of difficulty also vary in terms of features of language affected, such as grammar and vocabulary knowledge, as well as the extent that associated cognitive impairments exist (Bishop 1995, p.35). There is therefore potential for interventions to focus on a wide range of features of language impairment, and for these to vary considerably from child to child. Furthermore, the way SLTs choose to approach these areas of difficulty might also vary. Speech SLTs are seen to work across the natural sciences, behavioural or social sciences as well as the humanities (Siegel and Ingham 1987; Eastwood 1988; Bench 1991). The result is that SLTs incorporate a range of approaches in their practice.

Development of many interventions in speech and language therapy, and SRLI in particular perhaps, have not rigorously followed the steps suggested in complex interventions guidance, such as that proposed by the MRC (2008). Instead, interventions have often evolved through therapists' personal experience of what they believe might be helpful, what has been dictated in a therapy manual or sharing of ideas, rather than from strong theoretical underpinnings (Law et al 2006). It is perhaps because of the complex nature of interventions for language impairments that rigorous evaluation procedures have not been in place. Wilson (1997) notes in the field of clinical psychology the '500 year problem' or 'Parloff's Parody' (Goldfried and Wolfe 1996). Parloff estimated that it would take 500 years to administer the studies necessary to establish which treatment was appropriate for each presenting problem in clinical psychology. Parallels can be drawn in language interventions where establishing which interventions are effective for which profiles of language impairment is a difficult feat.

The MRC model for developing complex interventions (2000) has been "highly influential...and widely cited" (Craig et al 2008, p.337). The more comprehensive and revised guidance (MRC 2008) has made further improvements, making it ideal for guiding the development of interventions for SRLI. The MRC (2008) guidance should help indicate directions forward in a situation akin to 'Parloff's Parody'. As noted by Wilson (1997, p.553) "We need a guiding theory, principles, and strategies to drastically reduce the workload".

2.2 Using the MRC model to develop complex interventions

It is evident that in relation to interventions for SRLI we are early on in the journey toward establishing an evidence based intervention. Although the MRC (2008) model is posited as iterative, it is clear that the first phase toward creating evidence based interventions for SRLI needs to be focused on development. Indeed, the earlier MRC model (2000) situated the development phase as the first process to undertake, describing it as a 'pre-clinical' phase. Campbell (2000, p.694) indicates that problems often arise in evaluating complex interventions "as researchers have not fully identified and developed the interventions". This highlights the importance of work centred on development before interventions are evaluated.

2.2.1 The importance of identifying evidence and theory

Two of the key components in the development phase, described by the MRC (2008) are identifying the evidence base and developing theory. In terms of the evidence, it is clear from a systematic review (Law et al 2010), that there is insufficient evidence for the effectiveness for SRLI interventions in randomised controlled trials (RCT). It is therefore important that other types of evidence are considered.

The MRC complex intervention guidance (2008, p.9) describes the importance of elucidating the rationale for a complex intervention, in terms of "what changes are expected, and how change is to be achieved". Crucial to the development of an intervention is the use of scientific evidence and theory to establish mechanisms of change. Part of the process, in establishing plausible mechanisms of change, is establishing 'critical components of therapy', an important concept operant in medicine and psychology (Rosen and Davidson 2003; Michie and Abraham 2004). Rosen and Davidson (2003, p.305) call for "empirically supported principles of change" (ESPs) in psychology, rather than just empirically supported treatments (ESTs). ESP means developing an understanding of the critical processes or components of therapies and their causal mechanisms. Using ESPs rather than ESTs is proposed to avoid the development of therapies with weak theoretical underpinnings or novel therapies that begin with an established procedure that then "add functionally trivial bells and whistles" (Herbert 2000, p.118).

There are a few examples in SLT where therapies have arisen in the absence of well-articulated theory, but have nevertheless found evidence for success. For example, traditional articulation therapy (Van Riper 1939; VanRiper and Irwin 1958), is not based on a theory of acquisition and impairment, instead it focuses on 'ear training' and 'production training'. Despite a lack of understanding about how or why the therapy works (Wren 2005), there is evidence to indicate the approach nonetheless does work (Almost and Rosenbaum

1998; Klein 1996). A similar example is the 'Lidcombe Program' for stammering. The 'Lidcombe Program' is a behavioral treatment for early childhood stammering that aims to achieve stammer free speech (Hayhow 2008). It is not based on a causal theory of stammering, but a randomised controlled trial has demonstrated that it is effective compared to natural recovery (Jones et al 2005).

There are, however, a number of problems in implementing interventions that do not have well articulated theory. Firstly, as identified by Bernstein Ratner (2005), practitioners are less likely to adopt therapy methods that they cannot understand. Therefore an intervention without clear mechanisms of change in relation to the impairment(s) or clear 'critical components', is more likely to have potential issues of 'buy in' from practitioners. Secondly, rigid intervention programmes that focus on technical procedures rather than processes of change, reduce the ability of researchers and practitioners to be innovative in their approach. This in turn is likely to reduce the potential for clinical expertise as well as patient decision making. Thirdly, in order to improve and adapt therapies, there needs to be an understanding of how and why they work. Clear models of therapy that are testable and revisable allow for changing theoretical constructs. This enables development in terms of establishing which components are critical, as well as the reduction of features that, on further assessment, turn out to be extraneous (Bernstein Ratner 2005). It is difficult to break down a therapy into its separate parts and test what is or is not effective if there is no supporting theory for these separate parts. Additionally, the ability to conduct this type of fine tuning has implications for maximising cost effectiveness of interventions. This emphasises the value of attempting to establish the components of therapy in SRLI and the theory for these, in order that they can be assessed for their efficacy.

Treweek (2005) argues that for complex medical interventions, where the greatest parallels can be drawn with SLT interventions, it is particularly important that they are guided by theory. Although there is always a temptation to skip this process and assess methods that are not necessarily based on evidence or science, but appear promising, there is a greater risk that outcomes will not be satisfactory. Evidence in the behaviour therapy movement has served to warn that such approaches are sometimes too good to be true. A commonly cited example is eye movement desensitisation and reprocessing (EMDR). EMDR lacked any credible link to psychological science but was well marketed, leading to over 22,000 clinicians training to do EMDR (Wilson 1997). However, a meta-analysis of 34 studies examining EMDR (Davidson and Parker 2001) concluded that EMDR is no more effective than other exposure techniques (involving confronting clients with memories and images of traumatic event) and evidence suggests that the eye movements, integral to the EMDR intervention, are unnecessary (Davidson and Parker 2001, p.305). This underlines the importance of developing theory in interventions, since it should increase the likelihood of an

intervention's key components being 'critical' or 'active ingredients'.

2.2.2 Approach in the development of evidence and theory for intervention in SRLI

In order to move toward establishing a process of change, as recommended by the MRC (2008), it is evident that a starting point is ascertaining what needs to be ameliorated or changed. In relation to SRLI, this means having a well-defined theory of deficit:

"...theory of the deficit will need to be well-defined in order to describe both the subgroup of children under investigation and the parameters of the deficit to be targeted in intervention." (Law et al 2006, p.2)

In language impairments establishing this first step, a well defined 'theory of deficit' to be targeted in intervention, is a particularly complex task, as language impairments are multifaceted. This task is perhaps more challenging still for SRLI, as receptive language difficulties cannot be easily analysed or assessed on the basis of overt presentation. Language understanding is less observable and measurable than language production, posing difficulty for understanding comprehension processes and in turn, understanding where these break down. The effect of this can be seen in linguistics, where development has centred on language production (Sevick 2006) rather than understanding. Despite the likely challenge involved, it is important that understanding is gained about what the cognitive and linguistic deficits, related to comprehension in SRLI are, so that clarity concerning what interventions should be aiming to change can be established.

It is noted that impairments in the comprehension process, or the cognitive and linguistic deficits related to these, are just one way that SRLI difficulties can be viewed. In terms of the paradigms of disability, it is apparent that examining difficulties at the level of impairment is a medical model approach. The broader impacts of having SRLI, in terms of consequences on functioning and participation are also noted. For instance, it is recognised that these SRLI children often have social and behavioural difficulties (Botting and Conti-Ramsden 2000) such as fewer peer relationships. There will also be inevitable consequences of comprehension difficulties in participation in class and therefore upon the child's educational progress. Although these areas are noted to be important, theory in these areas will not be examined since an important first step is to establish whether theory of deficit, in terms of language and cognition, can lead to theory of therapy that can generate effective interventions. In addition, if interventions for SRLI are able to make improvements at the deficit level then consequential difficulties with participation and functioning might be seen.

In order to further develop evidence and theory, it is apparent that once evidence of deficit in SRLI is established, it will be necessary to examine how interventions attempt to change or ameliorate these areas of deficit, and the components that appear to be involved in creating change. By working at this level, it is hoped that theoretically motivated interventions will emerge. If specific components of interventions can be identified in relation to the areas of deficit then a theoretically grounded model of interventions for SRLI can be built. By mapping these out, it should facilitate further studies to establish which components might be 'active ingredients' or 'critical' to an intervention's success.

2.3 Aims and objectives

The focus on the present research project, in line with the advice of the MRC (2008), is on the development of evidence and theory for interventions for children with SRLI. The overarching aim of the research is to develop a model of SRLI that can generate hypotheses for interventions. The objectives within this are:

- To identify the evidence on the nature of cognitive and linguistic deficits in children with SRLI
- To examine and explore theories that link the evidence of deficit in children with SRLI to intervention approaches which target these areas of deficit
- To identify and explore components of interventions that are used to address common deficits in SRLI

CHAPTER 3 Identifying and developing theory; examination of language comprehension processes

An examination of typical comprehension processes is a useful precursor to an in depth evaluation of the deficits in specific receptive language impairment (SRLI). Understanding these processes can help to inform where comprehension processes might fail in SRLI, as well as provide potential clues in supporting or changing comprehension processes. This chapter presents influential models and theories of language comprehension (3.1). Firstly, models of speech processing are considered, followed by models that have looked at broader language processing, as well as sentence processing theories in particular. These models are considered against what is known about the nature of SRLI and the types of difficulty that children with SRLI are thought to have (3.2). Finally, conclusions are drawn about how to move the evidence base forward (3.3).

3.1 *Language comprehension processes*

3.1.1 Understanding speech

To understand spoken language a person is required to process speech at an auditory and sound level; they have to know the meaning of the words; they have to have an understanding of the structures (grammar and syntax) that the words form; they have to retain all this transient information while completing these tasks and, finally, they have to integrate all this information within the context it is said, and with an understanding of the speaker's intent.

It is possible to review language comprehension at a number of different levels and from a number of different theoretical perspectives. For example cognitive neuropsychology, psycholinguistics, cognitive-linguistics and theories of language acquisition might all take a different angle in understanding this process. However, a useful starting point is to examine models of speech processing, which strive to give an overview of the processes involved in understanding and constructing language.

3.1.2 Speech processing models

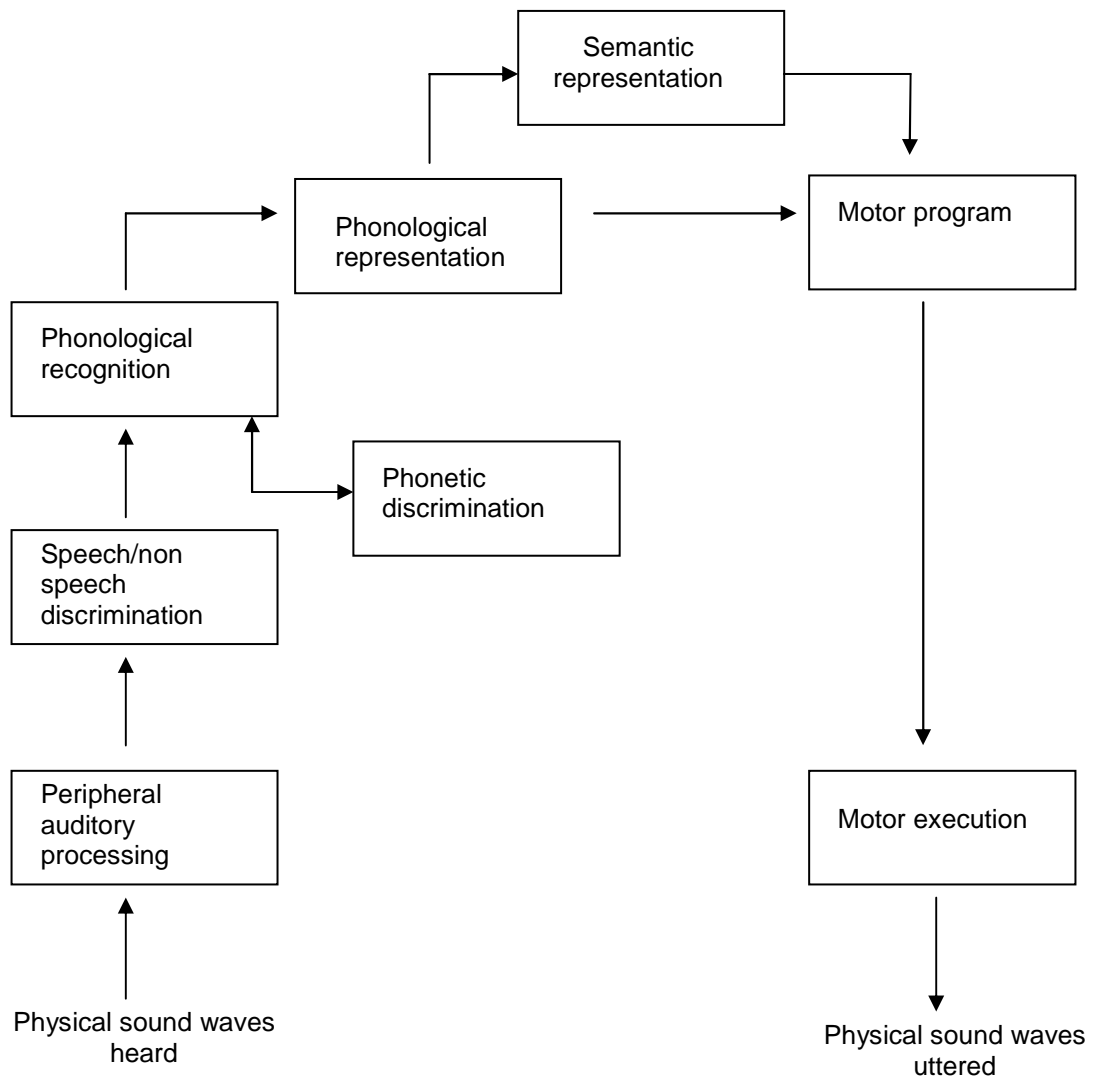
It is perhaps not immediately apparent that speech processing is involved in language processing, but intrinsic to understanding language is an understanding of the words and sounds that construct language, as well as the processes that help us to make sense of these words.

One of the earliest models of speech processing in children was proposed by Ingram (1976). He suggested that there were three levels of speech: a cognitive level which considers

how sounds are stored in the mind, a motor level, concerned with how the sounds are articulated, and a linguistic/organisational level for the phonological rules or processes that map between the other two levels. Similarly Stoel-Gammon and Dunn (1985) proposed four basic interacting components: auditory perceptual, cognitive, phonological and neuromotor.

More recent models of psycholinguistic processing extend these earlier theories and add additional levels. Arguably the most influential models include Dodd and McCormack (1995), Hewlett et al (1998) and Stackhouse and Wells (1997; see Figure 2). All of these models consider input (auditory signal) as well as output (speech) channels.

Figure 2 Speech processing framework, adapted from Stackhouse and Wells (1997)



Input starts with peripheral auditory processing, the ability to hear sound, and moves to the ability to discriminate speech from non-speech. The next level is phonological recognition, where speech sounds are recognised as being part of a known language. Phonetic discrimination sits outside of the main route as its function is to process unfamiliar speech sounds, for example accents and dialects. After a word has been recognised it is compared with phonological representations, where whole words are stored according to how they sound. Finally, at the semantic representation level, the meaning of words are accessed.

Models such as Stackhouse and Wells (1997) help people to understand how children might process speech. The model considers processing of sounds and, to some extent, the meaning of words. They have therefore been influential in treatment approaches in phonology (e.g. Wren 2005, describes using this framework to inform the computerised therapy 'Phoneme Factory'). However, although the Stackhouse and Wells (1997) model, among others, provides an insight into the sound to meaning process in understanding words, it does not incorporate any of the broader aspects in language understanding, in terms of how we gain an understanding of words within sentences and the context within which they are said. In order to understand these additional processes, other models need to be examined.

3.1.3 Other models of language processing

Although understanding words is an important aspect of comprehension, how they are organised in sentences affects the meanings of these words. In order to understand sentences they must be parsed into phrases that relate to units of meaning. The relationship between these phrases must also be deciphered, often through understanding the relationships denoted by verbs and prepositions. Further, within phrases themselves an understanding of morphology is necessary.

In speech and language therapy the most commonly cited sentence level model in SLT is probably Garrett's (1990) model. However, the focus of this model is on sentence production. There does not seem to be an equivalent frequently cited model for sentence processing but rather a number of models that broadly can be grouped into two approaches; principle based and constraint based, these will be considered in turn.

The principle based approach supports a modular view of language (Chomsky 1972) proposing that language knowledge is a distinct mental faculty. Modules are identified that process separate facets of language, such as syntax and semantics. Further, these modules are proposed to operate in a serial manner (one after the other), and other sources of knowledge such as real world knowledge are proposed to be accessed at later stages. An example of a principle-based account is Frazier and Fodor's Garden Path Model (Frazier

and Fodor 1978). In this model, comprehension entails two stages; with syntactic parsing taking place first. It is theorized that sentences are interpreted using the fewest phrase-structure nodes possible (minimal attachment principle). In the second stage, thematic and semantic information is used to evaluate the appropriateness of the initial analysis. 'Garden path' sentences are thought to exemplify this type of processing since the most likely initial interpretation will be that which will involve the fewest phrase structure nodes. This is usually the incorrect interpretation; the listener is 'lured' into an improper parse that turns out to be a dead end, i.e. led up the garden path. An example of a garden path sentence is "While the man hunted the deer ran into the woods". The deer tends to be evaluated as the object of hunted, until 'ran' is encountered, interpretation of the sentence is then revised.

The notion of linguistic 'modularity' has also been extended to modularity of the brain. Fodor (1983) proposed that there is a circumscribed region in the brain that is dedicated to the function of a module. For example a language module would be thought to have an innate capacity of language that could be located to a specific region. The assumption that the mind's language system is organised in separate modules of processing has been supported by case studies of individuals with aphasia¹. Some people with aphasia evidence selective language impairments, thought to be related to damage to specific modules. For example, Broca's aphasia is characterised by difficulty with expressive language, but relatively unimpaired comprehension (Goodglass and Geschwind 1976). Wernicke's aphasia, by contrast, is known as a fluent aphasia, where comprehension is poor but sufferers are able to speak with normal grammar, syntax, rate, intonation and stress albeit with incorrect content (Kolb and Wishaw 2003). This is an example of 'double dissociation', with two areas of neocortex being functionally dissociated by two behavioral tests, each test being affected by a lesion in one zone and not the other (Kolb and Wishaw 2003). This double dissociation is thought to support the specificity of language modules in the brain.

The principle-based approach has been the dominant linguistic paradigm for language processing (Fender 2001). However, Bishop (1997) argues that modularity approaches are not always useful:

"A conceptualisation of language in terms of modular process has been something of a straightjacket, focusing attention on representational deficits, leading to a neglect of processing accounts of comprehension problems" (Bishop 1997 p.16)

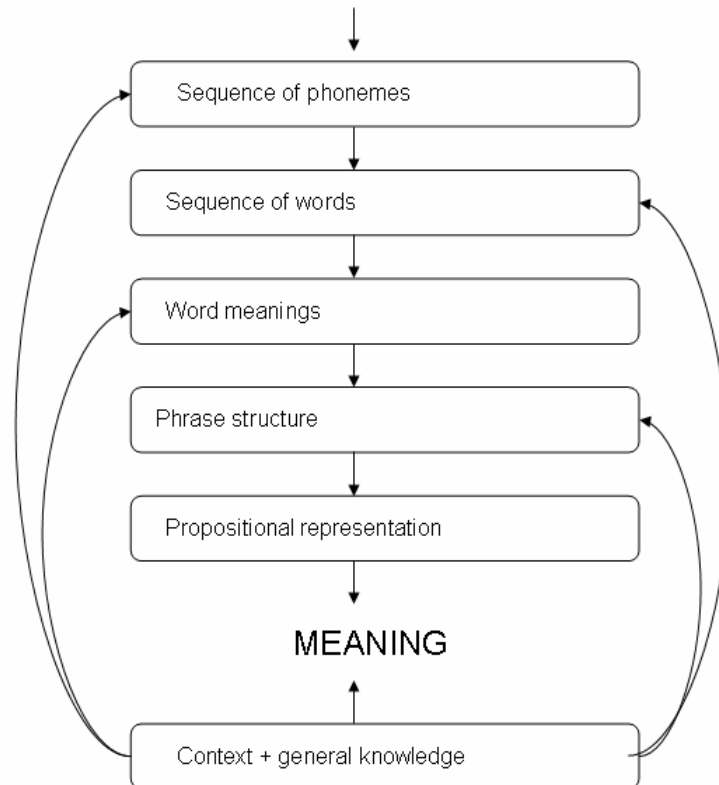
The constraint-based approach takes greater account of the processing aspects of understanding language. It describes multiple sources of knowledge; syntactic, lexical,

¹ Aphasia is an acquired language disorder which can affect any language modality. It results from lesions to the language-relevant areas of the brain, usually caused by stroke or brain injury

pragmatic and world knowledge, as interacting simultaneously during comprehension (Harrington 2001). These interactive processes are hypothesised to act in a parallel manner. Influential constraint-based accounts rest heavily on connectionist architecture and processing principles (McClelland et al 1986). Sentence processing is viewed as the process of activating interconnections between units in a network, while several sources of information are concurrently activated. The notion of interaction of knowledge sources is supported by evidence that top-down influences affect our understanding of language (Boland et al 1990). In particular, frequency effects have been found in sentence interpretation, and semantic or contextual knowledge have been shown to effect parsing (Tanenhaus and Trueswell 1995; MacDonald et al 1994). The two accounts, principle-based and constraint-based, perhaps seem incompatible, however, there have been several attempts to integrate the two since both have something to offer in understanding language processes (e.g., Ellis 1998; Hulstijn 2002).

Bishop (1997) provides an overview of language processing in a model that presents the stages in comprehension, from phonological representation to meaning (Figure 3). Some of the stages in Bishop's model relate to those found in the speech processing model. However, Bishop (1997) also considers the processes involved in understanding sentences. Word recognition is proposed to occur at the level of sequence of phonemes to sequence of words, 'Lexical semantic lookup' then occurs, where word meanings are accessed. These words are then proposed to be parsed into phrases, thematic roles are then assigned. Meanwhile, the context within which these words are said, and the knowledge of the listener feed in to the earlier stages, demonstrating top-down effects. Bishop's model (1997, Figure 3) provides a valuable synopsis of key stages in comprehension processes, and incorporates top down process, thus integrating aspects of both the principle-based and constraint-based models of language understanding.

Figure 3 An overview of stages involved in language comprehension, adapted from Bishop (1997, p.14)



All the models presented help to inform an understanding of the complexities involved in language comprehension. To get from the starting point of sound to the end point of meaning involves complex interactions of cognition, language knowledge as well as social/world knowledge. It is evident that though there has been a wealth of research dedicated to the process of trying to understand 'normal' comprehension processes, there has been a great deal of theorising with no certainty surrounding exactly how the process works. However, illumination of key processes in comprehension should be of value in terms of ascertaining areas of impairment found in SRLI.

3.2 How do comprehension processes fail for specific receptive language impairment?

Given the range of process that are thought to be important for understanding language, as well as the additional complexity of their interactions it is perhaps to be expected that there does not appear to be a clear explanation of the comprehension failings in SRLI. It has been noted elsewhere that there is "lack of clarity regarding the best model to explain RLI" (Law et al 2008, p.3).

Examination of theories of deficits in populations with language difficulties produces a range of explanations. It's unclear which of these is the most useful in explaining SRLI. Some researchers have pointed toward deficiencies in information processing as a source of comprehension difficulty, but they appear to be in disagreement over where the level of breakdown is. Hypotheses range from: perceptual processing difficulties particularly processing of brief or rapidly presented auditory stimuli (Tallal et al 1996; Ahmed et al 2001), limited short-term memory, (Gathercole and Baddeley 1990; Gillam et al 1995), limitations with the speed at which SLI children are able to process information (Miller et al 2001), as well as general limitations in processing capacity (Im-Butler et al 2006; Bishop 1992; Johnston 1992). Others have attributed gaps in linguistic knowledge rather than information processing as a source of comprehension problems, in particular difficulties with acquisition of grammar, morphology and syntax (Van der Lely 2004; Van der Lely and Harris, 1990). There are also theories that processing limitations interact with other linguistic deficits (Montgomery et al 2002). The evidence base is complex and it is difficult to decipher where the strongest evidence of deficit lies. Conceptual differences between studies and study methods, as well as conflicting results make it difficult to draw conclusions.

3.3 Conclusions; how to move the evidence base forward for SRLI

At the beginning of this chapter the importance of defining the impairment(s) for SRLI was discussed, as an essential precursor to developing critical components of therapy. As part of this process, models of typical comprehension processes have been examined.

An examination of models of typical comprehension processes has established that comprehension is complex, further, the literature does not appear to be clear about where comprehension processes fail for SRLI. Given this complexity and lack of clarity, it is apparent that an in-depth examination of impairments in SRLI would be of value. As part of the process of developing theory in complex interventions the MRC (2008) advise that it is useful to conduct a systematic review:

“You should begin by identifying the relevant, existing evidence base, ideally by carrying out a systematic review. You may be lucky and find a recent high quality review that is relevant to your intervention, but it is more likely that you will have to conduct one yourself.”
(MRC 2008, p.9)

Although the MRC are referring to systematic reviews of intervention studies, the same principle can be applied to an exploration of the deficits in SRLI. This is an area that appears to have not been systematically examined. Examination of the deficits in SRLI could be conducted in a traditional literature review, however, the complexity of the subject matter as well as the evidence base, suggests that it would be difficult to provide an objective interpretation of the deficits in SRLI. Additionally, traditional literature reviews place less evidence on the assessment of the strength of evidence. It would be of value to establish, amongst the complex array of deficits, what the strongest evidence of deficit in SRLI is.

A superficial examination of deficits for SRLI (3.5) has found that although there are many studies that examine comprehension processes for SLI populations, participants do not always appear to be included on the basis of a receptive language task performance. It is therefore evident that a systematic approach is necessary to ensure that the studies that will be examined include SRLI participants, rather than specific expressive language impairment (SELI) participants.

The comprehension processes that have been examined in this chapter should help to inform an understanding of the role of deficits/impairments in SRLI in impeding the comprehension process. The evidence for deficits or impairments in SRLI will later be considered against these processes, in light of whether research to date has investigated all the plausible avenues for why, or how, comprehension fails in children with SRLI.

CHAPTER 4 Cognitive and linguistic deficits in specific receptive language impairment: a systematic review

4.1 Introduction

This chapter explores the cognitive and linguistic deficits in children with specific receptive language impairment in a systematic literature review. Types of systematic review and methods of synthesis are first described (4.2) and the rationale and the research questions are presented (4.3). Before the methods of the review are described, definition and conceptual issues are addressed (4.4). Methods used in the review, including details of inclusion criteria, how studies were accessed and the critical appraisal approach are then described (4.5). Results are presented and, finally, there is discussion about the implications of these results (4.5 and 4.6).

4.2 Types of systematic literature review

The move toward evidence based practice has seen increased emphasis on systematic reviews as well as advances in systematic review methodologies (Chalmers et al 2002). It is widely recognised that primary research studies vary both in their quality and scale. Furthermore, it is commonplace to find contradictory findings among studies. Systematic literature reviews (SLR) emerged as a potential solution to these problems, providing both high-quality and current, synopses of the evidence. Rather than the traditional narrative literature review where informal, implicit approaches are adopted, systematic reviews use rigorous methodology designed to minimize bias in the selection and quality appraisal of papers (Egger et al 2001). The precise nature of the methodology is also documented in systematic reviews, making all decisions transparent to the reader.

Traditionally systematic reviews focus on questions of effectiveness and the synthesis of the findings of randomised control trials (RCT). Findings of the Cochrane Collaboration, recognised for its database of SLRs for healthcare interventions (Cochrane Library), have contributed to synthesis of RCTs studies in particular. Recent years have, however, seen the expansion of the use of SLRs into areas other than effectiveness of interventions. Pettigrew and Egan (2006), describe the move away from methodological 'gold standards' and incorporation of a wider range of research designs. This is to help ensure that SLRs "contribute meaningful answers to relevant questions" (Petticrew and Egan 2006, p.5).

Garret and Thomas (2006) note that a popular misconception about systematic reviews is that they only incorporate RCTs. This view seems to be particularly prevalent in subject areas where RCTs are scarce (Petticrew 2001). This misconception is unfounded; a key principle of systematic reviews is that the review question should determine the design of the studies included. While RCTs are generally accepted as the most robust study design with least risk of bias in answering questions of effectiveness (Harbour and Miller 2001), other questions are likely to be answered more effectively by other study designs. Systematic reviews frequently include a range of study designs including observational studies (Egger et al 2001).

4.2.1 Methods of synthesis

In addition to the range of study designs that can be used in systematic reviews, there are a range of methods of synthesis. SLRs which include RCT study designs tend to use meta-analysis, the statistical combining of data, for synthesis. Sometimes the term meta-analysis is used synonymously with systematic review, however, as Egger et al (2001) notes:

“ ..it is always appropriate and desirable to systematically review a body of data, but it may sometimes be inappropriate or even misleading to statistically pool results from separate studies.”
(Egger et al 2001, p. 5)

Meta-analyses are often considered to be the gold standard for synthesis since basing estimates of effect sizes on large numbers of studies is more likely to produce accurate, unbiased results. Importantly the use of meta-analyses provides higher statistical power to detect an effect than single studies. However, there are a number of problems that can arise in using meta-analysis: a weakness of the method is that sources of bias are not controlled for, thus it is possible to have a good meta-analysis of badly designed studies, resulting in misleading findings. It is therefore good practice to do analyses only on ‘good’ quality studies; others incorporate other factors such as consistency of findings, in overall evaluation. Meta-analysis should also only be applied if the data summarised are homogeneous. Eysenck (1994) likens meta-analyses that do not have homogenous data, as “adding apples and oranges”. Meta-analysis of observational studies needs to be approached with particular caution; Egger et al (2001) note, that these studies are more likely to be prone to confounding and bias which can distort findings in a way that is not true of high quality randomised trials. For example, since samples are not necessarily selected randomly in observational studies, we cannot be sure that they are representative of the individuals of the population. The validity of pooling results in this context (meta-analysis) would therefore be questionable.

An alternative method to meta-analysis is narrative synthesis. Narrative synthesis is a method of synthesising findings from multiple studies that relies primarily on the use of

words and text to summarise and explain the findings of the synthesis (Popay et al 2006). A disadvantage of narrative synthesis is that it opens authors up to a greater likelihood of bias; further, it is likely to provide less precise results. For example, although it can provide us with information about statistically significant differences between groups, it can not tell us anything about the size of these differences. There is, however, increasing recognition of narrative synthesis as a useful method. This is reflected in the Economic Social Research Council (ESRC) methods programme guidance (Popay et al 2006) as well as guidance from the National Institute for Health and Clinical Excellence (NICE) (Popay 2006). There is evidence to suggest that, when narrative synthesis is done well, its outcomes should not be dissimilar to meta-analyses. In a blinded comparison of narrative synthesis, following clear guidelines, with a meta-analysis (Rodgers et al 2009), conclusions of the two syntheses were broadly similar. The predominant difference was that the meta-analysis appeared to give stronger conclusions about effect, whereas the narrative synthesis was more extensive in its implications for future research.

4.3 Rationale and research questions

The rationale for the current review has been discussed in the previous chapter. In line with the MRC guidance for developing a complex intervention, it is first important to develop theory. A clearer understanding of the deficits in SRLI should help to inform the development of interventions that can target these areas.

The research questions for the present review are:

- What are the receptive cognitive and linguistic deficits in children with specific receptive language impairment?
- Are there areas of deficit that have particularly strong research evidence?

4.4 Definition and conceptual issues

4.4.1 Specific-receptive language impairment

As discussed in Section 1.1, the question of criteria for the diagnosis of specific language impairment has long been a subject of debate (Tomblin et al 1996), though SRLI itself has received little attention. The International Classification of Diseases and Related Health Problems (ICD-10, WHO 2003), however, gives criteria for research definitions of receptive language impairment (Table 1). Although the ICD-10 suggests a two standard deviation (SD) standardised test score below the mean criteria for receptive language impairment, studies have adopted a variety of criteria for language impairments with many employing the criterion of scoring at least 1.25 SD below the mean on two language measures (Archibald and Gathercole 2006; Bishop et al 2000) while others have adopted a one SD below the

mean criteria (Broomfield and Dodd 2004; Beitchman et al 1986). It could be argued that the ICD-10 criteria of two SD does not reflect the diversity of children that present in clinic, where therapists are using a combination of indicators, including standardised tests to determine impairment. A study by Tallal et al (1996) supports this; of 20 subjects specially selected from a school for dysphasic children, only 12 met the two SD below the mean criteria.

The present review included only studies where participants were required to perform at least one SD below the mean for their age on two standardised tests, one of which must be a test of language comprehension (see Table 1). This criterion was chosen in order to encompass the broadest range possible of receptive language impaired children found in clinic. This reflects the finding by Records and Tomblin (1994) that the likelihood of a child being diagnosed with a language impairment by practising therapists increases greatly when the child has a composite score (the score which results from summing two or more scores) that is at least one SD below the mean.

The ICD-10 also suggests that there should be at least a one SD discrepancy between non-verbal IQ, as assessed on a standardised test, and scores on a receptive language test, with the receptive language score being lower. Several authors (Cole et al 1990; Aram et al 1992; Bishop 1994) have questioned the value of a nonverbal discrepancy criterion on both theoretical and methodological grounds, and presented empirical evidence that this discrepancy criterion has little prognostic benefit. However, since intelligence within the normal range is what indicates that the receptive impairment is specific in nature (rather than a result of their general learning ability), in order for studies to be included in the SLR participant's non-verbal IQ had to be assessed as having IQs greater than 80 on a standardised assessment. The final SRLI criteria for studies included in the review can be seen in Table 1.

Table 1 ICD-10 SRLI criteria compared to SRLI criteria for studies included in the review

WHO ICD-10 criteria	Criteria for included studies
Language comprehension, as assessed on standardised tests, below the two standard deviations limit for the child's age.	Language performance at least one standard deviation below the mean for the child's age on two standardised tests, one of which must be a test of language comprehension.
Receptive language skills at least one standard deviation below non-verbal IQ as assessed on a standardised test.	Non-verbal IQ above 80, as assessed on a standardised test.
Absence of neurological, sensory, or physical impairments that directly affect receptive language, nor is there a pervasive developmental disorder.	Absence of neurological, sensory, or physical impairments that directly affect receptive language, nor is there a pervasive developmental disorder.

Table 2 Inclusion and exclusion criteria applied against studies

Inclusion criteria	Exclusion criteria
1. Cross-sectional case-control studies comparing SRLI with age matched (CA) or language matched (LA) controls, on a measure of receptive language or cognition.	1. Investigating a population that is not language impaired/ has an impairment unrelated to SRLI population.
2. >1973 when Tallal (1973a) conducted the earliest known seminal paper in the area.	2. Examining expressive language only.
3. Participants defined as having SRLI on a standardised measure of language achieving scores at least one standard deviation below the mean on a receptive language measure.	3. Not peer reviewed.
4. SRLI participants found to have intelligence quotients (IQ's) >80.	4. Non-English language studies or studies examining SRLI from foreign, non-English speaking countries.
5. Participants are children up to and including 13 years of age.	
6. Studies examining an aspect of language or cognition related to comprehension.	

4.4.2 What is meant by the cognitive and linguistic deficits?

It is important to operationalise the terms cognitive and linguistic to clarify what types of deficit the systematic review is examining. Cognitive deficits are those deficits that pertain to the mental processes of perception, judgment, memory and reasoning. Linguistic deficits refer to any difficulties that relate to language form or meaning. Language form includes structure i.e. grammar; encompassing morphology, syntax and phonology. Language meaning incorporates semantics (how meaning is inferred from words and concepts) and pragmatics (how meaning is inferred from context).

Studies were included that examined performance on any receptive cognitive or linguistic task. Since it was comprehension processes that were of interest, studies only examining expressive language were not included. The systematic review aimed to be as inclusive as possible of the range of deficits investigated, though the consequences of these deficits on functioning and participation were not investigated.

4.5 Methods

4.5.1 Identifying and describing studies

A crucial component in the reporting of systematic reviews is the transparent and explicit reporting of the process of identification and selection of the studies for review (Egger et al 2001). The next sections provide information on the inclusion and exclusion criteria, the search strategy, the databases searched and the quality assurance processes used.

4.5.2 Inclusion and exclusion criteria

Table 2 displays the inclusion and exclusion criteria. Only cross-sectional case-control studies were chosen to be included as this was considered the most appropriate design in establishing the deficits. Cross-sectional case-control studies refer to studies where a defined population, with a certain disease or condition (cases, in this instance SRLI) assessed at a set point of time, is compared with a matched group of people who do not have the condition (controls). This differs from standard case-control studies which are “designed to help determine if an exposure is associated with an outcome (i.e. condition of interest).” (Lewallen and Courtright 1998, p.57). Though these studies still compare cases and controls, they look back in time to learn about exposure(s), and are by definition retrospective (Lewallen and Courtright 1998). Case-control design was not considered appropriate since it was not exposures that might be linked with SRLI that were of interest, but rather how the condition presents.

Other study designs, including cohort studies and case studies, were also considered but concluded to be inappropriate. Cohort studies were not included because they are interested in establishing risk factors for disease, rather than examining how a disease presents. The case study design was chosen not to be included since it is limited by its lack of comparison group, and is low in the hierarchy of evidence (Greenhalgh 1997).

As section 4.4.1 indicates, it is important to define specific-receptive language impairment. The criteria for specific receptive language impairment adopted by studies is therefore a crucial component for the inclusion criteria. Other aspects of the inclusion criteria are discussed in Appendix 1. The exclusion criteria were applied at title and abstract level, and the inclusion criteria were applied against full articles.

4.5.3 Identification of potential studies: search strategies

Studies were identified through systematic searches of 11 bibliographic databases. The software RefWorks (version 1) was set up to manage references found during the review. Titles and abstracts were imported into this database. Preliminary searches were conducted using the OVID search engine in order to establish an appropriate search strategy, balancing specificity and sensitivity. Terminology was harvested through preliminary searches of the databases, using keywords and their synonyms, as well as knowledge of terms in the subject area. Text books were searched for terms previously used to describe specific language impairment. See Appendix 2 for a full record of the development of the search strategy. Table 3 displays the final search terms that were used, using two concepts; language impairment and child.

Table 3 Final search terms adopted to identify studies

Concept 1- language impairment	Concept 2-child
Receptive language impairment or specific language impairment or developmental dysphasia or developmental aphasia or developmental language disorder or central processing disorder or semantic-pragmatic disorder or pragmatic disorder or auditory processing or language processing or sentence processing or phonological working memory or phonological memory or language comprehension* or verbal understanding* not syndrome not dyslexia not hearing impairment* not bilingual not attention deficit disorder not attention deficit hyperactive disorder	Child* or young people or pupil* or infant* or boy* or girl* or preschool* or schoolchild* or toddler*

Table 4 Databases searched and numbers of results obtained

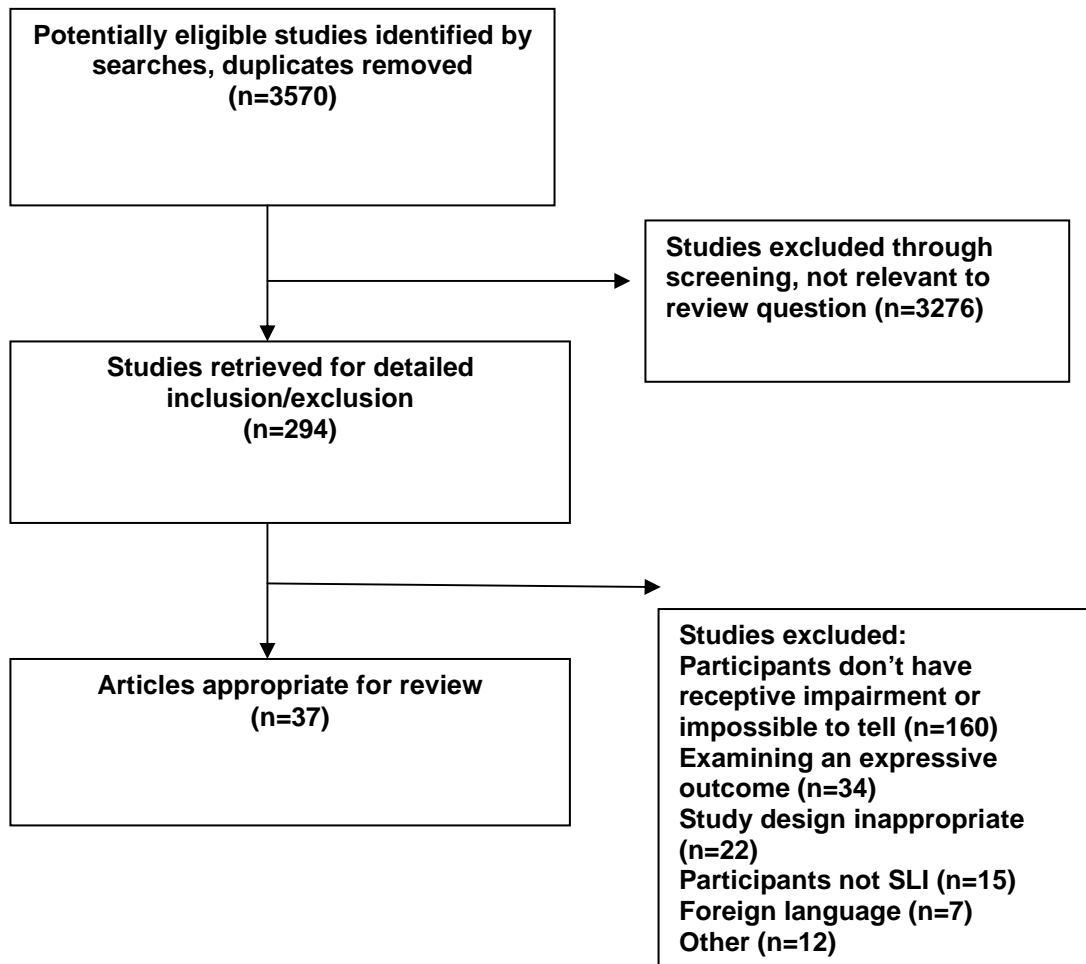
Search Interface	Databases	Date accessed	Number of results	Limit year >1973	Limit English language	Final with duplicates removed
OVID	AMED, BNI, CINAHL, EMBASE, HMIC, MEDLINE, PsychINFO	03/03/2008	5989	5545	5415	3284
DATA STAR	ERIC, BREI, AEI	03/03/2008	702	n/a	694	694
Wiley Interscience	Cochrane Library	10/03/2008	395	n/a	n/a	395

The terms were searched in key science and medical databases as well as the main education databases and Cochrane, shown in Table 4. A total of 4,373 citations were identified through systematic searches of the 11 databases. Duplicates were removed from within OVID. All citations were exported into the management software RefWorks (version 1), where further duplicates were removed.

Screening 3570 citations at abstract and title level excluded 3276 studies, leaving a total of 294 studies. For these 294 studies, full text documents were obtained and screened for inclusion. Following full text screening, a total of 37 studies were considered to meet the inclusion criteria. The filtering of the papers through the review process is shown in a Quorum flowchart in Figure 4.

In a moderation exercise a ten percent systematic sample was taken of the titles and abstracts and this sample was blind screened by an academic supervisor for inclusion. A further ten percent systematic sample was taken of full reports for inclusion. After review and discussion consensus was reached about those that were included.

Figure 4 Quorum flowchart of review process



4.5.4 Assessing the quality of studies

Two commonly used critical appraisal tools for case-control studies were reviewed for their topic coverage; the Scottish Intercollegiate Guidelines Network (SIGN 1995) and the Critical Appraisal Skills Programme (CASP) case-control study appraisal tools. The key questions from CASP were taken as a template for the quality appraisal. Questions that were not relevant were removed, for example regarding exposure. The final set of questions and questions used to help inform them can be found in Appendix 3.

The quality appraisal process was developed in discussion with an academic supervisor. Ten percent of papers were independently reviewed and scored, and a final appraisal profile was agreed. The appraisal questions were answered with 'yes', 'no' and 'medium' (Table 5 and Table 6). Where 'yes' was used, the study was felt to fill the criteria for that question. Where 'medium' was used, the study was considered to meet some of the criteria for the question, but not others. Where 'no' was used, the study was considered to not meet the criteria for the question. In some areas appraisal questions were found to be open to interpretation and difficult to definitively pick a yes/no/medium answer. For example, in relation to confounding factors, the authors may have demonstrated clear attempts to address most aspects of confounding, but there may be something that the authors did not appear to have taken account of.

Difficulty sometimes arose in accurately assessing study quality. Given the range of subject matter, it was not always possible to ascertain in-depth knowledge of assessment techniques that might be necessary to fully grasp potential confounding factors. Examples of the quality appraisal process are provided in Appendix 4 in order to demonstrate the type of issues that arose. No studies were ruled out on the basis of the quality appraisal since quality levels were similar between studies; studies instead were evaluated in light of their quality. Appendix 5 provides a reference list for the studies included in the review.

Table 5 Quality appraisal of studies identified in the SLR, using edited questions from the case-control quality appraisal tool by CASP

Study authors	Did the study address a clearly focused issue?	Were the cases recruited in an acceptable way?	Were the controls recruited in an acceptable way?	Is there a sufficient number of cases?	Have confounding factors been taken into account?	Has the study addressed construct validity?	Have the assessments/ tools used been validated?	Are the results precise?
Ahmed, Parker and Adams (2006)	yes	no	no	no	medium	yes	yes	yes
Archibald and Gathercole (2006b)	yes	medium	yes	no	medium	yes	medium	yes
Archibald and Gathercole (2006c)	yes	medium	yes	no	medium	yes	yes	yes
Archibald and Gathercole (2007)	yes	medium	medium	no	yes	medium	yes	yes
Archibald and Gathercole (2007b)	yes	medium	medium	no	yes	yes	yes	yes
Beverly and Estis (2003)	yes	yes	yes	no	no	medium	no	yes
Bishop, Adams, Nation and Rosen (2005)	yes	medium	medium	no	medium	yes	medium	yes
Coady, Kluender, and Evans (2005)	yes	medium	medium	no	medium	yes	medium	yes
Corriveau, Pasquini and Goswami (2007)	yes	medium	medium	no	medium	medium	medium	no
Criddle and Durkin (2001)	yes	medium	medium	no	yes	medium	no	no
Edwards and Lahey (1996)	yes	yes	no	no	medium	medium	medium	yes
Ellis Weismer (1985)	yes	yes	medium	no	medium	medium	no	no
Evans (1999)	medium	yes	no	no	medium	medium	no	yes
Fazio (1998)	yes	medium	medium	no	medium	medium	no	yes
Hanson and Montgomery (2002)	yes	medium	medium	no	medium	medium	no	yes
Horohov and Oetting (2004)	yes	yes	yes	no	yes	medium	no	medium
Mainela- Arnold and Evans(2005)	yes	medium	medium	no	medium	medium	no	yes
Montgomery (1995a)	yes	medium	medium	no	medium	medium	no	no
Montgomery (1995b)	yes	medium	medium	no	medium	yes	no	yes

Table 6 Quality appraisal of studies identified in the SLR, using edited questions from the case-control quality appraisal tool by CASP

Study authors	Did the study address a clearly focused issue?	Were the cases recruited in an acceptable way?	Were the controls recruited in an acceptable way?	Is there a sufficient number of cases?	Have confounding factors been taken into account?	Has the study addressed construct validity?	Have the assessments/ tools used been validated?	Are the results precise?
Montgomery (1999)	yes	medium	medium	no	medium	medium	no	yes
Montgomery (2000a)	yes	medium	medium	no	medium	medium	no	no
Montgomery (2000b)	yes	yes	yes	no	yes	medium	no	no
Montgomery(2002)	yes	yes	yes	no	yes	yes	no	no
Montgomery and Leonard (1998)	yes	yes	yes	no	medium	medium	no	no
Montgomery and Leonard (2006)	yes	yes	medium	no	medium	yes	no	no
Montgomery and Windsor (2007)	yes	no	no	no	yes	yes	no	yes
Nash and Donaldson (2005)	yes	medium	medium	medium	yes	yes	no	yes
Oetting (1999)	yes	yes	yes	no	medium	medium	no	yes
Oetting, Rice and Swank (1995)	yes	no	medium	no	medium	medium	medium	no
O'Hara and Johnston (1997)	yes	no	medium	no	yes	yes	no	yes
Redmond and Rice (2001)	yes	yes	yes	no	medium	medium	no	no
Rice and Wexler (1999)	yes	medium	medium	no	medium	medium	no	medium
Rice, Cleave and Oetting (2000)	yes	medium	medium	no	medium	yes	no	no
Stark and Heinz (1996)	yes	no	no	no	medium	medium	no	medium
Tallal (1976)	yes	medium	no	no	medium	medium	medium	no
Van der Lely and Dewart (1986)	yes	medium	medium	no	medium	medium	medium	yes
Van der Lely and Stollwerk (1997)	yes	no	no	no	no	yes	medium	no

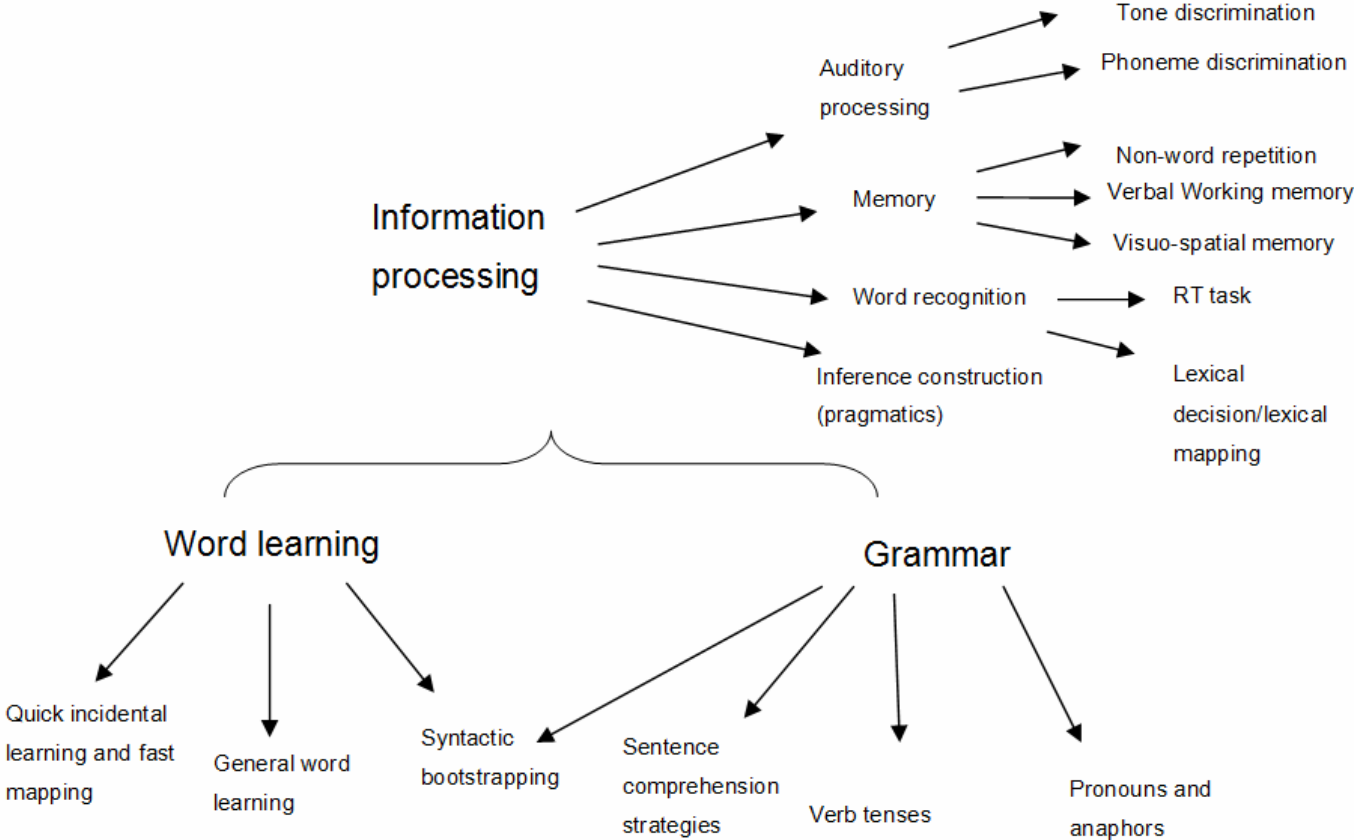
4.6 Characteristics of studies from preliminary data extraction

Following application of the inclusion/exclusion criteria, studies were read in detail and information was extracted in preliminary tables including participant details, methods, results and authors conclusions. As part of the tabulation process, studies were given topic area codes that summarised key areas of deficit that were reported by studies. A spreadsheet was then made to examine which topic areas were frequently coded. The codes were then examined to see how they might be grouped and characterised.

Categorisation of studies into key areas proved difficult due to studies often assessing a range of factors and investigating a range of overlapping deficits. Nevertheless, from this process, three areas investigated by the papers emerged these were: information processing factors, word learning ability and grammar comprehension. Further definition and discussion of these areas is provided below. Within these areas, studies had a range of foci; this was particularly true for information processing factors. Each area was examined for use of similar task types, and where there were several papers adopting a particular type of task these were grouped together for analysis. This is described in more detail in the approach to synthesis (section 4.6.1).

From the topic area codes a systematic map was made of the key topic areas and their foci (Figure 5). The robustness of the map was checked by examining each paper's topic area codes to confirm that they could be assigned to an appropriate sub-heading. The map serves to demonstrate the range of topics examined in the review and was used as a template for analysis.

Figure 5 A systematic map of the key topic areas that emerged from the studies



The majority of the studies identified by the review investigate the information processing skills of children with SRLI. These information processing studies could be grouped into different areas of focus, including auditory processing, memory, word recognition and inference skills. A number of studies investigated these areas alongside grammar or word learning tasks. There were seven studies that investigated word learning and eight that examined grammar. Only one paper in the review emerged that examined pragmatics/inferences.

Most investigations have been carried out with children aged seven to ten (n=24). No studies investigated children under four years old. However, there were several who examined children aged between four and seven years old (n=7), and children aged ten to 13 years old (n=6).

4.6.1 Approach to synthesis

The primary aim of this review was to summarise the evidence of deficit in children with SRLI, and therefore it can be seen to be predominantly integrative (concerned with combining study findings, rather than interpretive which would be seeking to generate new theory). Narrative synthesis was used to summarise the data, as the data produced was heterogeneous and therefore unsuitable for meta-analysis. Further, author's interpretation of task results appeared to play an important role in understanding the data. Narrative synthesis was therefore valuable in describing the interpretation of study results.

It was noted earlier that a criticism of narrative synthesis is that it cannot tell us anything about the size of the differences between case and control groups. One way of resolving this is to calculate and report effect sizes alongside narrative text. This process was adopted since it is able to indicate where the strongest evidence for deficit might lie. However, unlike a meta-analysis, effect sizes were not pooled.

Tables were created for each topic area, and within these topic areas, for similar types of task. For instance in auditory processing, studies that examined discrimination of tones, are separated from studies that examined discrimination of consonant-vowel (CV) syllables. Where studies included several tasks these were detailed separately in the tables; thus the studies are not mutually exclusive to one area. The systematic map (Figure 5) was used as a template for the tables. The tables report information regarding the tasks used in studies, and crucially whether statistically significant differences were found between SRLI groups and age or language matched controls. Where there is a statistically significant difference in a task or across tasks, this is reported as 'yes'; where there is no statistically significant difference this is reported as 'no' (under headings starting 'deficit against'). However, some studies investigated a number of different conditions or tasks, where there might be a

statistically significant difference on one task but not on another, in such cases 'some' statistically significant differences are reported.

Effect sizes and confidence intervals were calculated from available data in the studies. These were calculated with the software Revman, version 5, using standard mean differences (Cohen's *d*). These are reported in the tables to give an indication of the size of the differences between SRLI and control groups. Where data were not available to calculate the effect sizes, the author(s) were contacted. This resulted in one study providing the necessary data that were not available in the text (Nash and Donaldson 2005). However, for some studies there was insufficient data to calculate effect size.

Negative effect sizes indicate poorer performance by the SRLI group and positive effect sizes indicate poorer performance by the control group. Cohen (1992) suggests that an effect size of 0.2 to 0.3 might be a 'small' effect, around 0.5 a 'medium' effect and 0.8 to infinity, a 'large' effect. However, caution is advised in such a simplistic interpretation, since the terms 'small', 'medium' and 'large' have been noted to be "relative, not only to each other, but to the area of behavioural science" as well as the method employed (Cohen 1992, p. 25).

The majority of included studies used a control group matched with the SRLI group for age; these are referred to as the CA (chronological age) group. However some additionally, or instead, used control groups matched to the SRLI group on a language measure, referred to as the LA (language age) group. In all instances the type of control used is identified in the tables.

4.7 Results

The following section sets out the main findings of the systematic review under the heading of the three main topic areas; information processing, word learning and grammar. Each topic area starts with a definition and a brief overview of the subtypes of study. The format for the reporting of each subtype follows the same pattern: first a summary of the background to research within that subtype; and secondly a description of the research tasks for the studies. This is necessary since the tasks are complex, and controversy sometimes exists around what they are measuring. Tables are then presented which display the key findings from the studies and effect sizes where relevant. This is followed by a narrative description to help interpretation of results. Finally after each section a narrative summary of results emerging from the different kinds of tasks undertaken is presented.

Appendix 6 provides descriptive information on the participants included in the studies, including numbers of participants, age and inclusion criteria.

4.8 Information processing studies

Information processing is an area of study within cognitive psychology that focuses on the study of the structure and function of mental processing. The focus is on the mental operations through which information gets into the brain, is retained, recalled or reactivated for use. Put more simply; information processing examines a person's ability to effectively use the information the senses have gathered.

Information processing can be tapped at different levels. Typical information processing models, such as that proposed by Atkinson and Shiffrin (1968) include a sensory register, short-term memory (working memory), and long-term memory. The present review found studies at each of these levels e.g. auditory processing (sensory register), short term and working memory studies and subsequent matching of auditory input with existing lexical knowledge through word recognition and lexical decision (long term memory). Inference skills (pragmatics) were also included in the information processing section, as this is felt to encompass all aspects of information processing.

4.8.1 Auditory processing

Background

Tallal and Piercy (1973a) were the first researchers to hypothesise that language impaired children are impaired in their ability to discriminate and sequence speech sounds that incorporate rapidly changing acoustic spectra. It was found in a number of early studies that speech sounds that rely on brief temporal cues for their discrimination were most often misperceived by these children. As a result many of the auditory processing studies focus on temporal or rapidly changing acoustic spectra. Researchers have attempted to tap participant's auditory processing abilities at various levels; these are considered first at the tone, then at the level of phoneme² discrimination.

Tone discrimination studies

Tasks

Four studies were identified that focus on tone discrimination. Tone discrimination tasks typically involve participants making judgements about a pair of tones differing in frequency, length of presentation or proximity to one another. Tallal and Piercy (1973a) first used a task known as the Auditory Repetition Test (ART). The ART examines participants' ability to

² A phoneme is the smallest unit of sound that forms meaningful contrasts between utterances

perceive binary sequences of tones with different fundamental frequency, with varying intervals between them. Participants are first trained to associate each tone with a specific key press, and are then required to remember these over a set of trials. It was as a result of ART studies (Tallal and Piercy 1973b) that theory was developed which attributed the difficulties of children with SLI to problems of discrimination of rapid auditory signals, known as auditory temporal processing theory. A number of authors have, however, questioned the validity of the ART method arguing that performance on this task may be affected by factors other than auditory temporal resolution. These factors include memory (since it requires the child to remember key presses) and frequency discrimination.

Of the studies included in the present review, Tallal (1976) is the only study that adopts the ART method. Ahmmed et al (2006), Bishop et al (2005) and Correiveau et al (2007) adopt tasks designed to minimize information processing load, where children were not required to remember a key press. Instead, participants were given a forced choice between tones for features such as same, different or which sound came first (Bishop et al 2005; Correiveau et al 2007) or were required to indicate if they heard one or two tones (Ahmmed et al 2006).

Table 7 Auditory processing, details of tone discrimination studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Tallal (1976)	Auditory Repetition Test (ART) was administered, investigating ability to perceive binary sequences, through varying time intervals between two tones differing in their fundamental frequencies.	Yes	N/A	Performed significantly more poorly at speed.	Results interpreted to indicate that the rate at which acoustic information must be processed in time may be a critical feature of speech processing.	Insufficient data to calculate	N/A
Bishop et al (2005)	Investigated discrimination in direction of frequency glides a) where duration was adaptively increased and b) frequency was adapted. For both versions of the glide discrimination task, the child had to judge which of two glides differed in direction from a standard glide.	No	N/A	Groups did not differ on the glide tasks.	Perception of brief, transient, non-speech stimuli concluded to be normal. It's suggested that studies that find nonverbal auditory deficits are likely to be a result of task procedure.	Glide variable duration 0.59 [-0.06, 1.24], Glide variable frequency 0.27 [-0.37, 0.91]	N/A

Table 8 Auditory processing, details of tone discrimination studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Ahmed et al (2006)	The Auditory Fusion Test-Revised (AFT-R) was administered. Investigating temporal processing in gap detection task- varying time intervals between two matching tones, tested at three different frequencies.	Some	N/A	Performed more poorly only in one frequency condition, 400Hz. Existence of two SRLI subgroups, one with relatively better and one with poorer temporal resolution.	Poorer temporal resolution in the subgroup suggested to be linked with central neural timing mechanisms rather than auditory processing.	25 Hz condition -0.09 [-0.72, 0.55], 100Hz, -0.4 [-1.04,0.24], 400Hz -0.69 [-1.35,-0.03]	N/A
Corriveau et al (2007)	A battery of non-speech auditory processing tasks was administered using forced choice paradigms, including temporal order judgment (TOJ) tasks.	Some	Some	Significantly impaired on three tasks (one ramp and two ramp rise time, briefer sounds), but not the TOJ task. Impaired relative to both control groups on longer sound discrimination.	Concluded to have auditory processing difficulties, but these are thought to not be due to brief successive cues (TOJ). Instead they are concluded to be due to deficits in sensitivity to durational and amplitude envelope cues.	One ramp rise time -0.48 [-0.13, 1.10], two ramp rise time -0.18 [-0.43,0.79] briefer sounds -1.34 [-2.02, -0.67], longer sounds -1.63 [-2.34, -0.92] TOJ -0.55 [-1.17, 0.06]	One ramp rise time -0.07 [-0.67, 0.54], two ramp rise time -0.17 [-0.78,0.44], briefer sounds -0.23 [-0.84,0.37] longer sounds -0.88 [-1.52, -0.25] TOJ 0.03 [-0.58, 0.63]

Phoneme discrimination studies

Tasks

Six studies were found that investigate the auditory processing ability of children with SRLI through tasks where participants are required to discriminate or identify syllables or words that differ in one phoneme. The identification task (ID) adopted by Tallal and Stark (1981), is a common method used in auditory studies. Similar to the ART, children are taught to associate pairs of consonant vowel (CV) syllables with response buttons (e.g., /ba/) with one button and a second response button for another CV syllable (e.g., /da/). Once they demonstrate their ability to identify the appropriate stimulus, they are then tested on their ability to consistently identify correct syllables. A number of studies in the present review have used approaches similar to the ID task; (Stark and Heinz 1996; Hanson and Montgomery 2002; Montgomery 2002). As with the ART, some researchers have suggested that the ID task is undermined by the cognitive demands it requires for retaining button press associations. This is supported by findings by Hanson and Montgomery (2002) where a discrepancy in performance, of children with SRLI, between ID task and a similar but less cognitively demanding discrimination tasks was found. It was found that the SRLI children only performed more poorly on the ID task.

Coady et al (2005), Montgomery (1995b) and Bishop et al (2005) adopt tasks designed to minimize memory as an alternative to the ID task. For example, they require children to make same-different judgements or point to pictures, compare non-words, or match an aurally presented word with one from two words that are minimal pairs. However, processing demands in these types of tasks are difficult to eliminate, as participants are required to simultaneously store and compare phonemes.

Table 9 Auditory processing, details of phoneme discrimination studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery (1995b)	A nonsense word discrimination task was used to investigate perceptual abilities. Subjects had to listen to pairs of 'pretend' words (1-4 syllables in length).	N/A	Some	Only in four syllable word condition did a significant difference emerge.	Possible difficulty with processes related to phonetic segment identification, but further investigation is suggested.	N/A	4 syllable word condition -0.90 [-1.71,-0.08]
Stark and Heinz (1996)	Ability to perceptually label syllables /ba/ and /da/ was investigated using a cascade synthesizer with five formants. An Identification subtest was used to find the minimum formant transition duration (FTD) at which the child might be successful in identifying syllables.	Yes	N/A	Break down in identification of /ba/ and /da/ began to occur at 80 ms FTD.	Results are concluded to be consistent with the presence of inadequate central representation of phonemes. No support for temporal processing deficit as the children were not able to benefit from extended stop-vowel transitions to the extent expected.	Insufficient data to calculate	N/A
Hanson and Montgomery (2002)	Identification and discrimination of CV syllables investigated, discrimination task assessed both the accuracy and speed of discriminating perceptually similar sounding and dissimilar sounding pairs of CV syllables (same vs. different). An identification task required matching the CV syllables /ba/ /da/ and /sa/ to coloured dots.	Some	N/A	Significantly impaired on the identification task, however, no significant difference between groups on discrimination task.	Do not demonstrate a basic temporal processing deficit (hence comparable performance to CA on discrimination task), poorer performance on identification task is concluded to be a result of a more limited general processing capacity and the nature of the task.	Identifying stops -1.22 [-2.11, -0.34], identifying non-stops -0.57 [-1.39, 0.25]	N/A

Table 10 Auditory processing, details of phoneme discrimination studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery (2002)	The ID Speech Perception Task by Tallal and Stark (1981) was administered. Involving identification of the CV syllable pair /ba/ and /da/, by tapping the appropriate coloured dot corresponding to each CV pair.	Yes	No	SRLI children performed significantly worse than CA controls but similarly to LA children.	A diminished general processing capacity was proposed to hinder ability to handle the processing demands of the task.	Identifying stops -1.06 [-1.71, -0.41]	Identifying stops -0.4 [-1.06, 0.17]
Bishop et al (2005)	Participant's ability to match an aurally presented word with one from two words that were minimal pairs was investigated. These were presented in noise and no noise conditions.	Some	N/A	Significantly more poorly in conditions of noise, but not in no noise conditions	Results demonstrate poor speech discrimination.	In noise -0.64 [-1.30, 0.01] in no noise -0.26 [-0.90, 0.38]	N/A
Coady et al (2005)	Identification and discrimination of digitally edited versions of the words 'bowl' and 'pole' was investigated, where the [b]-[p] the duration of aspiration was altered. Identification involved a pointing task, with two-alternative forced choice. The discrimination task involved a same different judgment.	Some	N/A	There were no group differences for identification data but children with SRLI showed lower peak discrimination values. Children with SRLI performed more poorly on the discrimination task.	Deficits in memory, processing or representation are proposed to be cause of poorer performance on discrimination task (not auditory processing deficit), since performance was better on identification task that minimized memory load.	Insufficient data to calculate	N/A

Synthesis of auditory processing studies

The tonal and phoneme discrimination studies offer inconclusive support for auditory processing difficulties, with the majority (n=5) finding that children with SRLI appear to score more poorly against age matched controls only in certain conditions. Very little support is provided for a rapid or temporal processing deficit; with the exception of Tallal (1976) no studies cite support for a rapid or temporal processing deficit, with a number explicitly stating that the results seem to suggest that SRLI do not have difficulties in this area (Bishop et al 2005; Stark and Heinz 1996 and Hanson and Montgomery 2002). Other theories to explain why children with SRLI score poorly on auditory tasks include inadequate central representations of phonemes/degraded phonological representations (Stark and Heinz 1996; Corriveau et al, 2007), central neural timing mechanisms (Ahmmed et al 2006) and difficulty identifying phonetic segments (Corriveau et al 2007). Five studies have cited the demands of the task as reason for poorer performance by the SRLI group rather than an auditory processing difficulty (Hanson and Montgomery 2002; Montgomery, 2002; Coady et al, 2005; Bishop et al, 2005).

Effect sizes

For the tone discrimination studies, where statistically significant differences are reported, medium effect sizes were found. An exception is Corriveau et al (2007) who reported statistically significant difference, however, based on their data effect sizes were small and confidence intervals crossed zero.

In the phoneme discrimination studies, large effect sizes were found for identifying stops (Hanson and Montgomery 2002; Montgomery 2002). Though Bishop et al (2005) report statistically significant differences, based on the data provided, confidence intervals just cross zero.

Short term and working memory

Background

Short term memory can be described as the capacity for holding a small amount of information in mind, in an available state, for a short period of time. Short term memory can be distinguished from working memory, which refers to structures and processes used for temporarily storing as well as manipulating information. Atkinson and Shiffrin (1968) developed a famous model of memory that described all memories passing from short-term to a long-term store after a small period of time. Baddeley and Hitch (1974) later proposed a working memory model as an alternative to the short-term store in Atkinson and Shiffrin's

model (1968). Baddeley and Hitch's (1974) model of working memory, argues for the existence of multiple short term memory stores, and a separate interacting system for manipulating the content of these stores. There are a number of theoretical models and frameworks for working memory but key to all of them is the notion of a complex memory task where processing is combined with storage aspects of complex memory.

This section considers first non-word repetition studies (a measure of short term memory) then verbal working memory studies, these are then synthesized together. Visuo-spatial memory studies are then addressed.

Non-word repetition studies

Tasks

Six studies were found that use non-word repetition to measure short term memory. Non-word repetition (NWR), involves repetition of multisyllabic non-words. Traditionally non-word repetition is seen to be a measure of phonological short term memory, as is advanced by Gathercole and Baddeley (1990). It is argued that the unfamiliarity of the non-words forces participants to rely heavily on temporary phonological representations to support their repetition attempts. Support for this argument is provided by the fact that poor performance on non-word repetition correlates with poor performance on conventional measures of short-term memory such as digit span and word recall (Gathercole and Baddeley 1990). It is widely acknowledged, however, that there are other processes that are thought to be involved including lexical and sub-lexical knowledge, mechanisms for using such knowledge, representations of individual phonemes as well as speech output processes.

Disproportionate impairment has been found in non-word repetition compared to independent measures of short term memory (STM) or serial recall for children with SRLI (Archibald and Gathercole 2007b), indicating that performance on non-word repetition tasks can be explained in terms of the contribution of STM in part, but that in addition further processes are required. Articulatory complexity of non-word stimuli has also been linked with poorer performance in SRLI children (Archibald and Gathercole 2006b), indicating that phonological representations or difficulty forming novel phonological sequences play a role in non-word repetition tasks.

Table 11 Short term memory, details of non-word repetition studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery (1995a)	Repetition of twelve nonsense words at each of four syllable lengths (1, 2, 3, 4) was investigated. Half of the items contained an initial stop consonant; the other half a nonstop consonant.	N/A	Yes	Scored significantly less on three syllable and four syllable words.	Inferior nonsense word repetition interpreted to suggest limitations in phonological memory capacity, theory supported by performance in longer syllable conditions.	N/A	3 syllable -1.66 [-2.56, -0.77], 4 syllable 2.23 [-3.22,-1.24]
Montgomery (1995b)	Repetition of twelve nonsense words at each of four syllable lengths (1, 2, 3, 4) was investigated. Half of the items contained an initial stop consonant; the other half a nonstop consonant.	N/A	Yes	Difficulty perceptually processing four syllable nonsense words.	Results are thought to reflect a limitation in the phonological storage component of phonological working memory.	N/A	Non-word totals -1.93 [-2.87, -0.99]
Horhov and Oetting (2004)	Twenty of the 48 non-words used by Montgomery (1995b) were selected as stimuli.	Yes	Yes	Non-word repetition scores and standardised tests of vocabulary and syntax were moderately correlated with each other.	NWR is interpreted to be a measure of phonological processing and suggested as useful clinical marker of SLI.	Non-word totals -2.07 [-2.89, -1.24]	Non-word totals 1.31 [-2.04, -0.58]

Table 12 Short term memory, details of non-word repetition studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Archibald and Gathercole (2006b)	Children's Test of Non-word Repetition (CNRep; Gathercole & Baddeley, 1996) and the Non-word Repetition Test (NRT; Dollaghan and Campbell, 1998) were administered.	Yes	Some	Impaired compared to CA on both tests. Impaired on the CNRep compared to LA but not the NRT (cognitive adjustments). Had more difficulty repeating words with increased articulatory complex.	Poor verbal short-term memory, thought not to fully explain NWR difficulty. Poorer performance in conditions with increased articulatory complexity indicates other processes are involved.	CNRep 3 syllable -1.12 [-1.99, -0.25], NRT 3 syllable -1.24 [-2.12, -0.35], CNRep 4 syllable -1.23 [-2.12, -0.34] NRT 4 syllable -1.80 [-2.78, 0.83]	CNRep 3 syllable -0.26 [-3.70, 4.22] NRT 3 syllable 0.22 [-0.59, 1.02] CNRep 4 syllable -0.28 [-1.09, 0.52] NRT 4 syllable -0.09 [-0.89, 0.71]
Archibald and Gathercole (2007b)	Non-word repetition of three syllable lengths were used, three, four and five CV syllables.	Yes	N/A	Deficit in non-word repetition against CA persisted even when taking into account an independent measure in short-term memory.	Disproportionate deficit in NWR taken as indication that the difficulties can not be solely attributed to phonological short-term memory.	4 syllable NRT -1.21 [-2.03, -0.41]	N/A
Montgomery and Windsor (2007)	Repetition of 40 non-words varying in length from one syllable to four syllables, 10 items at each syllable length was investigated.	Yes	N/A	NWR predicted unique variance in CELF-R performance (about 15%).	Deficits in language knowledge as well as phonological short term memory. NWR as a good clinical marker for SLI.	Non-word totals -1.87 [-2.46, -1.48]	N/A

Verbal working memory

Tasks

Seven studies were found that examine the verbal working memory of children with SRLI. Studies adopt a number of ways to tap this 'complex' memory type. All the studies, examining working memory, involve a task with a storage and a processing aspect e.g. retain a word or words (storage), while putting them in order, or answering a question (processing). It has, however, been proposed (Maniela-Arnold and Evans 2005) that these tasks might be affected by existing lexical knowledge, and therefore might not be tapping just verbal working memory.

Montgomery (1995a) and Montgomery (2000a; 2000b) investigate comprehension of sets of linguistically redundant (longer) and a set of linguistically non-redundant (shorter) sentences. While these tasks are not working memory tasks per se (though longer sentences are considered to place greater demands on memory), they are included here as the authors examine the relationship between the participants performance on these redundant and non-redundant sentences with a conventional measure of verbal working memory.

Table 13 Details of verbal working memory studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery (1995a)	Investigated comprehension of a set of linguistically redundant (longer) and a set of linguistically non-redundant (shorter) sentences.	Yes	N/A	Comprehended significantly fewer redundant sentences than non-redundant sentences. Positive correlation was found between performance on the NWR and sentence comprehension tasks.	Poorer performance on redundant sentences is proposed to be a result of difficulties managing the increased demands on phonological working memory.	Non-redundant sentences -0.75 [-1.59, 0.08], redundant sentences -1.78 [-2.69, -0.87]	N/A
Montgomery (2000a) task one	Working memory was investigated in three processing load conditions; no load, single load, and dual load conditions. The load conditions combined remembering word list whilst simultaneously categorising them.	Some	No	Performed more poorly in the 'dual-load' task only against CA controls.	More limited functional working memory capacity proposed, as well as difficulty managing working memory and processing resources.	Single load 0.24 [-1.05, 0.56], dual load -1.98 [-2.98, -0.97]	Single load 0.15 [-0.65, 0.96], dual load -0.32 [-1.13, 0.48]
Montgomery (2000a) task two	Investigated comprehension of sets of linguistically redundant (longer) and a set of linguistically non-redundant (shorter) sentences.	Yes	Some	Comprehended fewer redundant and non-redundant sentences relative to the CA and fewer redundant sentences than LA.	More limited functional working memory capacity proposed, specifically difficulty in coordinating memory storage with processing.	Non-redundant -1.26 [-2.15, -0.37], redundant -2.81 [-3.99, -1.63]	Non-redundant -0.51 [-1.33, 0.31], redundant -2.35 [-3.43, -1.27]

Table 14 Details of verbal working memory studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery (2000b) task one	Working memory was investigated in three processing load conditions; no load, single load, and dual load conditions. The load conditions combined remembering word list whilst simultaneously categorising them.	Some	No	Performed more poorly in the 'dual-load' task only.	Less able to coordinate both storage and processing of working memory.	Single load 0.11 [-0.91, 0.69], dual load -1.65 [-2.59, -0.70]	Single load 0.17 [-0.63, 0.98], dual load 0.02 [-0.78, 0.82]
Montgomery (2000b) task two	Investigated comprehension of sets of linguistically redundant (longer) and a set of linguistically non-redundant (shorter) sentences.	Yes	Some	Comprehended fewer redundant and non-redundant sentences in a sentence comprehension task than CA, and fewer redundant sentences relative to the LA.	Comprehension difficulties proposed to be related to limited functional working memory capacity and difficulty managing general processing resources.	Non-redundant -1.36 [-2.21, -0.51] redundant -2.27 [-3.33, -1.20]	Non-redundant -0.62 [-1.44, 0.20] redundant -2.10 [-3.13, -1.07]

Table 15 Details of verbal working memory studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Archibald and Gathercole (2006d)	A computer software delivered two processing tasks (verbal and visuospatial) two storage (verbal and visuospatial) tasks, and four complex memory measures derived from combining these processing and storage tasks.	Yes	No	Slower and less accurate at processing both verbal and visuospatial material than the CA. Recall accuracy was reduced on complex memory tasks processing, to a greater extent than LA.	The poor performance on the verbal complex memory tasks is taken to indicate a combination of both a domain-general slowing in processing and a verbal storage deficit.	Complex working memory, verbal-verbal -1.06 [-1.86, -0.26] complex verbal-visuospatial -0.47 [-1.22, 0.29] complex visuo-spatial-verbal -0.71 [-1.48, 0.06] processing verbal accuracy -1.39 [-2.23, -0.56] processing verbal speed -1.59 [-2.46, -0.73]	Complex working memory 0.97 [0.18, 1.76]
Mainela-Arnold and Evans (2005)	The competing language processing task (CLPT) was administered. Subjects were asked to listen to lists of short sentences; they were required to respond, while attempting to retain the last word of each sentence.	Yes	N/A	Recalled significantly fewer target words on the CLPT. Significantly poorer performance with low frequency word in SRLI group.	Poorer performance on low frequency words interpreted to suggest importance of role of long term linguistic knowledge, not necessarily indicative of working memory deficits.	CLPT -1.94 [-3.05, -0.84]	N/A

Synthesis of short term working memory studies

The studies included in the present review found children with SRLI to be impaired relative to both LA and CA groups on tasks of non-word repetition. Performance appeared to be particularly poor on longer, three or four syllable non-words. Differences, however, emerged in the interpretations of these results in terms of the extent they reflect difficulty with phonological working memory. It can be concluded that these results do reflect a difficulty with phonological working memory in part, however, other processes are also involved.

Broader studies of working memory, found SRLI children to have difficulties against CA groups, but there is little evidence of working memory difficulties against LA groups. Three studies found, in more complex memory conditions in particular, that differences emerged between the SRLI group and controls (Montgomery 2000a; Montgomery 2000b; Archibald and Gathercole 2007), where tasks involved combining storage and processing. Montgomery (2000a, 2000b) speculate that in the absence of any additional processing requirements the SRLI children have a comparable simple storage capacity. However, these results could also indicate a general slowing in processing speed (Archibald and Gathercole 2007).

Mainela-Arnold and Evans (2005) found children with SRLI to not differ from the CA group in their ability to recall high frequency words. However, they performed significantly more poorly for low frequency words. This might suggest that performance on these tasks is affected by existing linguistic knowledge. Lack of examination of the word frequency issues in the other studies means it is not possible to draw conclusions about this hypothesis.

The evidence, from all the studies included in the systematic review, suggests that most children with SRLI have difficulty with their short term and working memories. Evidence from NWR studies is particularly strong, though the extent that this is a measure of just phonological short term memory is questionable. Existing linguistic knowledge, as well as increased processing demands have been found to influence these children's memory difficulties, but the nature of these relationships requires further examination. It is possible that in more simple processing conditions and in areas supported with linguistic representations that these children with SRLI would not exhibit a basic short term memory deficit. Working memory studies indicate, however, that complex demands on memory consistently cause difficulties for children with SRLI.

Effect sizes

In the non-word repetition studies large effect sizes were found on all studies where data was available against CA and LA groups, with the exception of Archibald and Gathercole

(2006b), where effect sizes were small. Large effect sizes were also found for the working memory studies, where statistically significant differences were reported between groups.

Visuospatial memory

Tasks

Three studies were found that examine visuospatial memory in children with SRLI. Visuospatial memory studies examine visual (rather than verbal) aspects of memory. These studies are interesting for determining the extent to which the memory deficits found in SRLI children are specific to the verbal domain, or indicate a more generalised memory deficit. These tasks typically involve remembering the sequence or location of colours, shapes or numbers on a screen.

Table 16 Details of visuospatial memory studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Archibald and Gathercole (2006c)	PC-based Automated Working Memory Assessment (AWMA) (Alloway et al 2004) was administered.	No	No	Visuospatial short-term and working memory abilities were found to be age appropriate.	Do not have a visuospatial memory impairment. Proposes a challenge to the notion of a 'general processing capacity' limitation.	Visuospatial short-term -0.52 [-1.25,0.21] visuo-spatial working memory -0.37 [-1.10, 0.35]	Visuospatial short-term -0.99 [0.22, 1.75] visuospatial working memory 0.65 [-0.09, 1.39]
Archibald and Gathercole (2007)	The experiment consisted of two processing tasks (verbal and visuospatial) two storage tasks (verbal and visuospatial) and four complex memory measures derived from combining these processing and storage tasks.	Some	No	Less accurate than CA on verbal and visuospatial processing tasks but not visual storage tasks.	Do not have visuospatial storage difficulties. However, domain-general slow processing was suggested as reason for difficulty with complex memory tasks.	Visuospatial storage -0.33 [-1.07, 0.42] processing visuospatial accuracy -0.82 [-1.60, -0.04] visuospatial speed -0.60 [-1.36, 0.16]	Visuospatial storage 1.26 [0.44, 2.08] processing visuospatial accuracy 0.99 [0.20, 1.78] visuospatial speed 0.77 [-0.00, 1.54]
Fazio (1998)	Children were tested for their serial memory for common objects, unfamiliar faces and scribble pictures.	Some	No	Performance was found to resemble CA controls under long presentation conditions. However, under short presentation conditions, performance was worse than CA on all 3 tasks.	Poorer performance in short presentation conditions taken as evidence for a limited processing capacity.	Serial memory short presentation -1.66 [-2.70, -0.61] serial memory long presentation -0.61 [-1.51, 0.30]	Serial memory short presentation -0.59 [-1.49, 0.31] serial memory long presentation 1.69 [0.64, 2.74]

Synthesis of visuospatial studies

Studies that examine visuospatial memory suggest that this is not a problem area for children with SRLI. Two studies (Archibald and Gathercole 2007; Fazio 1998) report some difficulty on visuospatial tasks compared to CA controls, however, this appears to be isolated to conditions where the visuospatial task is complex. In the study by Fazio (1998) the children with SRLI only performed more poorly under conditions of fast presentation; in the study by Archibald and Gathercole (2007) difficulties only emerged where visual storage and verbal processing tasks were combined. This seems to indicate that children with SRLI do not have a basic visuospatial memory deficit. Difficulties that emerge in more challenging memory conditions appear to be as a result of slower or general processing capacity limitations, not related to visual memory (Fazio 1998; Archibald and Gathercole 2007). It seems plausible then that it is not the short term memory system that is deficient in children with SRLI, but its interaction with verbal stimuli.

Effect sizes

Archibald and Gathercole (2007) found a large effect size that reached significance in the visuo-spatial accuracy condition. Fazio (1998) also found a large effect size in serial memory under the short presentation conditions.

4.8.2 Word recognition, lexical decision and lexical mapping studies

Background

An influential model of word recognition is the revised cohort theory (Marslen-Wilson and Zwierslood 1989). The revised cohort theory proposes several stages to word recognition that interact with one another. These stages include lexical contact, activation, retrieval, selection, recognition and integration. Models such as the revised cohort theory regard word recognition as an automatic, data-driven process that is facilitated by context (Montgomery 2002). Word recognition is proposed to tap where listener's linguistic knowledge interfaces with acoustic-phonetic input (Marslen-Wilson and Tyler 1980). A number of proposed stages in word recognition involve the listener mapping speech sounds to their existing vocabulary. These stages are described as lexical mapping (Montgomery 1999).

The following section considers first studies that have examined word recognition in reaction time tasks (RT). It then examines studies that have examined word recognition in other task types, including lexical decision and lexical mapping tasks.

Word recognition reaction time tasks

Task

Five studies examined the word recognition times of children with SRLI. Word recognition RT tasks involve subjects listening for a target noun in a sentence and pressing a response pad as quickly as possible upon recognising the word. This has traditionally been seen to be a measure of real time processing of spoken language (Montgomery et al 1990), with speed of response being indicative of how rapidly participants are able to process words. As all these methods require a rapid motor response, auditory detection reaction times are also measured. Slower RTs are thought to be indicative of a language processing deficit (slower processing speed) and difficulty in lexical retrieval.

Table 17 Details of word recognition reaction time (RT) studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery and Leonard (1998)	Word recognition times were examined in sentences with low phonetic substance (morphemes -ed and -s) and high phonetic substance inflections (the morpheme -ing). For half of the sentences, verb inflection was missing; for the remaining sentences, the verb was appropriately inflected.	Yes	No	Slower RTs overall than CA. Only demonstrated RT sensitivity to the presence of a higher-phonetic substance inflection, control groups displayed sensitivity to both higher-substance and low-substance inflections.	Slower RTs interpreted to suggest less efficient (slower) to process spoken language. Additional study of low-phonetic substance grammatical morpheme processing recommended.	High substance stem -1.79 [-2.51, -1.06], inflection -1.26 [-1.93, -0.60], low substance stem -1.45 [-2.14, -0.76], inflection -1.33 [-2.00, -0.65]	High substance stem -0.37 [-0.98, 0.25], inflection -0.02 [-0.58, 0.63], low substance stem -0.21 [-0.82, 0.40], inflection -0.20 [-0.81, 0.40]
Montgomery (2000a)	A word recognition time task was administered with, highly familiar, monosyllabic nouns.	Yes	Yes	Yielded an overall slower word recognition reaction time than the CA and LA group.	Slower RTs interpreted to demonstrate lower linguistic retrieval and/or slower to evaluate the linguistic properties of incoming words relative to prior context.	Word recognition -1.18 [-2.06, -0.30]	Word recognition -0.68 [-1.73, -0.03]
Montgomery (2002)	A word recognition time task was administered in sentences that were 'stop loaded' (contained high number of plosives) and sentences that were 'nonstop loaded' (contained a high number of fricatives and nasals).	Yes	Yes	Slower RTs than both control groups. Sentence type had no effect on any subject group's RT.	Slower word recognition concluded to reflect inefficient linguistic processing. Suggested that this is due to slowness in retrieving the linguistic properties (i.e. syntactic, semantics) of incoming words.	Word recognition -0.79 [-1.42, -0.16]	Word recognition -0.32 [-0.93, 0.29]

Table 18 Details of word recognition reaction time (RT) studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery and Leonard (2006)	A word recognition time task was administered in sentences with low phonetic (morphemes –ed and –s) and high phonetic substance inflections (the morpheme –ing). For half of the sentences, the verb inflection was missing; for the remaining sentences, the verb was appropriately inflected.	Yes	N/A	Slower reaction times overall, demonstrated RT sensitivity to presence of high-substance inflection only, the CA children showed sensitivity to both low and high.	Less sensitivity to low-substance inflections concluded to be a result of reduced language processing capacity (the surface account).	High substance stem -0.77 [-1.49, -0.04] high substance inflection -0.75 [-1.47, -0.03] low stem -0.77 [-1.49, -0.04] low inflection -2.07 [-2.95, -1.19]	N/A
Montgomery and Windsor (2007)	The word recognition time task was administered.	Yes	N/A	Yielded significantly slower word recognition. Clinical evaluation of language fundamentals (both expressive and receptive composites) were not correlated with word recognition RT.	Lack of correlation between RT and language assessments concluded to suggest speed is associated with processing more familiar language material (i.e. lexical content and structure).	Word recognition -1.30 [-1.74, -0.86]	N/A

Synthesis of word recognition (RT) studies

The results of these word recognition studies indicate that SRLI children are slower to recognise sentence-embedded words compared to CA groups. There is some limited evidence that indicates SRLI children also have slower word recognition RT relative to younger LA groups.

The slower word recognition RTs are likely to indicate inefficient and slower retrieval of linguistic material as well as inefficient ability to evaluate linguistic properties of words (Montgomery 2000a; Montgomery 2002). Children with SRLI appear to only be sensitive to inflections that have high substance i.e. longer duration (e.g. –ing), compared to shorter duration (e.g. –ed –s) (Montgomery and Leonard 1998; 2006), suggesting that word recognition might be constrained by the phonetic content of the words.

Effect sizes

Large effect sizes were found against CA groups in all studies, with the exception of Montgomery and Leonard (2006) where medium to large effect sizes were found. However, mixed effect sizes were found against LA groups. Montgomery's (2002) data produced small effect sizes.

4.8.3 Word recognition; auditory lexical decision and lexical mapping tasks

Tasks

One study was identified that examines children's ability with 'lexical decision' and another that examines their ability at 'lexical mapping'. In a similar vein to word recognition RT tasks, these are language processing tasks designed to see how long it takes to recognise a sequence of sounds as a word in the lexicon.

A typical example of an auditory lexical decision task is where participants listen to real and non-word stimuli and respond 'yes' or 'no' (vocally or by button press) with regard to whether it is a real word or not. Slower lexical decision times are generally interpreted to be indicative of limitations in linguistic processing capacity or deficits in phonetic/phonological representations. However, a lexical decision task does not necessarily isolate linguistic processing deficits per se, as the task is thought to use multiple complex operations that use general processing capacity for completion (Edwards and Lahey 1996).

There is one lexical mapping study (Montgomery 1999). In the lexical mapping task participants listen to successive chunks of familiar nouns and are asked to guess the word to which these

chunks belong. This task is thought to yield information about the point in the acoustic-phonetic stream at which listeners are able to establish a cohort point; the point where the listener is first able to produce a word, as well as the point they can identify the target word (isolation and acceptance points). Together this is thought to provide information about how well listeners are able to access the lexicon, based purely on an acoustic-phonetic analysis, as well as provide important information about listeners' lexical mapping abilities, independent of higher levels of linguistic processing.

Table 19 Word recognition, details of lexical decision and lexical mapping studies

	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Edwards and Lahey (1996)	Participants listen to real and non-word stimuli and respond 'yes' or 'no' with regard to whether it is a real word or not.	Yes	N/A	Significantly longer reaction times than CA peers. An expressive language impaired group had reaction times comparable to controls.	Slower lexical decision times interpreted to be a result of limitations in processing capacity, or deficits in phonetic or phonological representations.	Real words -0.94 [-1.60, -0.29] non-words -0.77 [-1.41, -0.12]	N/A
Montgomery (1999)	To examine the lexical mapping stage of auditory word recognition, a forward gating task was given. Participants listened to successive temporal chunks of familiar monosyllabic nouns, and were then asked to guess the identity of the word after each gate.	No	No	Performed comparably to the CA and LA children on seven dependent measures related to lexical mapping.	Similar performance to controls was taken to demonstrate a comparable lexical mapping phase (i.e. acoustic-phonetic analysis) of auditory word recognition.	No. of words correctly identified 0.42 [-0.19, 1.03], phoneme identification point 0.00 [-0.60, 0.60]	No. of words correctly identified 0.51 [-0.11, 1.12] phoneme identification point 0.45 [-0.16, 1.06]

Synthesis of lexical decision and lexical mapping studies

The lexical decision study found children in the SRLI group to perform worse than the CA group (Edwards and Lahey 1996). However, the study found high intra subject variability in their results, indicating that while some SRLI children have difficulty in conditions of increased processing demand, others do not. The lexical mapping study (Montgomery 1999) found no evidence that children with SRLI had difficulty compared with CA or LA groups. It's concluded that the SRLI children have a normal acoustic-phonetic phase of word recognition. The limited number of studies in this area makes it difficult to draw firm conclusions.

Effect sizes

A mixture of medium-large effect sizes were found in the study by Edwards and Lahey (1996).

4.8.4 Inference construction

Background

The work of Bartlett (1932) sparked an interest among psychologists in the constructive cognitive processes involved in comprehension and retention of information presented as stories or pictures. Inference constructions allow individuals to elaborate on given information in order to derive implicit meanings (Ellis Weismer 1985).

Task

There is only one study that examines a pragmatic aspect of the ability of children with SRLI to learn language. Children's ability to make causal and spatial inferences about verbal and picture stories is examined. Ellis Weismer (1985) is the only study in the review that uses cognitive matched controls (CC).

Table 20 Details of the Inference construction study

Study	Task	Deficit against age matched controls (CC)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CC)	Std mean difference and confidence interval (LA)
Ellis Weismer (1985)	Ability to construct spatial and causal inferences from short stories presented in a verbal and picture task was investigated. Questions were asked about information explicitly stated or depicted in the story, the premises, and on implicit information-inferences. One of each items were true, whereas the two remaining premise and inference items were false.	Some	No	Performed significantly lower on inference items than the CC control group on both tasks, even when they encoded and remembered the relevant premise information.	Proposed that there might be a connection between deficits in mental representation and inference construction abilities. Deficits in representational skills are speculated to impede ability to generate links between relevant pieces of information and integrate it in a meaningful fashion.	Verbal true inference -0.79 [-1.62, 0.05] verbal false inference -0.49 [-1.31, 0.32], 0.44], picture true inference -1.12 [-1.99, -0.24],	Verbal true inference -3.42 [-4.75, -2.09] verbal false inference -0.07 [-0.87, 0.73], picture true inference -0.34 [-1.02, 0.44]

Synthesis of inference construction study

Ellis Weismer (1985) found that the children with SRLI were significantly impaired compared to CC controls on inference items in both conditions. This is interpreted to be a result of a cognitive deficit; specifically it is proposed that there is a connection between deficits in mental representation and inference construction abilities. Deficits in representational skills are speculated to impede ability to integrate information in a meaningful fashion. However, it is not possible to draw conclusions about the ability of children with SRLI to construct inferences, since only one study in the review examines this issue.

Effect sizes

Effect sizes were predominantly medium with confidence intervals that crossed zero. Contrary to Ellis Weismer's (1985) report that significant differences were found in verbal and picture conditions, calculated effect sizes only found a large and significant effect for the true inference items in the picture condition.

4.9 Word Learning

Background

Word learning, or the ability to learn new words, is considered an important part of language acquisition. In relation to children with SRLI, some studies have looked at word learning broadly, several have looked at the ability of children with SRLI to fast map or incidentally learn new words, and others have looked at their ability to syntactically bootstrap.

Fast mapping is the term used to describe children's rapid, partial word acquisition given brief initial encounters. 'Quick incidental learning' (QUIL), makes a distinction between the 'quick' (the rapid and initial) phase of word learning and the 'incidental' nature of most word learning encounters. While QUIL is consistent with the idea of fast mapping, it makes a stronger claim for minimal environmental support for mapping (Oetting 1999). Syntactic bootstrapping refers to the theory that children make use of correlations between syntax and semantics to infer novel word's meaning (Gleitman 1990).

Tasks

Seven studies examine the ability of children with SRLI to learn new words. Word learning studies typically involve children being presented with novel words through a videotaped story or in sentences (O'Hara and Johnston 1997). The children are then subsequently tested on their knowledge and understanding of these words.

Table 21 Details of word learning studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Oetting, Rice and Swank (1995)	A task designed to examine QUIL was administered. Videotaped stories were presented with novel verbs embedded into the narrative. Children watched the videos then completed a picture comprehension test.	Yes	N/A	Demonstrated some word-learning ability, but significantly less than that of CA. They made particularly low gains on words from the action class.	Although capable of incidentally learning words, they find it more difficult to do so. Suggested reasons include a processing deficit account and working memory difficulties.	QUIL -0.66 [-1.12, -0.20]	N/A
O'Hara and Johnston (1997)	Syntactic bootstrapping ability was examined. Children were presented with sentences containing novel verbs and were asked to act out the meanings with toys.	N/A	Yes	Provided significantly fewer prototypic interpretations for sentences with novel verbs than LA controls (but were able to infer verb meanings above chance).	Demonstrate ability to syntactically bootstrap, but find it more difficult to do so. Poorer performance was suggested to be as a result of processing limitations.	N/A	Simple transitive -1.25 [-2.53, 0.04], locative -1.36 [-2.67,-0.05], coordinated -1.93 [-3.40, -0.46]

Table 22 Details of word learning studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Oetting (1999)	Task one, syntactic bootstrapping was examined using single action scenes. Task two, QUIL was examined using videotaped stories with novel verbs embedded into the narrative. Both tasks involved transitive or intransitive syntax.	Some	Some	On task one there was no difference between groups. On task two scores were lower than those of both control groups for retention. Scored more poorly against CA controls on verb interpretation.	Provide evidence that able to syntactically bootstrap and incidentally learn, however, appear unable to retain verb meaning. Plausible reasons; deficits in the storage and retrieval of grammatical information and /or general limitation in processing capacity.	Task 1 insufficient data. QUIL Verb interpretation -1.53 [-2.24, -0.82], viewing one -1.26 [-1.95, -0.58], viewing three -2.14 [-2.94, 1.35] viewing four -1.85 [-2.60, -1.10]	Task 1 insufficient data. QUIL Verb interpretation -0.38 [-1.01, 0.24] viewing one -0.69 [-1.33, -0.05], viewing three -1.31 [-2.00, -0.62], viewing four -1.11 [-1.78, -0.44]
Rice, Cleave and Oetting (2000)	Syntactic bootstrapping was examined. Things that can be counted as individual items (count nouns, e.g. car) were compared with things that are non-individuated substances (mass nouns, such as water). A videotaped story was used with syntactic cues in one condition and with neutral syntax in another.	Yes	No	Scored more poorly against CA but not LA. A second study found continued growth of bootstrapping ability, however, still performed significantly more poorly than CA.	Poorer performance proposed to be result of memory limitations, and incomplete mastery of the grammatical contrasts. However, it's concluded that difficulties with morpho-syntax hinder word learning ability.	5 years cued -0.88 [-1.52, -0.24], 7 years cued -1.69 [-2.78, -0.59], 5 years neutral -0.29 [-0.90, 0.32]	5 years cued 0.75 [0.11, 1.40], 5 years neutral 0.96 [0.30, 1.62]

Table 23 Details of word learning studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Beverly and Estis (2003)	A disambiguation task was used to determine the ability to quickly map nonsense words to unfamiliar objects given a forced choice. There were two word conditions; phonetically distinct and phonetically similar (to objects presented).	Yes	Yes	Selected unfamiliar objects significantly less than LA controls but more often than chance. In the phonetically similar condition consistently selected familiar objects.	Slow mapping of new words interpreted to be a result of not being able to consistently infer mutual exclusivity.	Phonetically distinct -3.31 [-5.56, -1.07], phonetically similar -0.97 [-2.33, 0.38]	Phonetically distinct -3.18 [-5.36, -1.00], phonetically similar -1.25 [-2.68, 0.17]
Nash and Donaldson (2003)	Children were presented with opportunities to learn novel words in an incidental and explicit contexts.	Yes	Some	Performed significantly worse on five measures of word learning than the CA group after six (time one) and 12 (time two) repetitions of novel words, in both recognition and recall tasks. Performed similarly to LA at time one, but significantly worse at time two on a naming task.	Difficulties not just restricted to incidental learning, but also arise in taught contexts. Poorer performance on all five measures of word learning thought to indicate difficulties with meanings as well as phonological forms of words.	Explicit teaching T1 -1.70 [-2.52, -0.88], explicit teaching T2 -1.17 [-1.93, -0.41] story picture T1 -0.99 [-1.73, -0.25], story picture T2 -1.38 [-2.17, -0.60]	Explicit teaching T1 -0.46 [-1.17, 0.24], explicit teaching T2 -0.20 [-0.90, 0.49], story picture T1 -0.26 [-0.96, 0.44], story picture T2 -0.40 [-1.11, 0.30]

Table 24 Details of word learning studies

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Horohov and Oetting (2004)	A videotaped reading of two stories that had novel words embedded in the narrative was presented. A number of different variables were examined; presentation rate, sentence complexity, and word type.	Yes	No	Scored significantly more poorly under 'fast rate' conditions than slow, but for LA and CA groups there was no difference in scores related to speed of presentation. Children's non-word repetition and standardised tests of vocabulary and syntax accounted for significant variation in their score.	Results demonstrate that ability to process language quickly has a negative and direct impact on ability to comprehend the meanings of novel words. Correlations between tests were taken to indicate the role of the existing lexicon and phonological working memory for learning new words.	Finger probe fast simple -1.21 [-1.93, -0.49], finger probe fast complex -1.16 [-1.88, -0.45], fast simple word synonym -1.51 [-2.26, -0.76], fast complex word synonym -1.31 [-2.04, -0.59]	Finger probe fast simple 0.25 [-0.41, 0.91], finger probe fast complex -0.19 [-0.84, 0.47], fast simple word synonym -0.05 [-0.70, 0.60], fast complex word synonym 0.26 [-0.40, 0.92]

Synthesis of word learning studies

The identified studies found that children with SRLI perform significantly worse than CA groups on word learning tasks (n=5). There is also some evidence that children with SRLI have greater difficulty learning words against LA groups.

Studies, that examine quick incidental learning, found evidence that children with SRLI are able to incidentally learn but seem to be less effective at doing so (Oetting 1999; Oetting et al 1995). SRLI children appear to have particularly profound difficulty with retention of new words learnt over time compared to both CA and LA groups (Oetting 1999). There is also evidence that these children cannot consistently infer mutual exclusivity i.e. infer the correct meaning of a word when the context presents only one reasonable option (Beverly and Estis 2003) and that they have difficulty with both the meanings and phonological forms of new words (Nash and Donaldson 2006). Similar conclusions can be drawn from the syntactic bootstrapping studies, where children with SRLI have been found to be able to syntactically bootstrap but appear less effective at doing so (O'Hara and Johnston 1997; Oetting 1999). There was, however, mixed evidence in this area.

Difficulties that SRLI children have with word learning appear to interact with their information processing limitations and/or memory difficulties (Oetting et al 1995; O'Hara and Johnston 1997; Rice et al 2000; Horohov and Oetting 2004). That children with SRLI have been found to present with a reduced ability to process rapidly presented sentences can be seen to support this claim (Horohov and Oetting 2004). The evidence overall suggests that SRLI children are capable of incidental learning as well as syntactic bootstrapping, but they seem to be less effective at doing so, and are perhaps less likely to retain new words over time.

Effect sizes

Large effect sizes were found against CA groups in all the word learning studies, except for the study by Oetting et al (1995) where medium effect sizes were found, and in the 5 year old neutral condition in the study by Rice et al (2000), where a small, non significant effect size was found. Against LA groups a mixture of effect sizes were found. Some large significant effect sizes in the direction of poorer performance by the LA group were found (Rice et al 2000; Horhov and Oetting 2004), however, others found large effect sizes in the direction of poorer performance by the SRLI group (Oetting 1999; O'Hara and Johnston 1997; Beverly and Estis 2003).

4.10 Grammar

Background

Grammar studies examine the role of morphology, syntax, and word order in understanding language. There are many theories regarding the acquisition of grammar and the failure to acquire it correctly. Those that arose in the present review are binding theory, the extended optional infinitive (EOI) account and the surface account.

Binding theory (Chomsky 1986) states that structural syntactic principles determine the referential possibilities for reflexives and pronouns. Binding theory is proposed to be part of universal grammar and to be innate. The EOI account is the theory that some children with SRLI fail to regard tense as a required syntactic feature (Rice et al 1999). This optional infinitive stage is characterised by the alternate use of finite and infinitive verb forms, where sentences require a finite form (e.g. using walk, where walked is required). Finally, the surface account proposes that children with SLI have a processing capacity limitation that has an adverse effect on the acquisition of grammatical morphemes of brief duration (low-phonetic substance morphemes e.g. -ed, -s).

Tasks

Eight studies examined the role of grammar in sentence comprehension. Since authors have examined different theories in relation to grammar impairments, they have examined different grammatical targets.

The majority of the identified studies adopt grammatical judgment tasks, in which grammatical sentences are presented, and participants have to make 'yes' or 'no' judgments about whether the sentences are grammatically correct. Other studies use picture pointing as a method to assess the understanding of sentences, and one study required participants to act out the meaning of sentences.

Table 25 Details of studies examining grammar

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Van der Lely and Dewart (1986)	Subjects acted out active or passive voice sentences that had either a positive or negative semantic bias or were unbiased.	Yes	Yes	Greater use of semantic cues than control groups. Word order responses were used equally frequently among SRLI and LA controls.	Rely more heavily on probable event strategy. Speculate that reliance on these semantics expectations is compensatory for a deficit in syntactic analysis.	Correct responses -4.15 [-5.74, -2.56]	Correct responses -0.95 [-1.85, -0.06]
Van der Lely and Stollwerck (1997)	Within sentence assignment of reference to pronouns (him, her) and anaphors (himself, herself) was investigated. Experiment one involved a yes/no sentence-picture judgment in which the test stimuli either matched or mismatched. Experiment two was similar, however, used subordinate sentence (e.g. Mowgli says Baloo Bear is tickling himself).	N/A	Some	Performed at chance level in conditions where they were required to use syntactic information. LA controls showed appropriate use of syntactic knowledge. Some significant differences were found between groups.	Results interpreted to be consistent with impairment of innate syntactic knowledge (binding theory). Proposed that syntactic representation is underspecified for the syntactic properties of pronouns.	N/A	Name pronoun match -0.79 [-1.62, 0.05], name pronoun mismatch -1.02 [-1.9, -0.18] mismatch quantifier reflexive -0.45 [-1.26, 0.37]

Table 26 Details of studies examining grammar

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Montgomery and Leonard (1998)	Knowledge of the –s/ed and –ing morphemes was examined through a grammatical judgment task where half were grammatical and half were ungrammatical, containing an inappropriately missing inflection (e.g., “My dad always shoot ducks when he goes hunting”).	Some	No	Performed more poorly than the CA controls only on sentences missing obligatory low-substance inflections (e.g., “Carl already jump over the fence”).	Findings discussed within framework of the surface account. Difficulty with low substance inflections is concluded to be either due to its phonetic substance or accessibility to grammatical function.	High substance inflection 0.16 [-0.45, 0.77], Low substance inflection -0.78 [-1.40, -0.15]	High substance inflection 0.32 [-0.29, 0.93] low substance inflection -0.23 [-0.83, 0.38]
Evans and Macwhinney (1999)	Participants presented with grammatical and semi-grammatical sentences comprised of 2 nouns and a verb, with animacy as a second factor. Required to point to the picture one that was ‘doing’ the action.	Yes	No	Different comprehension strategies to controls, relying more on animacy cues (semantic information) rather than word order.	Results are interpreted to suggest that development of adaptive strategies for processing language. A deficit in working memory is proposed as a reason for failure to attend to word order.	Insufficient data to calculate	Insufficient data to calculate

Table 27 Details of studies examining grammar

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Rice, Wexler and Redmond (1999)	Grammaticality judgment measures were collected over a period of two years for five types of measurement examining well-formedness judgments. The focus was infinitival forms of verbs.	Yes	No	Less accurate judgments than CA and were much less likely to judge optional infinitive items (e.g. he eat toast, he behind the box) as ungrammatical than other grammatical forms.	Results concluded to be consistent with the EOI account. Argue that these difficulties are not likely to be due to processing limitations (except in more complex grammatical constructions). Proposed to be a result of underlying grammatical representation.	Insufficient data to calculate	Insufficient data to calculate
Redmond and Rice (2001)	Participants were presented with grammatical and ungrammatical sentences which they were required to judge. The focus was on understanding of restrictions associated with irregular verb forms.	Some	Some	Accepted more past tense over regularisations (e.g. he failed) than the CA group and were less sensitive to errors involving infinitive forms in finite positions (he fall off). Accepted more finite form errors in complement positions (e.g. he made him fell) than both CA and LA.	The results are concluded to support many predictions of the EOI account, recommend that further investigation is needed before a conclusive assessment is made.	Finite forms vs. infinitives -1.11 [-1.78, -0.43] correct irregular vs. overregular -1.16 [-1.85, -0.48] infinitive vs Irregular -1.81 [-2.57, -1.05] infinitive vs. overregular -1.89 [-2.66, -1.12]	Finite forms vs. infinitives -0.52 [-1.17, 0.14] correct Irregular vs. overregular -0.37 [-1.02, 0.28] infinitive vs. Irregular -0.75 [-1.42, -0.08] infinitive vs. overregular -0.97 [-1.66, -0.29]

Table 28 Details of studies examining grammar

Study	Task	Deficit against age matched controls (CA)	Deficit against language matched controls (LA)	Details	Author's theory in relation to receptive language	Std mean difference and confidence interval (CA)	Std mean difference and confidence interval (LA)
Criddle and Durkin (2001)	Ability to detect phonemic changes in novel morphemes was investigated. Two comprehension tests were constructed, one for zeeb and one for voog, presented in a video. Ability to detect phonemic changes from the target morpheme was tested through presentation of phonemic variations of the morphemes.	Some	N/A	As able as CA to learn a novel morpheme. However, less able than CA to detect changes in a novel morphemes when presented in non-final utterance position. No group differences in the responses when given more processing time.	Although able to effectively learn a novel morpheme, they appear to have less complete representations of it and are therefore willing to accept a wider range of variants. Results concluded to be consistent with a limited processing capacity.	Non-final position: Zeeb 0.53 [-0.22, 1.29], weeb -1.32 [-2.15,-0.49], zeeb -1.07 [-1.87, -0.27] zark -1.66 [-2.54, 0.79], wark -1.05 [-1.85, 0.26]	N/A
Montgomery and Leonard (2006)	A grammatical judgment task was administered using low phonetic (morphemes -s) and high phonetic substance inflections (the morphemes -ing and -er). Half were sentences that contained one of the inflections (INF) and the other half had an inflection that was inappropriately missing. Among the INF sentences half were acoustically enhanced.	Yes	N/A	Performed worse than the CA children overall but on low-substance inflections in particular. Acoustic enhancement had a beneficial effect on the inflectional processing but it had no effect on CA children.	Findings are interpreted to be consistent with the surface account; that difficulty with low substance inflections is due to a reduced processing capacity. Difficulties might also be attributable to the grammatical function of the inflection.	Natural high substance inflections -1.28 [-2.05, -0.51] natural low substance inflections -1.35 [-2.13, -0.57], enhanced high substance inflections -0.68 [-1.40, 0.03], enhanced low substance inflections -0.54 [-1.25, 0.16]	N/A

Synthesis of grammar studies

The evidence suggests that children with SRLI have difficulty understanding a number of grammatical features compared with CA controls, and there is some evidence that they also have difficulty compared with LA controls.

It is evident that a range of theories exist in relation to these grammar impairments. A distinction can be drawn between the grammatical difficulties children with SRLI have been found to have, and the theories about the underlying cause for these difficulties. For instance, there is robust evidence of difficulty with tense marking. This is consistent with the EOI account (Rice et al 1999; Redmond and Rice 2001), and is also supported by the findings of Montgomery and Leonard (1998; 2006) that children with SRLI do not display sensitivity to –ed inflections. Differences, however, emerge in theorising why children have difficulty with tense marking. The EOI account proposes innate difficulty with grammatical features and not broader information processing difficulties. Montgomery and Leonard (1998; 2006), by contrast, attribute difficulties with tense markings to processing limitations. The greater difficulty that children with SRLI have with briefer durations, or low substance inflection (e.g. -ed and -s) compared to longer duration of high substance inflections (e.g. -ing and -er) supports this view. Criddle and Durkin (2001) also conclude that their findings are consistent with a limited processing capacity explanation; they found that SRLI participants are less able than CA participants to detect phonemic changes in novel morphemes.

The two papers that examine sentence comprehension strategies broadly (Evans and MacWhinney 1999; Van der Lely and Dewart 1986) both conclude that the SRLI group adopt a semantic based strategy relying on word meanings over word order. Van der Lely and Dewart (1986) speculate this to be a result of deficits in syntactic analysis. Evans and MacWhinney (1999), however, found evidence that syntactic analysis is hindered by processing capacity limitations (in particular memory). It was found that some children displayed changes in comprehension strategies with increased processing demands, from low to high cue competing contexts. This suggests that, for some children with SRLI, they may be able to use grammatical information when processing demands do not exceed available resources.

There was only one study that examined binding theory, finding children with SRLI to have difficulty with the syntactic properties of pronouns (Van der Lely and Stollwerck 1997). Like the EOI account (Rice et al 1999, Redmond and Rice 2000), the study concluded that the difficulties SRLI children have are a result of reduced syntactic knowledge or syntactic representations rather than processing limitations. Redmond and Rice (2001) concede,

however, that in complex sentences, interactions of morphophonology, morphosyntax, and language processing/parsing strategies might take place.

The evidence found in the review demonstrates that children with SRLI have a range of grammatical comprehension difficulties compared to CA controls. Evidence for difficulty with tense markings is particularly strong. However, opinion is divided about the cause of these difficulties. Grammatical impairments in children with SRLI are seen to be result of a complex interaction of factors, including phonemic analysis of grammatical morphology, information processing factors (working memory in particular) and understanding of the grammatical contrasts themselves.

Effect sizes

Where significant differences were reported, the effect sizes were large in the majority of instances; an exception is Montgomery and Leonard (1998) who found medium effect sizes in the low substance condition.

4.11 Summary of effect sizes

Many studies did not provide sufficient data from which to calculate effect sizes. Where it was possible to calculate effect sizes (reported in Table 5-Table 28), large to medium effect sizes were usually found where statistically significant differences between groups were reported.

There were a number of studies where statistically significant differences were reported between the SRLI group and controls, but calculation of the effect sizes proved otherwise, since confidence intervals crossed zero (Ellis Weismer 1985; Montgomery 2002; Bishop et al 2005; Corriveau et al 2007).

The most striking example of a reported statistically significant difference not being supported by the data was in the study by Corriveau et al (2007). In this study it was reported that there are statistically significant differences on the one-ramp rise time and two-ramp rise time tasks. However, based on the reported means and standard deviations, effect sizes are small and confidence intervals crossed zero. This was confirmed by independent examination of the data by a statistician. Reporting of a statistically significant result is assumed to be due to a calculation error.

4.12 Other findings from the systematic literature review

Of the papers searched in the present review it was found that the majority did not separate SRLI and SELI. Of the full papers accessed 159 were excluded for this reason. There were a number of different ways in which authors failed to classify SRLI participants:

1. Language ability was not measured on a standardised language assessment or no inclusion criteria were stated e.g. Creusure et al (2004), Gillot et al (2004) and Farrant et al (2006). Instead studies used SLT referral or records.
2. Participants were required to have a receptive or an expressive difficulty e.g. Gillam et al (1998), Hill et al (2005) and Stanton-Chapman et al (2007), resulting in the inclusion of participants who had only expressive language difficulties.
3. Participants were required to have a below average composite score on an assessment that included both receptive and expressive measures e.g. Leonard et al (1992), Van der Lely et al (2004) and Lum and Bavin (2007). Composite measures could not be included as they might reflect a severe deficit in expressive language, and a weak/no deficit in receptive language.
4. Participants were classified by subtypes of SLI, but authors do not separate these participants in analysis e.g. Connell and Stone (1992), Ellis Weismer and Hesketh (1996) and Hick et al (2005).

It was also noted that there were a wide range of different selection criteria for participants in the identified studies. Though all studies were required to meet the inclusion criteria for the review there was still variability.

4.12.1 Non-verbal intelligence criteria

Differences arose between studies on non-verbal intelligence criteria: while the majority (n=32) required participants to have non-verbal IQs within the normal range (i.e. no more than one SD below the mean or a standardised score of 85), three studies had a criteria of non-verbal intelligence scores >80, and two used a discrepancy criteria between language scores and non-verbal IQ scores. Studies also used a range of different non-verbal tests.

4.12.2 Language criteria

No less than 18 different standardised receptive language tests (or incorporating a receptive measure) were recorded. Most popular tests included the Test of Reception of Grammar (TROG; Bishop 1989), British Picture Vocabulary Scale (BPVS; Dunn et al 1982), Clinical Evaluation of Language Fundamentals–Revised (CELF-R; Semel, Wiig, and Secord 1987), The Peabody Picture Vocabulary Test–Revised (PPVT-R; Dunn and Dunn 1981) and the Test of Language Development-Primary (TOLD-P; Newcomer and Hammill 1988). The

assessments were also used in different combinations with one another.

In addition to the range of standardized assessment, studies also used different criteria for the magnitude of discrepancy from age norm expectations. The majority of studies adopted a one SD below the mean criterion ($n=22$), seven adopted a 1.25 to 1.33 SD below the mean criteria, six adopted a 1.5 SD below the mean criterion, one adopted a two SD below the mean criterion and two others used age norm scores, requiring a two year below average score. Variability also arose in terms of the number of assessments used; for instance, participants might be required to score one SD below the mean on one assessment (of a variety) or on two assessments that were the only assessments administered.

4.13 Quality Appraisal

The quality appraisal process revealed many issues with both the external and internal validity of the studies. The external validity of the studies was brought into question by a lack of detail regarding how participants were recruited; selection criteria seemed to be pragmatically led or underspecified. This made it impossible to determine if the participants are representative of a typical SRLI population. It was often unclear where the cases and controls had been recruited, and in many instances there was little or no attempt to account for socio-economic status, gender or racial heritage. A few studies referred to 'randomly' selected controls from a specific school, but the randomisation procedure was not explained.

Another major issue for the external validity of the papers was that the numbers of participants were relatively small across all studies, with no studies reporting that they used power calculations in determining the numbers of participants to include. The majority of the studies included only between 10 and 20 participants.

There were also issues with the construct validity of the tasks adopted in the studies. Investigation of specific aspects of language and cognition has led researchers to develop novel tasks in order to examine them. Although measurement validity has been addressed to some extent, through discussion of tasks and their interpretations, the use of the novel tasks types raises a number of issues. Particularly pertinent is that many of the assessments that have been used are not published or standardised tests, making them less open for scrutiny in determining their face validity. Further, due to the unique nature of many of the tasks, comparison between studies is more difficult. Although a number of studies used similar tasks types (e.g. studies of NWR and RT) differences in the task procedure and materials could cause differences in outcomes. There was also a tendency for authors to provide theoretical arguments about a specific aspect of the children's processing, without

providing any overall model or context in which to interpret this.

Validity of studies was in a few instances further hindered by reported statistically significant differences between SRLI and control groups that failed to be upheld when data was examined and effect sizes and confidence intervals were calculated. Corriveau et al (2007) for example, published in one of speech and language therapy's peer reviewed journals (Journal of Speech, Language and Hearing Research) from researchers at the University of Cambridge, reported findings of statistically significant differences between groups which did not match the data that was provided.

A number of key authors have contributed significantly to a large number of papers included in the current review, which could have influenced the studies' findings. James Montgomery, for example, has been an author in 15 papers included in the review. Lisa Archibald and Susan Gathercole have also been authors in four of the included papers. This is likely to be because these authors consistently adopt inclusion criteria for participants that match those required for the present review. It is recognised though that as a result, the findings of the review might be more strongly influenced by these authors' areas of interest and theories. Authors' bias towards their own theory of deficit might also inadvertently have affected the studies' outcomes. An example of this can be seen in the work by Paula Tallal. There was only one on study included in the review by Tallal (1976). There were a number of auditory temporal studies, which did not meet the inclusion criteria for the present review where Tallal was author (e.g. Tallal and Piercy 1973a; 1973b; 1974; 1975; Tallal and Newcombe 1976). These studies were not included since the participant inclusion criteria was either unclear or used only a six month below age expectations rule for receptive language impairment. All of these excluded studies reported evidence for a temporal processing difficulty among children with language impairments. However, these findings have failed to be replicated by the studies included in the present review, except the study that was her own (Tallal 1976). The differences in the findings of the Tallal studies, compared to the findings in the review, could be due to the participant inclusion criteria that were used. However, the fact that all of her studies reported differences between groups might indicate bias in producing results that support her own theory. Since studies are not blinded there is greater potential for bias where authors have vested interest in results supporting their own theory.

4.14 Discussion

The review aimed to answer the following questions:

- What are the receptive cognitive and linguistic deficits in children with specific receptive language impairment?

- Are there areas of deficit that have particularly strong research evidence?

It has been found that there is evidence that children with SRLI have deficits in word learning and grammar comprehension compared with CA controls. There is also evidence that they have deficits in short term and working memory, as well as the speed at which they process information. These processing limitations are thought to influence their grammar comprehension and word learning abilities. These areas are where there is strongest evidence of deficit; an important caveat is that a number of issues have been identified with the validity of studies, so findings should not be considered conclusive. An important point also to consider from the findings of this SLR is that there is an inherent difficulty in isolating areas of deficit in SRLI since language comprehension processes are influenced, not only, by factors relating to information processing but also existing linguistic knowledge. It is likely that the children with SRLI present with a range of cognitive and linguistic deficits that may have different presentations. This fact, combined with the relatively poor internal and external validity of the included studies, mean that the results should be considered as exploratory, providing tentative theories regarding the deficits in SRLI.

This discussion first considers how the range of studies that have emerged from the SLR compare with the models of comprehension that were reported in the previous chapter. Areas for consideration are then discussed in relation to understanding the results that have been found; the extent to which the comprehension processes found are unique to SRLI; the deficits found against CA, as well as interpretation of the studies in light of their quality. The strength and limitations of the systematic literature review are discussed in light of the overall findings of the thesis, in the final discussion (Chapter 8).

4.14.1 Results in relation to models of comprehension

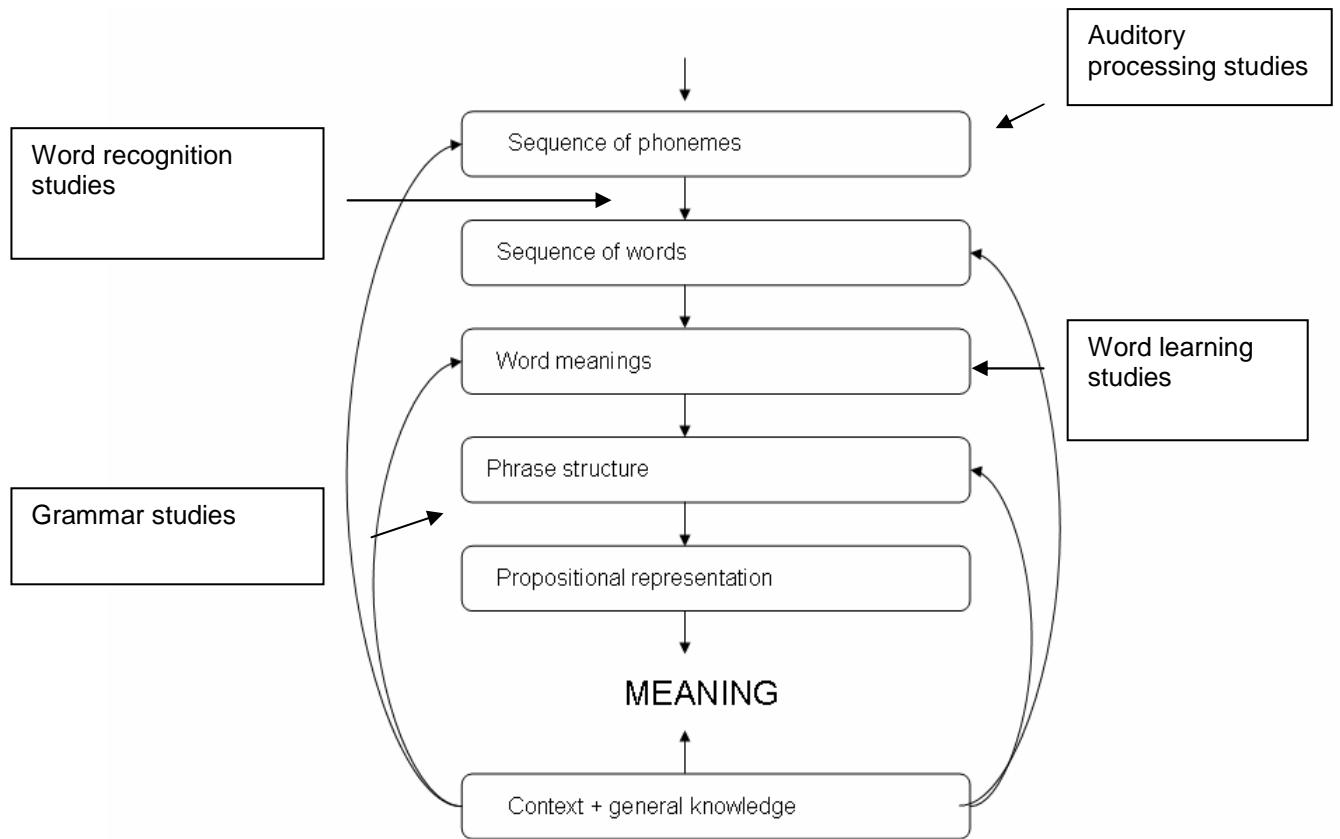
The types of comprehension processes that have been examined in SRLI have taken a constraint-based approach to comprehension, rather than a principle-based approach. This means they have focused heavily on the processing aspects of language, rather than treating language processes as separate modules. This appears to be in line with current thinking about comprehension (Harrington 2001), that it involves multiple sources of knowledge interacting simultaneously.

It is noteworthy that none of the studies that have been identified in the review refer to their results in relation to overarching models of comprehension, though some have referred to models in relation to specific components (e.g. lexical retrieval, Montgomery 1999; 2002). This makes it hard to draw direct comparisons with models of comprehension that were identified in the previous chapter. In relation to the model of comprehension proposed by Bishop (1997), however, it appears that the majority of the stages of comprehension

proposed have been, at least partially, examined in the studies of deficit in SRLI. Figure 3 presents Bishop's model (1997), with annotations of the types studies in the present review that can be linked with relevant stages.

The studies that were identified that examined auditory processing can be seen to fit with the first stage of Bishop's model, sequence of phonemes. Between the level of sequence of phonemes and sequence of words, word recognition is proposed to occur. A number of different study types address this stage, including the word recognition studies, lexical decision as well as lexical mapping studies.

Figure 6 An overview of stages involved in language comprehension, adapted from Bishop (1997, p.14)



Word meanings or semantics has been less explicitly examined by the studies that have emerged. Semantics have been examined implicitly in word learning studies; demonstrating that children with SRLI appear to have difficulties with word learning, implying that these children's semantic knowledge is weaker than age equivalent children. Equally, the studies that examined sentence comprehension strategies also refer to semantics, however, studies do not seem to have explicitly examined this. A direct study of semantics could, for example, test how children are able to group items together from the same categories (e.g. transport, electronics, and furniture).

The levels phrase structures and propositional representation presented by Bishop (1997) relate to grammar and have, to some extent, been examined in the studies that have emerged. For example, those that have addressed broad sentence comprehension strategies, in relation to word order vs. semantics (Evans and MacWhinney 1999; Van der Lely and Dewart 1986). Studies examining binding theory (Van der Lely and Stollwerk 1997) are also concerned with propositional representation. However, a large focus of the grammatical studies appears to have been on morphology rather phrase structure and propositional representation.

A number of deficits that have been investigated in the studies in the SLR, for example working memory, are not explicated in the model of comprehension (Bishop 1997). However, they clearly govern the processes suggested in the model. The studies that have emerged in the SLR have focused heavily on underlying processing, making it hard to draw accurate comparison against models of comprehension processes, such as that proposed by Bishop (1997). A reason for this might be that the 'surface' difficulties, such as those with grammar, are often used to define SRLI in the first place. For instance, the standardised assessments that are used to define the SRLI population often examine their comprehension abilities on a test of grammar (e.g. TROG; Bishop 1989) or word knowledge (e.g. BPVS; Dunn et al 1982). There therefore would seem to be circularity in testing a population, defined on these difficulties, on the same areas that were the basis for their inclusion. There is then a sense that children with SRLI will present with whatever they have been defined by.

4.14.2 The extent that results are unique to SRLI

The extent to which the deficits found in SRLI are exclusive to receptive language impairments and do not reflect deficits also found among specific expressive language (SELI) groups is difficult to determine. Three studies included in the present review (Edwards and Lahey 1996; Evans and MacWhinney 1999; Stark and Heinz 1996) examined SLI by expressive and receptive subgroups. In each of these studies performance differences between the SELI group and SRLI group were found between the subgroups

(Edwards and Lahey 1996; Stark and Heinz 1996; Evans and MacWhinney 1999), with the SRLI group tending to have poorer or more diverging patterns of performance compared with CA groups than the SELI groups. Evans and MacWhinney (1999, p.131) argue that the findings provide evidence that SLI should not be seen as a 'homogenous population'.

While there is dispute surrounding whether SLI should be seen to be a unitary condition or otherwise, it is rational that as a matter of course that SLI studies should assess participants on receptive and expressive language tests, and where different profiles of language ability i.e. SELI and SRLI emerge, that analysis should be conducted separately for the two groups. At present it is difficult to draw comparisons between the groups as there are a limited number of studies that have made such comparison. It is acknowledged, however, that larger sample sizes might be necessary to make valuable comparisons.

An external review was found of two data sets (Windsor and Hwang 1999) which concluded that SRLI subgroups exhibit slower processing rates relative to SELI. These findings, combined with the studies included in the present review, which found differences between the SRLI and SELI group, indicate that there are differences between these subgroups. However, the limited number of studies examining this makes it impossible to draw firm conclusions. The fact that so few studies appear to have directly compared SELI and SRLI population seems surprising in light of their having separate classification criteria in ICD-10, and the evidence that has linked receptive language in particular with negative outcomes (Beitcham et al 1994; Botting and Conti-Ramsden 2000).

4.14.3 Deficits against age matched controls

Younger language-matched controls, in addition to age-matched controls, are often used to examine the role of language level on performance. The present review, however, found that many studies only included aged matched controls. Of those studies that included both age and language match controls, deficits were much more likely to emerge against only the age matched group. This finding is important, since the predominant evidence of deficit against age matched controls indicates that the deficits identified in SRLI might not be unique to their language impairment. Instead it is possible that the identified deficits are product of their language ability levels. If deficits were found against LA groups, this would provide stronger evidence that impairments were unique to SRLI.

Plante et al (1993) note the difficulty with interpretation of the performance of subjects in studies using such dual control groups. Because language is a multidimensional skill, they argue that language disordered children cannot be reflected equivalently by younger language matched controls. Furthermore, their younger age is perhaps an inherently confounding factor. While the use of language matched controls might therefore be seen to

be controversial (and not necessarily beneficial) it is important that the absence of many statistically significant differences between SRLI and language matched controls is taken into consideration in interpreting results. It can be concluded that the areas highlighted in the present review might well be deficits for the children with SRLI, but it is not certain they are a cause of their difficulties, or a natural consequence of their language levels.

4.14.4 Interpretation of findings in light of study quality

It is important to emphasise that this SLR has synthesised the only available cross-sectional case control study evidence of deficit in behavioural studies of SRLI. However, the quality appraisal process revealed many issues with both the external and internal validity of the studies. This goes to demonstrate that 'best' evidence is not necessarily synonymous with 'good evidence'. The findings should therefore be considered exploratory, rather than confirmatory.

Aside from the obvious validity issues, there is additional difficulty in determining the validity of the authors' interpretation of findings. The process of language comprehension is complicated and governed by many aspects of cognition and existing linguistic knowledge, making it extremely difficult to isolate specific areas of deficit. Establishing the reasons for the SRLI groups' poorer performance on certain measures appears to involve a degree of interpretation and opinion. Theory is an important and essential part of unpacking the language comprehension process, but in terms of establishing evidence of deficit, sometimes it is not necessarily clear what deficit is being identified. For instance, there is evidence for slower RT times (against CA controls) in word recognition studies among SRLI children, but which deficits this reflects in terms of why they are slower, involves speculation.

4.15 Future recommendations

Implications from the review can be divided into two areas, those related to broad methodological considerations in speech science, and those related to areas for future deficit research for SRLI. These two areas are considered in turn.

4.15.1 Methodological considerations in speech science

The review has identified that there is a need for improved methodological standards as well as for greater standardisation throughout speech science research. In terms of methodological standards, in relation to the quality appraisal criteria that are recommended for case-control studies, it is clear that many of the studies investigating the deficits in SRLI are not fulfilling the criteria for 'good' quality. The key issues that were identified with study quality were as follows:

- Failure to perform a priori power calculations to inform sample sizes, and the use of small sample sizes
- Underspecified and pragmatically led selection of cases and controls
- Failure to collate demographic information for participants, in particular socio-economic background, ethnic heritage etc, and to consider the confounding influence of these variables

Future studies would benefit from attempting to improve these quality pitfalls. It is understood that it is often difficult to achieve 'gold standards' in designing research projects; problems arise in accessing large populations, as well as in selecting appropriate participants. Greater transparency and details surrounding these issues would allow interpretations of findings to be made in light of the limitations. One possible solution to difficulties with sample size would be to conduct multi-site studies.

The quality of research is also hindered by an issue that is easier to adapt and that is the lack of standardisation. There is a clear lack of consistency between studies in the selection and inclusion criteria of participants, as well as the types of tasks that are administered. The field would benefit from agreeing a preferred selection method for SRLI participants that clarifies ideal language and cognitive assessments, and the optimum discrepancy from the norm criteria. Although diagnostic criteria have been discussed extensively in the literature (Aram et al 1992; Tomblin et al 1996; Conti-Ramsden et al 1997) this does not seem to have led to any agreement. While SLTs might find it difficult to use strict diagnostic criteria in clinical practice, epidemiologic studies demand replicable diagnostic standards. There is little evidence that the existing guidelines in ICD-10 are being followed. There could be a variety of reasons for this. A plausible reason is that speech science sees itself as somewhat unique from the WHO (2003) medical framework. This might be enforced by findings that language tests can miss some aspects of communicative impairment that are regarded as clinically significant (Conti-Ramsden et al 1997). It has been noted elsewhere that SLT's clinical practice tends to involve objective assessments alongside personal judgement and intuition (Lees and Urwin 1997), making it hard to agree on diagnostic criteria that use only standardised assessments.

The Royal College of Speech and Language Therapists (RCSLT 2006), however, endorse the WHO (2003) guidelines. It would be valuable if researchers and SLTs were consulted to determine why they do not use the ICD-10 guidelines and to examine if additional or altered guidelines need to be provided. As the ICD-10 stands, although it provides information on optimum discrepancy from the norm, it does not provide information on which language and cognitive assessments should be used. The finding in the present review that 18 different standardised receptive language tests were adopted demonstrates that a very wide variety

of assessments are currently being used. Recommendations on core or ideal language assessments could reduce this range.

To ensure adherence to ICD-10 guidelines, it might be valuable for peer reviewed journals to only publish studies whose inclusion criteria align with ICD-10 (or new criteria). Alternatively, if studies do not adhere to them, they could be required to justify their reasons for not doing so. A self perpetuating cycle seems to have emerged where published papers adhere to the standards in existing published papers, setting a precedent for all those that follow. The problem with this is that it undermines the criteria given in the ICD-10, and causes confusion around the appropriate definition of SRLI.

A similar problem arises in terms of the tasks that are administered in the review with variation between studies even for very similar task types (for instance word recognition studies), making side by side comparison of studies very difficult. This seems to be because many of the tasks, designed to detect specific aspects of language processing have been developed by different researchers who have developed their own methods of assessment. On some tasks, such as non-word repetition, standardised assessments exist e.g. Children's Test of Non-word Repetition (CNRep; Gathercole and Baddeley 1996) and the Non-word Repetition Test (NRT; Dollaghan and Campbell 1998). This appears to be because they have more functional application for clinicians who might administer them (or perhaps because it is promoted by the researchers who use them). For studies such as word recognition and lexical decision a lack of clinical demand perhaps prevents published or standardised assessments being produced. Increased collaboration between researchers to produce standardised, or consistent, measures would allow meta-analysis of larger data sets, giving greater rigor to findings. Meta analysis would not have been appropriate in the present review due to the heterogeneity in studies tasks.

It has been noted that differences presented between authors' statistical analysis and confidence intervals calculated from the raw data in a number of studies in the review. It is therefore recommended that the peer review process of studies includes checks on the data analysis. If studies involving statistical analysis were routinely double checked by those competent in statistics, this would reduce the chance of erroneous results being published.

4.15.2 Areas for future research into deficits in SRLI

In relation to future deficit research, the systematic review found that there was limited research on pragmatic aspects of language; this is clearly an area that would benefit from further research. Only one study in the present review examined this issue, investigating the ability of children with SRLI to make inferences. Studies elsewhere have examined pragmatic language in relation to SLI populations, for example, Bishop and Adams (1992).

This study did examine receptive language performance on a standardised test against children's ability to answer inferential questions. However, unfortunately, it was not able to be included since participants did not meet the criteria for SRLI. In order to draw conclusions about whether the comprehension difficulties in children with SRLI extend to pragmatic aspects of language, further research is needed with this population.

Finally, the systematic review has highlighted that, of the many studies that have examined deficits in SLI, relatively few have examined deficits in SRLI. It is recommended that research on SLI populations include both receptive and expressive assessment measures as standard, and where expressive and receptive subgroups emerge, analysis is conducted by these subgroups. This will help to illuminate the extent that SLI should really be considered a singular condition.

4.16 Conclusions

The present review is the first to systematically review the literature in relation to receptive language impairments. It therefore provides a summary of the best available evidence in terms of deficits in SRLI. Unfortunately, quality appraisal found that best available evidence is not necessarily 'good' evidence. The conclusions are therefore presented, with the caveat that findings should be considered exploratory.

Two key topic areas from the review found weak evidence of a deficit among children with SRLI relative to controls. These topic areas were auditory processing and visuo-spatial memory. With regard to auditory processing, the evidence of a deficit can be described as limited in support of a deficit thus inconclusive in determining whether this is a problem area for children with SRLI. From a theory perspective, it is generally agreed by authors writing in the field that the children do not demonstrate a rapid or temporal auditory processing deficit (in contradiction with conclusions by Tallal 1976). The systematic review has also found little evidence of visuospatial memory impairment among SRLI children. In this instance the review finds, in contrast to other areas of short term and working memory, that this seems to be a relative strength for these children. In addition to these key areas of weak evidence, the review was only able to include one study on inference construction, from which it was not possible to draw any general conclusions.

By contrast, the review has found relatively strong evidence that children with SRLI have difficulties with word learning and grammar compared to age matched controls. Evidence from the studies of word learning suggests that children with SRLI are able to learn words after brief encounters. They also appear to be able to use the syntax of sentences to assist their learning, but they appear to be less effective at doing so than their CA peers and less able to retain learnt words over time. Finally, the review has found evidence that children

with SRLI have difficulty comprehending a range of grammatical contrasts, including tense/plural inflections and the referents of pronouns. These children have also been found to rely more on semantic rather than word order strategies for sentence comprehension.

In addition to these specific areas of difficulty, there is evidence that children with SRLI have limitations with processing capacity, the speed with which they process information as well as with short term/working memory. These processing limitations are thought to influence their grammar comprehension and word learning abilities. The theory that these children are slower to process language is supported by findings among word recognition studies that children with SRLI are significantly slower to process words than controls. The notion that they possess information capacity limitations is also supported by the finding that children with SRLI were found to score significantly worse on a range of short term and working memory studies, including studies of non-word repetition and on standardised working memory tests.

Analysing which aspects of information processing influence the understanding of grammar and word learning is a difficult feat. Authors have attempted to theorise why children with SRLI might be slower at processing and have presented a range of reasons. These include that they are slower at retrieving the linguistic properties of incoming words and/or evaluating their properties in context (Montgomery 2000a; 2002), they have difficulty with rapidly mapping acoustic signals onto stored lexical representations or they have deficiencies with these representations (Montgomery and Leonard 1998; 2006). These theoretical accounts of information processing difficulties are difficult to accurately assess or measure. An important outcome of the review has been to confirm language comprehension as a complex, multidimensional process. Whether it is important to further unpick these processes, from a speech therapy practice perspective, depends on the extent to which a deeper understanding of such processes can provide workable intervention targets.

In terms of the MRC model for complex interventions (2008), this review has made some contribution to the development phase, further identifying the evidence base and theory. However, further development work is needed at this level, in terms of what changes are expected to be seen through intervention with the identified deficits, and how change is to be achieved. In order to do this it is necessary to gain further understanding of existing interventions. An investigation of the interventions that target the deficit areas highlighted in the current review, as well as the theory behind these, is likely to bring us closer to the final stage of development in the MRC model where processes and outcomes can be modeled.

4.17 Systematic literature review update

Since the SLR initial search was conducted in 2008, the literature has been screened for subsequent studies that fulfilled the inclusion criteria. The same search strategy was applied (5/5/2011), using the same search terms and databases. These studies will not be reviewed in detail, but are presented in order to establish if there have been any significant developments since the initial search was conducted.

Four studies were found that met the inclusion criteria (Archibald and Alloway 2008; Cardy et al 2010; Montgomery 2008; Montgomery and Evans 2009). The studies were found to examine broadly the same areas that have been examined in the present review. The focus of Archibald and Alloway (2008) and Cardy et al (2010) was comparison with other disorders, rather than SRLI deficits themselves. Familiar tasks, such as word recognition were examined (Cardy et al 2010; Montgomery 2008); Word repetition (Archibald and Alloway 2008) and working memory (Montgomery 2008; Montgomery and Evans 2009). No substantially new areas of research have emerged, Montgomery (2008) has focused more on attention deficits, though the tasks used appear to be a variation of the word recognition task that has already substantially been investigated in the literature.

When screening recent papers, it was interesting to note that the same validity issues appear to be arising in new papers (unclear recruitment processes, small numbers of participants etc). In addition, studies appear to be using the same task types; there is a sense that researchers are trying to reinvent the wheel. The extent to which continued testing of these areas is of value is questionable unless studies improve their validity.

CHAPTER 5 An exploration of the theoretical basis of SRLI interventions

5.1 Introduction

This chapter examines the intervention literature for children with specific receptive language impairment (SRLI). Background and objectives are first provided (5.2). How studies were accessed is described (5.3) and the identified studies are presented (5.4). Studies are grouped under four different area of focus. In each area, a description of each study's intervention method and approach is given, as well as the espoused theory that underpins the intervention. The studies are then evaluated against the evidence of deficit identified in the systematic literature review (SLR) of the previous chapter and the evidence of their efficacy is considered. In the discussion (5.5) the findings are considered against the stated objectives, and findings are discussed in relation to other existing literature.

5.2 Background

The Medical Research Council (MRC 2008) guidance for developing and evaluating complex interventions describe both identifying the evidence base and developing theory as crucial features of intervention development. A crucial aspect of developing theory was examination of the literature on the deficits in SRLI, as identified in the SLR of the previous chapter. Another way to further develop theory is to explore existing published interventions. This is valuable for three reasons, identified below.

Firstly, it is useful to establish whether or not existing interventions for SRLI target the areas of deficit identified in the SLR. It is recognised that existing interventions could provide valuable insights into how change might be brought to the areas of deficit identified in the SLR. Exploring the development of existing theories and approaches should also prevent 'reinventing the wheel'. It is also useful to examine the extent to which interventions are targeting the areas of deficit supported by the evidence base from the SLR. A mismatch could either indicate areas that future interventions should explore or help to explain where interventions have not been successful.

Secondly, examining intervention studies could contribute to evidence of causative factors in SRLI. The case-control studies examined in the SLR only provide evidence of deficits associated with SRLI, not of causation. Bradford-Hill (1965) detailed criteria for assessing evidence of causation; one of these criteria relates to specificity. If altering only the deemed 'cause' of a disorder results in an effect, then this provides some evidence that the factor examined is likely to be a causal factor. Examination of intervention studies is therefore

useful; if the intervention targets a specific deficit and it is successful, it provides more evidence that the deficit is 'real'. Further, if targeting a specific deficit results in more general improvements in other areas, it provides evidence that that deficit might be a causative factor for other impairments. The value in examining the interface between theory and interventions in the literature can be usefully summarised by the following statement:

“First, theoretically grounded interventions are more likely to be effective, and second, such interventions can be used to test the theories on which they are based.”

(Ebbels et al 2007 p. 1331)

Finally, examining the published studies will help to establish the evidence of efficacy of existing interventions for SRLI. A systematic literature review for Cochrane (Law et al 2004; edited Law et al 2010) has already established that there is a lack of evidence for the efficacy of interventions for children with SRLI in RCT studies. However, there is also a limited number of RCTs that have examined SRLI interventions. It is therefore useful to examine, more broadly, evidence from intervention studies that adopt a range of methodologies. Although the results of non-RCT studies investigating SRLI interventions need to be interpreted more cautiously, these studies can provide useful information about the interventions that are available for SRLI and their theoretical basis. Further, they provide preliminary indication about the efficacy of an intervention, which could be later examined in a more reliable study design.

5.2.1 Objectives

The specific objectives for searching the intervention literature were:

- To examine the extent to which existing interventions are targeting the deficits that emerged from the systematic literature review (SLR Chapter 4)
- To explore the theoretical basis for the approaches provided in SRLI intervention studies
- To examine the evidence for the efficacy of SRLI interventions

5.3 Methods

5.3.1 Eligibility criteria

Studies were included that evaluated an intervention that targeted an aspect of language comprehension. The intervention had to be tested on SRLI children, as reported by the author (rather than the use of strict criteria as in the SLR of Chapter 4). Studies were not excluded on the basis of their design method or quality.

5.3.2 Searches

Searches were conducted for relevant studies in 11 databases (AMED, AEI, BNI, BREI, CINAHL, Cochrane library, EMBASE, ERIC, HMIC, MEDLINE, PsychINFO). Studies were searched from 1973-2010.

5.4 Findings

Table 29 Details of studies examining intervention(s) for children with SRLI

Study	Focus of intervention	Approach	Study design
Bishop et al, 2006	Grammar comprehension and temporal processing	Computerised grammatical training programme	RCT
Camarata et al, 2009	Grammar	Grammar intervention, using expressive transactional approaches	Subgroup from larger RCT study
Cohen et al, 2005	Temporal processing	Fast ForWord (FFW; Scientific Learning Corporation 1997; 2001), a computer-based intervention using acoustically enhanced speech stimuli	RCT
Dixon et al, 2001	Comprehension and mental imagery	Visualising and verbalising	Repeated measures design
Ebbels et al, 2007	Grammar	Meta-syntactic therapy using visual coding	RCT
Ebbels, 2007	Grammar comprehension	Shape coding- shapes, colours and arrows to make the grammatical rules of English explicit	Case-series (studies 1 and 2 utilised)
Gill et al, 2003	Memory management	Rehearsal and visualisation	Non-randomised trial
Joffe et al, 2007	Comprehension and mental imagery	Mental imagery for sentences	Cross-sectional case control study
Merzenich et al, 1996	Temporal processing	Computerised temporal training	Case-series
Parsons et al, 2005	Word learning	Curriculum vocabulary was selected and semantic and phonological methods were used. Collaboration with class and home	Case study
Tallal et al, 1996	Temporal processing	Synthetically modified and enhanced speech stimuli	Cross-sectional cohort study

Eleven intervention studies were found (Table 29). Three studies examine interventions that alter auditory input (temporal processing interventions), three examine mental imagery and memory management, four examine grammar interventions and one examines word learning. These four areas of focus are considered in turn. Methods employed to deliver the interventions are given, followed by the study's description of the intervention's theoretical basis; this is then considered against the evidence identified in the systematic literature review (SLR) of the deficits in SRLI of the previous chapter. The efficacy of the studies is then discussed. Following description of the identified studies, the studies are critically appraised for their impact and generalisability. Finally, tables are provided which make explicit the relationships between the areas of deficit identified in the SLR, the interventions that target them, as well as the interventions that target areas of deficit not supported by the SLR.

Where the term SLR is used, it is always referring to the SLR of the previous chapter, unless another reference is given.

5.4.1 Temporal processing interventions

Three intervention studies were found that focus on auditory comprehension (Merzenich et al 1996; Tallal et al 1996; Cohen et al 2005). The theoretical basis for these interventions stem from findings from auditory studies (e.g. Tallal 1976) that children with SRLI have a temporal processing deficit.

Merzenich et al (1996) employs audiovisual games that consist of adaptive training tasks designed to improve the ability of children with SRLI to hear differences between rapidly sequenced auditory stimuli. Merzenich et al (1996) report that the theory behind targeting rapid auditory stimuli emanates from studies of children with receptive language impairments who exhibited limited abilities to process brief phonetic segments (i.e. temporal processing difficulties). Merzenich et al (1996) cite neurology studies of practice based improvement in monkeys (Recanzone et al 1992), as well as improvements in temporal distinctions in adult animals after intensive behavioural training (Merzenich et al 1993). The study by Tallal et al (1996) uses the same children as the Merzenich et al (1996) study, as well as using adapted games from Merzenich et al (1996). However, half received additional temporally modified speech stimuli which prolonged and emphasised the brief rapidly changing elements of speech. In an earlier study, Tallal et al (1996) had demonstrated that language impaired children improved their ability to identify syllables when they were presented for a synthetically extended time (Tallal and Piercy 1975). Thus, the theory behind the approach is that if critical acoustic cues were extended in speech, comprehension would improve. An intervention based on these approaches, called Fast Forward®, was subsequently developed by Tallal et al (1996) and Merzenich et al (1996); this was examined by Cohen et al (2005) in an RCT.

The theory that children with SRLI have a temporal processing deficit is not supported by the SLR. The SLR concludes that there is little evidence to suggest SRLI children have temporal processing difficulties. Instead, the poorer performance on auditory tasks by SRLI children is theorised to be a result of a range of other reasons; inadequate central representations of phonemes/degraded phonological representations (Stark and Heinz 1996; Corriveau et al 2007), central neural timing mechanisms (Ahmed et al 2006) and difficulty identifying phonetic segments (Corriveau et al 2007). Further, where temporal processing tasks have been designed to minimise memory load (Hanson and Montgomery 2002; Coady et al 2005) temporal processing difficulties do not emerge.

Mixed results for the effectiveness of temporal processing training and use of synthesised speech have been found. Merzenich et al (1996) found pre to post training improvement. Tallal et al (1996) also reports that there were dramatic improvements that were significantly greater in the experimental condition than the control intervention that did not use modified speech. In a RCT Cohen et al (2005), by contrast, found no additional benefits of Fast Forward® compared to two control conditions. Although not a central aim of the study, Bishop et al (2006) also examine whether acoustically modified speech assist a computerised grammatical training programme. Little evidence was found that training with modified speech is effective, and no relationship was between the number of training sessions used and outcomes. Given the findings of the RCT (a study design higher in the hierarchy of evidence for interventions) by Cohen et al (2005), it is reasonable to be skeptical about the results found by Tallal et al (1996) and Merzenich et al (1996).

Therapies such as Fast Forward® appear to be based on the notion that a temporal processing difficulty is the cause of the difficulties of children with SRLI. That an intervention using temporally modified speech and attempting temporal training does not appear to create a significant improvement compared to control interventions (Cohen et al 2005), provides further evidence that auditory temporal processing deficit is not likely to be the cause of SRLI.

5.4.2 Comprehension, mental imagery and memory management interventions

Three interventions studies examine mental imagery approaches to language comprehension (Dixon et al 2001; Gill et al 2003; Joffe et al 2007). Though the studies use broadly similar approaches, they have different theoretical basis for using mental imagery.

Dixon et al (2001) examine a programme called Visualising and Verbalising® (Bell 1987) that moves through a system of visualising and describing pictures with 12 structured

words, through to visualising and describing sentences, then paragraphs, pages and sometimes chapters. Dixon et al (2001) report that Visualising and Verbalising® is based on the theory that children have comprehension difficulties due to being unable to form a gestalt (create imaged wholes) and this is attributed to weak imagery (Bell 1991). The objective of Visualising and Verbalising® is therefore to improve mental imagery skills and thus comprehension. Joffe et al (2007) employs a similar visualisation technique. The children are encouraged through picture cues to visualise sentences, first by breaking each sentence into its parts, then visualising a whole sentence and finally a five-sentence story. Initially visual prompts are used, but these are reduced over time. Like Visualising and Verbalising®, the children are then encouraged to share and describe their images. Joffe et al (2007) cite some similar theories to Dixon et al (2001), focusing on the failure of children with SRLI to construct a coherent and integrated representation of a story's meaning. This is hypothesised to result in impaired story comprehension. Research by Bishop and Adams (1992) is cited in support of this, but was not able to be included in the SLR owing to the participants having a range of language difficulties.

In addition to the role of visualisation in creating integrated representations of story's meaning, Joffe et al (2007) also discuss the role of visualisation in reducing overall processing demands on verbal short term memory. Joffe et al (2007) describe the role of visual imagery in terms of a 'conceptual peg hypothesis' whereby mental images serve a key role in organisation and retrieval from memory by acting as 'mental pegs' to which associated information can be 'hooked' (Sadoski et al 1991; Sadoski and Paivio 2001).

Gill et al (2003) employ both visualisation and rehearsal methods in their intervention study, targeting ability to follow directions. Those in the intervention group that only received rehearsal training were instructed to repeat instructions aloud after they were stated by the therapist. Directions were increased gradually as the children successfully carried out the tasks. Prompts to rehearse were faded as participants began to use the strategy spontaneously. Another intervention group received both rehearsal and visualisation training, once participants were able to rehearse with minimal cueing, they were also asked to 'visualise' doing the instructions as the therapist asked i.e. imagine it happening. Similar to Joffe et al (2007), Gill et al (2003) describe rehearsal and visualisation as compensatory strategies to help children remember directions, based on research that has found memory and information processing difficulties in children with SLI. Gill et al (2003) theorise that rehearsal might help children remember since research has found training, that targets the use of rehearsal, results in significant changes in children's recall and language learning (Keeney et al 1967; Connell, 1987). The use of visualisation in addition to rehearsal appears to be informed by findings elsewhere (Clark and Klecan-Aker 1992) that visual imagery increases the ability of the participants to learn new vocabulary over methods that only adopt rehearsal and categorisation.

The notion of supporting verbal working memory, as suggested by Joffe et al (2007) and Gill et al (2003), fits with findings from the SLR that children with SRLI have deficits in short term memory. In terms of the proposal that SRLI children have difficulty with imagery and the ability to form a gestalt (Dixon et al 2001) the SLR provides no evidence to either refute or support this. One study (Ellis Weismer 1985) proposes that poorer performance in inference construction tasks might be a result of deficits in representational skills, which could impede ability to integrate information in a meaningful fashion. However, Ellis Weismer (1985) does not directly examine this theory.

Mixed evidence was found for effectiveness of the visualising approaches. Dixon et al (2001) found that students appeared to benefit equally from Visualising and Verbalising® training and 'traditional' comprehension training, thus suggesting that, although the use of Visualising and Verbalising® resulted in some comprehension improvements, it had no additional benefit to traditional approaches. Joffe et al (2007), by contrast, found that a visualising intervention improved the question–answering performance of SRLI children, though improvement was only significant for the literal (not inferential) questions, and there was no intervention control group. Gill et al (2003) also reported positive results, finding that those taught to use a rehearsal strategy or a rehearsal/visualisation strategy made significant gains over a traditional language therapy. Further, the rehearsal/visualisation group retained gains over the traditional group eight months after the intervention.

Dixon et al (2001) propose that the reason the visualisation approach produced similar language gains to traditional therapy, is that visualisation might actually place extra demands on the child's working memory. This is due to visualising requiring participants to simultaneously process information into a new modality, as well as store it. This contrasts to the theory that visualising will help reduce working memory demands (Joffe et al 2007; Gill et al 2003). The postulation by Dixon et al (2001) appears to be supported by the findings from the SLR that SRLI children performed more poorly in more complex memory conditions, where tasks involve storage and processing (Montgomery 2000a; 2000b), as well as tasks where visual storage and verbal processing tasks are combined (Archibald and Gathercole 2007). However, the success of visualising reported by Joffe et al (2007) and Gill et al (2003), suggests that visualisation could, in apparent contradiction, be an effective strategy for memory management, particularly in combination with other memory management strategies (Gill et al 2003). Differing degrees of success of the visualisation techniques might be a result of differences in the underlying aims of the studies.

An interesting aspect of the visualising (and rehearsal) studies is that these studies adopt outcome measures that consider broader comprehension abilities. Gill et al (2003) use an Oral Directions Subtest from the Detroit Test of Learning Aptitude (Hammill 1985) and Joffe et al (2007) use literal and inferential questions. Given that an aim of these approaches is to

reduce memory load, improvement on these comprehension measures, suggests that working memory may be a cause or one of the causes of comprehension difficulties for SRLI children. This further supports findings from the SLR of an association between working memory difficulties and SRLI. However, RCT studies should be conducted to test this hypothesis, since the study by Joffe et al (2007) lacks a control group and Gill et al (2003) do not randomise participants to intervention groups.

5.4.3 Grammar comprehension studies

Four studies were found that examine grammar interventions; two studies use a shape coding approach (Ebbels 2007; Ebbels et al 2007), one adopts a computerised training approach (Bishop et al 2006) and another uses an expressive language method (Camarata et al 2009).

Ebbels (2007) and Ebbels et al (2007) describe a shape coding approach, which is used to teach a variety of grammatical constructs. The approach aims to represent visually and explicitly the major linguistic features of English syntax (via shape and colour coding), based on the notion that children with SRLI have difficulty with implicitly understanding the rules of language. The visual system, presented by shape coding, also aims to use the visual strengths of children with SRLI.

The intention behind shape coding is that children are only introduced to those parts of the system which are necessary for explaining the particular rule which is being targeted (Ebbels 2007), the two studies therefore focus on different grammatical rules. Ebbels (2007) examines the use of shape coding to teach comprehension of dative forms and comparative questions. These targets were selected based on research by Van der Lely and Harris (1990) who found that children with SLI have difficulties understanding dative versus prepositional constructions, involved in verbs such as 'give'. An example of a prepositional construction is 'the cow is giving the pig to the sheep', this is compared with the dative form 'the cow is giving the pig the sheep'. Ebbels et al (2007) intervention study, by contrast, focuses on linking particular syntactic constructions with the two general verb meanings: change of location (moving) versus change of state (changing). Theory for this approach is based on studies that have found expressive errors made by children with SLI, linking arguments to the correct syntactic positions (Ebbels 2007) (an argument is a phrase that appears in a syntactic relationship with the verb in a clause). Reasons for these errors have been proposed to be either as a result of difficulty with linking arguments themselves, or as this requires correct knowledge of verb semantics, inaccurate verb semantics. Shape coding was used as a syntactic–semantic therapy based on the former premise. The effectiveness of this approach is compared with a semantic intervention which provides detailed information about the semantic representations (meanings) of verbs.

Broadly, the SLR supports the theoretical basis for a shape coding approach: visuo-spatial memory seems to be a relative strength for children with SRLI children. The review also found difficulty with a range of grammatical constructs which might indicate a lack of understanding of the implicit rules of grammar. An example is that some children with SRLI were found to fail to regard tense as a required syntactic feature for an extended period of time (Rice et al 1999; Redmond and Rice 2001).

The SLR did not include any studies that examine the ability of children with SRLI to understand dative and comparative questions. However, it found that SRLI children frequently adopt semantic strategies, rather than word order, for comprehension (Evans 1999; Van der Lely and Dewar 1986) which would result in difficulty with dative forms. Thus the SLR broadly supports the grammatical targets adopted by Ebbels (2007).

The focus by Ebbels et al (2007) on children's understanding of semantics to inform syntax is sometimes described as forward linking or semantic bootstrapping. Forward linking was not examined in the SLR since this relates to children's expressive ability rather than their receptive ability. However, studies were identified in the SLR on syntactic bootstrapping, finding children with SRLI to be less effective at using syntactic structure to infer meanings of verbs (O'Hara and Johnston 1997). Syntactic bootstrapping (or reverse linking) can be seen to be the opposite of forward linking, the SLR therefore provides no specific support for forward linking, but difficulties with reverse linking might indicate difficulties with linking in general. The suggestion that children with SRLI might have inaccurate verb semantics is supported by the finding in the SLR that they have difficulty learning new words.

Shape coding was found to be effective in an examination of pre and post measures in two of three older children, aged 12-14 (Ebbels 2007). In an RCT (Ebbels et al 2007) both syntactic-semantic therapy (using shape coding) and semantic therapy were also found to be effective on expressive measures. The shape coding approach has therefore been demonstrated to be an adaptable resource for grammar impairments for older children. The extent to which its success can be attributed to the approach in general or to the use of specific theory driven grammatical contrasts perhaps requires further investigation.

The finding that both therapy conditions are effective supports both semantic and syntactic theories of grammatical impairment. Ebbels et al 2007 hypothesise that the children's initial difficulties with linking results from ill-defined semantic representations, whereas their limited use of arguments may result from syntactic difficulties. It is noteworthy, however, that the study by Ebbels et al (2007) does not focus on comprehension or measure outcomes on a receptive measure. This study is included since it adopts SRLI participants and because the flexibility of the shape coding approach makes it possible to focus on comprehension or expression.

Attempts have been made elsewhere to see whether expressive grammar interventions can result in receptive grammar gains in preschool children with SLI (Camarata et al 2009). Grammatical targets which were developmentally appropriate for the child were selected and treatment procedures included: direct imitation, imitation plus modeling, modeling alone (without a request to imitate the form), conversational recast and milieu techniques. Conversation recast involves following the child's lead, with the clinician providing an immediate response to a child's (grammatically incorrect) utterance that contains both the central meaning of the child's utterance and the target structure in a conversational context. Milieu teaching³ incorporates aspects of conversational recasting and imitation, with a focus on following the child's lead and elicitation of target structures through prompting and imitation. Recast is followed with a request for imitation, and if the child produces the target, praise is given. Camarata et al (2009) justify these methods with evidence in the literature that they increase expressive language skills (McCauley and Fey 2006). Camarata et al (2009) discuss language impairment in terms of a transactional dynamic systems model termed a Dynamic Tricky Mix (Nelson and Welsh 1998; Nelson 2000; Nelson et al 2001). In this model, expressive and receptive deficits are proposed to arise from on-line complexities of communication attention, long-term memory, working memory and emotional-social processes. Transactional approaches are suggested to help form new representations of grammatical forms.

The SLR supports the notion of deficits in grammar in children with SRLI. However, Camarata et al (2009) fail to make explicit how the expressive methods employed improve comprehension of grammatical forms; thus it is hard to relate the theory of deficit with the intervention. Nevertheless, Camarata et al (2009) found that the treatment group made significant gains in receptive language when exposed to expressive language intervention compared to a control group that did not receive intervention.

Bishop et al (2006) adopt a computerised training approach to improve grammar targets, focusing on a small number of grammatical constructions, ranging in difficulty, with the aim of making sentence interpretation more accurate and automatic. The programme is varied adaptively so that the child has numerous training trials with a few constructions that are not yet fully mastered. Bishop et al (2006) describe the theory behind this approach in terms of children with SRLI showing some understanding of specific syntactic structures, suggesting they do not need to be taught their meanings, but have difficulty interpreting them consistently (Bishop et al 2000).

³ Milieu is taken from the French word from environment. Milieu teaching is a naturalistic learning language approach.

It has been noted that the SLR provides some evidence that children with SRLI do not fully master implicit rules of grammar (for example, that they fail to regard tense as a required syntactic feature for an extended period of time). This would suggest that a training approach, that does not teach the implicit rules, might not be best in helping children to understand these rules. However, there is also evidence in the SLR that supports the notion, provided by Bishop et al (2006) that children with SLI appear to show some understanding of specific syntactic structures. For example, it has been found that children are able to use syntactic context to infer meanings of new words, though they appear to be less effective at doing so (e.g. O'Hara and Johnston 1997). This would support the suggestion by Bishop et al (2006) that a training approach would be sufficient in order to make sentence interpretation more rapid and correct.

In a randomised controlled trial, Bishop et al (2006) found that rote training of comprehension of reversible sentences is not effective at remediating grammatical comprehension difficulties. Bishop et al (2006) hypothesise that the interventions lack of success may be due to its isolated focus on grammar (rather than other aspects of language and communication along side) or the lack of naturalistic context. Given the success of shape coding in comparison however, it may be that the source of grammatical impairments SRLI is more often related to a lack of understanding of implicit grammatical structures/meaning, rather than a difficulty with automaticity or accuracy in processing them.

5.4.4 Word learning

One intervention study was found that targets word learning in a receptive context (Parsons et al 2005). Curriculum vocabulary was selected and semantic (describing word meanings) and phonological methods (describing word sounds) were used to teach the words. Collaboration with class and home was also described as an important part of the intervention. Parsons et al (2005) provide rationale for adopting a semantic-phonological approach in terms of methods adopted in word finding difficulty studies. The intervention approach is also inspired by a study examining naming in children with SLI, finding phonological and semantic errors (Lahey and Edwards 1999). Like Ebbels et al (2007), theory for the method that Parsons et al adopt is described as stemming from expressive errors.

In relation to the SLR, there is some evidence for adopting semantic and phonological methods. A study in the SLR by Nash and Donaldson (2005) found poorer performance on word learning, both for meanings, as well as phonological forms of new words.

Parsons et al (2005) found that word learning intervention is effective, though it only examined two cases without a control condition. The study also emphasises using a curriculum-based approach and part of its success is attributed to this, rather than the intervention itself. From such a small scale study it is difficult to interpret its results, in particular, whether its success is due to the curriculum based approach or its semantic and phonological methods.

5.4.5 Quality appraisal

The studies were appraised for their quality. No standard framework of critical appraisal was utilised, because of the varying study designs. However, relevant appraisal tools in relation to specific study designs from the Critical Appraisal Skills Programme (CASP) were used to guide appraisal. Consideration was given to the common canons of robustness such as blinding of assessors, allocation of participants and sample selection.

Tables 30 and 31 provide information about the studies, in terms of their design, in relation to the hierarchy of evidence for intervention studies (Greenhalgh 1997). The categories high, medium and low are adopted, though these are not taken from formal criteria. Instead high refers to studies in the top of the hierarchy of evidence (e.g. systematic reviews, randomised controlled trials), medium refers to those in the middle (cohort and case control studies), while low refers to those near the bottom (case series, case reports, expert opinion). A brief critique is also provided, for each study, to help readers interpret the studies' impact. It should be noted that for all the included studies generalisability is unfortunately low, this is because it is difficult to conduct studies with good external validity. In all the intervention studies only a small non-random sample of the population with SRLI (e.g. from a specific special school) that met inclusion criteria were invited to participate.

Table 30 Quality appraisal of the intervention studies

Study	Study design	Hierarchy of evidence (Greenhalgh 1997)	Critique and comments
Bishop et al, 2006	RCT	High	N=36, no power calculation. Allocation of participants using minimisation method (participants ranked by a number of factors and alternating sequential allocation used). Assessors blind to intervention group. Groups not statistically different on measures at base line. Three children lost to follow up. Wide variability in the amount of training that the children received; however, this is accounted for in the results. No confidence intervals reported, however, p values present.
Camarata et al, 2009	Subgroup from larger RCT study	High	N=27 (control group N=6), no power calculation. Recruitment and allocation referenced to another paper, however, the referenced paper is not an RCT and does not provide this information as described. No data on drop outs. No reporting on effect sizes or confidence intervals (however, p values present).
Cohen et al, 2005	RCT	High	N=66, with power calculation. Allocation of participants randomised, but procedure not explained Assessors blind to intervention group. Groups not statistically different at baselines. Missing data reported. No reporting of confidence intervals, however p values present.
Dixon et al, 2001	Between subjects design	medium /low	N=8, no power calculation or control group. Allocation of participants randomised from two groups of four, however, procedures not explained. Design similar to between subjects design described as “a sophisticated design from a set first described by Cox (1955)”, however, two participants received one intervention, two another (between subjects). Four participants received one of these interventions for half the time and the other intervention for the other half. This is not a within subject design since the children were not assessed half way. Analysis of covariance inappropriate in such small sample size.
Ebbels et al, 2007	RCT	High	N=27, no power calculation. Randomisation procedure explained. Assessors blind to intervention group. Groups not statistically different at baseline. To exclude outlier bias and to allow for differences in pre-test scores a “normalized gain score” was used. Large effect sizes, but no confidence intervals reported, however, p values present.
Ebbels, 2007	Case series	Low	N=3 were examined in a case series. Selection of cases is not described or justified but all described as ‘severe’. No inter-rater reliability or independent assessment used. Multiple baseline assessment was utilised. Statistical analysis reported.

Table 31 Quality appraisal of the intervention studies

Study	Study design	Hierarchy of evidence (Greenhalgh 1997)	Critique and comments
Gill et al, 2003	Non-randomised trial	Medium	N=30, no power calculation. Groups were matched for gender, year group and language scores. Blinding for analysis/results. Effect sizes and confidence intervals not reported, however, p values presented.
Joffe et al, 2007	Cross-sectional case control study	medium/ low	N=9 SLI, N=16 non-SLI, no power calculations. Case control study design not most appropriate for intervention effectiveness study; control subjects were not SLI (therefore poorly matched- confounding factor) and did not receive intervention. Large effect sizes reported.
Merzenich et al, 1996	Case-series	Low	N=7, participant selection and characteristics not reported (referenced to other studies). No inter-rater reliability or independent assessment used. Statistical analysis reported.
Parsons et al, 2005	Case-series	Low	N=2, participant selection and characteristics well described. No inter-rater reliability was conducted, however, there was blinding for final assessment. Only pre and post treatment assessments were conducted. Statistical analysis was reported.
Tallal et al, 1996	Non-randomised trial	Low	N=22, participant selection and characteristics not reported (referenced to other studies). Groups matched for measures of non-verbal IQ and receptive language. No power calculations or attempts at blinding reported. Difficult to assess confounding and bias in this study due to poor reporting. Statistical analysis within and between groups reported

5.4.6 Mapping of intervention studies to the areas of deficit identified in the systematic literature review (Chapter 4)

In order to make explicit the link between the intervention studies and the areas of deficit identified in the SLR,

Table 32 presents the areas of deficit identified in the SLR against the intervention studies, and their underlying theory. Table 33, by contrast, displays intervention studies and their theory by deficit areas not supported by the SLR.

Table 32 Intervention studies and their theory in relation to the areas of deficit identified in the systematic literature review (Chapter 4)

Area of deficit identified in the SLR	Intervention Studies	Approach and theory
Word learning studies	Parsons et al (2005)	Semantic and phonological methods were used. This approach was described in terms of naming errors in children with SLI, and also methods used in word finding difficulty studies.
Grammar studies	Bishop et al (2006)	Focused on training a small number of grammatical constructions, with aim of making sentence interpretations more accurate and automatic. Based on evidence that children with SRLI appear to show some understanding of specific syntactic structures, suggesting difficulty with consistent interpretation.
	Camarata et al (2009)	Transactional approaches were used. These are suggested to help create new representations of forms. Methods are described in terms of evidence that they increase expressive language skills. Language impairment as a result of a "Dynamic Tricky Mix" (where language impairment is proposed to arise from communication, attention and memory).
	Ebbels (2007)	Shape coding approach was adopted, which aims to represent visually and explicitly the major linguistic features of English syntax, based on the notion that children with SRLI have difficulty with implicitly understanding the rules of language. Aims to use the visual strengths of children with SLI. Dative forms and comparative questions were the focus of the study, based on research that SLI children had difficulty with these forms.
	Ebbels et al (2007)	Shape coding approach (see theory above for this approach). Change of location vs. change of state verbs were the focus based on expressive errors of children with SLI. Proposed reasons for these errors were difficulty with verb semantics and difficulty with linking arguments to the correct syntactic positions. Two interventions that targeted both these aspects were conducted.
Working memory studies	Joffe et al (2007)	Visualisation was employed to create integrated representations of story's meaning and to reduce overall processing demands on verbal short term memory. 'Conceptual peg hypothesis' is described whereby mental images are proposed to serve a key role in organisation and retrieval from memory by acting as 'mental pegs'.
	Gill et al (2003)	Rehearsal and visualisation employed as compensatory strategies to help children remember, based on research that found these processes to be beneficial with other populations.

Table 33 Intervention studies and their theory in relation to areas of deficit not supported by the systematic literature review (Chapter 4)

Areas of deficit (not identified in SLR)	Intervention studies	Approach and theory
Temporal processing	Merzenich et al, 1996	Audiovisual games were used that aim to train temporal processing deficits (identified as a problem area for SLI children in an earlier study), based on neurology studies of practice based improvement in monkeys, as well as improvements in temporal distinctions in adult animals after intensive behavioural training.
	Tallal et al, 1996	Used the same games as Merzenich et al (1996) Synthetically extended speech (to eliminate the temporal aspect) was also used, based on an earlier study that demonstrated that language impaired children improved their ability to identify syllables when they were presented for a synthetically extended time.
	Cohen et al 2005	Examining the efficacy of the approaches developed by Merzenich et al (1996) and Tallal et al (1996)
Mental imagery skills	Dixon et al (2001)	Visualising and Verbalising® was delivered to improve mental imagery skills. Visualising and Verbalising® is based on theory that children have comprehension difficulties due to being unable to form a gestalt (create imaged wholes) and this is attributed to weak imagery. Mental imagery is proposed to improve comprehension.

5.5 Discussion

The findings of the identified studies are considered in relation to the aims; in particular, the extent that existing intervention studies are targeting the areas of deficit identified in the SLR, the theoretical basis of SRLI interventions and the evidence for their efficacy. Other findings are then discussed, both relating to what is already known about SRLI interventions, and the evidence of underlying areas of difficulty for SRLI.

5.5.1 The extent existing intervention studies target the deficits identified in the SLR

Although the intervention studies found in the present review provide examples of interesting approaches to comprehension interventions, it is apparent that there are a limited number of interventions in comparison to the range of deficit studies identified in the SLR.

Four of the 11 identified studies focus on areas of deficit that the SLR did not find evidence for, in particular, a number of studies are based on temporal processing difficulties (Merzenich et al 1996; Tallal et al 1996; Cohen et al 2005). Visualising and Verbalising® (Dixon et al 2001) is also based on a premise of the failure of SRLI to have integrated representations of stories meaning, an area of deficit that the SLR did not provide any evidence for.

Seven studies have been identified that target the areas of deficit identified in the SLR. For example working memory (Joffe et al 2007, Gill et al 2003), grammar (Camarata et al 2009; Ebbels 2007; Ebbels et al 2007; Bishop et al 2006) and word learning (Parsons et al 2006). However, a number focus on broadly similar approaches to one another, for example, visualisation (Dixon et al 2001; Joffe et al 2007; Gill et al 2003) and shape coding (Ebbels et al 2007; Ebbels 2007). Additionally, only one word learning study has been identified. Thus it is apparent that a very limited range of intervention approaches have been evaluated for their efficacy, in relation to the areas of deficit identified in the SLR.

5.5.2 The theoretical basis for SRLI interventions

For some of the studies that have emerged, there were clear attempts to link the theoretical basis of the interventions with the intervention approach; however, for others this was not very evident. Those interventions that had well described theoretical underpinning included shape coding and the word learning study. Ebbels et al (2007) and Ebbels (2007) provide clear descriptions for both why the grammatical targets have been selected and the theory behind adopting a shape coding approach. The word learning intervention adopted by

Parsons et al (2005) also has some theoretical grounding, though the focus of the intervention appears to be in part based on the curriculum focus, rather than the intervention methods.

An intervention with a strong theoretical basis in its principle, but that did not match the SLR findings of deficit, can be seen in the Fast Forward® intervention (Merzenich et al 1996; Tallal et al 1996; Cohen et al 2005). It is proposed by advocates of Fast Forward®, that temporal processing is the basis of difficulties for children with SRLI. However, the SLR found limited evidence for temporal processing deficit and the RCT conducted by Cohen et al (2005) and Bishop et al (2005) suggest that speech modification (i.e. removal of the temporal aspect of speech stimuli) is not an effective intervention. It therefore seems that though Fast Forward® had strong theory for its approach, the central tenets of this theory are misplaced.

Some of the intervention studies do not make explicit the theoretical underpinnings of the interventions they present. In particular, there is a tendency for studies to justify their approach in terms of previous research finding that it has had beneficial effect with related populations or impairments (Gill et al 2003; Camarata et al 2009) rather than attempting to explain how or why the intervention works. This is particularly evident in the Camarata et al (2009) study, where very little explanation is given for how the modeling and imitation processes might lead to improved comprehension.

For the studies that involve visualisation approaches, there are some contradictions in the descriptions of their theoretical basis. For example Joffe et al (2003) and Dixon et al (2001) cite two different theoretical bases for using visualization. Joffe et al (2003) describe it as a compensatory tool for limited memory, whereas Dixon et al (2001) describe it as able to enhance children's ability to use imagery to integrate information, and that visualizing actually places extra demands on memory. The result is that confusion abounds about how this intervention approach might improve comprehension.

An interesting finding from the intervention studies is that a number have used expressive language errors to inform theories on the difficulties of children with SRLI (Ebbels et al 2007; Parsons et al 2005). Additionally an expressive language approach is adopted by Camarata et al (2009). Since the SLR focused on the cognitive and linguistic deficits that might inform comprehension difficulties, it does not provide information on expressive errors in children with SRLI. Because of this, it is difficult to comment on the legitimacy of the expressive language theories that inform these interventions. It is noted, however, that the use of expressive deficit evidence or expressive intervention approaches are other possible ways to further the development of evidence and theory for SRLI.

5.5.3 Evidence for the efficacy of the interventions for SRLI interventions

It has already been noted that there is limited evidence for the efficacy of SRLI interventions (Law et al 2004; updated Law et al 2010). The present review supports the case of limited evidence for the efficacy of SRLI interventions, and has identified some intervention approaches that do not appear to have much potential for success. However, it has also found some promising intervention approaches for further investigation. These are summarised below.

There are a few intervention approaches that the review has identified that would be useful to explore further for their efficacy. The study by Ebbels et al (2007) found good evidence of efficacy on expressive measures but does not provide evidence on the extent that this intervention has positive effects on receptive outcomes. Further investigation with this approach where receptive outcomes are measured would be valuable.

The study by Camarata et al (2009) found interesting results that would benefit from further exploration. Positive outcomes were gained for receptive language, from adopting an expressive language intervention approach. Though it adopts a subgroup from an RCT study, there are only six participants in the control group, additionally the lack of theoretical explanation for how or why this approach is effective makes the results more dubious. It is also noteworthy that this study examines preschool age children. A number of natural history studies have found that the language impairments in the early years (2.5 to 7) are unstable, and as many as half may spontaneously resolve (Dale et al 2003; Tomblin et al 2003; Law et al 2000). This suggests that language impairments in preschool years are qualitatively different and thus they might respond to different intervention approaches. Further research into approaches adopted by Camarata et al (2009) with larger and older populations would be valuable.

The mixed findings from the visualisation and memory support strategy studies also suggests that further research is warranted in this area. Finally, a word learning study (Parsons et al 2005) has found preliminary evidence for adopting a semantic and phonological approaches. However, its success was found in only in two case studies. It would be valuable to conduct word learning interventions of this nature with larger SRLI populations and against control groups.

This review has identified a number of intervention approaches that the existing evidence suggests are not effective. In particular, the temporal processing based interventions do not seem to be supported by evidence of deficit or intervention studies. Two RCTs have suggested that temporal adjustments to speech add no beneficial effect (Cohen et al 2005;

Bishop et al 2006). The studies also provide some evidence that rote training approaches are not effective for SRLI (Cohen et al 2005; Bishop et al 2006). However, Camarata et al (2009) had some success with a rote training approach in an expressive language intervention. It may therefore be that the computerised aspect of the Cohen et al (2005) and Bishop et al (2006) intervention approaches plays a role in their lack of success. It is plausible that language learning is more beneficial when it is contextualised, since computerised interventions do not operate in a normal language environment.

5.5.4 Other findings

As well as bringing to light a range of interventions that used a variety of study designs, the present review identified a number of additional RCTs that were not included in the systematic review by Law et al (2010). This appears to be because this review is only up to date to 2003. Since then a number of RCTs have been conducted that the present review has discussed; these include Cohen et al (2005), Camarata et al (2009), Bishop et al (2005), and Ebbels et al (2007).

There are a number of studies that Law et al (2010) identified (as measuring receptive language outcomes) that have not been examined here, since they did not specifically include SRLI participants (Cole and Dale 1986; Barratt et al 1992; Glogowska et al 2000). One exception is an unpublished study by Law et al (1999) that was also considered for inclusion. However, it has not been included since it evaluates the effectiveness (i.e. intervention in practice) of routine clinical practice rather than of specific intervention approaches. The other studies (Cole and Dale 1986; Barratt et al 1992, Glogowska et al 2000) also had a focus on effectiveness rather than efficacy, and as a result provide very limited details of the types of interventions children received (normally at SLTs discretion). Thus all of these studies are of little use in understanding interventions' theoretical basis.

It was noted at the start of this chapter that intervention studies might be able to contribute to our understanding of causative factors for SRLI. The intervention studies on temporal processing have reinforced the evidence from the SLR that this does not seem to be an underlying difficulty for children with SRLI. There is, however, some preliminary evidence that memory problems might underpin the language difficulties of children with SRLI, though this needs to be investigated in more reliable study designs.

5.6 Conclusions

A limited number and range of intervention approaches have been investigated for their efficacy for children with SRLI. Though there are some promising avenues for further investigation, in particular shape coding, word learning and expressive language interventions, there is still limited evidence of the efficacy of interventions for children

with SRLI. The exploration of the interventions theory of deficit in relation to the SLR in Chapter 4 reveals a misplaced focus on temporal processing. In addition, the theoretical basis of some intervention approaches for children with SRLI is not always apparent. The field would benefit from further evaluation of the interventions for SRLI that appear have preliminary evidence of effect. However, more crucially, the field would benefit from research that focuses on the development and evaluation of a larger range of intervention approaches which have more clearly articulated theoretical underpinning.

CHAPTER 6 Background and methods; focus groups with expert speech and language therapists

6.1 Introduction

Chapter 5 established that there is a limited range of intervention studies that examine approaches for SRLI intervention. It was clear that more work needed to be done to map the areas of deficit identified in the SLR in Chapter 4 to intervention approaches. This chapter explores approaches for further development of SRLI interventions; in terms of mapping evidence from the systematic literature review (6.2). After considering routes forward the need for new primary research is described (6.3). The research questions are clarified (6.4), with an emphasis on establishing speech and language therapists' knowledge and views. How this knowledge can be extracted is considered (6.6) and focus groups are concluded to be a valuable way forward. Pilot work for the focus groups is then presented (6.7), followed by a description of the focus groups' method (6.8).

6.2 Mapping evidence from the systematic literature review

The following section considers how evidence of deficit in children with SRLI from the systematic review can be used to develop therapies, it is concluded that there is a need for new primary research.

6.2.1 Linking evidence of deficit with therapies

The SLR has helped to establish the evidence of deficit in children with SRLI, however, it is still not clear how intervention can create change in these areas of deficits. The examination of existing interventions of the previous chapter has established that theory of impairment or deficit does not necessarily produce theories of therapy. As Byng and Black (1995, p.303) note, understanding of the impairments is "a necessary but not sufficient precondition of therapy". It is therefore important to consider ways in which theories of therapy, in relation to the deficits, can be developed.

It has been noted that in contrast to theories about impairments, "theories about therapies remain almost entirely undeveloped" (Byng and Black, 1995, p. 304). Byng and Black (1995) exemplify independent studies in which patients appeared to have the same deficits, but different approaches to treatment have been taken. A similar situation can be seen in SRLI; previous exploration of existing intervention techniques (Law et al 2008) has found therapists' rationales for therapy approaches rarely relate to theories of deficit. Law et al

(2008 p.1) also refer to the “relative homogeneity of the presenting symptoms in terms of test performance” and in contrast the “highly differentiated descriptions of intervention” by therapists.

There was debate in the early 1990s, about how cognitive neuropsychology deficits could inform therapies. Although the debate regards adults with acquired language disorders, the principles remain the same. Carmazza and Hillis (1993, p.226) suggest the following parameters are necessary for development of a theory in neuropsychological rehabilitation:

- 1) A model of the cognitive processes to be treated
- 2) Specific hypotheses about the nature of the damage to such processes in the patients to be treated
- 3) Motivated hypotheses about how specific interventions may modify the function of the identified damaged processes

While the notion of damage does not apply to children with SRLI, the same parameters for developing theories for therapy for this population can be applied. Rather than ‘damaged’, it is possible to look at the processes that are impaired. However, as Byng and Black (1995) note, these processes presuppose that one already has a notion of how to remediate impairment:

“The problem seems to be circular: to theorise about how to determine what therapy would be relevant requires we already know what it is.”
(Byng and Black 1995, p 305)

Indeed this problem of circularity seems to apply to the case of SRLI intervention. Examination of intervention studies (Chapter 4) found that they are limited in their range, furthermore, interventions do not always relate to the deficit(s) identified in the SLR. Where they have related to an area of deficit, it is not always clear how the intervention has brought change. From this as the starting point, it seems impossible to apply the approach, proposed by Carmazza and Hillis (1993), to children with SRLI.

Elsewhere, attempts have been made to clarify the theory development and modeling phases of the MRC model. Hardeman et al (2005) make explicit a causal modeling approach to developing complex interventions for theory-based behaviour change programmes. They base their selection of behaviour change techniques on:

- 1) The underlying theory
 - 2) Techniques used in other interventions aimed at similar target behaviours
 - 3) A review of evidence about effectiveness of techniques
- (Hardeman et al 2005, p. 678)

Although Hardeman et al (2005) focus on behaviour change programmes, these areas can also be considered in relation to the development of interventions for SRLI, by considering impairment rather than behaviour change. A component of underlying theory (point 1, above) has been establishing the deficit(s) in SRLI in a SLR, however, it is evident that there is more room for development in terms of how change in these areas of deficit is achieved. The question is how to develop this underlying theory further.

One approach to developing underlying theory, suggested in point two, is to explore intervention approaches used on other populations with similar impairments. However, this is not considered the most valuable way forward. Interventions on other populations are likely to have different theoretical bases, and therefore not necessarily cross apply to interventions for children with SRLI. The principles of applying behaviour change therapies to similar behaviours, are perhaps different and more transferable. In the case of interventions for SRLI, interventions for other population are not likely to include the special adaptation(s) that would make them fit for children with SRLI. They are also less likely to contribute to our understanding of theory of therapy in SRLI, since their theoretical basis will not be drawn from this population.

The final suggestion by Hardeman et al (2005) is to review evidence about effectiveness. Unfortunately, there is little evidence of the efficacy of interventions for SRLI. This was identified both in the systematic review by Law et al (2010) as well as in the investigation of interventions in the previous chapter.

Having exhausted the advice for developing theory in interventions, it is valuable to return to the model for complex interventions developed by the MRC (2008) that was presented at the start of this thesis. Their advice, in identifying and developing theory, is to develop a theoretical understanding of the likely process of change by drawing on existing evidence and theory. The MRC (2008, p. 9) describe this as “more likely to result in an effective intervention” than a purely empirical or pragmatic approach. Having examined the existing evidence and theory, in terms of the literature, it is felt necessary to explore other avenues. The MRC (2008, p.9) note that the process of identifying and developing theory should be “supplemented if necessary by new primary research”.

6.2.2 The need for new primary research

There are a range of avenues for primary research. When attempting to further develop a theory of therapy of interventions for children with SRLI, it is sensible to procure the knowledge and opinions of those who work with these populations, and who are responsible for delivering interventions: speech and language therapists.

Attempts have been made elsewhere to map theories of impairment to theories of therapy in a survey study of 56 SLTs (Law et al 2008). This study found that SLTs do not necessarily map therapy to theories of deficit. Law et al (2008) described the type of theory of impairments described in the literature as only partially accounting for the aims of the practitioners. This illustrates the gap that exists between:

“understanding of language-learning difficulties as characterised by those with an interest in the deficit in its own right and those with a more general interest in what can be done to relieve the impact of that deficit.”
(Law et al 2008, p. 15).

The survey study was unable to close the gap between deficits in SRLI and interventions that target them; it might therefore seem imprudent to further consult SLTs. However, it is noteworthy that Law et al (2008) only examined activities for a single child at a single point in time (limited to three activities). It therefore seems unlikely that this study reflects the range of interventions that SLTs are using. Further, the survey method gives no opportunity for detailed probing or exploration of therapists' theories. A more focused and detailed, approach might bring to light quite different findings than the Law et al (2008) survey study. By explicitly mapping evidence of deficit to intervention approaches, it is plausible that more theoretically grounded interventions, and theoretically motivated explanations for these interventions, will emerge.

There is some preliminary evidence from the Law et al (2008) study that further consultation of therapists would be of value, since in terms of theories of therapy, it has been suggested that this is something that therapists do have:

“In general, the key finding is that practitioners are developing their own theories of therapy and it is these that drive much of the activity with this group of children.”
(Law et al, 2008, p. 15)

6.3 The research questions

The SLR has helped to establish the evidence of deficits in SRLI. An understanding of how interventions for SRLI could target these areas of deficit is needed, as was set out in the initial aims. In order to help identify components of therapy that might be critical, it is necessary to examine if there are common therapy approaches that SLTs describe using

across SRLI interventions, Finally, in order to understand the potential process of change, referred to by the MRC, it is also necessary to examine the rationale and underlying theory that SLTs describe in interventions for children with SRLI.

The specific research questions that will achieve this are:

1. What therapies/activities do therapists use for children with SRLI in relation to the deficits identified in the SLR?
2. Do SLTs have common therapeutic approaches for interventions for children with SRLI?
3. What are SLT's rationale and underlying theory for the interventions they use with children with SRLI?

6.4 *Extracting tacit knowledge*

6.4.1 *Speech and language therapists with expert knowledge*

Expert SLTs are the most suitable to consult in helping to answer the research questions, since they have the most experience and specialist knowledge of interventions for children with SRLI. Ten years experience was chosen as a benchmark for expert knowledge. Ericsson et al (1993) are widely cited in the theory that 10 years (or 10,000 hours at 20 hours a week for 500 weeks) of practice is required to become an expert.

Dreyfus (1982) presents stages of development from novice to expert. As well as the obvious increase in knowledge, the stages broadly incorporate a shift from relying on rules to using intuition. Novices are described as having rigid adherence to taught rules and little situational perception or discretionary judgments. As learners progress through stages toward expert, they are considered to focus more on context, move from rational to intuitive in decision making, and to shift from an analytical approach in the assessment of context to a holistic approach. Experts are considered to no longer rely on rules, guidelines or maxims and to have an intuitive grasp of situations (based on tacit understanding). This shift toward intuition that comes with expertise, suggests that although expert SLTs are likely to have authoritative knowledge on a subject, much of their practice knowledge is likely to be 'tacit', that is, difficult to transfer.

Knowledge in practice (irrespective of the extent that it is expert or otherwise) has also been noted to be implicit. Higgs et al (2001) identified several different forms of knowledge, broadly these are; propositional, which is formal or scientific knowledge; professional craft knowledge, that is procedures and knowing 'how' to practice; and finally personal knowledge, including attitudes and values. Propositional knowledge is by definition explicit (Eraut 2000), whereas professional or craft knowledge is often described as tacit or implicit

knowledge (Freeman 2004). Personal knowledge is thought to generally be both implicit and explicit. It is evident that part of what is of interest in relation to interventions for SRLI, is craft knowledge. This type of knowledge is thought to be acquired through implicit learning, meaning that it is absorbed without conscious mediation and strengthened through experience (Eraut 2000).

Williamson (2001) describes a model of competency that breaks down the activity of practice into three layers: the activities/tasks themselves, how the tasks are carried out and judgment and decision making that underlie the observable activity. Freeman (2004, p. 483) describes the latter (two) of these as the most difficult to define and articulate. Schon (1983, p.81) refers to practitioners knowing “more than we can say”, and of “knowing in action”. Law et al (2008) notes that relatively little has been written about this process in speech and language science. The result is that practice knowledge is difficult to define, and perhaps more crucially, difficult to access.

6.4.2 How to extract knowledge; data collection techniques

It is recognised that there is an “inherent problem facing researchers attempting to capture what is, by definition, tacit” (Law et al 2008, p.14). Consideration is therefore given to different methods for data collection, with the likely tacit nature of the knowledge being taken into account.

Observational approaches could be adopted followed by discourse analysis. Discourse analysis has been used as a means of obtaining more detailed descriptions of practice and accessing the levels of ‘know how’ or practice expertise (Titchen and Ersser 2001; Ferguson and Armstrong 2004), particularly clinical decision making (Patel and Arocha 2000). However, this approach is unsuitable for finding out specific intervention approaches in relation to the areas of deficit identified in the SLR. Observational approaches and discourse analysis are useful for finding out what practitioners might be doing in practice, but do not allow for probing about specific intervention approaches.

A more extensive and evidence focused questionnaire could build on the Law et al (2008) study. Questionnaires are useful for accessing large sample sizes, as well as participants from a range of geographical locations. However, they are generally considered more appropriate for obtaining quantitative information, and discovering how many people hold a certain opinion (Kitzinger 1995). Questionnaires are less likely to elicit tacit knowledge, since they do not allow for probing. Questions are static, and cannot be moulded in relation to responses. Additionally, the survey study conducted by Law et al (2008) did not give the depth of understanding about theories of therapy that was required, further questionnaire(s) therefore seem unsuitable.

Interviews are another option. Frey and Oishi (1995, p.1) describe interviews as “a purposeful conversation in which one person asks prepared questions (interviewer) and another answers them (respondent).” One of the major advantages of interviewing is its ability to be flexible (Bell 2005). The interviewer is able to query responses, generate greater detail, allowing room for exploration of topics that might not have been foreseen. However, interviews are not an ideal method, since they only represent one version of reality. A large number of interviews would therefore be necessary to get meaningful answers. Further, though this method is more likely to tap tacit knowledge than a questionnaire, it does not enable debate, or the ability for answers to be contested; factors that Rycroft-Malone et al (2004) recommend in accessing tacit knowledge.

Focus groups offer another alternative. Focus groups are described as “group discussions organised to explore a specific set of issues.” (Freeman 2006, p.492). Kitzinger (1994) argues that interaction amongst research participants is what sets this method apart from groups, one-to-one interviews or questionnaires. The focus group method, suggest Kitzinger (1995, p. 299) “can help people to explore and clarify their views in ways that would be less easily accessible in a one to one interview”. They are noted to be a useful method for exploring people's knowledge, what they think and why. Participants are able challenge one another to consider their views as well as prompt each others thinking and ideas. An additional benefit of the focus group method is that they are able to elicit information about why an issue is salient, as well as what is salient about it (Morgan 1988). The interactive component to focus groups is particularly pertinent in being most likely to draw out tacit knowledge. Rycroft-Malone et al (2004, p.83) note that implicit or tacit knowledge has the potential to be made explicit “once it has been articulated by individual practitioners, then debated, contested and verified through wider communities.” Focus groups enable some of this debate and are therefore considered the most suitable method for data collection.

6.4.3 Marrying qualitative and quantitative approaches

The decision to use focus group methods raises some epistemological questions, with regard to its fit with the systematic literature review. While the former is qualitative the latter is quantitative (albeit with narrative synthesis). The philosophy behind the two methods, in terms of how we come to know about the world, are fundamentally different. However, this is not seen to be problematic; the disparate approaches are working toward the same broad aim and they are asking different specific research questions, which require a different set of approaches.

The 1980's saw what is often termed a time of 'paradigm war' (Gage 1989). The premise was that quantitative and qualitative methods were fundamentally incommensurable. The

years since have seen, according to Denzin (2010), a transformation in perspective to the current age of mixed methods endorsement:

“Mixed, multiple, and emergent methods are everywhere today, in handbooks, readers, texts. Their use is endorsed by major professional societies, as well as by public and private funding agencies and institutes.”
(Denzin 2010, p. 419)

Croninger and Valli (2009, p.545) warn against a return to the “intellectual drag that characterised the paradigm wars of the 1980s”. Although there are many important paradigmatic differences between qualitative and quantitative research Johnson and Onwuegbuzie (2004) note that there are often unacknowledged commonalities in the two approaches. Sechrest and Sidani (1995, p.78) highlight the similarities, in terms of describing data, constructing explanatory arguments and considering why the outcomes they observe happen. The necessity to link the research paradigm and research methods has been questioned by Howe (1992). While other researchers have sought to find common philosophy in mixed methods; Johnson and Onwuegbuzie (2004 p.16), argue for pragmatism as the “philosophical partner” for mixed methods research. They conclude though, that what is of fundamental importance is that investigators are not led to choose research methods by preconceived biases about which paradigm should have authority; rather, that methods and approaches are chosen with respect to their underlying research questions.

In the present research, two related but different sets of research questions are posed, that require different approaches. The first; ‘What are the cognitive and linguistic deficits in SRLI?’ seems best answered by direct examination of the deficits. This is something that (in theory) can be measured, and as such a more quantitative approach seemed fit for purpose. The other questions, regarding existing interventions for SRLI, particularly those pertaining to theory, is more exploratory, and as such a more exploratory, qualitative approach is required. It is not useful to measure and count theories of therapy. Both these quantitative and qualitative approaches, however, are thought have something to add in broadening understanding and development of interventions for SRLI.

6.5 Pilot and development work for focus groups

Prior to conducting focus groups it was necessary to conduct training work, in the form of observation, to develop the researcher’s facilitator skills. Mock and pilot focus groups were also conducted in order to help inform the focus group schedule and examine what questions and strategies were likely to be useful for answering the research question. The following section outlines the details of the observation work and the mock and pilot focus groups. The learning outcomes from these processes are also discussed.

6.5.1 Development of focus group schedule

Prior to the mock focus groups a draft topic guide was created. The mock and pilot focus groups were used to help inform the final focus group schedule in terms of useful strategies/approaches that might help to further elicit information.

6.5.2 Mock focus groups

Two mock focus groups were conducted. The first was centred on the practical aspects of running a focus group; the second explored the questions that were being asked. The first mock focus group was with University of the West of England (UWE) PhD students. A neutral topic was selected that was felt to be appropriate to the participants. The title for the discussion was 'The PhD experience at UWE'. The focus groups ran for 45 minutes, with some time at the end for feedback about how the group was led.

The second mock focus group was conducted with four colleagues at the Speech and Language Therapy Research Unit. Three participants were qualified speech and language therapists and the other had a background in psychology but had a significant amount of experience in speech and language therapy research. Participants were asked about the schedule guide and what they thought could be improved, as well as activities that might help to further elicit information. This group ran for 45 minutes, taking the format of an open discussion.

6.5.3 Lessons learnt from mock focus groups

The first mock focus group helped the researcher to develop an understanding of the practical aspects of running focus groups, such as giving good time to set the room up, putting a sign on the door and allowing appropriate time for gaining consent. An independent observer, with focus group facilitation experience, was also able to feedback on facilitation style.

The second mock focus group produced a number of useful suggestions for changes to the focus group schedule; activities as well as feedback on questions that led to relevant adjustments (the details of the final focus group schedule are reported below, section 6.7.1).

6.5.4 Pilot focus group

The pilot focus group was conducted to evaluate whether the focus group schedule would be feasible and effective in answering the research aims. Participants for the pilot were nominated through invitation sent by a head of paediatric speech and language for the local NHS trust. Five SLTS, with varied amounts of experience, were able to attend the pilot focus group. The group followed the focus group schedule that was intended for the

main study, with the exception that it focused on only one area of deficit, namely, working memory. The group ran for an hour, with a 15 minute presentation at the beginning setting working memory difficulties in the context of the evidence from the SLR.

6.5.5 Lessons learnt from pilot focus group

Responses demonstrated that the questions elicited a range of data relevant to the research aims. Participants completed feedback forms that also reported that it was a positive experience. Suggestions for improvement included giving the initial presentation more slowly. This adjustment was made for subsequent focus groups.

The pilot focus group highlighted that participants might want information in exchange for their participation. Eder and Fingerson (2002) suggest reciprocity as one way of empowering participants, noting that researchers expect to gain information from participants, often without giving anything in return. This led to the development of strategies for coping with this (i.e. allowing time for questions or feedback at the end and providing email address for contact). The pilot focus group also led to the development of strategies and phrases for participants going off topic, dominating discussion or giving insufficient detail.

6.6 Focus groups with expert speech and language therapists

The following section outlines the method and procedures used. Methods of analysis are also described. Favourable ethics approval was given by NHS Southmead Ethics Committee before this study commenced.

6.6.1 Method

Qualitative data was gathered using three semi-structured focus groups with expert SLTs. The principle guiding the number of groups was that of saturation. The notion of saturation was first introduced by Glaser and Strauss (1967) and refers to the idea that research should be conducted until no new themes emerge. An iterative approach was adopted, where the transcripts were read and reflected on following each group, to identify concepts to be examined in subsequent sessions. This helped to establish agreement and whether saturation was reached. Although saturation was reached after only a relatively small number of focus groups, this was thought to be beneficial in allowing more in-depth analysis (Carlson and Glenton 2011). A final larger group was also conducted with a group of mostly SLTs as well as others who worked with children with language impairments. This group was constructed to help confirm findings, and to enable more debate among “wider

communities”, as suggested by Rycroft-Malone et al (2004, p.83).

6.6.2 Recruitment for focus groups

The process of peer nomination was used to ascertain experts in the area for the focus groups; interested participants were then asked to make contact. Peer nominations came from the following sources:

- The Royal College of Speech and Language Therapists (RCSLT) advisors in SLI
- Lead contacts for the Special Interest Groups in SLI registered with the RCSLT
- Academics, who had written prominent work in the area of SLI
- Key people at the Speech and Language Therapy charities I CAN (a children’s communication charity) and the National Association of Professionals concerned with Language Impairment in Children (NAPLIC)

6.6.3 Inclusion criteria for focus groups

The following inclusion criteria for participants were used in focus groups 1-3:

- Ten years experience as a qualified SLT working with language in child populations or in speech therapy research in child language
- Currently practicing as an SLT

The decision to use ten years experience was made in light of Ericsson et al (1993) deduction that becoming an expert requires ten years experience. The requirement that they must be currently practising as an SLT was used to ensure that participants were up to date with current approaches and methods used in practice. It was also felt that SLTs would more readily be able to access their knowledge if they were currently using it in practice.

6.6.4 Participant sampling for focus groups

A purposive sample was initially proposed to select the participants from those who had volunteered to participate, taking into account geography, where they had trained and years of experience. However, due to poor recruitment, it was not possible to purposively select groups. For the final two focus groups, the sampling strategy was widened. In order to improve feasibility a more ‘localised’ approach was taken. This was based on feedback from those who were not able to participate, that there were viability issues in their being able to attend distant locations. SLT managers that had been nominated and had agreed to participate in the study were asked if they could nominate people in their region who had sufficient expertise in language impairments. Table 34, Table 35 and Table 36 displays information on how each participant was recruited in focus groups 1-3.

6.6.5 Recruitment and inclusion criteria for group 4

A larger group (group 4) consisted of participants who had attended special interest group (SIG) on interventions for children with SRLI. There were no inclusion criteria for this group since it sought to capture broader views, though the SIG was advertised with an emphasis on interventions in SRLI.

Table 34 How participants were recruited for focus group 1

Participant number	Nominated by
Participant number 1	Royal College advisor
Participant number 2	Royal College advisor
Participant number 3	Royal College advisor
Participant number 4	SLT manager
Participant number 5	SLT manager
Participant number 6	SLT manager

Table 35 How participants were recruited for focus group 2

Participant number	Nominated by
Participant number 1	Royal College advisor
Participant number 2	SLT manager
Participant number 3	SLT manager
Participant number 4	SLT manager
Participant number 5	SLT manager

Table 36 How participated were recruited for focus group 3

Participant number	Nominated by
Participant number 1	Academic in SLI
Participant number 2	SLT manager
Participant number 3	SLT manager
Participant number 4	SLT manager
Participant number 5	SLT manager

6.6.6 Participants in focus groups

The current work place of participants in each focus group is displayed in Table 37. Descriptive information for participants in each focus group is provided below.

Focus group 1

Participants emanated from three different training establishments, and collectively had 104 years of experience (mean 17 years, range 10-22).

Focus group 2

Participants emanated from four different training establishments, and collectively had 111 years of experience (mean 22 years, range 16-30).

Focus group 3

Participants emanated from three different training establishments, and collectively had 107 years experience (mean 21 years range 8- 40).

One participant in this group did not meet the criteria for 10 years language experience; however the manager advised she would be a strong candidate for the group and was very keen to participate. Further, it was felt that an extra participant would be valuable for further generating discussion.

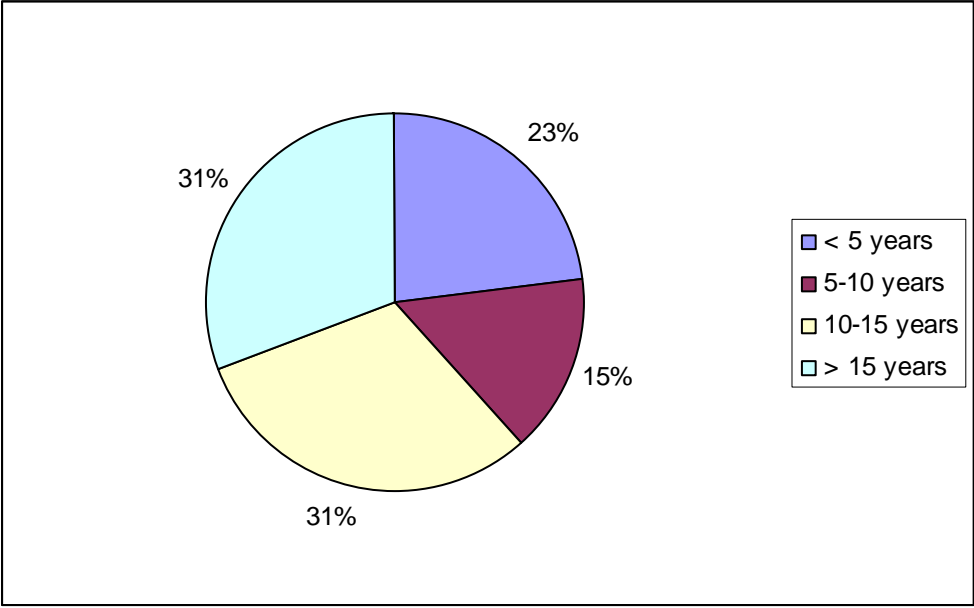
Table 37 Speech and language therapists in each focus group by their current position

Current position	Language resource space	Mainstream school	Community clinics	School for children with SLI	Therapy centre
Focus group 1	2	n/a	n/a	3	1
Focus group 2	n/a	4	1	n/a	n/a
Focus group 3	5	n/a	n/a	n/a	n/a

6.6.7 Participants in group 4

Twenty-three participants attended group four. These included three participants who were working as learning support assistants. Of those who were SLTs, there was a range in the number of years that they had been working; the proportion of participants in relation to their years of experience is presented in the pie chart in Figure 7. It can be seen that the majority had more than 15 years experience working as an SLT.

Figure 7 Speech and language therapists who attended group 4, by the years of experience they had in clinical practice



6.6.8 Overview of focus group characteristics

An overview of the focus groups, including the number of participants, their relationship to one another and the duration of the groups is provided in Table 38.

Table 38 Overview of focus groups and group four

Focus group	Anticipated number of participants	Actual number of participants	Duration	Participants' relationship to one another
Focus group 1	7	6	3 hours with 1 hour 15 minute breaks	Two unknown to one another and the rest of the group, four worked in the same region
Focus group 2	6	5	2.5 hours with 15 minute break	Three worked in the same region, the remaining two worked in the same region but did not know the other four
Focus group 3	5	5	2.5 hours with 15 minute break	All participants worked in the same region
Group 4	30	23	2.5 hours	Participants from a variety of locations, some came with members of their team.

6.7 Procedure

The focus groups were facilitated by the researcher. The first two focus groups and final larger group also had an independent observer who took skeleton notes. Focus groups were recorded on to two digital recorders: the Olympus WS-200S digital voice recorder and Edirole Roland R-09HR.

6.7.1 Focus group schedule

All participants were sent information ahead of the focus group informing them of the topic areas that would be discussed as well as suggested preparation (see Appendix 7).

Due to the iterative nature of the focus groups, each focus group took a slightly different approach. However, the core questions and methods for eliciting information were the same. The final focus group schedule for the first group can be found at Appendix 8. Each focus group was presented with information from the SLR (Chapter 4), to start, summarising the key findings. Interventions in relation to the areas of deficit identified in the SLR were then considered in turn; working memory, word learning, grammar and information processing. Case examples and resources were chosen as methods to help elicit information on these areas. These approaches were chosen partially due to recommendation from the mock focus groups, but also because it has been noted elsewhere (Freeman 2004, p.284) that practitioners are more able to make their knowledge and skills, that they use in practice, explicit when concrete examples are used. SLTs' rationales for their intervention approaches were then explored (see focus group schedule, Appendix 8 for examples). Finally, participants were probed about specific details of the approaches, in terms of who they are suitable for and how they are delivered.

6.7.2 Iterative nature of the focus groups

Changes were made to the focus group schedule in light of emergent findings. The key modification of the schedule was presenting interventions raised in earlier focus group(s) to subsequent ones. The order in which the interventions were presented was also altered. The second focus group were presented with emerging interventions preceding discussion. It was felt, however, that this might influence participants' contributions. Focus group 3 therefore asked participants for three interventions that they felt were 'key', from each topic area, before the previously raised interventions were presented. The final larger group, by contrast, was only presented with interventions following discussion. These altered approaches were used to gain a picture of levels of agreement and disagreement between the groups on different methods and approaches to interventions for SRLI.

Finally, the order in which rationales were discussed was altered. For the first focus group rationales and specific interventions details were discussed subsequent to intervention approaches. However, rationales were found to arise more naturally within discussion of intervention approaches. Subsequent groups were therefore asked for rationales and details of the approaches as the intervention approaches arose.

6.7.3 Schedule for larger group

Group 4 had a slightly different schedule since it required a different approach in response to the larger group size and expectations of participants attending a SIG. A longer presentation was given at the beginning which presented the findings from the SLR (Chapter 4). Rather than consulting the whole group about interventions in relation to the areas of deficit identified in the SLR, participants were split into three smaller groups that separately considered interventions in relation to a specific area of deficit. The three groups considered interventions and rationales in the following areas: working memory, grammar and word learning.

The groups were given time to write down interventions and methods that they adopted in their topic area, as well as their rationales (see Appendix 9). A volunteer from each group was then asked to feed the information back from their group to the larger group. This was followed by a whole group discussion to explore other intervention ideas and rationales. The final area of deficit identified in the SLR; information processing, was discussed with the whole group.

6.8 Method of analysis

All focus groups were fully transcribed, by the researcher, using Transcriber 1.5.1. Transcripts were then imported in Nvivo 8 to support thematic analysis.

6.8.1 Approach to thematic analysis

Braun and Clarke (2006, p.77) described thematic analysis as “poorly demarcated and rarely acknowledged, yet widely used qualitative analytic method”; this is because it can be used in a diverse range of ways, and within different theoretical perspectives. Thematic analysis is essentially, though, a method for identifying, analysing and reporting themes across a data set. It is designed to organize and describe a data set, though it may also be interpretive. A theme captures something important about the data and represents meaning within it.

Braun and Clarke (2006) describe how thematic analyses can occur at the explicit or semantic level or at a latent or interpretative level. The approach adopted in the present

study was semantic, that is, themes were identified within the explicit or surface meanings of the data. These were progressed from description, summary and organisation to interpretation, where the broader significance of these patterns were developed. The approach adopted was also inductive, where themes identified emerged strongly from the data itself, rather than any preconceived or existing frameworks. Braun and Clarke's (2006) 6 step by step guide was used to help the thematic analysis:

Phase 1: familiarising yourself with your data

Phase 2: generating initial codes

Phase 3: searching for themes

Phase 4: reviewing themes

Phase 5: defining and naming themes

Phase 6: producing the report

Figure 8 displays the processes involved in data analysis. This diagram was inspired by Hayhow (2008 p.109). Initially a large number of free nodes were created for all the data. Created nodes were available for analyses of all data sets, so the numbers of new free nodes created decreased as analyses of data sets progressed, and as overlapping themes emerged. As the diagram demonstrates, the process of developing nodes was iterative, after nodes were created transcripts were reanalysed to ensure that the nodes addressed all the themes that emerged in the data.

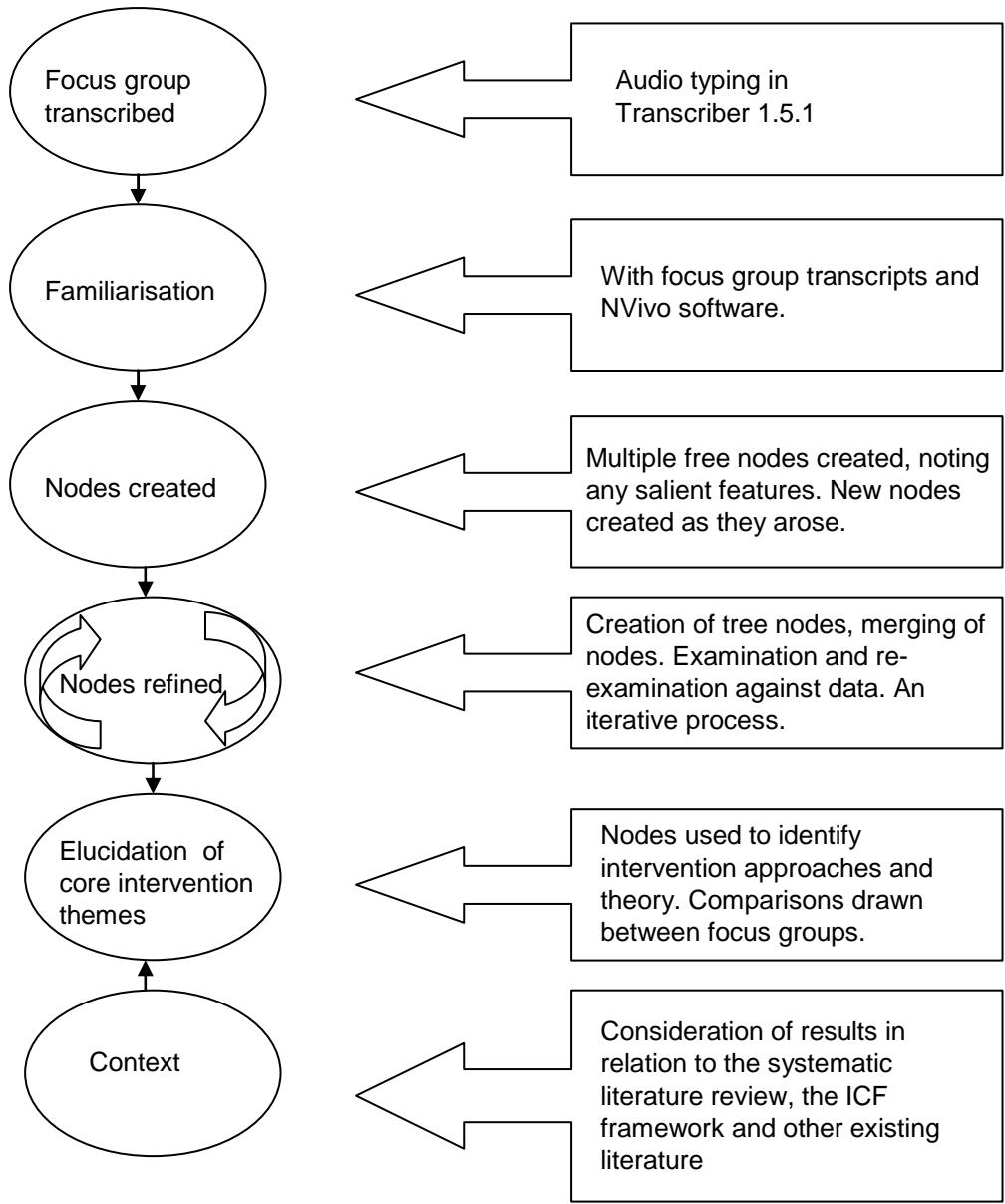
Following the creation of free nodes, tree nodes were created. These are nodes organised into a hierarchical structure, creating categories and subcategories. Nodes were examined and re-examined against the data. Where appropriate, nodes which overlapped with one another were merged into one node. The tree nodes were used as a structure to develop broader themes in the data, whilst not losing any of the detail of the free nodes. See Appendix 10 for examples of free nodes and tree nodes.

6.8.2 Interpretative influences

While the researcher aimed to be neutral in interpreting the data, the researcher does not hold a naive realist view. It is acknowledged that it is not possible to free yourself of your theoretical position. There are likely interpretative influences of the researcher's background that influence the data. The key interpretative influence for the researcher is her training background as a speech and language therapist. This has an influence on two levels; the first is that the researcher's biomedical science degree has a medical model, positivist influence. The second is that there will have been an implicit interpretation of SLT terminology and intervention terms that the researcher was already familiar with.

Despite a positivist background, the researcher has not taken a positivist approach to the research. Were such an approach taken, hypotheses would be drawn. However, attempts were made to be inductive in drawing out themes. Since interpretative methods were new to the researcher, care had to be taken in holding back a priori assumptions. Broadly the approach taken can be seen to be phenomenological to the extent that it focuses on interventions as described and experienced by practitioners themselves, rather than from an observed context.

Figure 8 Processes involved in data analysis



CHAPTER 7 Findings; focus groups with expert speech and language therapists

7.1 Introduction

The following chapter presents the findings of the focus groups with expert SLTs, in relation to the research aims. Although the first aim of the research was to identify interventions in relation to the areas of deficit identified in the SLR, the interventions that emerged are not presented in the SLR categories, since inductive analysis found slightly different themes emerged. These themes are described (7.2), and the interventions are detailed under these themes (7.3, 7.4, 7.5 and 7.6). The second research aim was to identify if there were core approaches that underpin therapy methods and techniques for SRLI. Core intervention approaches and factors in target selection were identified and are described (7.7). Additional findings emerged from the data, including factors that appeared to influence intervention delivery, these are presented in 7.8. The final research aim, to examine SLT's theory behind intervention approaches, is then addressed in 7.9. The degree of concurrence and divergence in relation to SRLI interventions, both within and between focus groups is then discussed (7.10). Finally, the overall findings are discussed in relation to the research aims (7.11).

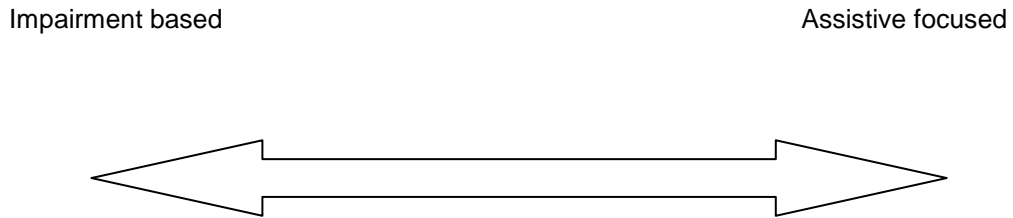
7.2 Intervention themes

An aim of the focus groups was to explore the interventions for children with SRLI in relation to the areas of deficit identified in the SLR. Inductive analysis, however, found that though the focus group schedule had focused on particular areas of deficit, the interventions raised by SLTs could be classified in slightly different ways. Principally, interventions could be seen to be impairment based or assistive focused in their emphasis. These can be seen to be presented on a continuum, as seen in Figure 9. Interventions that were classified as impairment based interventions were those that targeted a specific area of impairment that the child had difficulty with, attempting to remediate or improve that area of impairment. However, a large number of the interventions mentioned, focused on maximising the existing skill sets that the child had through self help strategies, as well as supporting their impairments with additional materials or adaptations to their linguistic environment. These types of interventions were coded as assistive approaches.

Dockrell and Messer (1999, p.237) describe interventions as "any planned action". The following section will use the descriptors: therapies, activities and interventions synonymously (though it is understood that in other contexts their meanings could be interpreted differently). All these terms refer to the actions of the practitioner that are aimed

at supporting or remediating the difficulties of children with SRLI.

Figure 9 Impairment vs. assistive focused intervention continuum



The interventions are considered to belong to a continuum (Figure 9), since in some instances the focus of an intervention was clear, but for many of the interventions, there appeared to be both an assistive and an impairment based component. For example, in word learning activities, children were explicitly taught new words (impairment based), but they were also taught the features and strategies they should apply when they encountered new words (assistive approach). For this reason, it was not always easy to categorise interventions into an impairment based or an assistive focused approach. The section on Impairment based interventions therefore considers any interventions that are predominantly impairment based, but might include assistive features. The section on assistive focused interventions, by contrast, considers interventions that appear to have very little or no impairment based features.

Interventions can also be classified by whether they are child centred or environment centred. Child centred interventions focus on assisting or remediating an impairment the child has. In contrast environment centred interventions make external changes, focusing on the resources available to the child, their environment or the behaviours of others with the child. The following sections consider first child centred, impairment based intervention, then child centred interventions aimed at assisting difficulties, followed by environment centred interventions aimed at assisting difficulties. Finally, after discussion of these areas, a theme that appeared to sit outside these approaches, empowerment, is discussed.

7.3 Child centred – impairment based

Therapists described a wide range of activities, games and resources which can all be regarded as impairment based interventions. These interventions are directly addressing deficits in the child's language or cognition, aiming to remediate or improve their performance.

Since the SLTs were asked to consider interventions in relation to the evidence of deficit in the systematic review, interventions targeting these areas inevitably emerged. However,

inductive analysis found there were additional areas of deficit that were not taken from the SLR, in particular, verbal reasoning and auditory processing. These areas of deficit and the types of activities that targeted them, are considered in turn.

7.3.1 Short term and working memory

In all four focus groups, participants described a range of short term and working memory activities they conducted with SRLI children. The aims of interventions in this area were variously described in terms of using the full capacity of children's memory or attempting to increase a child's memory span. There was general consensus that teaching strategies for memory help children to remember more and this was where the greatest emphasis lay for memory intervention. These strategy approaches are discussed in more detail under assistive approaches (section 7.4.1).

Many of the activities that were described for memory involve group games where the first child is required to state an item, subsequent children are then expected to add their own additional item, after recalling all the previous items that have been raised. A variety of games and tools for these sorts of activities were described; see Box 1.

Box 1 Example activities and tools for short term and working memory

Progressively increasing memory load in game formats: 'I went to the market', 'shopping game', 'recall the beat', 'Kim's game'. Strategy work, using song and rhythm, silly stories and practising digit span.

7.3.2 Phonological awareness

Therapists discussed a number of activities which focused on phonological awareness. These are tasks that target phonological and syllabic aspects of words. The majority of the work discussed in auditory processing was on phonological awareness. Box 2 provides examples of activities for auditory processing.

"Actually we do a lot of work on very basic auditory processing of single words, lots of same different judgments lots of the sort of Stackhouse and Wells things, phonological awareness and attention."

SLT focus group 1

Box 2 Example activities for phonological awareness

Segmenting words, syllable counting, sorting sounds games, syllable clapping/counting, same/different judgements and identifying first sounds.

7.3.3 Grammar

The importance of verbs and teaching verb forms was emphasised by practitioners.

“Do a lot of, you know, working on verbs, because verbs are what drives a sentence drives practically the rest of grammar, and you’ve got to get those established before you can go anywhere else.”

SLT focus group 3

“You’re not teaching the actual grammatical part but you are, because it’s so focused around the verb, you automatically teach different verb forms through focusing on the verbs within the umm semantic activities that you’re doing.”

SLT focus group 2

Existing publications, in particular those on colour coding and shape coding (Ebbels 2007) seem to play a predominant role in practice in the area. Alongside these visual approaches, many practitioners advocated the use of signing, in particular Paget Gorman Signed Speech (1990). Providing a structure for children to work from and teaching children the grammatical rules of language also appeared key.

“Making the rules explicit to the children, in terms of how grammar works and just putting it in a way to help them understand ...explaining how language works.”

SLT group 4

Box 3 provides examples of activities and tools used for grammar.

Box 3 Example activities and tools for grammar

Colour coding and shape coding (describing the rules of grammar), activities with verbs, modelling grammatical structures, filling in blanks (grammatical words). Using narrative as a way to model grammar.

7.3.4 Vocabulary/word learning

SLTs emphasised the concept of breaking words into all their semantic and phonological parts. Semantic features are those that are related to the meaning of the words and the category in which the word fits. Phonological features are those that relate to the sounds that make up the word. The following quote demonstrates the types of questions that therapists ask children:

“It would be things like, what group does it go in? What parts does it have? What do you use it for? umm, and then other phonological things, like how many syllables does the word have? What sound is at the beginning? and what’s it sound like? So it’s just different semantic phonological things umm to really help them encode the word.”

SLT focus group 1

Mind maps (also known as ‘topic webs’) were a popular tool for displaying this information; they were mentioned in all the focus groups. Other similar visual tools that aimed to display the phonological and semantic features included ‘walk the word’ (a visual pathway) and a ‘word wheel’. In keeping with the visual aspect of these approaches, some practitioners also reported linking word learning with colour coding. This involves using different colours for different word types, for example red for verbs, blue for nouns and green for adjectives. Box 4 provides examples of activities and tools for word learning.

Box 4 Example activities and tools for word learning

**Semantics- odd one out games, categorising words, discussing their purpose/use, finding opposites.
Phonology- rhyming, clapping syllables, identifying first sounds. The use of objects and pictures to support this; mind maps/topic webs, visual pathway, word wheel, colour coding (e.g. by verb, object or adjective) vocabulary or dictionary sheets, vocabulary books and boxes. These contained detailed information about the words children were learning, or had learnt and were designed to be referred back to. Practising words in different contexts or with different morphology.**

7.3.5 Verbal reasoning

Verbal reasoning or higher level reasoning and comprehension activities emerged in most of the focus groups. These are activities which focus on the language context, non-literal language and ability to make inferences. Tasks were typically described in terms of presenting children with a paragraph or story and asking questions that require making

inferences or discussing outcomes or consequences of actions. Sequencing pictures was reported to be a useful tool for this. However, there did not appear to be a prescriptive formula for these activities and practitioners seemed to express a lack of clarity/ focus in this area.

“Could I just mention verbal reasoning? Because in terms of your comprehension, verbal reasoning is massive, and we don't tend to, I think, do enough about it.”

SLT focus group 2

“We use the TALC (Test of Abstract Language Comprehension) assessment quite a lot, it's what you do with the results that's been a bit challenging!”

SLT focus group 2

Box 5 displays examples of verbal reasoning activities.

Box 5 Example activities and tools for verbal reasoning

Blank's level of questioning- questions move from concrete to more abstract concepts and are developmentally sequenced (Blank, Rose and Berlin, 1978). Sequencing pictures, reading stories or paragraphs and asking questions that require drawing inferences.

7.3.6 Resources

Therapists cited a very large variety of published resources and books as influencing their practice. Some of these resources are therapy programmes, often working on an all encompassing range of activities, while others are used to help specific areas of impairment. The resources that were raised in the focus groups are listed by areas of impairment as well as those that aim to improve comprehension in more general terms in Appendix 11. It seemed that resources are used both as a way of assisting the existing aims of practitioners, as well as to provide complete therapy programmes for SLTs.

There were a number of resources that were cited a large number of times. Particularly popular resources were the Black Sheep Press Ltd, who produce illustrated worksheets and assessments designed to assist development of children's speech and language. Black Sheep provides materials for a range of speech and language problems, but especially popular appeared to be those for narrative therapy (Rippon 2002). The Derbyshire Language Scheme (Masidlover and Knowles 1982) was also popular. Derbyshire Language Scheme incorporates a programme of intervention, targeting early language skills, starting

from single words and moving to long complex sentences.

7.3.7 Interventions targeting more than one type of impairment

Although practitioners were asked to consider interventions for particular impairments, the interventions that emerged did not always relate to an isolated impairment type as the preceding section might indicate. It was unusual for practitioners to describe working on a single impairment at one time. Further, it seemed that they viewed interventions as targeting multiple areas of impairment simultaneously:

“That’s what’s so difficult to, yeah it’s hard to separate all these things out isn’t it? Because you’re working on comprehension and at the same time you’re working on vocabulary, you’re working on their listening skills, you know you do all of those things wouldn’t you, you’d target all of them at the same time.”

SLT group 4

“It’s processing and it’s semantics, it’s the whole thing about Derbyshire is that it incorporates all the word learning the semantic syntactic, it incorporates, auditory memory, all within that one type of task, of following a command and describing what they’ve done and, so it’s receptive and expressive combined.”

SLT focus group 1

Participants also referred to the interactive nature of impairments, where an improvement on one area of impairment was felt to impact upon another area, or areas, of difficulty. For example, therapists described working on phonological awareness in order to improve grammar function, and word learning to improve general comprehension skills:

“I find that aspects of grammar improve as phonological awareness improves, without having to do the direct work on it, simply because one level has had an impact on another so the listening skills again increase the children’s self awareness their... better listening skills.”

SLT focus group 1

“Doing sort of underlying skills so if their, if you... improve their vocabulary knowledge and improve those phonological awareness, those sort of skills, then sometimes the information isn’t so complex to them.”

SLT group 4

7.4 Child centred, assisting difficulties

Two areas were identified which appeared to be aiming to support the difficulties of children with SRLI. These included work around the 'meta' aspects of language learning and reflection and those that focused on listening and attention. These two areas are considered in the following section.

7.4.1 Metacognition and metalinguistics

The term metacognition refers to activities that involve "thinking about thinking" (Flavell 1976) i.e. awareness of one's own ability to think and learn, as well as monitoring of these processes. Similarly, the term metalinguistic is used for activities that aimed to enhance understanding of the rules used to govern language.

Practitioners spoke of trying to encourage the child to use strategies to assist in their learning, and reflect on their use of strategies (metacognitive work). For memory activities strategy work was mentioned in several groups.

"We were just saying that when we're doing memory activities the big thing is to try and teach the child strategies for their memory, you know if you they do remember something to get them to think about well what did you do that helped you remember?"

SLT focus group 1

Box 6 displays examples of strategy work for memory

Box 6 Example strategy work for memory

Repeating and rehearsing information, visualising (mental imagery) and 'chunking' information, including grouping things in to related categories. Activities that were described as helping children to practise these strategies included creating a delay before asking the child to recall something and gradually increasing the amount of information that the child was expected to remember.

Therapists also described broader metacognitive work with the children, in terms of making explicit to the child when and how to use particular strategies. Another component of the child's reflection on their own learning was broader, giving the child general self-help strategies and learnt phrases, so the child is able to say if they need something repeated or if they didn't hear or understand something.

"I think we teach strategies to encourage children to ask for help."

SLT focus group 4

A crucial part of the strategy based work appeared to be in deciphering the best strategies for the child in question. Therapists described exploring this with the child, or where appropriate asking the child what they believe their best strategies are:

"When you're working with children you're maybe working on a particular strategy with the child, and suddenly that will actually trigger another strategy that the child's actually developed themselves, and it's always very interesting, particularly with the older SLI children to ask them what strategy they are using."

SLT focus group 1

These broader strategy work approaches are detailed in Box 7.

Box 7 Broad approach to strategy work

Encouraging child to ask for help/repetition, to reflect on their understanding, to establishing their best strategies. Tools used to support this included the use of learnt phrases, cue cards or flip books.

The metalinguistic activities focused on rules about how language works or how to learn language, so that the children might be able to apply them in other contexts. These activities were most commonly raised in terms of understanding grammatical structures.

"You know getting away from the language and explaining how the language works, I heard someone say meta-linguistic on another table and I thought yes! That's it, that's what we're doing, we're just giving them the rules of how it all works and then we're telling them that, actually, there are exceptions to the rules, because that's the nature of English."

SLT group 4

“Yeah, so that they learn the vocabulary that they need and then hopefully they learn other vocabulary because they've got the way to learn vocabulary now, sorted.”

SLT focus group 3

Box 8 displays examples of metalinguistic work for grammar and vocabulary.

Box 8 Meta-linguistic work for grammar and vocabulary

Grammar: colour coding and shape coding (describing the rules of grammar)

Word learning: Encouraging child to reflect on semantics and phonological features of words.

7.4.2 Listening and attention

Listening and attention were discussed with great frequency across the groups. Some activities that were raised appeared to be directly practising listening, for example listening for a particular sound or word. Others activities were described in terms of trying to get children to gain a greater awareness of their listening and attention skills (thus could be deemed metacognitive).

“They're learning that I do need to sit and listen and I can't be looking out the window and I can't start to talk.. you know so that they're aware of themselves of... their responsibility to themselves to try and be a better listener.”

SLT focus group 1

“Bringing in some of the strategies for listening and not just working on the digit span but actually getting them to think at a higher level about how they're listening and how they can improve their listening.”

SLT focus group 1

Many participants expressed how common it was for SRLI children to have problems in this area, attempting to encourage attention appears to be seen as a necessary pre-cursor to other activities, and regarded as an ongoing issue.

“I don't think I've ever known anyone with a err, you know the SLI children to then have, if they've got comprehension difficulties, to have really good attention and listening, I mean I've never come across one.”

“She’s just sent me one aged 11 and he’s still not listening at all still, so I mean he could have been in a primary school language resource for 6 years ...and you would still be working on attention and listening because he doesn’t focus.”

SLT focus group 3

7.5 Environment centred, assisting difficulties

Three key areas emerged that could be described as environment centred, because they involved making adaptations to the child’s language learning context. These areas were; adults altering their language, use of visual materials and objects and adaptations to background noise. These areas are considered in turn.

7.5.1 Adults altering their language

Many therapists, across all the focus groups spoke about the need for adults, who worked with SRLI children, to alter their language in order to help the children’s understanding. There were two key types of changes that came up with regularity; changes to the pace at which they spoke to the children, and changes to the amount and complexity of information they gave the children at any one time.

“We’ve actually said to the staff, you need to, YOU need to talk slower, you need to put pause gaps in.”

SLT focus group 1

“We emphasise that in our training to teachers (slowing down) and it’s a shame for them because it’s such a hard thing for teachers to do because naturally they’re trying to keep everybody going and if they slow down and if they give more pauses, it interferes with their management in the classroom, but we drum on about a lot because it really helps our children.”

SLT focus group 2

“Chunking the information, umm I suppose ordering it in the way that it ... need to be carried out, changing vocabulary so maybe using simpler words.”

SLT group 4

Adults are also recommended to pitch their language to the number of key information carrying words that a child is able to understand in a sentence, referred to as their 'word level' or 'key word level'. Word levels were cited as useful as these are felt to be a concept adults can easily grasp:

"Working on a key word level approach certainly non-speech and language therapists or teaching staff who experience it find it much easier to bring their language level down. If you say there's only 2 key word level immediately they get their language level will become much less complex and they'll be, they'll find it much easier to simplify their language if the teachers are use to working in key word levels."

SLT focus group 1

"I think one of the things with Derbyshire (Language Scheme) though is if you if everybody recognises that a child's at a 3 word level... everybody then talks to the child at a 3 or 4 word level."

SLT focus group 3

Box 9 summarises the alterations that adults are encouraged to make to their language use with children with SRLI.

Box 9 Ways in which adults are encouraged to alter their language use with children with SRLI

Slowing down, using pause, gaps, chunking information, reducing number of key words, reducing complexity of vocabulary.

7.5.2 Visual materials and objects

A variety of visual materials were suggested as a mechanism of support for children with SRLI, for example, the use of pictures, photos, written words, use of colour coding and shape coding as well as objects of reference. Use of sign systems including Paget Gorman, Makaton and cued articulation were also mentioned by therapists. The use of visual supports was raised across diverse intervention areas e.g. from memory to grammar. These are also discussed in multi-sensory approaches (see section 7.7.2.).

7.5.3 Adaptations to background noise

Only members of group four mentioned keeping noise levels to a minimum in order to help children to process auditory information.

“We talk about noise levels particularly if you’re working on this stuff then try and keep the noise levels down and do you have to have the projector on all the time? and it’s very hard.”

SLT group 4

Adaptive strategies were also mentioned for the physical environment of the classroom, such as having rubber on chairs to stop them scraping on the floor, thus helping to reduce noise levels.

7.6 Empowerment

Interventions raised by practitioners did not always appear to be directly targeting a language or cognitive issue, but rather the repercussion of such difficulties. Empowerment was a key theme across the focus groups. Practitioners described confidence building work, and the child as a ‘partner in therapy’, in order that they take responsibility for their own learning.

“Absolutely key particularly when working with RLI (receptive language impairment), is that they have to be alongside you and working with you as a partner not doing it to them.”

SLT focus group 1

Practitioners described anxiety that some children experienced around their communication, and the importance of children remaining ‘emotionally intact’. Some therapists described working on adjectives in order to allow children to discuss their feelings.

7.7 Core intervention approaches

A number of recurring themes emerged from the data across the areas of deficit that were discussed. These recurring themes could be seen in how therapists described selecting targets for therapy (Table 39) as well as in the underlying features of intervention approaches (Table 40). The themes emerged across the different intervention approaches and areas of deficit.

Table 39 Factors involved in selecting therapy targets for SRLI

Factors in selecting therapy targets	Details
Consultation with teacher or teaching assistants (TA)	To help inform the child's context
Developmental order	Working on the earliest acquired aspects of language first
Functionality	Selecting targets that are purposeful and useful to the child
Priority areas	An order of priorities for intervention
National Curriculum vs. core concepts	Teaching NC vocabulary or focusing on core/basic concepts
Severity of difficulty	Prioritising aspects of language the child has the most difficulty with

Table 40 Core components or approaches for SRLI interventions

Core method or approach	Details
Active pre-teaching	Priming the children for learning
Child enjoyment	Making therapy activities fun and enjoyable
Feedback	Providing specific feedback about the child's performance
Hierarchical	Increasing the difficulty or complexity of tasks as the child makes progress
Making connections	Semantic links, helping the child to organise things in their head
Multi-sensory	Multi-modalities, auditory, visual, tactile, physical
Practice	Lots of repetition and rehearsal
Tailoring to child	Linking things to real life. Making tasks specific to child's needs

7.7.1 Factors involved in selecting therapy targets for SRLI

Therapists discussed issues they consider as they select targets for therapy. Emergent themes regarding how practitioners select the intervention activities, displayed in Table 39, are detailed below.

Consultation with the child's teacher or teaching assistants

Therapists reported that in order to establish each child's context and help them make decisions about their interventions they consult the child's teacher or learning support assistants (LSA).

Participant 1: I'd want to know more information from the teacher or the teaching assistant, you know staff within the classroom- as to their views as well.

Participant 2: Get their academic levels.

Participant 3: then tie all that information together before I decide.

Focus group 3

Priority areas

An inherent hierarchy in selection of targets emerged from the focus groups. In particular, listening and attention were emphasised across focus group, as a key precursor to all activities. It was stressed that without these, the subsequent aspects of learning are impossible. There was also general consensus that vocabulary development would usually be the next priority area, though this would be somewhat child dependent.

Developmental order

Practitioners referred to selecting targets by the order in which they are naturally acquired, for example grammatical contrasts that are acquired earliest would be worked on first.

"And it's a developmental bit here as well, about how important it is to do things like, making sure a child can understand 'not', would be much more important than the fact, you know 'he' and 'she', that is developmental as well."

SLT focus group 3

Functionality

Practitioners indicated that the functionality of target areas is crucial. Application in real life situations is considered to be an important aspect in deciding which targets or features of interventions are focused on.

"We look at the functionality of the ones in therapy, trying to teach them so you know. Some of the ones that come up in the National Curriculum are never likely to come up again."

SLT focus group 1

"I tend to skip to narrative then and things like specific grammatical structures umm I'll have an attempt at tidying them up a bit, but I don't actually focus on them too much I think if you've got to 11 if its something about actually being able to talk to people rather than me say actually you've not got -ed on the end of that."

SLT focus group 3

Most significant deficit

Therapists described choosing therapy targets in relation to where the children's most significant area of difficulty appeared to be. Assessment or error analysis was reported to be used to indicate these areas.

"It's about identifying the area that you feel has got the most significant difficulty and targeting your therapy there."

SLT focus group 1

"..then prioritise what would either the most significant deficit or or the one that you think you might actually be able to help them with (laughs)."

SLT focus group 3

"If you look at the sort of errors that the child made if you've got a framework in your head to interpret those errors then that helps you work out maybe where you think the breakdown is and then, so you go in and support that."

SLT focus group 1

National Curriculum vs. Core concepts

It emerged that there was some conflict for therapists, between choosing to teach vocabulary relevant to the National Curriculum (as well as topic work), and teaching 'core' or basic vocabulary concepts. It was clear, however, that therapists selected vocabulary targets with these in mind;

“For your language delay ones pre-teaching curriculum vocabulary... works really really well and it's quite easy, you know, support staff and teachers to do that, but it's when the gap is quite big between their level and the level of their peers working at.”

SLT focus group 3

“You're encouraged to follow the curriculum topic being taught in class room and the children, and the children have such massive gaps at the basic level, and I am frustrated by the fact that because of the pressure of the National Curriculum it would be more beneficial for the children to go back and focus on the basics.”

SLT focus group1

7.7.2 Core components or approaches of interventions for SRLI

Core components of interventions for SRLI were identified across the areas of deficit that SLTs address. These core components, presented in Table 40, appeared to be considered fundamental to work in SRLI populations.

Active pre-teaching

Practitioners described pre-teaching and priming children, so that they have familiarity with concepts before they are introduced in a 'normal' context. The notion of active pre-teaching was raised a number of times in relation to vocabulary development.

Participant 4: and its important to do pre-teaching if you can, and the whole thing about vocabulary is, and we always say this to start with, is active pre-teaching, so you can't just mention the word,

Participant 1: yes

Participant 4: it has to be actively talked through strategies and it has to be pre-taught, so they can get that.

Focus group 1

However, priming for listening and remembering was also used more broadly:

"I'm going to say 4 things to you and I want you to remember the last one, or the first and second you know building it up that way but pre-priming them"

SLT group 4

Child enjoyment

Therapy activities were described in terms of being 'fun' or 'motivating'. Child enjoyment appeared to be regarded as an important feature for ensuring engagement in the intervention

"If the children aren't having fun they're not going to engage with you."

SLT focus group 1

"Computer games and umm perhaps use of power point rather than mind maps anything that engages the child and is more motivating really."

SLT group 4

Hierarchical

A hierarchy emerged in which intervention activities were administered. This hierarchy is based on increasing the complexity of activities. Common approaches include increasing the information load, using more challenging concepts/tasks and withdrawing support. The use of graded exercises was also reported to be used to see how successful a child is at learning or applying a taught strategy.

"Starts off with maybe just repeating maybe two or three words, or two or three digits and it goes up to maybe five or six and some, it will be repeating related words which is easier because of umm all the semantic work and then it will have unrelated words which is a heavier memory load, and again the directions will start off with simple one, just one direction to maybe three or four."

SLT focus group 1

"You can start off with it non-verbally, so that they're sorting pictures by the category to do it visually... a far harder task, is for them to actually name items without any visual prompt ... start off purely non-verbal."

SLT focus group 2

“The visual support would be there to start with and gradually you reduce the level of visual support so they're only actually understanding the verbal.”

SLT focus group 1

Feedback

Therapists described giving feedback to the children about how they were performing in an intervention activity. Feedback was described in terms of being specific about their success or failure to complete an activity.

“..what they're doing that made them successful so ahh, you know, I really like the way you looked at the banana and oranges ”

SLT focus group 1

Tailoring to child

Practitioners described how they tailored the interventions they adopted to the child they were seeing. This could be seen in a number of different ways; in terms of assessing the child to see where their particular area of difficulty lay, establishing which strategy worked best for the child, and making things personal to them by linking it with their own environment.

“Then the child works out which is most effective for them, and then we would give them a little picture card to remind them that's their strategy.”

SLT focus group 2

“We have umm, so, personal dictionary sheets.”

SLT focus group 2

“We often make up books for the children so we might be working on colourful semantics but we take photos of them doing the sentence if you like, or their friends.”

SLT focus group 1

Making connections

Practitioners described 'making connections' or linking things together, in a number of ways. There was a particular focus, as part of vocabulary teaching, on categorising items semantically as well as linking the semantics with the phonological features of words. However, making connections was discussed in a broader sense as well; in memory activities as a strategy for helping to remember or describe something, and in grammar in linking aspects of a sentence together.

"Its also very important that we do that connected stuff because these children are so good at filing things away in little boxes and they are never connected together, particularly RLI children, things do just seem to be filed in little boxes."

SLT focus group 1

Multi-sensory approaches

"It makes logical sense if you're 'auditorally' poor why persist on using words to explain other words, you need to use other things to explain other words, as well as, words."

SLT focus group 3

An emphasis emerged on using multisensory approaches to enhance the SRLI children's understanding and learning. This included incorporating auditory, visual, tactile and physical/ motor skills in interventions. Visual materials in particular were emphasised with great frequency across groups. Visual materials included the use of pictures, photos and written words. Visual methods were also described in terms of aiding the children to conceptualise topics. For example therapists reported using mind mapping for assisting word learning, and shape coding and colour coding for assisting grammar.

The use of objects seemed to play a role for word learning, in particular, therapists described their role in adding a tactile or kinesthetic aspect to learning. Other kinesthetic aspects to tasks were also found to be popular with clinicians. So for example in word learning a 'word path' might be created that the children had to move along or the child might be required to perform an action related to a word they were learning.

“Actually ask them to carry out umm auditory tasks where there was a physical element to it as well so to jump to the chair and hop to the door, so they actually have to do something physical as well.”

SLT focus group 1

“Physically getting him to do things getting him to understand the concept physically then... using objects and pictures.”

SLT focus group 1

Finally, since language is most commonly presented through auditory channels, inevitably interventions predominantly use the auditory modality. Interventions that focused specifically on the ‘auditory aspect’ were addressed in the earlier section on phonological awareness (7.3.2.).

Practice

Repetition and practice were mentioned as important aspects of all interventions. This was rarely quantified, but rather spoken of in terms of as much as was necessary for the child to learn or grasp the particular word, grammatical feature or concept being taught.

“Well it’s just plenty of practice really..”

SLT focus group 3

“...and also the importance being they have to say it several times, we always have (the) first one is always ‘give us five’.”

SLT focus group 1

7.8 Influences on target selection and intervention delivery

There were two key areas that emerged from the focus groups that appeared to influence the delivery of interventions in specific ways. These were the age of child who was receiving the intervention as well as whether the interventions were conducted in the community, or within a language resource space. These differences are detailed below.

7.8.1 Age of the child

“But they all need a different approach don't they?”

SLT focus group 3

The emergence of the theme in the core intervention components ‘tailoring to the child’ demonstrates that different children are seen to require different approaches depending on their area of difficulties and to make interventions relevant to their own context. While most of these differences are specific, child-dependent differences, there was one variable in children that followed a pattern across focus groups, and that was the age of the child.

For younger children therapy was described as more play based. In memory activities, for example, therapists said they would apply games such as the ‘shopping game’ or ‘I went to the market’. There was also an emphasis on the use of basic vocabulary concepts for younger children. Crucially, there also appeared to be more emphasis on impairment based activities for younger children.

“Particularly with the younger ones sometimes, actually they really need to know some really basic vocabulary, because they are not comprehending basic things in classroom.”

SLT focus group 1

Older children were taught to reflect more on their learning ability, and so strategies were more explicitly taught:

Speech therapist 3: *I do it with my four or five year olds... the basic ones (strategies) the rehearsal and umm all the good listening approaches all the very early strategies, but when you get to visualisation and umm using those higher level cognitive skills it's..*

Speech therapist 5: *Bit older*

Focus group 1

However, there does not seem to be a set formula for selecting age-based activities:

“With the SLI children its not age it would be when they can understand what you're saying to them.”

SLT focus group 3

7.8.2 Interventions in the community vs. language resource space

Differences emerged between how practitioners described therapy approaches in a mainstream or community based context, to those in a language resource space. Community based intervention was described as being more pressured by time constraints, and therapists reported that they felt that this affected their ability to thoroughly assess children's needs as well as to plan and deliver therapy. Perhaps, as a result of this, more strategy work was reported in relation to community work.

“Your mainstream caseloads you know you would intend to do a therapy programme but you'd also put, you know the strategies in, because usually they haven't got the support either, in the classroom that the resource children have... it has to be mainly strategies.”

SLT focus group 3

“This kind of nitty gritty stuff, I, associate very much with work in a language unit really; when you've got the time and you're working with very closely with other colleagues and you, it's a luxury really.”

SLT focus group 2

“There's that sense then when you are working in the community that you have to be very superficial about what you do, and I think it's very frustrating.”

SLT focus group 1

Language units by contrast, were described as environments that allowed SLTs to carry out more thorough assessments and plan interventions that targeted more specific areas of difficulty.

“I feel in language units we are very lucky because we probably have more opportunities to carry out a more thorough assessment before we start intervention programmes and it's difficult I think sometimes in community clinics where you've only got sometimes 30 minute slots to carry out a thorough assessment.”

SLT focus group 1

“They can have that intensive one to one therapy (in language unit); you would do a more specific therapy programme.”

SLT focus group 3

7.9 Theory behind intervention approaches for SRLI

The following section describes the theory provided by therapists for the interventions they use for children with SRLI. First, the rationales that therapists provided are presented and the extent that their rationales referred to theories of impairment is discussed. Therapists' description of how interventions create change are then examined. Finally, the interventions that therapists provided the clearest theoretical descriptions for are described.

7.9.1 Rationales for interventions

Therapists appeared to find it difficult to provide rationales for their interventions. Interventions tended to be explained in terms of 'this is the child's area of difficulty (or gap in their knowledge) so I'm working on that'. An example of this type of rationale is provided below:

“There's all the information around the word that we know these children need to have, based on the theory that they have gaps and that they're missing bits of information, filling in the information for them so that they can learn the words that we want them to learn and then learn new words in the future.”

SLT focus group 3

For some practitioners, it was evident that though they had some rationale for their intervention, they had difficulty articulating it. For others, rationales were confused and a multitude of reasons were cited for an approach. An example is provided below in relation to an intervention for word learning:

“Umm it's sort of given another peg almost to hang that word on to give them more knowledge about that word, to help them with word finding. Another way of sorting.”

SLT focus group 1

Further lack of clarity of rationales could be seen when similar approaches seemed to be being used for different purposes. An example of this was work on digit spans, an SLT from one focus group felt they could improve this, while another suggested that digit span work is not necessarily aimed at the impairment, but rather the child's listening/attention skills:

“Yeah I think you can improve their digit span by working on it, at least giving strategies like using fingers, visualising.”

SLT focus group 3

"It gets them to pay attention doesn't it rather than help their understandingpay attention".

SLT focus group 1

Work on sequencing was also described with various purposes, with most practitioners relating it to enabling children to correctly order their thoughts, or to establish beginning middle and end. However, another practitioner described it as a method for encouraging visualisation:

"Working on things like I suppose sequencing and retelling stories in all of that as well to help their ordering and things like that everyday."

SLT focus group 1

"Sequence their thoughts in a logical order and to be able to get out in the right sequence so what happens first what happens next what happens last, so it sort of then helps with their story retelling, that there's a beginning middle and end."

SLT focus group 3

"It can be used to encourage visualising, you know if you have some simple sequences you know like the child getting out of bed and the child having breakfast or something, you can say visualise what happened between those two pictures."

SLT Group 4

It was evident though that some therapists appeared to be aware that they found it difficult to explicitly reflect on their own rationales:

"We came up with a whole side packed with interventions and then we thought, oh, what about the rationale? You know it wasn't obvious each time well I do this because of that, I do this because of that, it was sort of this is what I do, seems to work.."

SLT group 4

Many practitioners, instead of referring to explicit theory, rationalised their approaches with their own experience. Rationales were, at times, given in terms of 'because it works'. There was also some suggestion that they used their own judgement and experience to inform this rationale:

"I know in terms of sort of research base for that programme, I'd only ever read one paper in Child Language Teaching and Therapy which wasn't particularly positive about it umm, but my clinical judgment led me to believe that umm, I think for children with her type of profile that it was a useful intervention."

SLT focus group 1

A number of practitioners hinted at other justifications for why they were not explicitly referring to theory. These explanations appeared to be related to the complexity of language in terms of the multifaceted nature of learning, and also to a lack of a strong evidence base.

"How to separate all of these things out?...I don't think any of us really felt we really got to the bottom of what we were actually working on or being able to record what we worked on and how effective that had been".

SLT group 4

"We just don't really know enough about it really so in a way we're just trying things out and finding something that works and trying it again, but it's not coming from any strong evidence base."

SLT group 4

Although it appeared to be the case for only a minority of therapists, some also described a lack of time to reflect to on rationales:

"My case load is now watered down its very hard to give any decent evidence really, I don't know what I'm doing and why I'm doing it! To be honest ...because we're very busy rushing on to do the next thing, giving things for other people to be doing umm that it's got to be things that are, suitable to be handed over that others are going to be able to carry out."

SLT focus group 3

7.9.2 Theory of impairment

There was variation in the amount that practitioners referred to explanations of language impairment to explain their practice. Few mentioned the work of specific authors or theories except in the context of those that had developed the intervention or technique. However, some did; the Stackhouse and Wells (1997) model of speech processing was referred to as was Garret's (1975) model of sentence production. Focus group one, in particular seemed to link their interventions more with explicit theories in terms of models of language.

7.9.3 What changes are expected/ how change is to be achieved

An underspecified aspect of theory seemed to be in SLT's description of how working on a particular area of difficulty achieved change. There appeared to be a general assumption or description, that if you practice or work on an area of difficulty, it will improve. There was not, however, clear descriptions of how interventions improve or change deficit(s).

"There's the taking heed of what we know to be right in that we should be actually getting these children hands in on things and touching things to learn words"

SLT focus group 3

When probed about how they 'know' it to be right:

Participant 3: *it's from experience I'd say would you not?*

Participant 5: *No no no, but I... yes I wouldn't be able to quote you what that was out of, but that's what I was told when I was at (names poly) and that's what the teachers are taught.*

7.9.4 Interventions with strong theoretical underpinnings

An aim of the research had been to identify if there were any interventions with strong theoretical underpinnings. There were no clearly identifiable interventions with strong theoretical underpinnings. An exception was the theoretical descriptions for colour and shape coding in grammar, provided in focus group 1, by a therapist with specialist expertise on these approaches:

" I think the shape and colour coding is different because it actually taps into the umm underlying semantic, syntactic relationships the actual meaning levels of grammar rather than just umm things like 3 person singular and past tense, ... colour coding and shape coding actually taps into the relationships and semantic relationships between the words and what that actually means ... although some of the shape coding also does, does do the sort of more surface morphological type of processing.."

SLT focus group 1

7.10 Concurrence and divergence across focus groups

The iterative nature of the focus groups, allowed for ready examination of areas of agreement and disagreement between the groups. The groups were in different geographical locations so regional differences were anticipated; the first and last groups, however, included participants from a range of locations.

In spite of the variations between practitioners in terms of where they trained and worked there was a great deal of similarity in their approaches. Very similar themes arose across focus groups and few new codes were required to be created after the first two groups. Many of the areas of concurrence have been emphasised throughout the results sections, in terms of the core components and the key targets that participants appeared to select. Similarities in both the interventions used and theory were noted by the participants themselves in focus group 1:

Participant 4: *I think it's so amazing that we come from 3 different areas and yet we are all saying very similar things*

Participant 3: *similar things*

Participant 4: *it's quite affirming for us actually you know where we got to in our theory and our practice is not way off*

Focus group 1

There were, however, some areas of divergence. A difference has already been noted between the focus of interventions depending on whether the practitioner conducted interventions in a language unit or the community. However, additional areas of divergence emerged that appeared to be related to personal experience of the clinician or the resources available to them. The areas where divergence seemed most apparent were for specific published interventions and interventions that required training. For instance, Paget Gorman signs, Visualising and Verbalising and Johansen sound therapy were recognised by some members of some focus groups, but many therapists were unfamiliar with these interventions.

"The trouble is, is that no one else uses it (Paget Gorman) other than those - I think they use them in the residential schools as for children with language disorders."

SLT focus group 3

There were a few interventions that therapists had heard of or were familiar with, but some had chosen not to use. Some practitioners did not provide explicit reasons for not using a particular approach, but would report that they had 'dabbled' with an intervention, or heard of it but chosen not to use it. It seemed that there was a degree of personal preference for some approaches. Some that provided reasons said they perceived an intervention to be complex and thus chose not to use it. This complexity sometimes appeared to relate to their own understanding or use of an intervention, for example, regarding shape coding:

"I'm all for presenting these differently but I sort of look at (shape coding) and think AAH!"

SLT focus group 3

“(shape coding) very complicated! I find it confusing”

SLT group 4

However, complexity was also mentioned in relation to the child, as one practitioner described the method visualising as difficult for SRLI children:

“I can't work out what goes on in their heads of my language disordered children I don't, you know something like that (visualising) is too complicated for them because it... I mean..what are you really thinking in there?”

SLT focus group 3

7.11 Discussion

The analyses of the focus groups has established and specified the details of SLT perceptions of interventions for SRLI. Key factors in selecting targets for SRLI as well as components of therapy that appear to be ‘core’, have been identified. The focus groups have also provided insight into the rationales of SLTs in relation to SRLI interventions. In the following section, the findings of the focus groups will be discussed in relation to the research aims; additional findings from the focus groups are then addressed. The strengths and limitations of the focus groups are discussed in light of the overall findings of the thesis, in the final discussion (Chapter 8).

7.11.1 Which therapies/activities do therapists use for children with SRLI in relation to the deficits identified in the systematic literature review?

It was noted at the start of this chapter that the findings would not be presented in relation to the areas of deficit identified in the SLR. Instead, thematic analysis found that interventions could readily be categorised in other ways. This section considers first the explicitly impairment based interventions in relation to areas of deficit identified in the SLR of Chapter 4. It then discusses the more general assistive approaches that emerged from the focus groups and how these can be related to the International Classification of Functioning, Disability and Health framework (ICF; WHO 2001).

Impairment based interventions

SLTs identified a range of interventions in relation to three of the areas identified in the SLR; word learning, grammar and short term and working memory. However, the themes that emerged from SLTs included, in addition to these areas, verbal reasoning and phonological

awareness. Further, the broad category of 'information processing' did not emerge as an intervention theme.

The emergence of interventions that targeted areas of impairment that were not identified in the SLR, suggests that SLTs priorities for intervention are not the same as those identified in the literature. The results are perhaps indicative of a gap between the types of deficits that are of interest to researchers and those which practitioners assign importance to. The findings are reminiscent of comments by Law et al (2008) who noted:

“the gap that exists between the understanding of language-learning difficulties as characterised by those with an interest in the deficit in its own right and those with a more general interest in what can be done to relieve the impact of that deficit.”
(Law et al 2008, p. 15)

An important finding from the focus groups was that SLTs do not appear to view the areas of deficit as independent, but rather overlapping. This was demonstrated in the descriptions of interventions that simultaneously targeted a number of areas of impairment, as well as descriptions of improvement in one area of impairment impacting on another. This perspective can be seen to be in line with current thinking about comprehension processes, where multiple sources of knowledge interact (Harrington 2001). Although these types of intervention do not map neatly onto the areas of impairment identified in the SLR, they perhaps reflect the fact that linguistic processes do not act independently, and that theory in this area is complex.

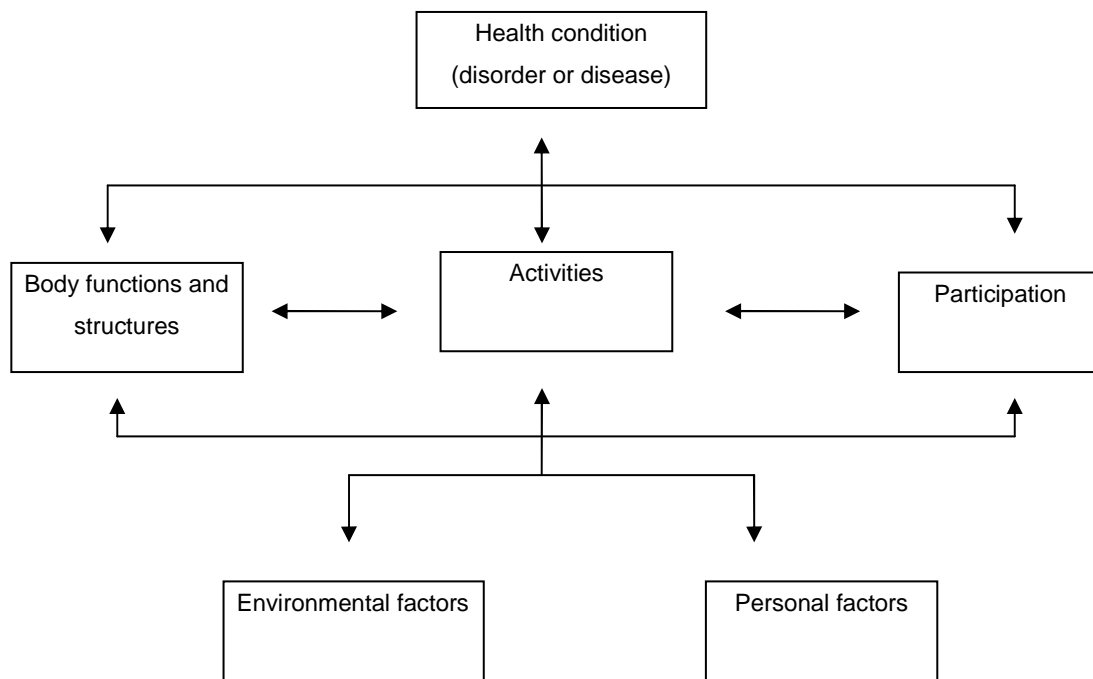
Assistive approaches

The areas of impairment presented to SLTs in the focus groups can be seen to fit with the medical model of disability. An early definition of the medical model describes it as a scientific process that moves from the recognition of symptoms (of a disease) to etiology and pathology and consequently rational and specific treatment (Kety 1974). Despite practitioners being presented with impairments (or what could be classified as symptoms of a disease), it was readily apparent that many intervention approaches that they raised target broader aspects of difficulty. Although some of the assistive approaches targeted specific areas of impairment identified in the SLR the environment centred approaches, in particular, appeared to be aiming to improve functioning or to support comprehension processes more generally.

Many of the assistive focused approaches that emerged can be seen to fit with the International Classification of Functioning, Disability and Health (ICF; WHO 2001). Figure 10 presents a graphic representation of the ICF conceptual framework. The World Health

Organization's ICD-10 (WHO 2003) has traditionally been the global standard for classifying health-related diseases. However, it received criticism for not commenting on the functional status of diseases and disorders. As touched upon in Chapter 2 (section 2.1.3.), to complement the ICD-10, the ICF was developed and approved in 2001, demonstrating a shift in paradigms in how disability was viewed from the medical model to what Simeonson (2003) describes as a biopsychosocial model (p.3). The focus has moved from etiology and treatment of the individual to disability being a consequence of the individual's interaction with their environment.

Figure 10 International Classification of Functioning, Disability and Health (ICF redrawn)



The ICF considers a number of factors that might contribute to an individual's health status (WHO 2001). In contrast to the ICD-10, domains are classified from body, individual and societal perspectives and since functioning occurs in context, the ICF also includes environmental factors. The ICF manual contains hundreds of codes covering all aspects of human functioning, disability and health. As many are not relevant to certain people or conditions "core sets" of codes have been created relevant to different fields. A set of ICD codes applicable to the classification of communication disabilities was first developed by Simeonsson (2003) who identified 54 applicable codes; addressing Body Functions and Structures (30), Activities and Participation (11), and Environmental Factors (14). Other authors have looked at more focused aspects of communication disability, including Washington (2007), who identified a core data set for children with SLI, and Westby (2007) who also indicated ICF codes relevant to children with language impairment. It is noteworthy that a child and youth version (The International Classification of Functioning, Disability and Health Children and Youth Version ICF-CY, World Health Organization, 2007) of the ICF was subsequently created when it became apparent that a classification system based upon static concepts of functioning was not fit for the development of children (McLeod and Threats 2008).

Many of the interventions for children with SRLI that emerged from the focus groups can be seen to fit the ICF framework and the codes proposed by Simeonsson (2003) and Washington (2007). The cognitive and linguistic impairments presented to participants predominantly seem to come under the body functions and structures domain, for example, B144 Memory functions, B160 Thought functions and B164 Higher-level cognitive functions. However, the interventions that emerged from the focus groups seem to relate to other ICF domains; including activities, described as the execution of actions, and tasks and participation, defined as involvement in a life situation.

Specific ICF 'activities and participation' codes that relate to the independent codes gleaned from the focus groups include D11 listening, D135 rehearsing and D160 focusing attention. Broad speech and language therapy aims could be argued to be inherently linked with activity and participation, since the activity of participating in conversation directly relates to improved speech or language. For instance, the ICF activity codes D310 Communicating, receiving spoken messages and D315 Communicating, receiving nonverbal messages, could be regarded as broad aims which underpin speech and language therapy in SRLI. There were areas of ICF coding suggested by Simeonsson (2003) that were not evident in the focus group data, for example, D140 Learning to read and D145 Learning to write, however, this was due to participants being asked to focus on verbal communication.

The theme 'empowerment' that emerged from the focus groups also seems to be relevant to activities and participation, though this does not explicitly appear in the ICF coding. The

emphasis on SRLI children taking responsibility for their own learning, as well as giving them confidence and strategies for doing this seems to be enabling them to engage in activities and participation in contexts where the speech and language therapist is not present to support them.

The SLTs suggested many contextual factors raised by the ICF, including environmental factors. The ICF describe these as factors that comprise the individual's physical, social, and attitudinal environment. Some of these can be seen to fit with the environment centred, assistive approaches, theme that emerged from the data. In particular, the use of a range of visual materials can be seen to fit codes E125, products for communication as well as E130, products for education and E1351 assistive products for education (note these are deemed core codes for communication impairments by Simmeonson (2003) but are not recorded for SLI by Washington (2007). Other relevant codes include E25 sound (e.g. reduction of noise), E3 support and relationships and E4 attitudes (e.g. use of adult altered language).

The other contextual factors the ICF considers are personal factors, which are described as those that relate to the background of an individual that are not part of their health condition. It emerged from the focus group that personal factors are certainly considered in delivering SRLI interventions as is demonstrated by the core component, tailoring to the child. The phrase "but they all need a different approach don't they" (section 7.8.1), demonstrates that therapists appear to adapt their approach in terms of the needs and progress of the child and other aspects, such as age.

It is interesting that interventions that the SLTs described could be linked with the ICF given that exploring interventions in relation to activity and participation was not an original aim of the research. It suggests that SLTs are adopting a socially oriented view toward interventions. This reflects the findings of Enderby and John (1997a, b), that the majority of SLT's treatment time is spent working on goals that are not aiming to remediate the deficits. It also supports the suggestion by Law et al (2008) that SLTs are more concerned with the impact of impairment, or the functionality of language use, rather than evidence of deficit per se.

The fact that some of the assistive interventions are environment centred, supports the claim by Pickstone et al (2009, p.76) that SLTs have become "increasingly involved in work to change aspects of the child's environment to improve language development". However, it contrasts with reports elsewhere that traditionally SLTs have tended to focus on body functions when assessing children with communication impairments (McLeod and Threats 2008). McLeod and Threats (2008) found in a survey of 198 SLTs, Body Functions was the dominant domain (80%) considered in the assessment and diagnosis of speech impairment.

Similarly, an examination of 22 speech interventions found, of the intervention approaches, all could be categorised using the Body Functions domain “Articulation functions”. A plausible explanation for the difference between the present findings and the study by McLeod and Threats (2008) is that there are differences in approach between interventions that target speech impairments, and those that target language impairments.

One of the key areas identified in the assistive focused interventions, ‘metacognition and metalinguistic’ was also identified in the survey study by Law et al (2008). They classified all interventions under either ‘skills acquisition’ or ‘metacognitive activities’. The fact that the present study, as well as the Law et al (2008) study, has identified these as key areas of focus for interventions, confirms that these are popular approaches to intervention in SRLI. However, the present study has additionally identified a number of other types of assistive focused interventions. Interestingly, however, these findings do not appear to be supported by Clarke and Collins (2007). In an audit, of caseloads in one Primary Care Trust, Clarke and Collins (2007) found that only 6% of 264 children were reported to be receiving intervention that treated functional communication strategies, which compensated for language difficulties. However, a larger percentage (34%) was reported to be receiving intervention that focused on environmental change (which inherently includes a functional focus). Differences may be, in part, because the majority of these children were preschool and key stage 1-2 age, where it is perhaps less common to teach functional communication strategies. These plausible differences in approach at different ages are discussed in more detail in section 7.12.2.

7.11.2 Do SLTs have common therapy approaches for interventions for children with SRLI?

The findings identified both core approaches that underpin therapy methods for SRLI as well as factors that appeared to be crucial in selecting targets for this population. The emergence of these ‘core approaches’ for SRLI demonstrates that there are common therapy approaches in interventions for children with SRLI.

The finding that there are common therapy approaches for interventions for children with SRLI is interesting, since it contrasts with findings with the Law et al (2008) survey study, where practitioners presented with ‘highly differentiated’ descriptions of interventions for receptive language. The reasons for the commonality in approaches found in the present study, that were not found in the survey study by Law et al (2008), is likely to be due to the detail of information gathered. In the focus groups, on a surface level, practitioners’ cited a large range of resources and targeted a range of aspects of comprehension. It was only when thematic analysis was conducted, that overarching similarities in approaches adopted by SLTs emerged. The iterative approach to the focus groups further confirmed the

consistencies in approach that SLTs described.

7.11.3 What are speech and language therapists' rationales and underlying theory for the interventions they use with children with SRLI?

Difficulty in describing rationales

There was considerably variability in the degree to which SLTs provided rationale for the intervention approaches they described. SLTs appeared to find justification for their intervention choices difficult. There are a number of plausible explanations for this, including a lack of evidence of efficacy of interventions, the implicit nature of SLTs knowledge or because they fail to reflect on the theory behind their practice.

For some practitioners, lack of rationale seemed to relate to the lack of evidence for the efficacy for interventions. For example, it would be reasonable to justify using a specific intervention with the premise that it should be effective, as it has been demonstrated to be effective in a previous study. However, it has been established that there is little evidence of efficacy of interventions for receptive language impairment (Law et al 2010, also see Chapter 5). The preference for using personal experience over research evidence that emerged from the focus groups might therefore be a result of the limited evidence base to support intervention approaches in SRLI.

For other SLTs, it was apparent that they had a well developed theory of therapy but are not consciously aware of the 'rules' to which they adhere. The tacit knowledge and theories of practitioners has been noted previously by Law et al (2008). The best professionals have been described as knowing more than they are able to put in words (Schon 1983). That so many common approaches emerged, with a relative dearth in coexisting explanations suggests that, in many instances, this was the case. It was noted in Chapter 6 that craft knowledge is difficult to access. Judgment and decision making that underlie observable activities have been described as the most difficult features of practice to define and articulate (Freeman 2004, p. 483). Though the focus groups allowed an engaging environment that was hoped to tap some of the tacit knowledge of SLTs, perhaps some of the inherent difficulties in accessing this knowledge were not overcome.

For a minority of therapists it appeared they had not reflected on their rationales for interventions. This appeared to be the case for those who worked in the community in particular. This is of concern, since a lack of reflection on interventions and their rationales suggests that therapists are not adhering to one of the tenets of evidence based practice, in

“integrating the best available external clinical evidence” (Sackett et al 1996, p.71). Further, it suggests that clinicians are not maximising their clinical expertise and prior knowledge to inform their decisions, another core component of evidence based practice (Roulstone 2010). The downstream effect of this is likely to be inconsistency in the service that children with SRLI are receiving.

Rationales provided

It was found that a range of rationales emerged from the focus groups. This corroborates findings from the survey study by Law et al (2008) where a ‘wide range’ of rationales were cited. Most practitioners described using their own judgement and experience to inform therapy rationales. The finding that intervention rationales were rarely described in relation to theories of impairment is interesting. This is consistent with the findings of Law et al (2008), where theories of deficit were described as playing a relatively small role in speech therapy practice. Practitioners instead referred to theories of practice. Law et al (2008, p.12) suggest that a reason for this is “postulating underlying theories often do not speak directly to practice.” The focus groups were conducted in the hope that by explicitly linking evidence of deficit to intervention approaches, theoretically motivated explanations for these interventions might emerge. However, it is apparent that expert SLTs, too, find it difficult to close the gap between theory of impairment and theory of therapy.

7.12 Other key findings

Other findings that emerged from the focus groups, not explicitly related to the research aim, are considered in the following section. This includes the use of resources, interventions in relation to children’s age, interventions in the community vs. the language resource units, and finally, areas of concurrence and divergence across the focus groups.

7.12.1 Use of resources

The wide range of resources that therapists reported demonstrates the breadth of resources that are drawn upon in practice. The finding that Derbyshire Language Scheme (Masidlover and Knowles 1982) is popular correlates with findings elsewhere; in a large survey study conducted for the Better Communication Research Programme, this was found to be the most frequently reported resource (Lindsay et al 2011). It is interesting that the programme that this resource supports is so popular since there are no known studies examining its efficacy on receptive or expressive language impaired populations. It is noteworthy that there is little evidence of efficacy in the use of the programmes that SLT resources support in general. However, the way that therapists described using resources suggests that they are pulling on certain aspects of a resource or their concepts rather than following set

programmes. Though there was a wide range of resources mentioned in the focus groups, this therefore does not necessarily represent a range of disparate approaches. Instead, broadly similar approaches seem to be used with a range of materials. The identification of core components across SRLI interventions appears to confirm this suggestion.

7.12.2 Interventions in relation to children's age

The finding that SLTs described that their work with older children involved encouraging them to reflect on their learning ability, as well as the explicit teaching of strategies, is consistent with findings from the survey study by Law et al (2008). Law et al (2008) reported that therapists' description of interventions appeared to shift from a 'skills acquisition' orientation for younger children to a 'meta-cognitive' orientation for older children (7 years and above). In other words, SLTs appear to move away from teaching specific linguistic behaviours towards teaching children strategies for thinking and using their language.

A plausible reason for the shift toward strategy-based approaches could be due to the ability of older children to reflect more on their own language learning. Fisher (1998), for example, notes that from age four to nine there are significant developments in children's awareness of themselves as thinkers and learners. Flavell et al (1979) argue that bringing learning to a conscious level, helps children gain awareness and control or mastery over the organisation of their learning,

An alternative explanation is that SLTs are focusing more on providing resources for older children to manage the consequences of their impairment, due to a belief that it is more difficult to change the impairment in this group. For instance, there is strong evidence that children with language impairments who reach school age are likely to have persisting difficulties (Stothard et al 1998; Johnson et al 1999). There are also universally known theories about the plasticity of the brain in younger children, and therefore perhaps a corresponding belief that there is a greater likelihood that deficits can be 'fixed' in younger populations.

7.12.3 Interventions in the community vs. language resource space

Differences were found between those interventions that were reported to be used by practitioners who worked in language units and those that worked in the community. Practitioners who worked in the community reported that they had less time to work on more specific areas of difficulty. Linked with this issue is the recent shift toward a consultative or indirect model of service delivery (Law et al 2002), already common place in many community settings. The consultative model refers to SLT work being delivered by

other appropriate people who work with the child. Several studies (Law et al 2002; 2008) have reported that practitioners are concerned about the application of this model of service delivery, and that most prefer a direct model of service delivery, that is commonly found in language units (Law et al 2008). A recent RCT that examines the efficacy of an indirect service delivery model (by SLT assistants) and SLTs (Boyle et al 2007) concluded that well-trained, well-supported and well-motivated SLT assistants can act as effective surrogates for SLTs in interventions for primary language impairment. However, a cohort study (McCartney et al 2011) found that the effectiveness of an indirect approach in practice looks less favorable. The present findings that community based practitioners described being less able to do thorough assessments, reflects SLT's concerns with a consultative service model.

7.12.4 Concurrence and divergence across focus groups

A large degree of concurrence was found across the focus groups. Given that SLTs were practicing in a range of geographical locations, and had trained at different universities, this finding is encouraging. It indicates that there are consistencies in the interventions that children with SRLI receive. The focus group also found, however, that there were some areas of divergence, particular in the use of published interventions, interventions that required training or interventions that were seen to be complex. It is likely that these sorts of differences are partly driven by the budgets/decisions of different Trusts. It should not be assumed that these difference are specific to SRLI, since the government commissioned Bercow report (2008) highlighted inconsistencies and lack of equity in SLT services in general, describing it as a "postcode lottery" (p.59).

7.13 Conclusions

Expert SLTs in the focus groups were able to identify a range of interventions in relation to the areas of deficit identified in the SLR. However, inductive analysis revealed different themes and it was evident these were not the only areas of focus for SRLI interventions. SLTs described interventions that were working on other areas of impairment (in particular, verbal reasoning and phonological awareness) as well as interventions which target a number of areas of impairment simultaneously. Further, many of the interventions that emerged were found to be assistive focused. These assistive interventions appeared to focus on the impact of impairments on participation and functioning, and many could be linked with ICF codes. The elucidation of specific intervention approaches is useful since it has been noted that therapy in SRLI has been "often under specified with too little detail to replicate" (Law et al 2008, p.15).

In addition to detailing a range of interventions for SRLI, the focus groups were able to identify core approaches in interventions for children with SRLI, as well as key factors that they consider in selecting intervention targets. The emergence of these core approaches, and key factors indicates a large degree of concurrence among SLTs in their approach to intervention for SRLI.

SLTs were found to have difficulty providing rationales for interventions for SRLI, producing a range of explanations for their approaches. SLTs rarely provided rationales in light of theory of impairments. This is perhaps not surprising given the discrepancies identified between the areas of deficit identified in the SLR, and the focus of interventions in the area. This work illustrates the difficulty in closing the gap between theory of deficit and intervention. It is evident that SLT's priorities for intervention in SRLI are different to the areas of impairment that have been the focus of behavioural studies within this population. This has implications in the development of interventions in SRLI and suggests that future intervention studies should incorporate the broader aims of SLTs in improving activity and participation that the assistive based approaches, they describe, appear to reflect.

CHAPTER 8 Discussion

8.1 Introduction

This chapter considers the findings of the research in terms of its overall contribution to evidence and theory in interventions for SRLI. The major contributions of the systematic review (8.2) are discussed as well as how the results compare with recent research. The findings from the focus groups (8.3) are then considered, and are used to inform a model of interventions for SRLI. The findings are also discussed in relation to the areas of deficit identified in the SLR and their contribution to developing a theory of therapy for SRLI interventions. Both the results of the systematic literature review and then the findings from the focus groups are drawn on in the discussion of mechanisms of change (8.4), an important part of theory development for SRLI interventions. These major contributions are considered in the light of the original aims and objectives (8.5). Key areas for future research are then suggested (8.6). Finally, the strengths and weakness of the systematic review and the focus groups are discussed (8.7), and conclusions from the project as a whole are drawn (8.8).

8.2 Findings from the systematic literature review

The objective of the SLR (Chapter 4) was to identify the cognitive and linguistic deficits in children with SRLI. The SLR identified key areas of difficulty for children with SRLI. However, it is clear that SRLI is an area that is theoretically complex. Though specific areas of deficit were identified, it was noted that there is an interactive component to the areas of deficit, therefore they cannot be viewed entirely independently.

A key area of deficit for children with SRLI identified in the SLR, was in the comprehension of a range of grammatical contrasts and structures, particularly tense and plural inflections. Difficulties with word learning were also identified, with studies finding that children with SRLI were less effective at learning words after brief encounters and to infer word meanings from the syntactic context. In addition, children with SRLI were identified as having difficulties with information processing, particularly in short term and working memory tasks. Children with SRLI were also found to have deficits in the speed at which they are able to process information; in particular, it was found that they have slower word recognition times. The SLR concludes that the information processing deficits in children with SRLI play an important role in their associated difficulties with word learning and in their comprehension of grammar. The review was the first of its kind to systematically examine the cognitive and linguistic deficits in SRLI; it therefore provides a unique overview of the deficits in SRLI.

Perhaps one of the most important issues to emerge from the SLR, was the complexity of the theory and related evidence. The result is that the evidence of deficit in SRLI is difficult to interpret. Studies were found to examine a number of competing and overlapping theories of deficit, with different task types. In addition, although attempts have been made to examine isolated areas of deficit, it is clear that linguistic processes do not act independently. This reflects the current constraint-based approach to language processing that was described in Chapter 2. Multiple knowledge sources are thought to interact simultaneously during comprehension; syntactic, lexical, pragmatic and world knowledge (Harrington 2001), thus comprehension might be constrained by any one of these factors.

The challenge in interpreting the evidence base was exacerbated by the fact that studies that were found to examine cognitive and linguistic deficits in SRLI do not describe themselves in the context of a model of comprehension to which they subscribe. The lack of clarity about the underpinning models that are being tested and how studies contribute to our overall understanding of SRLI, make it difficult for those trying to interpret the evidence to develop evidence based interventions.

The SLR revealed a number of shortcomings of the studies that have evaluated deficits in SRLI, in particular, there are issues with both the internal and external validity of the studies. For example, recruitment processes were unclear, participant numbers were small, and the outcome measures used were not usually validated. The conclusions that have been drawn from the SLR are therefore considered exploratory, reflecting the quality of the studies conducted in the area. A recent re-examination of the evidence since the SLR was conducted, suggests that there are still significant shortcomings in these types of studies. One of the important recommendations from the SLR is therefore that future research needs to pay attention to the existing research evidence and its shortcomings and seek to make improvements.

Since the research was conducted, a brief narrative literature review has been published by Boyle et al (2010) which summarises the theory underlying SRLI and interventions for children with SRLI. It should be noted that this review is not a systematic review, and there is no description provided for search terms, databases searched or inclusion or exclusion criteria, as well as no reported attempts to appraise the evidence. Boyle et al (2010) draw some similar conclusions to the SLR, however, there were some important differences. A key difference between the findings of the SLR and those of Boyle et al (2010) is that the latter report that children with SRLI:

“..are commonly observed to have auditory processing deficits, both at the level of frequency discrimination and in rapid auditory processing.”

Boyle et al (2010, p.995)

In contrast the SLR in Chapter 4 concluded that evidence, from a larger number of studies than those referenced by Boyle et al (2010), does not support the suggestion that children with SRLI have a temporal (rapid) processing impairment. One of the papers referenced by Boyle et al (2010), to support the suggestion of frequency discrimination impairments, on examination, was found to report that the SLI group “were not poorer at rapid auditory processing than controls” (McArthur and Bishop 2004). Boyle et al (2010), however, fail to acknowledge this mixed evidence.

Boyle et al (2010) make limited reference to the difficulties with word learning that children with SRLI have been found to have. Although Boyle et al (2010) write that children with SRLI find it hard to learn new words or morphemes, they suggest that this is only in the context of processing demands being high, unlike the SLR which found more general difficulties with word learning. Elsewhere, Boyle et al (2010) also report that children with SRLI have slower reaction times “than children with expressive problems only” (Boyle et al 2010, p. 995). Though the SLR in Chapter 4 found children with SRLI to have slower reaction times than controls, insufficient evidence was found to suggest that these problems are specific to receptive language.

Another important difference between the literature review by Boyle et al (2010) and the SLR in Chapter 4 is that many of the studies that are referenced by Boyle et al (2010) do not examine children with receptive language impairments in particular. One example, is a study by Bortolini et al (2002), which is referenced in relation to the grammar impairments of SRLI children, however, children who participated in this study were included on the basis of their mean length of utterance (an expressive language measure). A large proportion of the evidence cited by Boyle et al (2010) also comes from secondary evidence i.e. translators of theory, rather than studies that have directly examined the deficits. This would suggest that the SLR in Chapter 4 provides a more comprehensive and accurate account of the evidence of deficit in SRLI. It also highlights the hazards of non-systematic approaches to literature reviews.

8.3 Findings from the focus groups

The findings from the focus group are now considered in the following sections. A model of interventions for SRLI is presented which summarises key intervention findings from the focus groups. The interventions that have emerged are then discussed in relation to the areas of deficit identified in the SLR. Finally, this section considers the theory that SLTs describe as underpinning the interventions they adopt for children with SRLI.

8.3.1 A model of interventions for SRLI

Findings from the focus group were used to create a model of interventions for SRLI, displayed in Figure 11. The model summarises the combined findings from the focus groups and SLR, aiming to visually represent the intervention approaches used for children with SRLI. The range of factors that influence SLTs selection of targets is presented on the top line of the diagram. The central boxed area indicates key approaches to intervention, and targets for SRLI. Finally, factors that might influence the delivery of interventions are presented on the bottom line.

The range of factors that influence therapists' selection of targets feed into the top of the diagram. Five of the factors on the right hand-side are those that were identified, from the focus group, as core in influencing target selection for SRLI. The remaining two factors on the left were also identified as influencing SLT's target selection in the focus groups themes but were not identified as core, since they were not explicitly described by the SLTs in how they select their targets.

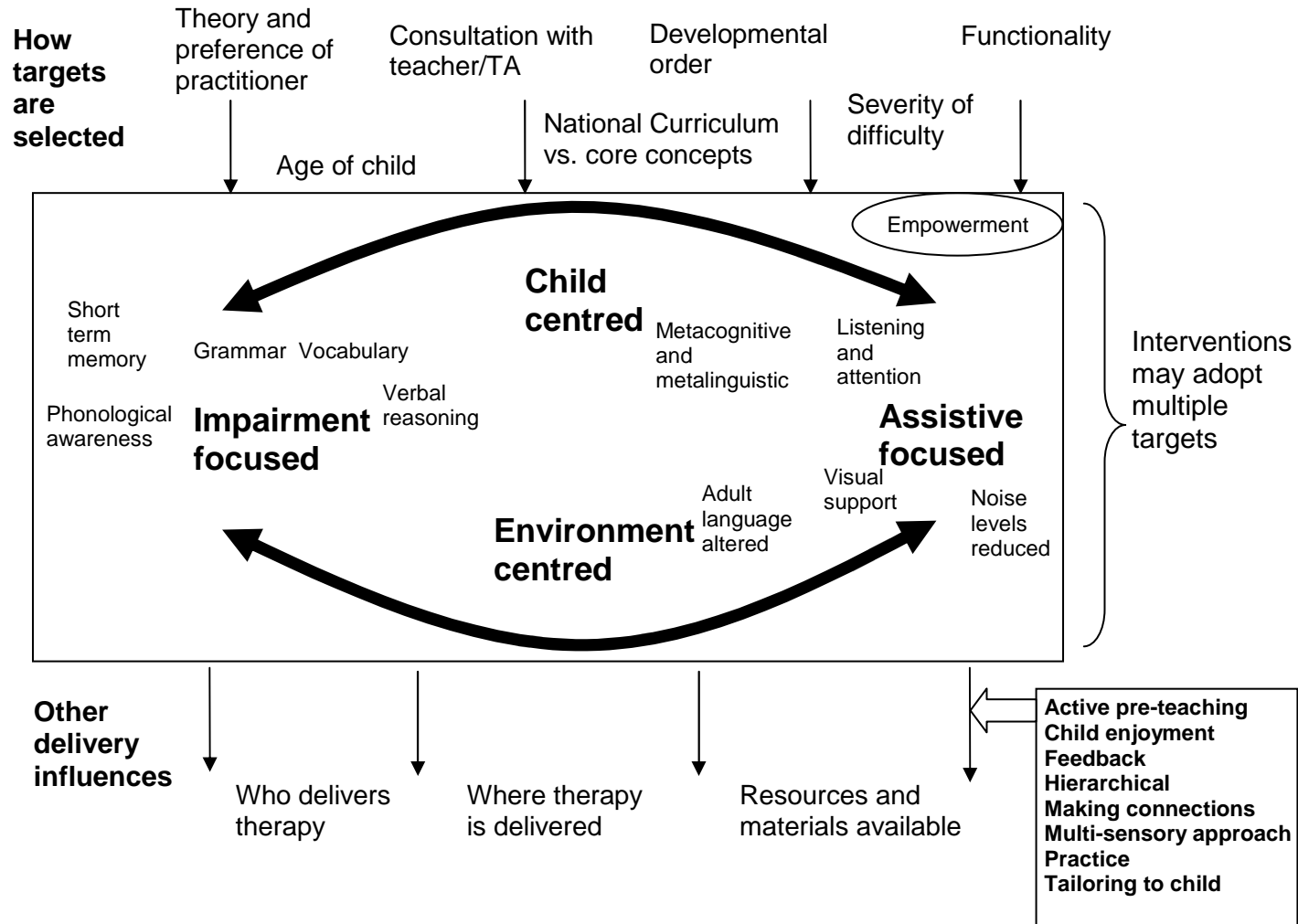
The central boxed area presents the four approaches to interventions for SRLI. These include impairment focused and assistive focused, as well as child centred and environment centred. In the previous chapter, impairment and assistive focused interventions were presented as being on a continuum. The findings of the focus groups, however, suggest that there is an interactive component to these approaches, in which working in one approach seems to impact upon another. For instance, direct work on impairments, such as word learning or grammar is likely to interact with the use of assistive approaches where, for example, less visual support/ prompts might be required. Equally, SLTs who described working on an assistive approach, such as metacognitive or metalinguistic approaches, also described this as directly impacting on impairments. For this reason, in Figure 11 the continuum has been adapted and is displayed instead with bidirectional arrows that are intended to convey the interaction of impairment and assistive based approaches.

Still in the centred box area, are the targets that emerged from the focus groups. These targets are situated in the diagram close to their relevant approach. For instance, interventions that focus on phonological awareness, short term working memory, grammar and verbal reasoning, are placed toward both the child centred and impairment focused approaches. Interventions that focus on listening and attention as well as metacognition and metalinguistics are placed towards both assistive focused and child centred approaches. Finally, interventions that focused on visual support, noise levels and adults altering their language are placed toward both assistive focused and environment centred approaches. The theme empowerment that appeared to be core to interventions is situated

outside the centre, since its focus is not directly related to language or cognition.

Factors identified as influencing intervention delivery are situated at the bottom of the diagram. Also influencing the delivery of interventions, are the components that have been identified, from the focus groups, as core to interventions for SRLI. These core components are boxed in the bottom right of the diagram, with an arrow indicating that the core components feed into the intervention delivery.

Figure 11 A model of interventions for SRLI



What the model adds to our understanding of the process and context of intervention for SRLI

As well as visually summarising the findings of the research, the model helps to make explicit the different foci of interventions in SRLI, the key features in selecting targets, as well as core methods adopted in intervention delivery. The model aims to highlight the complexity of language interventions, but clarifies some the important features of interventions for SRLI that SLTs consider among this complexity.

The model is designed to be descriptive; it maps out the interventions and important aspects in intervention, as described by SLTs. It also provides information about important aspects of the context of interventions, in terms of the features of therapy that SLTs consider in their target selection, as well as other delivery influences. The model contributes to our understanding of a 'theory of therapy' because it denotes some of these important features of therapy. In particular, the core methods adopted in intervention delivery that feed into the model (bottom right hand corner of the model), capture an important aspect of theory of therapy.

However, what the model does not provide is information on the decision making process of how SLTs select the various components of therapy and how these processes affect outcomes. The provision of targets and key components go some way in providing this information, but the therapy procedures are not made explicit. It also does not describe how therapy features might contribute to outcomes, except that broadly they might be focused on impairment or assistive changes, and be child or environment centred.

It is useful to consider this model against existing models of intervention. Early models of intervention processes include Yodor and Kent's (1988) decision making trees. One of these (Ellis Weismer 1998, p.42) maps out interventions for children with specific language learning problems. This model suggests some important things to consider in interventions for SLI, including: determining linguistic input, the intervention context as well as the training technique. However, the Weismer model does not provide explicit information on how intervention approaches will create change. More recently, other models, such as McCauley and Fey (2006, p.6) have attempted to describe processes involved in language intervention, describing the goals, the context, the agent, the dose, the procedures, the goal attack strategy and finally the intervention activities. This model too, is descriptive. To date no one else appears to have attempted to produce a model of therapy (that incorporates a range of intervention types) that describes how interventions lead to change.

An additional reason that the model for interventions for SRLI (Figure 11) does not provide information on theories of therapy, in terms of processes of change, is because this aspect of theory was underspecified by the SLTs. These issues are addressed in more detail in section 8.4.

8.3.2 Interventions for SRLI in relation to the deficits identified in the SLR

The model of intervention for SRLI (Figure 11) demonstrates the range of targets in interventions for SRLI. It is apparent that though the deficits or impairments identified in the SLR are important targets in interventions, there are a number of other areas of focus that have not stemmed from the SLR. This is evident not just from the range of impairment based interventions presented, but from the emergence of assistive focused interventions (that are not aiming to improve the deficit per se). It also emerged from the focus groups, as noted in the model, that the descriptions of interventions provided by SLTs do not always clearly map to isolated areas of deficit.

The focus groups were able to identify a number of interventions that target the deficits identified in the SLR, in particular, interventions emerged that consider grammar, vocabulary and short term memory. However, a number of interventions emerged that target other areas of deficit, not identified in the SLR, in particular, verbal reasoning and phonological awareness. Further, the interventions that emerged could not neatly be bracketed into the category information processing. It should be noted, that although verbal reasoning and phonological awareness did not emerge as areas of deficits for children with SRLI this was due to an absence of studies identified in the SLR examining these areas. Just one study examined inference construction (Ellis Weismer 1985), an aspect of verbal reasoning. Though a number of studies examined the auditory processing ability of children with SRLI (where there was mixed evidence) none examined phonological awareness in particular. These appear to be areas of impairment that remain under explored in SRLI. As discussed in the previous chapter, these results are perhaps indicative of the gap between the types of deficits that are of interest to researchers and those which practitioners assign importance to.

SLTs described many intervention approaches that target a range of impairments simultaneously. Commonly used resources, such as the Derbyshire Language Scheme (Masidlover and Knowles 1982), reflect this integrated approach. The Derbyshire Language Scheme for instance integrates word learning, grammar and memory. SLTs therefore raised this type of intervention across all the areas of deficit that were discussed at the focus group.

It is interesting to consider the identified targets, from the focus groups, against the intervention studies that were identified in Chapter 5. The intervention studies for children with SRLI do not adopt any approaches that target verbal reasoning. The temporal processing interventions (Cohen et al 2005; Merzenich et al 1996; Tallal et al 1996) focus on phonological awareness, but adopt methods different to those described by SLTs (i.e. the synthetically extending speech sounds). The finding that SLTs adopt interventions that target multiple impairments also contrasts with intervention studies conducted with children with SRLI. The identified intervention studies appear to focus on relatively specific areas of difficulty. For example memory (Dixon et al 2001; Joffe et al 2007; Gill et al 2003), grammar and specific grammar difficulties (Ebbels 2007; Ebbels et al 2007) and temporal processing (Cohen et al 2005; Merzenich et al 1996; Tallal et al 1996). This suggests a disparity between interventions that have been examined for their efficacy, and those that are used in clinical practice. Although it is valuable to know whether specific approaches are effective in remediating SRLI, future efficacy studies should perhaps adopt intervention programmes that target a range of deficits, more closely reflecting clinical practice, as well as the nature of the overlapping deficits identified in the SLR. It has been noted elsewhere by experts in SLI, that it is not necessarily helpful to focus on one area of impairment in language interventions. One of the principles in grammar is:

“Grammatical form should rarely, if ever, be the only aspect of language and communication that is targeted in a language intervention programme.”
Fey et al (2003, p.5)

An important finding from the focus groups is SLTs heavy emphasis on assistive approaches, which do not appear to be aiming to improve an area(s) of deficit per se. Many of the assistive approaches could be linked with the the International Classification of Functioning, Disability and Health (ICF; WHO 2001). These interventions aim to assist or support the child with the impairments that they had, largely through the use of strategies for the child (child centred) or changes to the environment (environment centred).

Unfortunately there currently seems to be little evidence base for the use of assistive interventions in language impaired populations in either child centred or environment centred approaches. The studies identified in Chapter 5 included some child centred assistive elements to the interventions. However, these only appear to be examined in relation to specific strategies for memory e.g. visualisation and repetition (Dixon et al 2001; Joffe et al 2007; Gill et al 2003). There were also aspects of metalinguistics in the shape coding intervention (Ebbels 2007; Ebbels et al 2007). Since shape coding adopts a combination of approaches it is not clear if it is the metalinguistic aspect of the intervention that can be attributed to its success. No studies were identified that examine the role of assistive approaches, more generally, in improving or facilitating comprehension or functioning.

None of the studies identified in Chapter 5 examined the efficacy of environment centred approaches. Unfortunately evidence in other studies, that have examined the role of environmental approaches in improving language outcomes, has not found promising results. In a systematic review of environmental interventions, for preschool children with language impairment, Pickstone et al (2009) concluded that the evidence base is weak in this area and that the potential for impacting on the child's language skills is unclear. Given the emphasis that SLTs describe placing on assistive interventions (both child and environment centred) for receptive language, it is evident interventions studies that focus on these approaches are underexplored in the intervention literature.

8.3.3 Theory underpinning interventions for SRLI

Theory underpinning interventions for SRLI is considered below, in relation to the rationales for intervention approaches and the development of a theory of therapy.

Rationales for intervention approaches

The SLTs appeared to find it difficult to provide explicit rationales for their intervention approaches. The focus groups found considerable variability between SLTs in both the extent that they were able to provide rationales and the types of rationales they provided. For some SLTs this seemed to relate to the tacit nature of their knowledge and, for a minority, it appeared that they had not reflected on the rationales for their practice. For other practitioners it appeared that the lack of efficacy for SRLI interventions made it more difficult for them to provide rationales for their intervention approaches. The plausible reasons for the difficulties that SLTs had in providing explicit rationales were touched upon in the previous chapter.

When the difficulties that SLTs demonstrated in providing rationales are considered in relation to the broader research project findings, another plausible explanation emerges. The SLR (Chapter 4) found that there is no simple set of deficits associated with SRLI. Indeed, as already noted, it was found that many of the studies in the area concluded that poorer performance on various cognitive and linguistic tasks was a result of information processing capacity limitations. The SLTs difficulty in providing rationales for interventions, particularly in relation to specific areas of deficit, is perhaps therefore a reflection of the complexity of the evidence base. The fact that SLTs rarely referred to theory of impairment and that a number of the interventions that they described were simultaneously working on a number of overlapping impairments, supports the view that SLTs do not view therapy in terms of isolated areas of impairment. Language learning instead seems best viewed from the perspective of holism, a term coined by Smuts (1927) but best described by the famous

Aristotle phrase 'The whole is greater than the sum of its parts'.

Theory of therapy

Byng and Black (1995) describe the importance of developing a theory of therapy. Part of the process of developing a theory of therapy includes 'identification of the crucial parameters of intervention' (Byng and Black 1995, p.304). SLTs helped to contribute to this important aspect in developing a theory of therapy. The emergence of key factors for selecting targets and core components of interventions for SRLI, from the focus groups, suggests that SLTs have a common 'theory of therapy' in terms of having a shared understanding in what they consider crucial parameters to intervention in SRLI. Clarification of possible 'core components' as well as the specification of the details of interventions provides ground work in establishing which aspects of therapy might be critical for their efficacy. At this stage it is not possible to determine whether all the identified components are critical (or active ingredients) to an intervention's success and whether the list of components is exhaustive.

Other researchers have attempted to describe potential (broad) active ingredients for language interventions. In a RCT, Boyle et al (2007) examined direct vs. indirect intervention approaches and, as part of this study, parameters for interventions were established. Discussion with a therapy team and consultation of UK models of therapeutic practice resulted in the development of what were thought to be potentially 'active ingredients' for interventions. These active ingredients include:

- 1 The formation of a strong therapeutic alliance between the SLT/speech and language therapy assistant and child, focused on the alleviation of communication problems
- 2 Encouragement of child self-reflection and self monitoring
- 3 Repeated exemplification and practice of language features in a motivating context

These proposed active ingredients hold similarities to the intervention approaches that emerged from the focus groups. Therapeutic alliance (point one above) has been described as the "active collaboration between the patient and the therapist." (Ackerman and Hilsenroth 2003, p.1). Most perceptions of therapeutic alliance stem from the work of Bordin (1979) who defined alliance as including three features: an agreement on goals, assignment of tasks and development of bonds. Therapeutic alliance can be seen to overlap with the theme 'empowerment' that emerged from the focus groups. SLTs described empowerment in terms of children taking responsibility for their learning and being a partner in therapy. It's clear that part of being a partner in therapy involves the three features proposed by Bordin (1979).

The emphasis on self-reflection and self monitoring (point two above) links with the use of metacognitive and metalinguistic strategies that were emphasised in the focus group. As noted previously, metacognition refers to activities that involve ‘thinking about thinking’ (Flavell 1976), and developing awareness of one’s own ability to think and learn. It is only through the use of self-reflection and monitoring that it is possible to adopt metacognitive strategies that the SLTs described.

Point three (above) has two features that overlap with the intervention approaches that emerged from the focus groups. ‘Repeated exemplification and practice’ can be likened to the core component ‘Practice’ that was identified from the focus groups. Point three also refers to the ‘Motivating context’ in which to practice. A motivating context could perhaps be interpreted in a number of ways, but the concept of motivation generally refers to inciting one to participate. The core component ‘Child enjoyment’, that was identified in the focus groups overlaps with this concept, since child enjoyment appeared to be, partially, for the purposes of motivating children’s engagement. Indeed, the term motivating was one that was used by the SLTs.

Unfortunately, Boyle et al (2007) found that though interventions (delivered three times a week for 30–40 minutes over a 15-week period) yielded significant improvements on standardised scores for expressive language, the same was not true for receptive language. In addition, children with a receptive component to their language impairment were less likely to show improvement than those with expressive language impairment. This might suggest that the potential active ingredients, suggested by Boyle et al (2007), are not sufficient in themselves in contributing to effective intervention for SRLI.

If the intervention components for children with SRLI that have been identified in the present research were systematically manipulated in intervention studies, a picture might emerge in terms of what ‘critical components’ of therapy might be (or how many of the components identified need to exist in a successful intervention). However, it is likely that further work is needed to expound the nature of the components, in terms of finding a way to measure them and classifying what counts as a component. For example, in relation to the component ‘feedback’, ascertaining the type and amount of feedback required. There is also an additional element too, in relation to intervention components, and that is their relative weighting (Byng and Black 1995). It is useful to establish if some components are more important than other, and whether this balance differs from one person to another. Further research is required to help answer these questions. See section 8.6.2 for further discussion.

8.4 Identification of mechanisms of change for SRLI

Although a theory of therapy has been identified in terms of what SLTs describe as crucial parameters of interventions for SRLI, there is a second feature of theory of therapy that has not emerged from the focus groups, and that is how the crucial parameters of therapy 'affect outcome' (Byng and Black, 1995 p.304). This feature of theory of therapy can be seen to be equivalent to the development of mechanisms of change. The following section considers why mechanisms of change are important, and why they have not emerged from the focus groups. Plausible mechanisms of change for both impairment based and assistive focused interventions are suggested. The role of expressive language interventions, as an additional mechanism of change, is also considered and finally establishing mechanisms of change is discussed.

8.4.1 Why identify mechanisms of change?

"The rationale for a complex intervention, i.e. what changes are expected, and how change is to be achieved, may not be clear at the outset (of the research)"
(MRC 2008, p.9)

The MRC quote above demonstrates that rationales for complex interventions are seen as synonymous with 'how change is to be achieved'. However, the focus groups with expert SLTs demonstrated that their rationales were not described in these terms. There was a general perception that working on a target area/practicing an area of difficulty will improve it. How the process of change happens, however, was not clear.

In Chapter 2 the importance in identifying and developing theory was described. One of the features in developing theory, that was touched upon was establishing empirically supported principles for change (ESPs, Rosen and Davidson 2003). Rosen and Davidson (2003) describe this in terms of both developing an understanding of critical processes and understanding therapies causal mechanisms. The present work has helped to clarify what might be critical processes of therapy, in terms of the details of intervention as well as identifying core components. It has not, however, been able to map explanations or proposed theories in terms of causal mechanism. Pawson (2006, p.23) describes mechanisms in terms of "what it is about the system (or in this case, the intervention) that makes things happen". In order that future interventions are developed for SRLI that are effective, it is not only useful to try to understand what works, but why and how they work. As was discussed in Chapter 2, theorising how interventions might produce change is valuable, since it should improve the chances of the development of interventions that are effective. Further, if how an intervention works is understood, then there is flexibility for the development of future interventions that are based on the same causal mechanisms.

8.4.2 Challenges in the identification of mechanisms of changes

As discussed in Chapter 7, the identification of mechanisms of change for both impairment and assistive interventions is hindered by a lack of clear existing evidence that interventions change deficits in SRLI. The reviewed efficacy studies for SRLI interventions (Chapter 5) established that though there were some promising avenues for SRLI interventions, there was still limited evidence for the efficacy for interventions in the area. A recently updated systematic review of SLT interventions (Law et al 2010) also found limited evidence for the effectiveness of interventions for those with receptive language impairments. With this as a backdrop, it is perhaps not surprising that expert SLTs are unable to provide clear pictures of potential mechanisms of change. Moreover, expert SLT's interests do not appear to lie with theoretical constructs of mechanisms of change but rather the approaches and techniques that they adopt for interventions (that they hope will bring change). This is perhaps to be expected, since the concern of practitioners is arguably more likely to be whether intervention has brought change, rather than how it has managed to bring change.

In light of the overall findings, the issue of mechanisms of change can be seen to be further complicated by the emergence of both impairment based interventions and assistive based interventions, since they are likely to have different mechanisms of change. The different approaches have different issues in the development of mechanisms of change, thus are considered separately below.

Mechanisms of change for impairment based interventions

The development of mechanisms of change for impairment or deficit based interventions appears to be hindered by (in addition to the poor evidence base) a lack of clarity or 'independence' of the deficits, as well as the ambiguity around the extent to which they are causally related to comprehension difficulties.

The SLR (Chapter 4) confirmed comprehension as a multidimensional process. Reflecting this complexity, the SLTs in the focus groups described interventions that simultaneously worked on a range of areas of deficit, or targeted the consequence of these deficits. Although there is logic to interventions targeting as many problem areas as possible, interventions that aim to target multiple areas of deficit cause problems for specifying potential mechanisms of change in interventions for SRLI. This is because where interventions are successful, it is difficult to know which parts of the intervention have contributed to its success, in other words, which parts are critical.

A conflict arises between interventions targeting specific areas of deficit in order to clarify mechanisms of change, and the potential value gained from interventions that are limited to a specific area of deficit. If interventions are sufficiently reduced to focus on individual areas

of deficit, if change is established, it seems less likely that the change will impact upon broader comprehension abilities. Individual deficits might be one of many contributing factors, but not necessarily a causal factor for the children's comprehension difficulties.

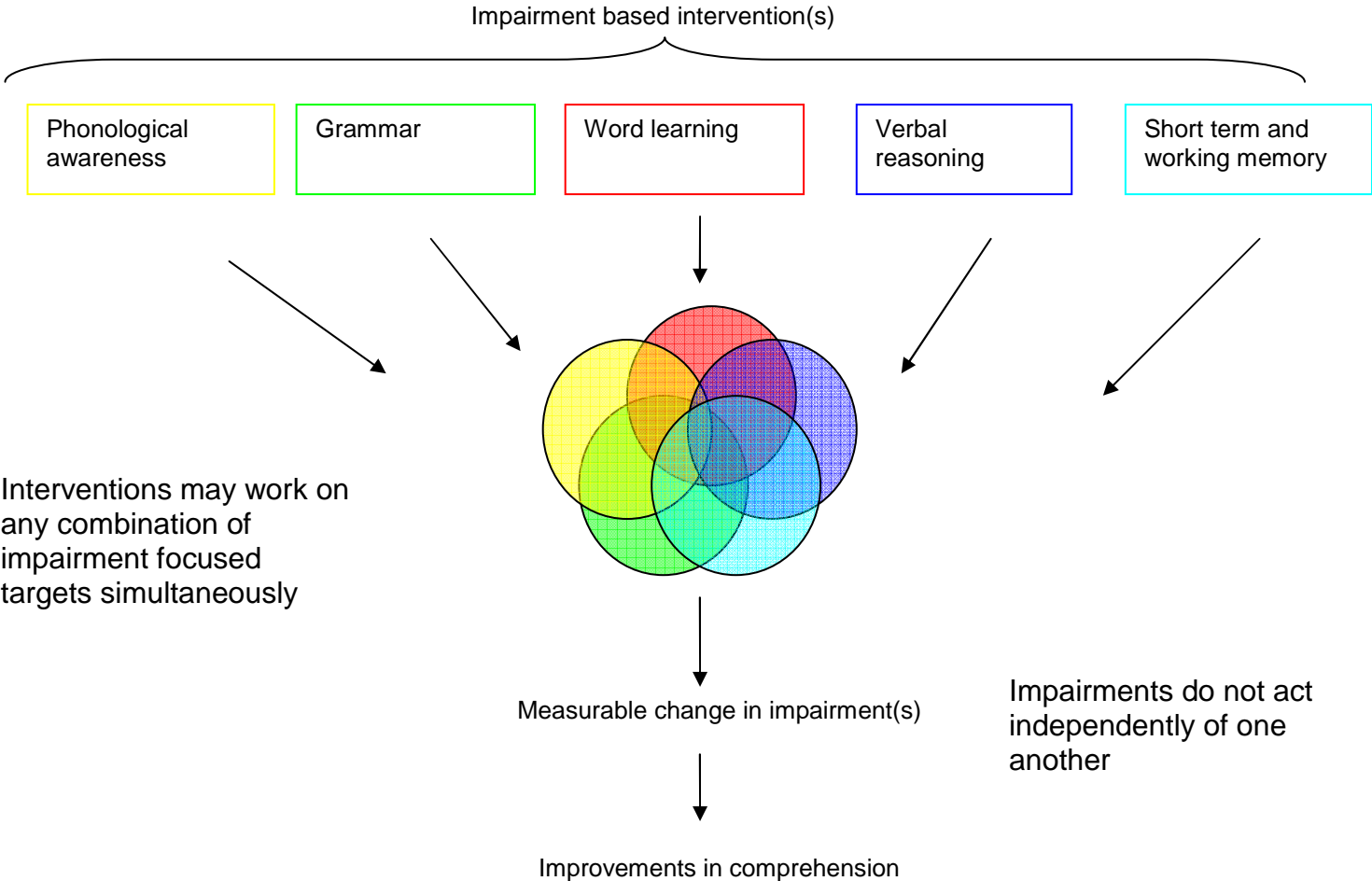
Figure 12 demonstrates the complexity involved in establishing mechanisms of change for impairment based interventions. At the top of the diagram, the range of impairment focused targets that emerged from the focus groups are presented. These impairment based targets are colour coded and the impairments themselves are represented in the Venn diagram in the centre of Figure 12 in the same colours. The potential outcomes of the interventions are displayed below this, emerging from the Venn diagram.

The range of impairment focused targets that emerged from the focus groups at the top of the diagram are followed by arrows into the Venn diagram. The arrows aim to reflect the fact that SLTs may target any combination of the impairments simultaneously, incorporating the SLT's descriptions of interventions in the focus groups.

The Venn diagram, representing the impairments themselves, seeks to demonstrate the interrelationship of the different areas of impairment with one another. This suggested interrelationship incorporates the indications in the SLR that the areas of impairment are not likely to act independently from one another. This means that an improvement in one area of impairment, for example phonological awareness, might produce resulting improvements or changes in the other areas of impairment.

Below the Venn diagram, it is indicated that the intervention might create measurable change in one or more of the impairments. Deciphering which mechanisms has led to this change, from the range of impairment targeted, as well as from the interrelationship of the impairments with one another, is evidently a difficult challenge. The final outcome at the bottom of the diagram, indicates a final potential mechanism of change, where changes to the impairment(s) could have a resulting impact on improving comprehension.

Figure 12 Complexity in developing mechanisms of change for impairment based intervention



Mechanisms of change for assistive interventions

The emphasis on assistive interventions, which emerged from the focus groups, suggests different potential mechanisms for change, adding further complexity to the picture. SLTs tended to describe the aims of assistive interventions as not to remediate the deficits per se, but to support the child and effectively improve functioning. Figure 13 maps the broad plausible interventions for SRLI informed by the focus groups. It incorporates both impairment and assistive based interventions, and reflects the fact that improvement to functioning is a plausible therapy outcome. Enhanced comprehension might result from either of the final stages; improvements to functioning or changes in underlying impairments.

The left hand side of Figure 13 presents the continuum identified in the model of SRLI interventions, indicating that an intervention might be predominantly assistive, or predominantly impairment based or feature elements of both. The plausible choices for intervention vary from there, where the approach might be child or environment centred. The final boxes on the right hand side indicate the outcomes that the intervention might produce.

The assistive focused intervention box has an arrow that is linked to both environment centred and child centred approaches since assistive focused interventions might adopt methods that place either the child or the environment at the centre of the intervention. The impairment focused intervention box, by contrast, has an arrow that is only linked to the child centred approach, since the impairment itself is seen to lie within the child.

Environment centred interventions are not directly working on impairment(s) and thus it is indicated in the diagram that the only change they might directly produce is an improvement in functioning. They are not able to directly change or remediate deficits. Child centred approaches, however, should be able to improve the child's function or change their language related deficits. The extent that the intervention is able to do this depends on whether it is assistive or impairment focused. The arrows are presented as dashed to indicate that the plausible mechanism of change can not occur in every case. Improvements in functioning are only likely to occur from an assistive approach, and changes to impairments are likely to only stem from an impairment focused approach.

Changes in either functioning or impairment are likely to impact on one another, for this reason the final two boxed outcomes on the right hand side of the diagram are presented with interactive arrows between them. For example, if an adult working with a child with SRLI adapted their communication to address the child's appropriate level of comprehension (assistive focused, environment centred), the child should be able to understand more (improve functioning). The increased access to understanding, that the child then has,

should also then improve their opportunities to learn new words or grammatical structures (changes in impairment). Equally, remediation of linguistic related deficits, assuming they are contributing to the comprehension impairment, should create resulting improvements in functioning.

Figure 13 serves to indicate, that at a macroscopic level, there are several approaches that could lead to change. Within each approach, there are different plausible mechanisms for change, to be detailed. Figure 12 demonstrates the numerous possibilities for mechanisms of change for impairment based approaches alone. It will not be possible to consider all the plausible mechanisms of change for assistive based interventions here. However, in order to illustrate how an assistive focused approach might create change; an example of an assistive based, child centred intervention (strategies for memory) is displayed in Figure 14. The first three proposed effects of the intervention are an improvement in functioning. The final stage, that is improvement in underlying deficits, is only possible if the prior stages have been successfully fulfilled. This mechanism of change is informed by the way that SLTs described strategy approaches for memory in the focus groups, although they did not explicitly describe mechanisms of change in these terms. Considering mechanisms of change for assistive approaches is important as there appears to have been no previous attempt to examine theory in relation to assistive approaches for SRLI. For example, it was noted by Law et al (2008, p.13) in a survey study that “little mention was made of the theoretical underpinning of the metacognitive approaches to intervention” and that this needs further exploration. The proposed mechanism of change displayed in Figure 14 for memory interventions, displays just one example of how a metacognitive approach, described by SLTs, could create change.

Figure 13 Mapping plausible mechanisms of change for interventions for SRLI

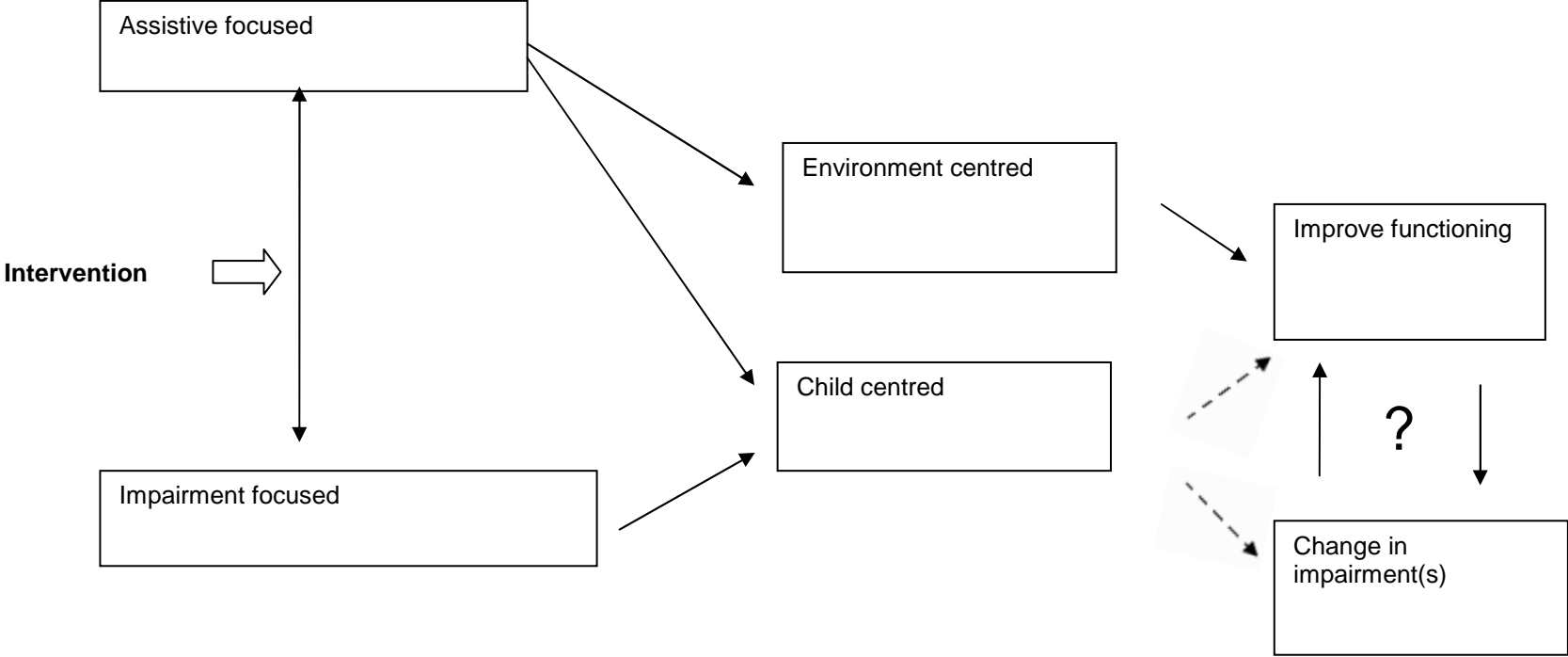
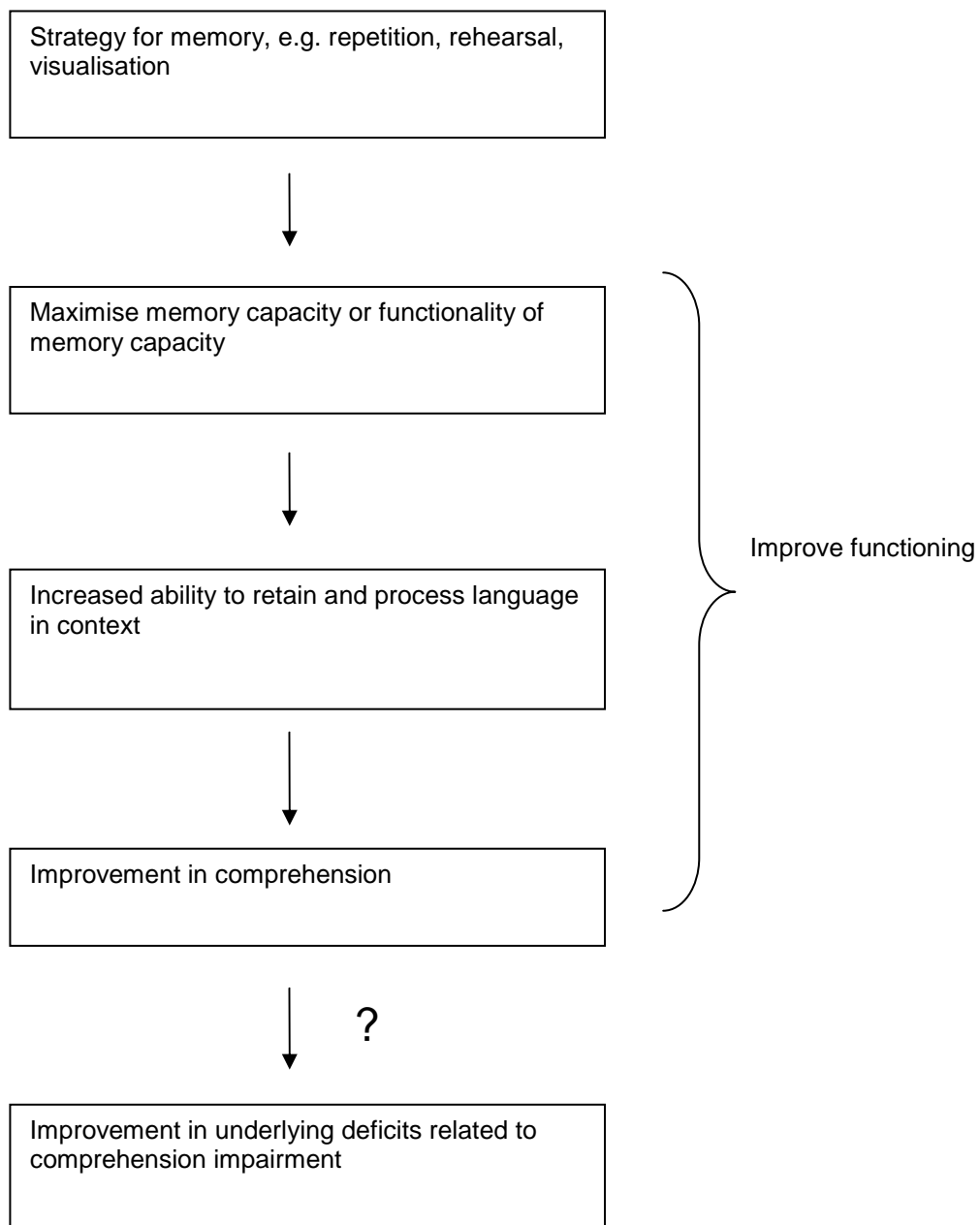


Figure 14 Possible mechanisms of change for strategy approaches for memory



The possible mechanisms of change for interventions for SRLI that have been suggested in Figure 12, Figure 13 and Figure 14 are important for developing a theory of therapy for SRLI. No known attempts have previously been made to delineate how mechanisms of change for interventions for SRLI might work. This work therefore contributes to theory development for SRLI interventions. However, the diagrams presented in Figure 12, Figure 13 and Figure 14 serve to illustrate the complexity involved in establishing which features of interventions lead to change and how change occurs.

8.4.3 The role of expressive language interventions in improving receptive language

This thesis has intentionally focused exclusively on the nature of comprehension difficulties and therapies that might remediate these. At the time that the research was started, there was little evidence that working on expressive language affected receptive language. Law et al (2008, p.3) noted "it is assumed that working on the former (expressive language) has a direct effect on the latter (receptive language) even though there is emerging evidence that this is not the case". It is more accurate to say that, rather than there being evidence that expressive interventions do not help receptive language, there is insufficient evidence that they do. It is clear that more examination is needed on the role of expressive language interventions in improving comprehension.

In the focus groups SLTs reported that they felt that working on expressive language interventions had cross over effects for receptive language. Interventions that emerged in discussion included expressive features, even though the focus had been on comprehension activities. For example, the SLTs described the use of modeling in interventions for grammar, where the correct verbal form of a sentence is provided by the SLT (and the child might be asked to imitate it). It was also noted in the examination of interventions for receptive language impairments that some interventions had been theoretically driven by expressive errors, for example shape coding (Ebbels et al 2007) as well as word learning (Parsons et al 2005).

Gillum and Camarata (2004, p.204) argue "there is an interconnection between receptive and expressive language" and point to accounts that describe this interrelationship. These accounts are the transactional model of speech production and bootstrapping models. The transactional model (McLean and Snyder-McLean 1978) describes interaction between comprehension and expression during real-time conversation. It refers to the adaptations that adults make to their own language in relation to the language used by children. These adaptations are proposed to help the child's understanding, and in turn, help the child to acquire new language skills. Bootstrapping arguments (e.g. Fodor and Katz 1964) describe

the use of knowledge to deduce the meanings of new (expressive) input. An example is syntactic bootstrapping, which was described in the SLR, where the knowledge of syntax helps to inform the learner of the meaning of novel words.

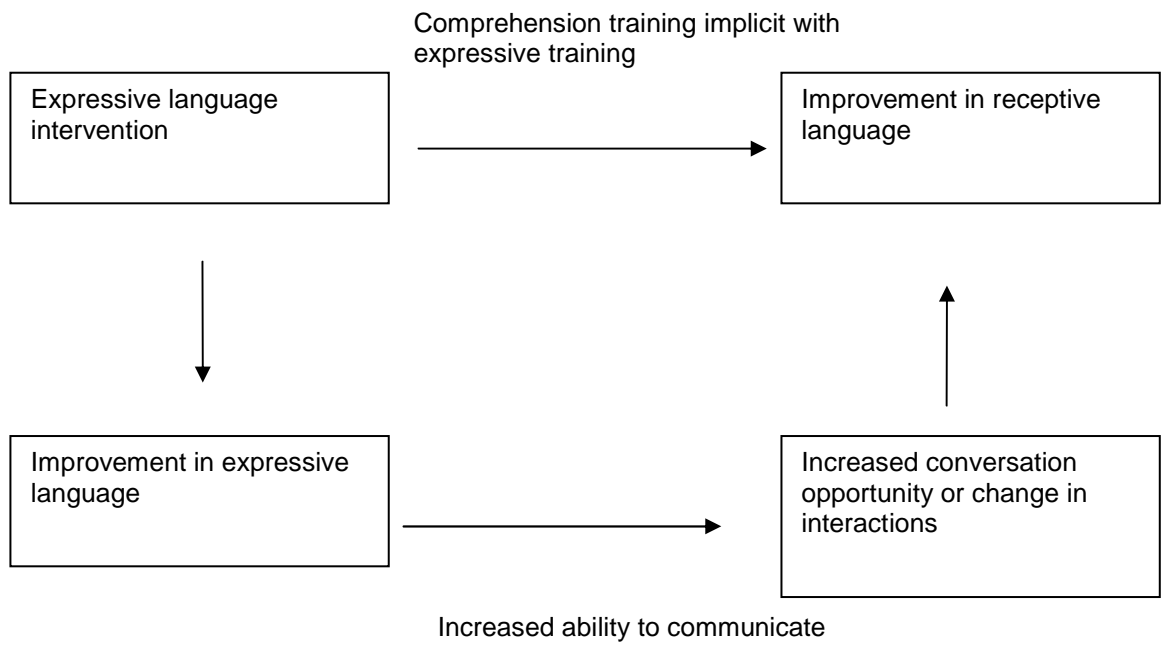
It was noted in Chapter 4, that recently, in a study of 21 SRLI preschool children, Camarata et al (2009) found expressive grammatical intervention improved the children's scores on a standardised auditory comprehension measure compared with six matched waiting-list controls. Up until then, there had 'been no direct test' of the impact of expressive language intervention on generalised receptive skills in SRLI. Elsewhere, there appears to be some mixed findings in terms of the impact of 'cross over' effects between expressive and receptive interventions. Guess (1969) attempted cross over training in a study of adolescents with Downs Syndrome, but found that comprehension training on grammatical morphemes did not improve expressive use, and neither did training in expression yield improvements for comprehension. By contrast, Bucher and Keller (1981) found some evidence that expressive language gains (in productive labeling of pictures) can be made from receptive training in children with language impairment as well as normal populations.

There seems to be something particularly resilient to training in comprehension impairments that suggests the expressive-receptive interaction is not straightforward. In a large scale RCT of four treatment conditions (Gillam et al 2008) children aged six-nine with SLI were found to improve on a global language test in all four conditions. However, on closer analysis the children made less improvement on a test of sentence comprehension than they did on a global language test. The authors concluded:

"The difference in the effect size... suggests that children's expressive language skills improved more than their receptive language skills. This occurred despite the fact that three of the four arms of the study primarily focused on listening."
(Gillam et al 2008, p.17)

The use of expressive language interventions for SRLI provides another possible mechanism of change in comprehension for SRLI. Figure 15 suggests two possible mechanisms of change for how expressive language interventions might be able to improve receptive language. One mechanism, indicated at the top of the diagram, suggests that comprehension language training is implicit in expressive training and it is therefore difficult to separate the two. It was this route that appeared to be inferred by SLTs in the focus group from their descriptions of SRLI interventions. The other possibility is that expressive language training could improve expressive output, thus increase conversational opportunities or result in different interactions with others which could, in turn, lead to improved comprehension. It is clear that further investigation is needed to confirm the link between expressive language interventions and improvements in receptive language outcomes before these mechanisms of change can be clarified.

Figure 15 Possible mechanisms of change for expressive language interventions



8.4.4 Establishing mechanisms of change

The mechanisms of change that have been suggested here, map broadly the ways intervention might produce change, but do not detail how the mechanisms might function. It is possible for theories of language acquisition to further inform how mechanisms of change might function. An example of the type of theory that could explain a mechanism of change is connectionist theory. Connectionist theory was outlined in Chapter 3, in the context of examination of comprehension processes. The central connectionist principle is that mental phenomena can be described by interconnected networks of units. Typically theorists postulate a layer of units that represents input and a layer that represents output. Units can present any number of different linguistic properties or otherwise, for instance, mapping from phonetic features to words or verb stems to past tense forms (Rumelhart and McClelland 1986; 1987). If an input unit is highly active and it has a strong connection to an output unit, that output unit will also be highly active. Learning is achieved by system training, the strength of connections between units is then adjusted accordingly to match or mismatch a stimulus with expected output. At its most basic level, connectionist theory helps to explain learning through practice, where more examples of input producing certain output should help increase the strength of connections. There is potential for connectionist theory to help explain other interventions processes in terms of how they might lead to language changes in SRLI. For example, a core component of intervention identified in the focus groups, such as the use of multi-sensory approaches, could be considered in the light of increased connections between units. By providing more than one modality to convey a concept, it is likely that more input units will be activated to reach the output unit (or concept).

Although other examples of language learning theory could be used to help to develop mechanisms of change, it is important to establish whether there is supporting evidence for possible mechanisms of change alongside theory. An example of an intervention approach that was misguided in its principle of change is the Fast ForWord® programme. The programme had some 'core principles' for change based on studies of training paradigms that led to neural change in animal models (Merzenich et al 1996). In an RCT comparison of this intervention with 'Academic Enrichment' an intervention which did not include many of the core principles of FFW-L, language outcomes were 'very similar' (Gillam et al 2008), leading the authors to conclude:

"Some basic behavioural teaching principles that lead to behavioural and neurophysiological change in animal models may not be necessary components of protocols for teaching language to human beings."
(Gillam et al 2008, p.19)

This example demonstrates that although it might be valuable to further develop theories about potential processes or mechanisms of change, this process should be iterative,

existing alongside establishing efficacy of the possible mechanisms. As Hayhow (2010) notes:

“..either a treatment works but we do not adequately understand why, or an overemphasis on theory building and modelling may mean treatments are never sufficiently evaluated.”
(Hayhow 2011, p.11)

In order to establish mechanisms of change, it is necessary to assess which parameters of therapy lead to successful interventions. The specification and development of the details of interventions for SRLI, as well as their core components, in the present research has helped to clarify what some of these parameters might be. They can therefore be tested in future efficacy studies. Byng and Black (1995) recommend working at the level of therapy parameters first, when attempting to establish change mechanisms:

“Identification of the crucial parameters of therapy needs to be established before the relationship of the pre-therapy to the post-therapy damaged states can be detailed.”
(Byng and Black 1995, p.313)

Although Byng and Black (1995) are referring to ‘damage’ in those who have had a stroke, the same principles apply. Future research which examines the therapy parameters identified in the present research, in relation to intervention outcomes, should help to further clarify the mechanisms of change in SRLI. Whether, among all this complexity, it will be possible to hypothesise clear mechanisms of change for children with SRLI, remains unclear. Nevertheless, it is important that more attempts are made to examine mechanisms of change, since a clearer understanding of these mechanisms should inform the development of future interventions.

8.5 Does this research meet its aim and objectives?

The aim of the project was to develop an ‘explanatory model of SRLI that could generate hypotheses for intervention’. The objectives within this aim were:

- To identify the evidence on the nature of cognitive and linguistic deficits in children with SRLI
- To examine and explore theories that link the evidence of deficit in children with SRLI to intervention approaches which target these areas of deficit
- To identify and explore components of interventions that are used to address common deficits in SRLI

The research has been able to meet these objects. The SLR was able to identify the evidence on the nature of the cognitive and linguistic deficits in SRLI. Both literature and

focus groups were utilised in exploring theories that link evidence of deficit in children with SRLI to interventions that target these areas. Finally, the focus groups were able to identify components of interventions in light of the evidence of deficit in children with SRLI. The findings were used to develop a model of interventions for SRLI (Figure 11). The model has been constructed to bring together the findings from the focus group and the SLR and shows key features involved in interventions for children with SRLI. The model is explanatory to the extent that it provides an overview of a range of approaches to intervention for SRLI that are adopted in practice, the targets for these and factors that might influence both their selection and delivery. However, at this stage, the model does not provide an explanation that links deficit to outcome; it therefore cannot be described as an 'explanatory model of SRLI' that was described in the original aim.

The difficulty in providing an explanatory model of SRLI can be seen to be a result of the weak theoretical link that has been found between specific deficits and the approaches that aim to remediate these deficits. The SLR demonstrated that the deficits are complex and interrelated. The generalised nature of both the impairments in SRLI, as well as the interventions that SLTs describe, makes it difficult to produce such a model. Nevertheless, the model is able to provide a descriptive account of interventions for children with SRLI.

8.6 Future Research

The focus of future research recommendations is around how the evidence and theory identified and developed in this thesis can be used for informing and evaluating SRLI interventions. First, this section considers how theory and evidence from expressive language research, related disciplines and activity and participation literature might be used to inform SRLI interventions. This is followed by a discussion of the development of outcome measures, approaches to modelling processes and outcomes for SRLI interventions and, finally, how efficacy might be established.

8.6.1 Other avenues for further theory exploration

There are four areas for future exploration that could further develop theory for SRLI interventions which will be considered in turn, these are: expressive language research in SLI, research in related disciplines, activity and participation and assistive interventions.

Expressive language research

The project established that expressive language interventions are a potential avenue for improving receptive language (Camarata et al 2009). Further exploration of how expressive errors/deficits can inform comprehension processes, as well as how expressive interventions

can impact upon comprehension processes, could contribute to understanding possible remediation approaches. A systematic literature review of the expressive deficits in SLI that might inform receptive interventions would be valuable, since this research has demonstrated that traditional literature reviews, that are not systematic, are flawed.

Research in related disciplines

The intervention studies that were examined in Chapter 5 were tested on receptive language impaired populations. Intervention studies that considers other populations with relevant cognitive or receptive language impairments, or intervention studies on 'normal populations' could also be of value for informing interventions for SRLI. Bernstein Ratner (2006) proposes that SLTs should use this type of evidence where there is limited existing evidence in relevant populations.

Examples of relevant studies can be found for vocabulary and memory interventions. Vocabulary interventions have been found to be successful for younger normal populations, in a meta-analysis of 67 studies (Marulis and Neuman 2010). Many of the approaches in these interventions appear to be based on book reading, an approach that does not seem to have been examined in an SLT context. In the field of psychology, attempts have been made to delineate the components of memory interventions (Rankin and Hood 2005) which could also help inform memory interventions in an SLT context. Examinations of other literature could provide further avenues for exploration.

In addition, other advisory papers have been published for specific language impairment interventions but they do not seem to have been examined in an SRLI context. For instance, Fey et al (2003) published 10 principles of grammatical intervention for children with SLI. It would be interesting to correlate published expert opinion on interventions for SRLI with the present findings. It is possible that papers, like the one by Fey et al (2003), will be able to provide more theory for approaches to SRLI interventions.

Activity and participation

It has been noted that the SLR (Chapter 4) examined the cognitive and linguistic deficits in SRLI. It did not, however, examine issues with activity and participation. Further, the SLTs were not explicitly asked about these issues at the focus groups. To further inform interventions for SRLI it would be valuable to explore these issues.

Some of the difficulties that children with SRLI have with activity and participation were outlined in Chapter 1. An initial examination of the literature reveals other examples of difficulties in access to activity and participation in SLI children. For example, Brinton et al

(1998) found that in co-operative group tasks four out of six children with SLI played very minor roles in co-operative work. Liiva and Cleave (2005) also found children with SLI were addressed significantly less by their play partners, participated in less group play, and engaged in more individual play and on-looker behaviour. Finally, Fujiki et al (1996) found children with SLI to have poorer social skills, fewer peer relationships and were less satisfied with the peer relationships in which they participated when compared with their age-matched classmates.

Though many of the interventions that have emerged from the research address issues of activity and participation, it is likely that research has not been exhaustive in this area. Consideration of the types of issues in activity and participation that result from language impairments could lead to more targeted development of interventions that specifically aim to facilitate these areas. For example, it could help to inform interventions that focus on social language, or communication in co-operative tasks.

Assistive interventions

The concept of assistive interventions is overlapping with that of interventions which target activity and participation (ICF; WHO 2001). The focus groups identified a large number of interventions that were assistive in nature; focusing on maximising the existing skill set that the child had through self help strategies, as well as supporting their impairments with additional materials or adaptations to their linguistic environment. Further exploration of assistive interventions would be of value.

It has been noted that there currently seems to be little evidence base for the use of assistive interventions in language impaired populations in either child centred or environment centred approaches. The examination of the intervention literature (Chapter 5) identified no studies that examine the role of assistive approaches in children with SRLI, that, for example, that focused on self help strategies, or the effects of adaptations to their environment. This suggests it would be of value to examine the efficacy of a range of assistive approaches. Intervention studies that target these areas in children with SRLI should help to assess whether these approaches are of value for these children. Additionally, it would be of value to explore broader literature on the effects of assistive approaches, such as the use of strategies in improving comprehension for other populations, for example, more globally delayed or learning difficulties populations. This could further inform theory for these approaches, as well as provide preliminary information on the efficacy of assistive interventions, prior to piloting on SRLI populations in particular.

An important point for consideration in examining assistive interventions is the use of sensitive outcome measures that examine impact on both comprehension and activity

and participation. Unpicking relationships between assistive interventions and the changes that might result on comprehension as well as activity and participation will be complex and will therefore require good outcome measures. Discussion of outcome measures for activity and participation is considered below under 'Development of sensitive outcome measures'.

8.6.2 Modelling Processes and Outcomes

The present research has focused on the development of evidence and theory in relation to SRLI interventions. The MRC (2008) propose that development of evidence and theory are important stages in developing complex interventions. The final step proposed by the MRC (2008) in the development phase is modeling processing and outcomes. They describe this phase as important since modeling can provide important information about the design of both the intervention and the evaluation.

The process of modeling processes and outcomes in SRLI will be complicated since it is unlikely that a 'one size suits all' approach will be found for SRLI, as different clients are likely to present with different profiles of impairment. Indeed, Ellis Weismer (1991) noted that it is better to think in terms of which approaches for child language remediation work best for particular children, rather than work on averages.

It is interesting to consider the notion of 'one size suits all' in relation to the findings of the present research. Many of the studies identified in the SLR described and selected SLI participants as if it were a unitary condition. The WHO (2003), however, classifies SLI by expressive and receptive subtypes indicating that they should be examined separately. Additionally, a number of studies have linked those who have receptive and expressive language impairment with increased risk of negative outcomes, compared to expressive language impairments alone (Law et al 2000; Beitchman et al 1994; Tomblin et al 2003). The SLR highlighted the dearth of research that has investigated distinction between these groups, with studies rarely comparing receptive and expressive subtypes. Even with the distinction between receptive and expressive language impairments that has been adopted in the present research, the SLR was forced to consider 'averages' in terms of establishing what were common areas of difficulty for SRLI children. This prevented the possibility of a picture of variability (or consistency) emerging across SRLI or broader SLI profiles. Indeed:

"Most people who have had any experience of language impaired children will agree that there is considerable variability from child to child."
Bishop (1997, p.35)

The focus groups with expert SLTs confirmed that they adopt this view, of variability amongst children, and consider a range of individual features in selecting targets. This

indicates that what will be considered a priority for intervention will vary from child to child.

It remains to be seen whether it is possible to develop an effective intervention programme for SRLI, which does not consider individual differences. With this in mind, it would seem that a flexible research design should be used to model processes and outcomes, which could incorporate individual differences of children. An example of such an approach is found in the study by Adams et al (2006) who used a case series design in studies of pragmatic language impairment intervention programmes. These programmes were individually designed to mirror the child's profile. A randomised controlled trial is currently underway that has built on this work in a programme called the Social Communication Intervention Programme (SCIP). SCIP is investigating the effectiveness of a manualised speech and language therapy intervention for children with pragmatic language impairments (PLI) (Adams 2008). The manual allows interventions to be targeted to individual profiles of difficulty.

It would seem a valuable way forward for intervention programmes for SRLI to follow a similar approach to that adopted in the SCIP. A manualised approach would allow comparisons to be drawn between intervention activities, within a flexible programme. For example, a selection of intervention tasks and materials (for each area of impairment) could be provided, from which relevant ones could be selected. These tasks could include the core components in interventions for SRLI that have been identified in the present research.

It is probable that patterns will be difficult to discern when modeling processes and outcomes. In a study of SLI interventions by Gillum et al (2008), children in the three treatment arms as well as the active comparison arm (which was not a language intervention) all made clinically relevant gains on measures of language (predominantly expressive) and temporal auditory processing. This suggests that a variety of intervention activities and approaches can facilitate language development. Thus, there is potential for a large number of components to be 'active ingredients' and it may not be possible to get a clear picture of the weighting of intervention components for SRLI.

Developing sensitive outcome measures

Given the likely difficulties in modelling processes and outcomes, it will be important that there are well developed, sensitive outcome measures. This part of the evaluation has been described as "crucial" by the MRC (2008, p.12). This is not only important in establishing success criteria(s), but also in clarifying mechanisms of change. It has already been established that this is complex in SRLI, since it has emerged that SLTs work on a variety of overlapping deficits which do not function independently. Further, the research has

established that improvement of the deficits only appears to account for part of SLT's intervention aims, with assistive interventions appearing to aim to support the child as well as to improve functioning.

The MRC (2008) provides an interesting case example of a study (Hardeman et al 2005) which models change in behavioural therapy. In order to examine which aspects of an intervention may have resulted in success, they used multiple outcome measures at different time points. This allowed a picture to emerge of which aspects of an intervention were able to induce change. A similar approach was conducted by Adams et al (2006) in a signal generator study. Signal generator studies are designed to indicate the presence or absence of treatment effects. Adams et al (2006 p.44) notes that signal generation studies are a "useful precursor to substantial intervention studies and inform their planning". Adams et al (2006) used a case series design in order to establish a signal, with multiple points of assessment on a range of standardised and other assessment types, to indicate where changes might be measured. This type of approach could be usefully applied to SRLI interventions in order to help unpack mechanisms of change. Disentangling an intervention effect when it is targeting multiple overlapping deficits will be challenging. However, documentation of all the outcomes should help to build up a picture of when change has occurred, how and why.

It is interesting to note that the intervention studies for SRLI, identified in Chapter 5, do not assess multiple outcome measures. For example Ebbels et al (2007) found success for shape coding on their self developed measure, which assessed argument structure. Parsons et al (2005) also found success on their self developed measure of vocabulary. Since these studies did not measure performance against a broader language assessment, it is not possible to determine the impact of these improvements on other areas of language and communication. Other studies such as Joffe et al (2007) examine performance on a broad assessment of story comprehension, but do not directly examine changes that may have contributed to comprehension performance (such as memory). As a result, it is difficult to build a picture that can contribute to the understanding of mechanisms of change.

The other issue that will need to be considered in relation to outcome measures will be the development of measures related to improvements in functioning. Existing published standardised measures tend to assess language performance but do not generally assess the impact of these impairments on day to day communication and learning environments. Attempts have been made in other areas of speech and language therapy to design outcome measures that consider activity and participation, in particular the Therapy Outcome Measure (TOM) (Enderby 1992; Enderby and Emerson 1996; Enderby and John 1997a,b). TOM was designed to assist therapists in making subjective, but reliable, descriptions of their patients, using four scales related to the domains of Impairment,

Disability, Handicap and Wellbeing. The domains were originally based upon the World Health Organisations International Classification of Impairments, Disabilities and Handicaps 1 and 2 (ICIDH 1&2), and have now been updated in line with the new ICF (WHO 2001) framework with 'Disability' being renamed 'Activity' and 'Handicap' renamed 'Social Participation'. The reliability of TOMs has been reported by John and Enderby (2000), though it has been found to be influenced by training. TOMs aims to provide a 'snapshot' outcome measure. As noted by John and Enderby (2000):

"While no outcome measure can, on its own, without a formal trial assuredly reflect data that could be attributed to a specific intervention, they should be designed to reflect areas that are likely to be affected by the associated intervention."
(John and Enderby, 2000, p.288)

Although TOMs is undoubtedly useful as an outcome measure, a distinction can be made for measures like TOMs which are designed to function across cases and *research* measures that are often required to detect specific changes in client subgroups. The TOMs includes rating scales relating to the domains of the ICF, but does not breakdown these domains into further components. As a result, it is too broad to establish how change occurs. It would be valuable if a new outcome measure was developed, perhaps building on the TOMs, but including more detailed components from the activity and participation domains. The relevant codes identified from the focus group from the ICF, would be a useful starting point for this process.

8.7 Strengths and limitations of this thesis

The following section considers the strengths and limitations of this thesis in relation to the systematic literature review and the focus groups.

8.7.1 The systematic literature review

A valuable way to assess the strengths and limitations of the systematic review is to evaluate it against quality reporting criteria for systematic reviews. An appropriate checklist to do this against, since it considers the reporting of systematic reviews for observational studies, is provided by Stroup et al (2000). Commonly referred to as the MOOSE statement (meta-analyses of observational studies in epidemiology), the checklist was developed as a result of a workshop held in Atlanta, in April 1997, with 27 experts in a range of fields. Material used for the workshop came from a systematic review of the published literature on the conduct and reporting of systematic reviews. Although the MOOSE statement checklist relates to reporting of meta-analysis, which was not used in the systematic review in the present research, it provides many valuable and transferable recommendations.

The systematic literature review has been assessed against the checklist provided by the MOOSE statement (Appendix 12). It can be seen that it met most of the criteria for good quality reporting in systematic reviews of observational studies. In the few places where it did not meet the criteria, these were largely related to factors that are specific to meta-analysis, rather than narrative synthesis that was used in the systematic literature review.

The reliability of the systematic review was upheld by the transparent reporting of all procedures used in the identification and selection of the studies. The validity of the findings of the SLR, however, is affected by the validity of the studies that were identified within it. It was noted in the reporting of the SLR that there are many issues with the external and internal validity of studies that have examined the cognitive and linguistic deficits in SRLI. Results were interpreted in this context and due consideration was taken of these issues in the discussion. Clear acknowledgement and descriptions of these issues have been important in indicating areas for improvement in SLT research.

8.7.2 The focus groups

Typically the terms 'reliability' and 'validity' are used for testing or evaluating quantitative research. In relation to qualitative research (such as the focus groups) there has been debate around the appropriateness of these terms (Stenbacka 2001; Creswell and Miller 2000). Several authors propose that the hallmark of scientific rigour in qualitative research is establishing trustworthiness (Seale 1999; Lincoln and Guba, 1985). Lincoln and Guba (1985) suggest criteria for trustworthiness should include credibility, transferability, dependability and confirmability. A number of different authors have suggested ways in which research should try to meet these criteria. The following section will consider ways in which the focus group method met criteria for trustworthiness.

Credibility and dependability

Credibility is perhaps one of the most important factors in relation to the trustworthiness of the data. Credibility can be described as how congruent the findings are with reality (Shenton 2004). Lincoln and Guba (1985) emphasise the similarities between credibility and dependability, arguing that, in practice, a demonstration of the former goes some distance in ensuring the latter, for this reason these two are discussed together.

One method that is recommended for ensuring credibility is negative case analysis (Miles and Huberman 1984). This involves searching for and discussing elements of the data that do not support or appear to contradict the general themes (Yin 1994; Miles and Huberman 1984). Since an aim of the focus groups was to discuss a range of intervention approaches, the findings of the focus groups attempted to describe all intervention approaches that were

raised. The iterative approach to data analysis endeavored to ensure that none were excluded. In relation to the rationales for interventions, the findings also describe general themes, and the exceptions to these, thus incorporating 'negative cases'. Similarly, Ritchie et al (2003) recommend saturation of the data and the opportunity to recruit further participants who might contradict expected findings. The number of focus groups was determined by the principle of saturation, and the iterative nature to the groups allowed opportunities for contradiction.

The use of a clear audit trail is generally agreed to be a good marker of dependability (Koch 1994), that is, a transparent description of the research steps taken from the start of a research project, to the development and reporting of findings. Part of demonstrating a clear audit trail was making explicit the details of the focus groups and their analysis. The use of Nvivo 8 software also allowed clear records to be kept using nodes and tree nodes, as well as memos which have contributed to the process of analysis being recorded. Linked with audit trails is the suggestion by Maxwell (1996) to control for threats to the accuracy of data collection. An example is the use of audio tape and verbatim transcripts, which were utilised in the present research.

Another aspect of dependability, that has also been argued to be important in credibility, is prolonged engagement in the field (Lincoln and Guba 1985). Unfortunately, it was not possible to engage with the focus group SLTs over a long period of time. Confirmation of the interventions that they reported using, as well as their rationales, could perhaps have been supported through direct observation of their practice over a prolonged period. However, there would have been feasibility and ethical issues in observing SLT sessions. Instead focus groups were of a relatively long duration to ensure that there was an opportunity to discuss a range of interventions as well as rationales for these interventions. This also provided a chance to check and clarify SLT's suggestions after they had said them.

The use of participants from different geographical locations, as well as a final larger group, helped to ensure that a range of perspectives was gained. However, the original intention was to purposefully select participants, unfortunately due to low recruitment numbers this was not feasible. Had this been possible it is likely that a greater spread of geographical locations, as well as the inclusion of SLTs from a larger range of qualifying universities, would have been gained, which may have improved the range of responses.

Transferability

Transferability refers to the extent that the findings of qualitative research can be transferred or generalised to other contexts or setting. Shenton (2004 p.69) notes (in a qualitative

project) “it is impossible to demonstrate that the findings and conclusions are applicable to other situations and populations”. In qualitative research, transferability is primarily the responsibility of the one doing the generalising. Lincoln and Guba (1985) argue that it is the responsibility of the investigator to ensure that sufficient contextual information is provided to make sure the reader can make a transfer.

Thick descriptions have been described as a valuable way of making research transferable (Lincoln and Guba 1985). This has been provided in the present study through provision of background information on those who participated (within the perimeters of confidentiality), how they were nominated, as well details about the data collection method and duration. Numerous quotations were also used in the focus group findings. The provision of details of responses is generally interpreted to allow the reader to make decisions about the accuracy of the author’s interpretations.

Confirmability

Confirmability refers to whether there is a correspondence between what the study’s participants meant and what the researcher inferred. Member checks of the data have been recommended as one way to assess this (Miles and Huberman 1984). The present study did not directly check the research interpretations with participants. However, an iterative approach to the focus groups, where previous intervention approaches were raised at subsequent groups, allowed participants to express agreement and disagreement. Some use triangulation to improve credibility (Lincoln and Guba 1985; Miles and Huberman 1984) but this was not feasible.

Although attempts were made to reduce author’s bias through an independent author reading transcripts for focus group 1, and independently developing themes, it is likely that bias was not completely avoided. All qualitative research analysis involves some interpretations of the researcher (Glesne 2006). The higher order analysis that was used to inform the model of interventions for SLR, is therefore argued to reflect the data, but only to the extent that it reflects the author’s interpretation of the data.

8.8 Conclusion

The research has contributed to the development of evidence and theory of interventions for children with SRLI, in doing so it provides foundations for future development of evidence based interventions for children with SRLI. The systematic literature review identified some common areas of deficit in children with SRLI. However, it demonstrated that the cognitive and linguistic deficits that underpin comprehension in children with SRLI are interactive and

difficult to define. It is perhaps a reflection of this complexity that the intervention approaches described by expert SLTs in the focus groups often targeted numerous areas of deficit simultaneously. The focus groups were, nevertheless, able to identify a range of intervention approaches in relation to the areas of deficit in the SLR. Further, they were able to elucidate factors involved in the selection of targets for SRLI interventions, as well as the components of SRLI interventions that appear to be core. The focus groups also identified that SLTs adopt many intervention approaches for SRLI that can be described as assistive, rather than impairment based. The findings from the focus groups were used to generate a model of interventions for children with SRLI. This model helps to make explicit both the different foci of interventions in SRLI, key features in selecting interventions, as well as the core methods adopted in the delivery of SRLI interventions.

The research has highlighted the difficulties in mapping theories of deficit to intervention approaches for SRLI, and thus in producing an explanatory model of SRLI that can generate hypotheses for intervention, as was set out in the aims. The research, however, has helped to contribute to theory for SRLI interventions through the development of possible mechanisms of change, for both impairment based and assistive interventions. Though it is clear that further development work is needed in order to confirm the proposed mechanisms of change, the provision of these tentative theories, alongside details of interventions for SRLI, provides groundwork for modeling processes and outcomes for SRLI interventions.

It is hoped that the work in this thesis will make a substantial contribution to the future development and evaluation of interventions for SRLI. The adoption of a systematic approach which considered evidence and expert SLT opinion has contributed to the evidence base and identification and development of theory for SRLI interventions. This contribution is valuable since these are crucial stages in developing complex interventions, recommended by the MRC (2008). It is hoped that this work will inspire future intervention studies for children with SRLI, since this vulnerable population remains under investigated in the research literature.

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APPENDICIES