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Investigating Relative Clauses in Children with Specific Language Impairment

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This is to certify that the research in this thesis is my own unassisted work.

Pauline Frizelle

This thesis is dedicated to Eddie and to you who have not yet taken your place in the world.......

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Abstract

Background: It is well documented that children with Specific Language Impairment (SLI) experience significant grammatical deficits. While much of the focus in the past has been on their morphosyntactic difficulties, less is known about their acquisition of complex syntactic structures such as relative clauses. The role of memory in language performance has also become increasingly prominent in the literature.

Aims: This study aims to investigate the control of an important complex syntactic structure, the relative clause, by school age children with SLI in Ireland, using a newly devised sentence recall task. It also aims to explore the role of verbal and short-term working memory in the performance of children with SLI on the sentence recall task, using a standardized battery of tests based on Baddeley's model of working memory.

Methods and Procedures: Thirty two children with SLI, thirty two age matched typically developing children (AM-TD) between the ages of 6 and 7,11 years and twenty younger typically developing (YTD) children between 4,7 and 5 years, completed the task. The sentence recall (SR) task included 52 complex sentences and 17 fillers. It included relative clauses that are used in natural discourse and that reflect a developmental hierarchy. The relative clauses were also controlled for length and varied in syntactic complexity, representing the full range of syntactic roles. There were seven different relative clause types attached to either the predicate nominal of a copular clause (Pn), or to the direct object of a transitive clause (Do). Responses were recorded, transcribed and entered into a database for analysis. The Working Memory Test Battery for children (WMTB-C — Pickering & Gathercole, 2001) was administered in order to explore the role of short-term memory and working memory on the children's performance on the SR task.

Outcomes and Results: The children with SLI showed significantly greater difficulty than the AM-TD group and the YTD group. With the exception of the genitive subject clauses, the children with SLI scored significantly higher on all sentences containing a Pn main clause than those containing a transitive main clause. Analysis of error types revealed the frequent production of a different type of relative clause than that presented in the task — with a strong word order preference in the NVN direction indicated for the children with SLI. The SR performance for the children with SLI was most highly correlated with expressive language skills and digit recall.

Conclusions and Implications: Children with SLI have significantly greater difficulty with relative clauses than YTD children who are on average two years younger — relative clauses are a delay within a delay. Unlike the YTD children they show a tendency to simplify relative clauses in the noun verb noun (NVN) direction. They show a developmental hierarchy in their production of relative clause constructions and are highly influenced by the frequency distribution of the relative clauses in the ambient language.

Chapter 1

Introduction

This thesis is about the control of complex syntax in children with Specific Language Impairment (SLI). The definition of SLI is primarily one of exclusion. SLI is an impairment of language comprehension, language production, or both, in the absence of hearing impairment, the absence of a general developmental delay (i.e. a normal performance IQ), the absence of any neurological impairment (e.g. seizure disorders, perinatal bleeds) and no diagnosis of autism (Schwartz, 2008, p.3). Studies of SLI have become increasingly prevalent, in English and in other languages. In English, much of the focus has been on the morphosyntactic deficits of children with SLI. The area of complex syntax has not been investigated so extensively, however the documentation of complex syntax development is critical to our understanding of the linguistic deficits that characterize these children. This thesis examines the control of one important area of complex syntax by school-aged children with SLI — specifically relative clauses.

A relative clause is a subordinate clause that modifies a noun or noun phrase in an associated main clause. Relative clauses are considered a very useful form of complex syntax to study as they allow for the manipulation of syntactic complexity while maintaining the length of the sentence. This is important in helping us to disentangle the role of memory and processing difficulty in areas of complex syntax for children with SLI. While a number of researchers in the past have investigated relative clauses in SLI (Hakansson & Hansson, 2000; Schuele & Tolbert, 2001; Schuele & Dykes, 2005; Hesketh, 2006; Novogrodsky & Friedmann, 2006), all of the studies have included a limited range of types of relative clause constructions. This study aims to redress this imbalance by exploring a wider range of types of relative clauses than has been attempted before. While previous studies have primarily analysed relative clauses in which the relativised item has just two syntactic roles (subject and object), the current study will look at all the available syntactic roles — subject, object, indirect object, oblique and genitive. In this study the type of main clause will also be manipulated, as previous studies have neglected to account for the impact of the syntactic role of the head noun of the main clause.

The methodological tool used to explore the control of relative clauses by children with SLI, is a newly devised sentence recall task. This involves the oral presentation of individual sentences, with the child required to repeat each sentence verbatim. Sentence recall is considered a highly discriminative marker of children with SLI (Conti-Ramsden, Botting, & Faragher, 2001) and is posited as a sensitive measure of children's syntactic knowledge. Sentence recall taps into phonological short-term memory as well as previous language knowledge stored in long-term memory. It facilitates the elicitation of a range of selected targets in a more systematic way than in spontaneous language production — making it more difficult for a child to avoid particular structures e.g. complex syntax. Sentence recall allows for a child to make a wide variety of errors in relation to a target structure i.e. they may make substitutions, additions, transpositions and omissions — all of which can occur at word, morpheme or phoneme level. It also allows us to analyse changes that are made to the syntactic structure as a whole, thereby providing significant qualitative information about the underlying difficulties that these children experience.

Over the last decade, there has been increasing interest in the role of memory on the language learning and processing abilities of children with SLI. It is well attested in the literature that children with SLI have limitations in a number of central cognitive domains such as memory, attention and other executive functions. This study addresses the role of short-term and working memory in the performance of children with SLI on the sentence recall task. While there are a number of different models of working memory, (e.g. the capacity theory of comprehension — (Just & Carpenter,1992) much of the research with children with SLI has been dominated by Baddeley's model of working memory, resulting in the development of standardized assessment materials, such as the Working Memory Test Battery for Children (WMTB-C), (Pickering & Gathercole, 2001). The current study uses the WMTB-C (Pickering & Gathercole, 2001) to take independent measures of phonological memory, visuospatial memory and central executive (working memory) functioning from the children with SLI. This will allow for possible relationships to be examined between the children's performance on the relative clause sentence recall task and their performance on different tests of short-term and working memory.

The thesis is organised in five chapters — *Introduction, Literature Review, Methodology, Results and Discussion.*

The literature review gives a brief outline of the morphosyntactic and complex syntactic difficulties of children with SLI. This is followed by a review of the linguistic and processing theoretical proposals concerning the bases of SLI. The methodological paradigm of sentence recall is then introduced — its relationship to long and short-term memory and how it can be interpreted in the light of Baddeley's model (2000). This is followed by an explanation of relative clauses as well as an overview of previous relative clause studies and their associated theories

in typically developing children. Finally, existing research studies on relative clauses in SLI are reviewed.

A description of the current research study is given in the Methodology chapter. This includes details of the participants, inclusion and exclusion criteria and information regarding the language status of each group of children.The materials used in the study are then outlined — i.e. the newly devised sentence recall task as well as a brief description of the WMTB-C (Pickering & Gathercole, 2001).This is followed by an account of the methodological procedure and a detailed description of the scoring system devised to allow for analysis of the full range of errors by children with SLI.

The results chapter is made up of three main sections — *Group differences, Relationship Questions and Error Analysis.* Differential statistics allow for an analysis of the differences between the three groups of children (children with SLI, age-matched control children and children who are on average two years younger). The impact of the type of main clause as well as the syntactic role of the relative clause is analysed, as well as the differences between subject and object relatives, relative clause conversion types, transitive and intransitive clauses and prepositional difficulties. This is followed by a description of the inferential statistics completed, in order to examine relationships between dependent and independent variables — including variables of language and memory. Finally the error analysis provides a detailed account of the error patterns of children with SLI in relation to those of age-matched and younger typically developing children.

The discussion chapter analyses the impact of the group differences for the children with SLI in relation to the typically developing children. This is followed by a discussion of the effect of the main clause and the effect of the relativized syntactic role. This chapter also focusses on the implications of the error patterns shown by the children with SLI and possible explanations are posited. The role of short-term and working memory in the control of relative clauses for these children is then discussed, followed by the role of children's language status. Finally, the clinical implications of the study and possibilities for further research are considered.

Chapter 2

Literature Review

2.1 Introduction

Children with Specific Language Impairment are a heterogenous group with regard to the characteristics they exhibit in acquiring language. This heterogeneity has led to considerable variability in the descriptions of the symptoms associated with this disorder. Epidemiological evidence suggests that children with SLI represent the largest segment of children with language impairments, estimated at 7% of the general population (Johnson et al., 1999; Tomblin et al., 1997). However, both clinical and research communities have expressed dissatisfaction at the exclusionary way in which SLI is currently being diagnosed. This has led to much discussion regarding the underlying mechanisms of SLI as well as the identifcation of 'markers', which would differentiate accurately between individuals with and without language disorders, even when superficially the language difficulties appear to have resolved.

There are two significant approaches in the formulation of theories of SLI, psychological and linguistic. Those that explain SLI as a result of deficits in linguistic knowledge, typically attribute it to a delay in linguistic maturation or a deficient representation of language and those that apply a psychological approach explain SLI in terms of a deficiency in cognitive processing. Central to these psychological accounts is whether the deficits are *domain-general*, affecting both linguistic and non-linguistic cognitive processing or *domain-specific*, affecting the processing of linguistic material only. The greatest limitation of the theories that have been put forward is that they are not sufficiently comprehensive to account for all the deficits that are associated with SLI.

2.1.1   Morphosyntactic Deficits

Morphosyntactic deficits are the most studied language deficits in children with SLI and seem to manifest themselves in different ways according to the language the child is acquiring. English speaking children with SLI have particular difficulty with verb morphology. They tend to omit the functional morphemes that mark finiteness (i.e. tense and agreement) and instead produce bare stem verbs (e.g. ask) without third person singular or past tense endings. They also appear to do this at rates that are higher than those of language — matched controls, especially when children's mean length of utterance is above 3.5 (Leonard, 1998; Beverly & Williams, 2004). While these measures of finite verb morphology are extremely sensitive in distinguishing young children with and without SLI, as children grow older their profiles become less predictable and morphosyntactic deficits are no longer a highly discriminating diagnostic marker of SLI (Conti-Ramsden, Botting & Faragher, 2001). Studies of past participle forms (e.g. *was thrown...* in the sentence *The ball was thrown by John.*) have yielded mixed findings. Some studies show that children with SLI produce participles comparably to language matched controls (Redmond & Rice, 2001) while others revealed difficulties (Leonard et al., 2003). Some studies also revealed deficits in noun plurals and articles (Leonard, Bortolini, Caselli, McGregor, & Sabbadini, 1992; Leonard, Eyer, Bedore, & Grela, 1997) and others showed only minimal deficits (Oetting & Rice, 1993; Rice & Wexler, 1996). Case marking for pronouns in English (subject versus object) is also impaired in children with SLI compared to language matched controls, (Loeb & Leonard, 1991; Loeb, Pye, Richardson, & Redmond, 1998) with error rates differing between *he* and *she* (Wexler, Schutze, & Rice, 1998). However, other studies showed that not all children with SLI make these errors (Pine, Joseph, & Conti-Ramsden, 2004).

2.1.2   Syntactic Deficits

While much of the research to date has focussed on documenting the morphosyntactic difficulties of children with SLI (Leonard, 1998), the linguistic problems that these children have, are not restricted to the domain of morpho-syntax. Research studies also suggest that children with SLI have particular difficulty understanding complex syntax (Bishop, Bright, James, Bishop, & van der Lely, 2000; Norbury, Bishop, & Briscoe, 2002). However this area has not been investigated as extensively and as a result we have an incomplete characterization of the grammatical acquisition of children with SLI. Trask (1993, p.273) provides a description of syntax as 'the branch of grammar dealing with the organization of words into larger structures, particularly into sentences'. Complex syntax however, involves utterances that consist of more than one clause either through coordination, subordination or embedding, (Quirk, Greenbaum, Leech, & Svartik, 1985). Some examples of complex syntax include relative clauses e.g. *that the girl*

baked in the sentence *The cake that the girl baked was burnt,* subordinate clauses, such as *because I was in a hurry* in the sentence *I ran because I was in a hurry,* and infinitives such as *to shop* in the sentence *I like to shop.* From a descriptive perspective, the term complex sentence is a useful catch-all regarding how we syntactically link simple sentences, but for effective assessment and intervention the distinct functions of the above forms have to be recognized, in addition to their syntactic requirements.

The majority of what we know about complex syntax comes from language sample studies, with some more recent studies using targeted elicitation. A small number of studies have also used online and offline comprehension tasks. It is suggested in the literature that children with SLI have difficulty understanding and producing sentences that involve long-distance dependencies, such as relative clauses (Friedmann & Novogrodsky, 2004; Schuele & Tolbert, 2001; Hakansson & Hansson, 2000). As some of these studies included children with SLI that spoke languages other than English, it is suggested that this is a global difficulty.

Hesketh (2004) carried out a study comparing the grammatical output of children with SLI on elicitation and narrative tasks. Sixty five children, aged between 6 and 11 years, took part in the study. She found elicitation to be more facilitative and considered that it more closely reflected the children's grammatical knowledge. She provided approximate sentence values for each of the following structures within the elicitation tasks: post-modifying clause: 74%, subordinate clause: 48%, elided co-ordination 63%, conditionals 44%. Donaldson, Reid, and Murray (2007) found that 5 to 7 year old children with language impairment have problems using subordinate clauses, specifically sentences with connectives such as *because* and *so.* According to Owen and Leonard (2006) sentences with finite complement clauses also pose problems for children with SLI. Syntactic deficits in argument structure, that affect both their production and comprehension of complex sentences, are also noted in the literature (Grela & Leonard, 2000; Chiat, 2000; Thordartottir & Ellis Weismer, 2002).

2.2   Representational Accounts

In attempting to account for both the morphological and syntactic difficulties that children with SLI experience, a number of proposals have emerged. The main linguistic approaches will be outlined (e.g representational accounts) in this section followed by those that apply a psychological interpretation (e.g. cognitive processing accounts).

Central to the representational accounts of language difficulties in children with SLI is the notion that the deficit is at the level of the linguistic representation with disagreement regarding the central cause of the impairment. One of the most

influential representational accounts of SLI is the Extended Optional Infinitive (OI) Account (Rice & Wexler, 1996) and its new version, the Extended Unique Checking Constraint (UCC) Account (Wexler, 1998). The early version of this account maintains that children with SLI extend a period that occurs in typically developing children in which they show optional use of tense marking. The cause of the deficit is a maturational delay and the result is that finite verbs are produced without markers such as tense and number. The more recent version of this account (UCC) incorporates the linguistic concept of *checking*. This account posits that children with SLI experience an extended period in which they are limited to checking a single functional category, however in order for an element to be produced a feature in a phrase must check all of the relevant functional categories. This causes the omission of tense or agreement marking. Again, typically developing children are said to experience the same constraint in *checking*, but as they mature it disappears.

The UCC explanation is limited to morphosyntax, and specifically finiteness problems in English. Another representational account which purports to account for syntactic problems is that put forward by van der Lely (1998). In her work van der Lely has strived to answer the question of whether children with SLI have a specific deficit in their syntactic system. Inspired by Chomsky, van der Lely and colleagues proposed the Computational Grammatical Complexity hypothesis (CGC) (Marshall & van der Lely, 2006; van der Lely, 2005), a development of the previously known Representational Deficit for Dependent Relationships (RDDR) hypothesis.

van der Lely (2005, p. 55) suggests that the CGC predicts 'a pervasive deficit in grammatical components determined by structural complexity'. She claims that the core deficit of some but not all children with SLI is in the representation and / or mechanisms responsible for building hierarchical grammatical structures. Their syntactic deficit is considered a difficulty in computing long-distance syntactic dependencies between different sentence constituents that include any kind of syntactic movement. The linguistic operation of *movement* is the dislocation of syntactic elements (i.e. phrases or heads) and is claimed to be a universal property of human languages (Chomsky, 1986). It is seen in passives, wh-questions, object relative clauses and pronoun or reflexive antecedent relations. In individuals who have not determined that movement is obligatory, ungrammatical productions or interpretations of sentences may result. A dependency is 'any relation between two elements or positions in a sentence where the presence, absence or form of an element in one position is correlated with the presence, absence or form of an element in another position' (Trask, 1993 p.77). An example of dependency perhaps in its simplest form would be subject-verb agreement in English. Compare for example the sentences in (1) and (2), the choice of marking on the verb is dependent on the subject of the sentence. This is considered a local dependency.

1. The girl goes to the shop on Monday

2. The girls go to the shop on Monday.

3. I met the man who the dog bit.

An example of a non-local dependency is seen in the relative clause. If we consider the relative clause structure at (3.), this can be regarded as a syntactic dependency in that the thematic role of the relative clause object is unspecified until we encounter the relative clause verb. The CGC predicts problems with these syntactic dependencies for children with SLI.

van der Lely (1998) argues that children with SLI do not consider *movement* to be an obligatory operation and that this leads to inconsistent interpretations of relative constructions. Furthermore, complexity is defined by the distance of the movement operations. Subject relative clauses therefore, are predicted to be less problematic than object relative clauses (A detailed description of relative clauses is given in section 2.6). This account claims that children do not have the ability to process movement necessary to create the link between the clausal head and its role in the clause. If children 'lose' the thematic role of the clausal head they tend to assign it the default role of agent. In subject relatives (4.) this yields the correct response but for object relatives (5.) this interpretation results in chance performance because both the clausal head and the subject of the clause now have an agent role. The existence of two competing agents may lead the child to randomly choose between the correct and the incorrect interpretation.

4. The milkman that ＿＿ pushes the boy.

5. The milkman that the boy pushes.

6. The girl that the boy kissed was smiling.

There are a number of limitations to the CGC account. Firstly, it predicts that deficits linked to nonlocal dependencies and movement are specific to the grammatical system and cannot be attributed to such factors as perceptual deficiencies or working memory limitations. This is somewhat controversial, with many researchers proposing a strong link between working memory limitations and the comprehension abilities of children with SLI. Bishop & Adams, 1992 suggested that these children's poor comprehension of complex sentences relative to simple sentences would be best explained in terms of the number of words that have to be retained before a correct interpretation is possible. For example, in the relative clause in (6.) both noun phrases must be stored in working memory before either of them can be syntactically or semantically integrated with the following verb phrase. It is difficult then, not to consider memory as a possible contributor in the parsing /processing of any sentence that involves movement.

In fact memory is implicated in a number of the hypotheses posited to explain how typically developing children attempt to deal with relative clauses e.g. the non-interruption hypothesis and the filler-gap hypothesis. These will be discussed

in sections 2.7.2 and 2.7.5.

Secondly, the CGC account has been developed based on work carried out with a sub-group of children with SLI called G-SLI. This group of children are considered to be a comparatively homogeneous subgroup of the SLI population and are characterized by a persistent and relatively pure grammatical impairment in at least three components of the grammatical system: syntax, morphology and for most phonology (van der Lely, 2005). Other researchers have questioned the usefulness of using this categorization. Studies researching the classification of children with SLI such as that carried out by Conti-Ramsden and Botting (1999), point out that individual children's language strengths and weaknesses change over time and consequently, a large proportion of children with SLI move to different subgroups. They argue that SLI is a dynamic condition that changes developmentally. Other studies, such as that carried out by Norbury et al. (2002), specifically investigated whether impaired grammatical comprehension in children with SLI provided evidence for an innate grammar module. They found only a small percentage of the children in the SLI group showed a comprehension profile of syntactic deficits consistent with a 'pure' G-SLI. They considered that the pattern of errors on syntactic tasks and the relatively weak correlation between different indicators of syntactic deficit seemed incompatible with a modular hypothesis. They concluded that children with SLI do not suffer from a modular deficit in the syntactic computational system. Certainly, if a G-SLI group does exist, it is posited by many researchers (including van der Lely) that this population forms a very small percentage of the larger SLI group, who also demonstrate concomitant difficulties in other areas (Bishop et al., 2000).

2.3   Why investigate complex syntax?

At present our knowledge base of the developmental course of complex syntax comprehension and acquisition in children with SLI, does not equal the level of detail that exists for morphosyntactic development. However, our full understanding of language impairment will rely upon a thorough description of all characteristics of specific language impairment. Given that grammatical limitations are considered a significant feature of SLI, it is essential to investigate further how this grammatical vulnerability is exhibited across these children's development (Tager-Flusberg & Cooper, 1999). Therefore, it is important to develop a complete picture of the acquisition and comprehension of complex syntax, in order to have a more complete understanding of SLI. As complex syntactic difficulties are characteristic of these children's language, then any proposed theory must account for both morphological and syntactic limitations. Before attributing the grammatical limitations of children with SLI to any one theory, it is critical to have 'a good characterization in broad descriptive terms of the grammatical errors

committed by' children with SLI (Newmayer, 1997, p.61). The study of complex syntax is therefore likely to be informative in the evaluation of the relative merits of proposed accounts of SLI. Complex syntax difficulties may also be an important clinical marker of SLI beyond the preschool years (Tomblin, Freese, & Records, 1992). The identification of 'markers' has direct clinical implications both from a diagnostic and an intervention perspective and is also significant in attempting to trace heritablity. As children approximate mastery of grammatical morphemes, the further use of these structures as clinical markers becomes limited. Limitations in complex syntax may then emerge as reliable clinical markers. In any ca'se, clinical intervention techniques will also be strengthened by a better understanding of complex syntactic development in children with SLI.

2.4   Processing Accounts

It is well documented in the literature that children with SLI have deficits in a number of cognitive processes. The research provides evidence of limitations in short term and working memory (Gathercole & Baddeley, 1990; Kirchner & Klatzky, 1985; Montgomery, 1995) speech perception, (Tallal & Piercy, 1973, 1974) and slowed reaction times (Kail, 1994; Leonard et al., 2007), as well as deficits in attention (Noterdaeme, Amorosa, Mildenberger, Sitter, & Minow, 2001) and other executive functions. These deficits in cognitive processes have caused many researchers to look beyond pure linguistic accounts to explain the linguistic behaviour of SLI. Central to cognitive processing accounts is whether the deficits are general – affecting both linguistic and non-linguistic cognitive processing *(domain-general)*, or whether they are specific to language *(domain-specific)*. This is a complex differentiation, as *domain-general* deficits will include language related cognitive processes (e.g. working memory, auditory perception) and *domain-specific* deficits will include aspects of these same processes which are specific to language (e.g. phonological working memory, speech perception).

2.4.1   Speech Perception

There is ample experimental evidence to indicate that children with SLI have deficits in their ability to receive stimuli that are presented rapidly, are brief in duration and that have components that change rapidly (e.g. formant transitions) (Tallal & Piercy, 1973, 1974; Stark & Tallal, 1981; Leonard, McGregor, & Allen, 1992; Sussman, 2001). The interpretation of these deficits has changed over the years from being a general processing deficit, to a general auditory deficit, to a deficit specific to speech processing. Growing out of this research, the *surface account* has been put forward by Leonard (1989, 1998) to account for the morphosyntactic difficulties in English, exhibited by these children. It suggests that for children with

SLI, markers that have low phonetic substance require more exposure to become established because of the processing demands required by their poor perception. So past tense or agreement markers that involve adding a consonant to a stem e.g. *walk-s,* may be more difficult for children with SLI to pick up. It has also been suggested that these deficits are related to a more general deficit in attention that might also affect other aspects of language. According to Coady, Kluender, and Evans (2005) these perceptual deficits may reflect general task demands, such as, working memory, attention and attentional control. However the specific nature of these deficits and their relation to the language difficulties exhibited by children with SLI remains unresolved.

2.4.2 Short-term Phonological Memory

There is much evidence that children with SLI have deficits in phonological and working memory that may underlie their language difficulties e.g. retrievel (Gillam, Cowan, & Day, 1995; Gillam, Cowan, & Marler, 1998; Kail, Hale, Leonard, & Nippold, 1984) and verbal storage capacity (Gathercole & Baddeley, 1990; Kirchner & Klatzky, 1985; Montgomery, 1995).

A large body of evidence is provided by studies of non-word repetition. Non-word repetition tasks involve the immediate spoken recall of novel phonological forms, which gradually increase in syllable length e.g. *nerb, mabon, jertonped, woogalamic.* Typically, children with SLI diverge from their peers once the non-words reach three syllables in length (Archibald & Gathercole, 2006a; Conti-Ramsden et al., 2001; Montgomery, 1995; Gathercole & Baddeley, 1990). It has been suggested that non-word repetition is a relatively pure measure of phonological short-term memory as it requires children to use a variety of phonological and memory-related processes (perception, encoding, storage, retrieval, production), somewhat independently of lexical knowledge (Gathercole, 2006; Gathercole, Willis, Emslie, & Baddeley, 1992). In 1990, Gathercole and Baddeley reported that a group of children with SLI were significantly more impaired than younger language matched control children on tasks involving the immediate memory of phonological material. The deficit was particularly evident in the non-word repetition paradigm. The above finding of impaired non-word repetition in children with SLI has since been replicated in many independent studies (Archibald & Gathercole, 2006a; Montgomery, 1995; Dollaghan, Biber, & Campbell, 1993; Edwards & Lahey, 1998; Sahlen, Reuterskiold-Wagner, Nettelbladt, & Radeborg, 1999; Weismer et al., 2000; Conti-Ramsden et al., 2001; Conti-Ramsden, 2003).

While there is no doubt that non-word repetition reflects the ability to store verbal material in short-term memory more recent research does indicate that non-word repetition is facilitated by previous language knowledge. For example, research by Gathercole (1995), and Gathercole, Frankish, Pickering, and Peaker (1999), showed

a clear advantage for the immediate memory of non-words rated as high versus low in word-likeness. They suggested that memory for familiar non-words is facilitated by the activation of long-term lexical knowledge. Vance, Donlan, and Stackhouse (1999) suggest that children's non-word repetition accuracy is determined to some extent by the accuracy of their speech processing skills. They found a significant correlation between non-word repetition and speech output (measured by picture naming) and non-word repetition and speech input (measured by a mispronunciation detection task) in TD children aged 3 to 7 years. They consider that non-word repetition difficulties may be as much a reflection of speech processing difficulties and reduced vocabulary knowledge as of a short-term memory deficit.

Further evidence that children with SLI have deficits in phonological short-term memory compared to their TD peers is provided by studies examining their performance on other measures of verbal short-term memory. These include measurements of span such as free recall of pictured items(Kirchner & Klatzky, 1985), as well as the serial recall of words and digits (Archibald & Gathercole, 2006a; Conti-Ramsden, 2003; Hick, Botting, & Conti-Ramsden, 2005). A study by Montgomery (1995) found that children with SLI have more difficulty comprehending longer than shorter sentences of equal syntactic complexity. Evidence for a short term memory deficit is also provided by findings that these children have problems remembering lines from common nursery rhymes and often recall the rhymes in an unconventional order (Fazio, 1997).

2.4.3 Working Memory

Deficits in the simultaneous processing of information as well as the storage of verbal material have also been reported in children with SLI. An important source of evidence is provided by complex memory span tasks that involve both the storage and processing of verbal information. These tasks are considered to represent verbal working memory and examples include backward digit recall, (the recall of digits while reversing their order) (Archibald & Gathercole, 2006a; Weismer, Evans, & Hesketh, 1999) and The Competing Language Processing Task (CLPT)(Gaulin & Campbell, 1994), where children are presented with sets of short (three-word) simple sentences (e.g., Pumpkins are purple, Fish can swim), asked to make a truth value judgement on each sentence (i.e. answer a yes/no question) and then to recall as many sentence-final words as possible from each set. The extent of the deficit of children with SLI on complex memory tasks cannot be explained by deficits in verbal short-term storage alone (Archibald & Gathercole, 2007a). For example, Marton and colleagues (Marton & Schwartz, 2003; Marton, Schwartz, Farkas, & Katsnelson, 2006) reported two studies in which children completed tasks involving either non-word repetition in isolation (storage only) or processing a syntactically simple or complex sentence (in long and short form) while repeating

the sentence final non-words (storage plus processing). As expected the children with SLI were impaired in the isolated non-word repetition task, however they showed much greater difficulty remembering the sentence final non-word as syntactic complexity increased. The results of both studies showed that sentence complexity had a larger impact on working memory performance than the length of the sentences. It is consistently the case that the extent of the SLI deficit in verbal complex memory tasks is greater than that in verbal storage tasks that impose minimal processing demands (Archibald & Gathercole, 2006a). Although SLI children were shown to be slower at processing visuospatial information compared to their typically developing peers (Archibald & Gathercole, 2007b), their deficits are more substantial and consistent when storing and or processing verbal information than on the visuospatial equivalents (Archibald & Gathercole, 2006a, 2006b).

These findings have been interpreted as suggestive of a domain-specific account of the aetiology of SLI (Gathercole & Baddeley, 1990). They put forward the theory that children with SLI have a predominant deficit in the short-term storage of verbal material and this causes problems for these children in any tasks that involve verbal short-term storage. Other authors posit the view that the poor performance of children with SLI on tests of verbal short-term memory is simply a manifestation of an overall (but specific) verbal deficit (Kohnert, Windsor, & Yim, 2006; MacDonald & Christiansen, 2002; Snowling, Chiat, & Hulme, 1991). Archibald and Gathercole (2007) put forward a double deficit view following their investigation of the contribution of verbal and visuospatial storage and processing limitations to the poor performance of children with SLI on complex memory span tasks. Their results indicated that the SLI children's recall accuracy was reduced on the complex memory tasks, that combined verbal storage with either verbal or visuospatial processing, to a greater degree than the younger language control group. They considered that as the deficit could not be accounted for by impairments in verbal storage alone, the results indicated that children with SLI have a double deficit i.e. a slow rate of processing combined with a specific verbal storage deficit.

2.4.4   Processing Speed

Reaction time has long been used as a measure of cognitive processing speed and it is well documented in the literature that children with SLI have slower reaction times than their typically developing peers. This has been found in verbal tasks such as picture naming and grammaticality judgments (e.g., (Lahey & Edwards, 1996; Miller, Kail, Leonard, & Tomblin, 2001; Montgomery, 2000a; Montgomery & Leonard, 1998; Stark & Montgomery, 1995; Wulfeck, Bates, Krupa-Kwiatkowski, & Saltzman, 2004)) and in non-verbal tasks such as mental rotation and visual search (Johnston & Weismer, 1983; Miller et al., 2001; Schul, Stiles, Wulfeck, & Townsend, 2004). A recent study carried out by Windsor, Kohnert, Loxtercamp, and Kan (2008) found that a language impaired group was slower than two typically developing

(one Bilingual) groups in tasks such as mental rotation and arithmetic, and also slower than the typical monolingual group in odd man out, pattern matching, and form completion, with the response time increasing equivalently across groups as the task difficulty increased.

In keeping with the theory of general processing limitations, Kail (1994) put forward the Generalized Slowing Hypothesis. This hypothesis posits that slow processing speed has a selective impact on language learning. This is because processes that are central to language such as parsing and extracting linguistically relevant information in the speech stream, are more time-dependent than processes involved in other areas of cognitive functioning (Miller et al., 2001). The critical variable in speed of task completion within a general time limited perspective is the difficulty rather than the content of the task (e.g. whether it is lexical or phonological). Therefore, a general slowing account does not imply that all tasks will be slowed by the same amount. It has been proposed that the proportionate increase in slowing with successive processing steps will have the greatest impact on tasks involving a number of processing components (Windsor, Milbrath, Carney, & Rakowski, 2001). Applying this hypothesis, the more complex the task the longer it will take to complete, in spite of the type of information to be processed (phonological, grammatical, lexical, spatial, visual, etc.).

Some studies have supported the slowing hypothesis (Leonard et al., 2007; Miller et al., 2001). When tasks were analysed in groups, the linguistic and non-linguistic tasks each resulted in slower reaction times for the SLI children than their typically developing peers. However when the tasks were subdivided, the motor and lexical tasks did not result in slower reaction times for the children with SLI. Nor did reaction times at age nine predict their reaction times at age fourteen. If processing speed were considered a causal factor of SLI, then we would expect that it would be related to the severity of the impairment, however this is not the case (Lahey, Edwards, & Munson, 2001). A more recent study (Leonard, Weismer et al., 2007) suggests that working memory and processing speed measures are related to language scores seperately. Predictive models showed that they accounted for almost two thirds of the variance in the language scores.

Although the generalized slowing hypothesis fits well with the notion that children with SLI have deficits in cognitive processing there are also some limitations to this theory. For example, reaction time on linguistic versus non-linguistic tasks may reflect different cognitive processes. Even within the domain of language, detection tasks and on-line language processing tasks would be considered overall to tap into a very different set of cognitive-linguistic processes.

2.4.5   Attention and Executive functions

Central to cognitive and perceptual processing is the concept of attention. Although it is often treated as a single concept, it can be subdivided into orienting, selective attention, divided attention, and sustained attention. Executive functions refer to the control of attention as well as other cognitive processes such as shifting attention, inhibition and planning. Both attention and executive functions are closely related to working memory. Some memory models suggest that working memory is tied directly to attentional control in explaining individuals performance on tasks that involve distraction or interference (Barrett, Tugade, & Engle, 2004). It is argued that working memory reflects attentional control in task switching ability (Towse, Hitch, & Hutton, 1998) and in the ability to inhibit irrelevant information (Hasher, Stoltzfus, Zacks, & Rypma, 1991). Working memory is also said to improve with greater abilities in controlling attention, in focussing on thoughts relevant to the task at hand, in suppressing irrelevant information and in co-ordinating simultaneous processing and storage of information (Engle, Kane, & Tuholski, 1999; Lustig, May, & Hasher, 2001; Miyake, 2001).

In attempting to explain how aspects of processing and memory interact with each other, Towse and Hitch (1995) put forward the Task-Switching Hypothesis. This can be exemplified through complex memory tasks which are said to be co-ordinated in working memory. According to the task-switching hypothesis, individuals alternate between processing information and attempting to maintain representations of the items to be stored. The greater the processing demands, the greater the interval between storage episodes. This increases the period of time over which representations may be lost due to decay. Barrouillet and colleagues (Barrouillet, Bernardin, & Camos, 2004; Barrouillet & Camos, 2001; Gavens & Barrouillet, 2004) suggest that performance on complex span tasks is constrained by a 'limited resource allocation'. This refers to a person's ability to divide his/her attentional resources between two or more different concurrent mental activities. The resource allocation is said to support processing activities that involve the retrieval of information from memory as well as the maintenance of item representations. They have proposed that complex memory span is related to the cognitive load of the task. This is the extent to which attention is switched away from maintenance of the material to be stored, to retrieval of information during a particular period. This is exemplified in Montgomery's research (2000b), where he studied working memory capacity and language comprehension in children with SLI. The children were required to recall as many words as possible under three conditions: no load (simple span), single load (storage and one mental operation) and dual load (storage and two mental operations). When the processing requirements were low, the children with SLI exhibited a storage capacity similar to that of their peers (single load). However, as the processing requirements increased (dual load) children with SLI were considered to have demonstrated a trade-off between

storage and processing.

Archibald and Gathercole (2007a) consider that this theoretical account may provide an explanation for the magnitude of deficits on complex memory span tasks found in children with SLI. It could be suggested that the slow processing speed of children with SLI, particularly with verbal stimuli, leaves longer periods of time in alternating between attending to storage and maintenance and therefore results in a high rate of decay from working memory. However, while memory is implicated to some degree it could also be argued that these children's slower real-time sentence processing is primarily related to inefficient lexical retrieval operations rather than a working memory problem.

Several other studies of working memory have revealed that children with SLI have poor cognitive control. In a study by Gillam and McFadden (1994) children with SLI showed exaggerated recency effects compared to their typically developing peers, in recalling one syllable words following a set of digits. Other studies requiring the recall of words and sentences, showed that children with SLI often provided irrelevant words from previous sentences or from other sentence positions when the required response was the final word (Marton & Schwartz, 2003; Weismer et al., 1999). These findings suggest that children with SLI have difficulty inhibiting linguistic information which is not relevant to their response.

A study by Im-Bolter, Johnson, and Pascual-Leone (2006) revealed that children with SLI performed more poorly than their typically developing peers on a large battery of verbal and non-verbal tasks involving the inhibition of activation of task relevant information and in updating working memory. This study provides evidence for *domain-general* deficits in executive function. These deficits could be related to deficits in processing speed, speech perception, working memory and the previously discussed deficits in language acquisition and processing that these children experience.

Clearly the relationship between memory and the processing of language is an extremely complex one. It seems evident from the research, that difficulties exhibited by children with SLI cannot be explained by a verbal storage deficit alone. Studies indicating slow processing rates also cause problems in the application of linguistic theories that do not take into account an overall psychological framework. However, many research findings can be manipulated or interpreted in order to present a case for a preferred approach. Following a review of the literature it would seem that children with SLI have deficits in both cognitive processing and verbal storage. It is difficult to ascertain whether one is more primary than the other or whether the difficulties are as a result of an inability to divide attentional resources between processing and remembering material simultaneously.

Given that children with SLI have deficits in both cognitive processing and verbal storage it is important to address their linguistic deficits with an approach that taps

in to both of these areas. The approach / methodological tool used in this study is sentence recall. How sentence recall relates to phonological verbal storage and the processing of language material will be discussed in the following section.

2.5   Sentence Recall

Sentence recall tasks (also referred to as sentence repetition or elicited imitation), have long been used by clinicians to screen children for potential language impairments (Carrow, 1974; Hammill & Newcomer, 1991). Standardized sentence recall tasks usually involve the oral presentation of individual sentences and require that the participant repeat each sentence verbatim. They are commonly part of many clinical tests, such as the Clinical Evaluation of language Fundamentals (CELF) (Semel, Wiig & Secord, 2003) and the Test of Language Development (TOLD)(Newcomer & Hammil, 1997).

In researching potential positive psycholinguistic markers for children with SLI, Conti-Ramsden and colleagues (2001) found sentence repetition to be the best indicator of SLI compared to other linguistic tasks, such as non-word repetition and tense marking. Other researchers have argued however, that sentence recall tasks do not necessarily reflect children's performance during spontaneous productions (Bloom, Lightbown, Hood, Bowerman, Maratsos & Maratsos, 1975; Case & Kurland,1980). Lust, Flynn, and Foley (1996) considered them to be a fairly sensitive measure of children's syntactic knowledge — the logic being that children are better able to repeat structures they know best. This sensitivity to syntax has been recognised in the literature and as a result sentence recall has been fairly widely used to investigate typically developing children's syntactic competence (Diessel & Tomasello, 2001; Kidd, Brandt, Lieven, & Tomasello, 2007) Despite this, there is a dearth of studies using sentence recall to investigate syntax in clinical populations. This may be as a result of the uncertainty over the cognitive processes that are involved, making it difficult to determine the root cause of poor performance.

2.5.1   Sentence Recall and long-term Memory

Evidence that long-term memory (LTM) is involved in sentence recall is provided by findings that normal individuals have the ability to repeat words in meaningful sentences that greatly exceeds their memory span (the number of unrelated digits, letters or words they can repeat). In sentences, 12 or more words can be recalled verbatim (Butterworth, Shallice, & Watson, 1990), while in contrast, for unrelated material memory performance is generally restricted to six or seven items (Baddeley, 1986). It is argued that when the length of an utterance exceeds the individual's word span they must use previous semantic and syntactic knowledge (stored in long-term memory) to 'chunk' the utterance and facilitate recall.

The role of long-term memory in sentence recall is also evidenced by the lexicality effect (Hulme, Maughan, & Brown, 1991), the phonotactic frequency effect and the redintegration process (Hulme, Quinlan, Bolt, & Snowling, 1995; Schweickert, 1993). The lexicality effect refers to the fact that children can recall more words when the words are more familiar and occur more frequently in the language (Majerus & Linden, 2003). The phonotactic frequency effect refers to the immediate recall advantage for non-words containing phoneme combinations that are high rather than low in frequency. The redintegration process refers to the 'filling in' or reconstruction of partially degraded memory traces, using long-term knowledge to facilitate the process of remembering what the word is, (Brown & Hulme, 1995, 1996; Hulme, Roodenrys, Schweickert, Brown, & al, 1997; Schweickert, 1993). These top-down processes rely on existing lexical representations in long-term memory to aid the process of remembering. The role of long-term memory is also implicated in sentence recall by the finding that, when errors in verbatim sentence recall do occur, the gist of the sentence is often preserved (Jarvella, 1971; Saffran & Martin, 1975).

Potter and Lombardi (1990, 1998) and Lombardi and Potter (1992) argue that participants primarily apply a semantic analysis of the sentences they are asked to recall, and that when repeating the sentences back they are using the same sentence production mechanism they use when producing regular speech. They propose that 'a sentence is generated in immediate recall from a representation of its meaning (in long-term memory) using recently activated words' (Potter & Lombardi, 1990, p. 633). They manipulated the standard sentence recall procedure by investigating the effect of intervening material, such as, lure words (Potter & Lombardi, 1990; Lombardi & Potter, 1992) and sentence primes (Potter & Lombardi, 1998). Using a lure intrusion paradigm, participants were presented with a sentence to be recalled, such as, *the knight rode around the palace searching for a place to enter.* followed by a word list which included a semantic lure. For example in the list *turtle, recipe, booth, castle, medal* the word *castle* is the lure for the target word *palace* as it is considered to be more strongly associated with the word *knight.* A further word then appeared *e.g. medal* and participants had to indicate whether it occurred in the previous word list. This is considered a distractor task. The participants were then required to recall the sentence. Potter and Lombardi (1990) found that during recall, the lure and target words were more likely to be exchanged when the lure was present in the word list, than when it was not. The rest of the sentence was usually recalled verbatim. Sometimes spontaneous intrusions of the lure word occurred, even when it did not appear in the word list. Potter and Lombardi (1990, 1998) suggested that this occurred because regenerating a sentence relies on recently activated lexical items from conceptual information in long-term memory. In their verb priming task, participants who substituted the main verb during recall tended to maintain the original verb argument structure, therefore the syntactic form of the structure was preserved (Lombardi & Potter,

1992).

Lee and Williams (1997) also argue that regeneration from the semantic / conceptual level is of great importance in sentence recall. However, they argue for a different cause of the lure intrusion effect. They suggest that this effect reflects a form of 'retroactive interference' at the stage of retrieving a conceptual representation from long-term memory, not competition at the stage of lexical access after a conceptual representation has already been retrieved.

A more recent study by Alloway (2007) used a similar paradigm to that of Potter and Lombardi (1990) and Rummer and Engelkamp (2001). In contrast to these earlier studies, where sentences were constructed to elicit the most semantically salient word in the sentential context, Alloway (2007) eliminated contextual cues, such that neither the target nor the lure words were semantically associated with the events in the sentence. The results showed a much lower percentage of intrusions (2% to 5%) compared to previous studies (24% to 53% in Potter & Lombardi, 1990; Rummer & Engelkamp, 2001). This influence of contextual clues on low intrusion rates is consistent with evidence that semantic coherence boosts recall (Poirier & Saint-Aubin, 1995). In summary these studies suggest that during the sentence recall process, individuals reconstruct the stimulus sentence from lexical, semantic and syntactic representations in their long-term memory.

2.5.2   Sentence Recall and Phonological short-term Memory

While Sentence Recall taps into representations in LTM, there is also compelling evidence that phonological short-term memory capacity (STM) contributes to the recall of sentences. Alloway and Gathercole (2005) observed marked differences in the number of words accurately recalled in a sentence between high and low phonological memory groups (the low phonological memory group achieving significantly lower scores). The high phonological memory group also retained the structural aspects of the sentence (such as word order) significantly better than the low phonological memory group, who were more likely to commit errors of omissions and insertions. It is therefore considered that phonological memory does in some way assist in the preservation of the structure of the sentence.

Willis and Gathercole (2001) also found that children who demonstrated high phonological short-term memory ability, were better at repeating sentences than children with lower phonological short-term memory ability. However, the two groups did not differ in their ability to comprehend the same sentences. They also found that increasing the length and number of words in a sentence (as well as varying the syntactic structure) significantly affected verbatim sentence recall but not comprehension of the sentences. It has been argued that the word-length effect may alternatively arise from differences in either the phonological structure of short and long words (Caplan, Rochon, & Waters, 1992; Lovatt, Avons, & Masterson, 2000),

or in their relative delays prior to output (Cowan et al., 1992; Dosher & Ma, 1998). For the present study, disputes regarding the detailed origins of the word-length effect are not critical; the important point is that the effect is widely believed to emanate from phonological short-term memory.

A word length effect was also observed in research by Rummer, Engelkamp, and Konieczny (2003). They presented a group of adults with subordinate and coordinate temporal and causal sentences. While the sentences did not differ semantically, each sentence type was presented with monosyllabic and tri-syllabic nouns. Lexical errors occurred more frequently if the sentences contained three-syllabic nouns than monosyllabic nouns but the word length effect did not interact with the syntactic structure of the sentence. The effect disappeared when recall of content only (and not verbatim recall) was analysed. Rummer and colleagues (2003) suggest that the fact that word length and syntactic structure affect verbatim recall independently but do not affect recall of content, suggests that both short-term phonological memory and long-term memory of syntactic structures contribute to immediate verbatim recall.

Other work carried out by Rummer and Engelkamp (2001) involved the manipulation of sentence recall tasks — by varying the presentation modality (verbal or visual) as well as the length of time for which the child must retain the sentence (by presenting a word list before or after the sentence to be recalled). Sentence recall was significantly better for material that was presented verbally when the word list preceded the sentence. This modality effect disappeared when the word list was presented after the sentence. Because the presentation of the word list following the sentence negatively interfered with its recall, Rummer and Engelkamp (2001) attributed this to the decay of phonological codes in short-term recall. They concluded that sentences are processed at several different levels and along different informational aspects (phonological, lexical, syntactic and conceptual) all of which, if available, may by used as retrieval cues in sentence. They suggest that even if conceptual information is central to sentence processing and recall, the contribution of phonological information to short-term sentence recall should not be neglected.

Further evidence that phonological short-term memory capacity contributes to the recall of sentences comes from neuropsychological data. Adults with impairments in phonological short-term memory were typically poor at recalling word lists and sentences, although their comprehension of sentences was often intact (Hanten & Martin, 2000; McCarthy & Warrington, 1987). McCarthy and Warrington (1987), consider the influence of phonological short-term memory to be particularly pertinent in the verbatim recall of sentences under certain 'constrained' conditions, such as when sentences are particularly syntactically complex. McCarthy and Warrington (1987) propose that although under most circumstances language processing occurs on-line without difficulty, phonological memory representations

Figure 2.1: Baddeley's Working Memory Model
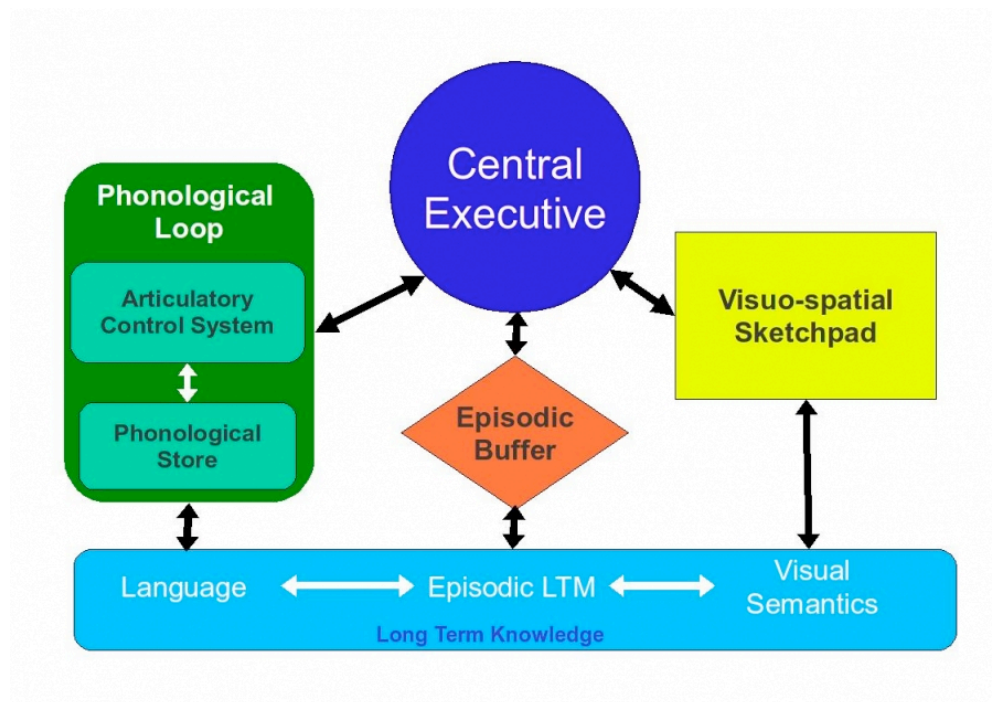
may be more readily recruited to enable backtracking and possible re-analysis of spoken language under conditions where on-line comprehension is not possible. Such conditions might include fast rates of presentation or where processing is slow. This may be particularly significant for children with SLI whose semantic and syntactic processing skills are acquired later in development and often appear to operate at a slower rate. As a result they may rely more heavily on their phonological short-term memory to support language processing.

2.5.3   Sentence recall and models of memory

Sentence recall can be discussed in relation to a number of different working memory models described in the literature. The model that is applied in this research study is that put forward by Baddeley (2000). Baddeley's working memory model can account for the contributions of short and long-term memory to sentence recall tasks. This is a development from the original model put forward by Baddeley and Hitch (1974) and is exemplified in Figure 2.1. Baddeley's model includes a Central Executive component. The Central Executive is linked with a variety of control processes including temporary activation of long-term memory, coordination of multiple tasks, shifting between tasks or retrieval strategies (Baddeley, 1996), and selective attention and inhibition (Baddeley, Gathercole, & Papagno, 1998). It is responsible for the attentional control of working memory. The Central Executive is supplemented by two slave systems specialized for temporary

storage and manipulation of material in specific domains. These are the Phonological Loop and the Visuospatial Sketchpad.

The Phonological Loop is made up of two subcomponents. The first is a temporary storage system that holds information for a very brief period. This information will decay within 2 seconds unless it is refreshed by the second component. This is the Subvocal Rehearsal System (shown as the Articulatory Control System in 2.1), which is used to maintain information within the store to prevent decay. It also registers visual information and translates it into a phonological code that can be rehearsed in the store (provided the items can be named). According to this model, performance on short-term memory tasks, involving the serial retention of verbal material, is supported by the Phonological Loop. The longer the list of items to be remembered or the longer the retention period, the harder it is to continue to rehearse the items in the phonological store, resulting in an increased likelihood of decay.

The Visuospatial Sketchpad specializes in integrating spatial, visual, and possibly kinesthetic information into a unified representation, which can be temporarily stored or manipulated.

The final component of Baddeley's model, which is linked to the Central Executive, is the Episodic Buffer. The Episodic Buffer is considered to depend heavily on executive processing and to have a limited capacity. However, it is considered different from the Central Executive in that it is mainly concerned with the storage of information rather than with attentional control. It is suggested that sentence recall taps the capacity of the Episodic Buffer (Baddeley & Wilson, 2002; Alloway, Gathercole, Willis, & Adams, 2004). The buffer integrates information from temporary memory subsystems such as the phonological loop (to support the verbatim recall of individual words and their order), with syntactic and semantic knowledge held in long-term memory.

2.5.4   Sentence Recall — Summary

In summary the relationship between comprehension and sentence recall is clearly a complex one. The above data converge on the view that sentence recall is supported by lexical, conceptual and syntactic representations in long-term memory as well as by phonological short-term memory processes. It would seem that sentence recall involves the process of reconstructing a partially decayed phonological representation so as to be consistent with the conceptual /semantic representation of the sentence while at the same time conforming to the general linguistic / syntactic constraints imposed by the language (the notion of 'redintegration'; see, e.g., Hulme, Maughan, & Brown, 1991; Schweickert, 1993). While children can arguably use their phonological short-term memory to 'parrot' short sentences without understanding them, sentences that exceed a child's STM

span must be understood in order to be repeated successfully. If the sentence length is such that it cannot be supported by STM then syntactic and semantic representations in LTM are likely to play a more significant role in recalling the sentence. And if the sentence is not understood then these representations are likely to differ from the original stimulus (Vinther, 2002). On the other hand if a child's semantic and syntactic processing skills are acquired later in development or are operating more slowly than in a typically developing child, for example in children with SLI, they may rely more heavily on their phonological short-term memory to support sentence recall.

Despite the uncertainty over the cognitive processes that are involved in sentence recall, it is recognised as a highly discriminative marker of children with SLI (Conti-Ramsden et al., 2001). It can also help us to identify specific profiles of language difficulty. Typically, children with language difficulties tend to make a wide variety of errors on sentence recall tasks, including omissions, substitutions, transpositions and additions — all at word, morpheme or phoneme level. They may also change the syntactic structure of the sentence. This provides us with significant qualitative information regarding the underlying difficulties these children have. For example, children with poor reading comprehension, whose difficulties were semantically based, tended to make a greater number of semantic substitutions than their language matched controls (Marshall & Nation 2003). Qualitative information from sentence recall tasks can be particularly useful in comparative studies. For example adolescents with SLI presented with a different error profile than those with Autism and language impairment, characterized by higher error rates on object relative clauses, and a greater tendency to make syntactic changes during repetition (Riches, Loucas, Baird, Charman, & Simonoff, 2010). Children with SLI also presented with a different error profile to children with phonological disorder, manifested by a higher proportion of errors involving word omissions (Seef-Gabriel, Chiat, & Dodd, 2005).

While sentence recall has been used to investigate language profiles to some degree, it is only very recently that qualitative studies of sentence recall in language impaired populations have begun to emerge. This paradigm allows us to investigate in detail the kinds of errors children make, which kinds of syntactic elements or constructions are most affected and how they are affected.

2.6   Relative Clauses

In section 2.1.2 we discussed the fact that children with SLI have difficulty producing and comprehending syntactically complex sentences. The lack of extensive studies in the area of complex syntax (for children with SLI) has also been referred to. Of particular interest in this study is the complex syntactic structure — the relative clause. This has been studied extensively in typically developing

children but studies in children with SLI have included a very limited range of types of relative clause constructions. The following sections will outline relative clause studies and theories in TD children and relative clause studies in children with SLI.

The relative clause is a type of subordinate clause where one sentence is embedded into another. The role of a relative clause is to modify the head noun of a noun phrase, thereby providing further information about the head noun. A relative clause is often introduced by a relative pronoun or 'marker' such as, *that* or *who,* although the marker may be omitted in certain situations. There are several different types of relative clause and two features are commonly used to characterize their structure. The first is the sentential position of the head noun that is post-modified and this is known as the head. The second is the function of the relativized noun phrase within the relative clause and this is known as the gap. While head and gap can serve any syntactic role the focus in most of the experimental literature to date, has been on relative constructions in which the head and the gap function as core arguments (i.e. subject or object). Based on these two categorizations, the following four types of relative clause have been primarily examined in the comprehension literature: OS, SS, SO and OO, where the first letter refers to the sentential position of the modified NP (O= object, S= subject) and the second letter refers to its function within the relative clause (7 – 10).

7. SS: The girl (S) *that* (S) ate the cake is feeling unwell.

8. OS: The girl ate the cake (O) *that* (S) was in the cupboard.

9. SO: The boy (S) *that* (O) Joe kicked ran away. (*that* is optional).

10. OO: Joe kicked the boy (O) *that* (O) Mary knew (*that* is optional).

Diessel and Tomasello (2001) highlight the need to broaden the categorization of relative clauses in acquisition studies. Following their analysis of the corpus data of four English-speaking children, they highlight the need to include those constructions that truly reflect the existing linguistic data i.e. the relative clauses that children actually say and hear. They also suggest a developmental approach whereby research studies would include those relative clauses that appear early in children's speech as well as those that appear much later. They point out, that as well as the subject (in (7) and (9)) or the object (in (8) and (10)), the head of the clause could also be an oblique, a predicate nominal or an isolated noun (phrase).

11. I wanna go to *the zoo* that has those animals.

12. *This is the girl* I gave the key to.

13. *People* that can jump in there.

A relative clause attached to an oblique main clause is one in which the object is the object of a prepositional phrase in the main clause (11). Diessel (2004) refers to a clause attached to the predicate nominal of a copular clause (where the main verb

is the verb 'to be') as a predicate nominal (PN) (12) or a presentational construction. An example of a relative clause attached to an isolated noun phrase head is shown in (13).

The gap can also be divided into a number of different types: subject (in (7) and (8)), object (in (9) and (10)), oblique, indirect object and genitive. An oblique relative clause is one in which the object is the object of a preposition (14). The indirect object relative clause is one in which the indirect rather than the direct object is relativized, (15) and a genitive relative clause is one in which the noun that is post modified is the possessor of a nominal modified by the relative pronoun. In contrast to all other relative clauses, Gen-relatives establish the link between the head noun and the relative clause by a genitive attribute. There can also be two types of genitive relative clause, a subject genitive (GenS)(16) and and an object genitive (GenO)(17). A subject genitive relative clause is one in which the noun phrase containing the genitive functions as the subject and an object genitive relative clause is one in which the noun phrase containing the genitive functions as the object.

14. Emma saw *the man* that the horse ran away from.

15. I saw *the guy* who she borrowed the book from.

16. I met *the woman* whose daughter lives next door.

17. I know *the woman* whose horse Peter heard on the farm.

Combining these syntactic roles of head and gap would result in a total of thirty relative constructions as opposed to the more traditionally researched four types of relative clause.

2.7   Relative Clause studies and theories in TD children

Until recently the majority of relative clause research focused on children's comprehension of relative clauses e.g. Smith 1974, Sheldon 1974, Tavakolian 1977,1981; Flynn & Lust 1980, Goodluck & Tavakolian 1982, Hamburger & Crain 1982, Tager-Flusberg 1982, Hildebrand 1987, Labelle 1990, 1996, McKee & McDaniel 2001, Eisenberg 2002, Kidd & Bavin 2002, Diessel & Tomasello 2001, 2005, Diessel 2004. Researchers have tended to use either, an act out task in which children had to act out the meaning of the relative clauses presented (using toy animals) or an imitation task in which the children had to repeat the relative clause sentences. The errors that the children produced led researchers to propose a number of hypotheses regarding the strategies that children use in their interpretation of relative clauses. These five hypothesis will be discussed.

2.7.1   The NVN — schema Hypothesis

This hypothesis asserts that English speaking children acquire a canonical sentence schema based on a prototypical transitive clause. The NVN clause consists of a noun (denoting an actor) *The boy*, a verb describing a transitive activity *kicked* and another noun (denoting a patient) *the ball.* This hypothesis was first proposed by Bever (1970) who found that 2 – 5 year old children had little difficulty understanding relative clauses that included a subject gap compared to their performance on object relative clauses which was much less efficient. He explained his results arguing that those including a subject gap involve a NVN sequence (18), which allows the child to use the canonical sentence strategy in interpreting the sentence, whereas those with an object gap are more difficult to interpret as they involve a sequence of nouns and verbs that does not match the NVN-schema (19) .

18. I met the boy (N) who likes (V) Emma (N). (OS)

19. I met the boy (N) who Emma(N) likes (V). (OO)

Further support for this theory comes from research by Hakuta (1981) who found that Japanese-speaking children used an NNV — schema in their interpretation of relative clauses, based on the dominant SOV word order of Japanese.

2.7.2   Non Interruption Hypothesis

The Non interruption hypothesis asserts that children have greater difficulty processing relative clauses that interrupt the main clause than relative clauses that follow it (Slobin, 1973). Relative clauses that interrupt the matrix clause are called centre-embedded relative clauses. In the sentence (20) the relative clause follows the main clause whereas in the sentence (21) it is embedded in the centre of the main clause, between the subject and the main verb.

20. I met the boy that Linda likes. (OO)

21. The boy that Linda likes is from Cork. (SO)

Slobin (1973) posits that children have difficulty interpreting grammatical structures that are interrupted by some other element. If a grammatical unit is not continuous, processing requires that the child holds an incomplete parse in working memory while constructing or interpreting the intervening element. When this intervening element is a complex syntactic unit such as a centre embedded relative clause, it is quite likely that this may exceed the individual's memory span. Therefore 'the greater the separation between related parts of a sentence, the greater the tendency that the sentence will not be adequately processed' (Slobin, 1973). Much research has tested this hypothesis, both in English and other languages with preschool children (Hakuta, 1981; Corrêa, 1995a, 1995b; Kidd & Bavin, 2002) and results have shown that TD children tend to misinterpret

centre-embedded clauses more often than they do relative clauses that do not interrupt the matrix clause. Support for this hypothesis could also come from an acquisitional single case study carried out by Brandt, Diessel & Tomasello (2008). They investigated the development of relative clauses in the speech of one German speaking child (Leo) and found that his SUBJ-relatives accounted for 4.1% of his relative clauses in comparison with 0.7% SUBJ-relatives in their English speaking data (Diessel, 2004 : chap. 6). They suggested that the relatively large number of SUBJ-relatives in Leo's data is related to the fact that they do not generally interrupt the main clause in German (they are not centre-embedded).

There are a number of factors that may also be influencing how children process these relative clauses. Overall centre embedded relative clauses are rare in early child speech (Diessel & Tomasello, 2005). Analysis of corpus data from English, showed that only one child in four produced a few centre-embedded relative clauses before the age of 5 years (Diessel & Tomasello, 2001). Limber (1976) suggested that this may be the case due to pragmatic reasons. Relative clauses usually serve to modify the topic of the main clause but the topic is usually familiar to those engaged in the discourse, therefore it is more likely to be expressed by a third person pronoun sentence subject, which negates the necessity for using a relative clause. For example, in the conversation at (22 – 24) there is no need for person (1) to repeat the whole sentence as a relative clause. Both the subject and verb of the relative clause are discourse old — as a point of clarification person (1) would not feel the need to reiterate the information in the form of a SUBJ relative i.e. *The boy that Linda likes is from Cork*, but would simply say *He is from Cork*. Therefore while it is conceivable that centre embedded relative clauses cause comprehension problems as a result of interrupting the matrix clause, it may also be as a result of their infrequent use.

22. **Person 1:** I met the boy that Linda likes.

23. **Person 2:** Oh, yes, I heard he is from Kilkenny.

24. **Person 1:** no, he's from Cork.

2.7.3   The Parallel function Hypothesis

This hypothesis stems from work carried out by Sheldon (1974) and posits that children find relative constructions in which the head and gap have the same syntactic role (i.e. SS and OO relatives) easier to interpret than relative constructions in which the roles are different (SO and OS relatives). Under this hypothesis children assume that for sentences of the form SX, the subject of the main clause is also the subject of the relative clause and similarly for OX sentences the object of the main clause is also the object of the relative clause. Sheldon (1974) found that 3 and 4 year old children demonstrated an understanding of

significantly more SS and OO relatives in an act out task (mean scores 1.58 and 1.52) than SO and OS-relatives (mean scores of .64 and .88). More recent research does not seem to support this hypothesis (Kidd & Bavin, 2002).

2.7.4 The Conjoined — clause Hypothesis

This hypothesis states that children interpret relative clause constructions as co-ordinate sentences (i.e. conjoined clauses). Tavakolian (1981) maintained that there are two rules central to this hypothesis. The first is that complex sentences that children cannot successfully process, are interpreted as conjoined clauses and the second, is that any missing noun phrase is treated as the subject of the second clause and interpreted as coreferential (having the same referent) with the subject of the first clause. When analyzing the results of her study, Tavakolian (1981) noticed a pattern on children's performance of SS and OS relatives. While 78% of the SS relatives were acted out correctly, only 19% of the OS relatives were correct. The most frequent response pattern for both of these sets of clauses was where the child acted out two actions, one, where the first noun phrase acts on the second noun phrase and the other where the first noun phrase acts on the third noun phrase. For example in a SS relative clause (25) this interpretation would yield a correct response where the sheep would knock down the rabbit and the sheep would stand on the lion.

25. The sheep that knocks down the rabbit stands on the lion.

26. The sheep stands on the lion that knocks down the rabbit.

However for an OS relative such as (26) this interpretation yields an incorrect response, in an act out situation, the sheep would stand on the lion and the sheep would knock down the rabbit. There was a low percentage of this kind of error in SO and OO relatives. Tavakolian argued that the word order of SS and OS relatives is similar to the word order of two co-ordinate clauses in which the subject of the second sentence has been omitted (NP.... V.... NP... V.... NP) whereas the word order of SO and OO relatives involves a very different string. She suggests that this explains why the children responded differently to the two latter types of clauses and argues against any undermining of the conjoined clause analysis.

2.7.5 Filler — Gap Hypothesis

Central to this hypothesis is the concept of movement. Dislocation of various syntactic elements (i.e. phrases or heads) is known as syntactic movement and is claimed to be a universal property of human languages (Chomsky, 1986).

In relative clauses, those with a subject gap (27 – 28) are created when the subject moves to the beginning of the relative clause whereas object relatives, are created by

the movement of the object. (29 – 30).

27. I hugged the man (filler) who (gap) likes Mary . OS

28. The boy (filler) that (gap) kicked the ball is hungry. SS

29. I hugged the man (filler) who Mary likes (gap). OO

30. The girl (filler) that Eddie kissed (gap) ran away. SO

The head of the relative clause is called the filler, while the gap is the relativized element. The filler-gap hypothesis posits, that the processing load of the relative clause is determined by the varying distance between the filler and the gap. In relative clauses including a subject gap, the distance between the filler and the gap is minimal, as in (27) and (28). The only element that occurs between them is the relativizer. However, in relative clauses including an object gap, the filler and gap are separated from each other by the subject and the verb of the relative clause, as in (29) and (30). A number of research studies have shown that adults and children have more difficulty interpreting an object gap than a shorter subject gap (Villiers, Tager-Flusberg, Hakuta, & Cohen, 1979; Corrêa, 1995b; Wanner & Maratsos, 1978). Wanner and Maratsos (1978) examined adults comprehension of subject and object gap relative clauses. They argued that it is difficult for the individual processing the relative clause to keep the filler in working memory until it encounters the gap, which provides the necessary information to integrate the filler into the relative clause. The longer the individual has to retain un-integrated information, the harder it is for them to parse the relative clause (Gibson, 1998). Other relative clauses such as those with an oblique (31) or an indirect object gap (32) further lengthen the distance between the filler and the gap. The longer the distance between the filler and the gap the more deeply embedded the gap. Although these relative clauses have not been researched as much as those with an object and subject gap, studies have shown that children find these relative clauses more difficult to interpret (Diessel & Tomasello, 2005).

31. The boy (filler) who the girl played with (gap).

32. The boy (filler) who the girl gave the football to (gap) .

Support for the filler-gap hypothesis comes from young children's use of resumptive pronouns in relative clauses. The term resumptive refers to 'an element or structure, which repeats or in some way recapitulates the meaning of a prior element'. (Crystal, 1992). Studies by McKee and McDaniel (2001) and Diessel and Tomasello (2005) noted that children often insert a resumptive pronoun in the place of the gap, (33) and (34). Interestingly, they noted that the occurrence of the resumptive pronoun correlated with the distance between the filler and the gap i.e. the longer the distance between the filler and the gap (or the more deeply embedded the relativized syntactic role) the more likely the use of the resumptive pronoun.

33. Here is the girl (filler) who the boy borrowed a football from (gap) her.

34. I hurt my finger (filler) that Thomas stepped on (gap) it.

Several studies reported earlier could also provide support for this hypothesis in that there is evidence that working memory contributes to complex sentence processing, for example, the fact that high working memory span listeners more reliably comprehend such sentences than low working memory span listeners (Chen, Gibson, & Wolf, 2005; Just & Carpenter, 1992; King & Just, 1991).

However most results from the English speaking study carried out by Diessel and Tomasello (2001, 2005) questioned the filler-gap hypothesis. The filler-gap hypothesis is consistent with the fact that subject relatives caused fewer difficulties than other relative clauses. However it did not explain that fact that, although intransitive subject and transitive subject relatives involve the same distance between the filler and gap, transitive subject relatives caused more difficulties. And children produced approximately the same number of errors in response to object, oblique and indirect object relatives even though the distance between the filler and the gap varies for all three, Genitive relatives involve a short distance between the filler and the gap (especially subject genitives) but children had great difficulty repeating these correctly.

If we also look at data from other languages such as German, the filler-gap hypothesis does not explain the difficulties that these children have with relative clauses and therefore cannot be considered a universal processing strategy (Diessel & Tomasello, 2005). In German the relativized syntactic role is indicated differently than in English and the processor is given all the information necessary to recognize the relative syntactic role at the beginning of the relative clause. The processor therefore does not have to keep un-integrated information in working memory while processing the relative clause, their difficulties therefore cannot be attributed to the distance between the filler and the gap. In agreement with Diessel and Tomasello (2005), one might conclude that while the varying distances between filler and gap might play a minor role in the interpretation of relative clauses in English, other factors such as the distributional frequency of the different types of relative clauses, the similarity between the various types of relative clauses (for example, word order commonality) and their relationships to other constructions of grammar, (particularly common constructions such as simple sentences) are much more important.

While these theories have attempted to explain how children may deal with relative clauses that they cannot process, all of the research leading to these hypotheses should be considered within the context of the type of relative clauses that were used and the reliability of the methods of assessing relative clause knowledge. Many investigations have been criticised (most prominently by Diessel and Tomasello (2005)) for using relative constructions that children rarely hear, that emerge very late in the acquisition process and that do not reflect those that are used and heard in early child speech. Criticisms have also been noted for complicating the childs

task unnecessarily (using the act out task) and for the lack of any supporting discourse context. For example in the research carried out by Sheldon (1974) and Tavakolian (1981), sentences such as (35) and (36) were presented and the children were required to act them out using props. The results indicated that children under 5 years showed little knowledge of relative clauses but later criticisms questioned whether these conditions would accurately reflect children's abilities. (Hamburger & Crain, 1982).

35. The dog [that chased the cat] jumped over the cow.

36. The cow [that the horse bumped] stood on the goat.

This leads us to some of the more recent research on the both the comprehension and production of relative clauses.

2.8   Usage-based approaches

While most of the previous studies investigate relative clauses in the framework of generative grammar, Diessel and Tomasello (2001, 2005) provide a usage-based analysis of the development of relative clauses, in which constructions are the basic elements of grammar. A construction is a complex linguistic sign combining a grammatical pattern with a particular meaning (Goldberg, 1995). Diessel and Tomasello (2005) support and extend somewhat the NVN hypothesis, originally proposed by Bever (1970). They carried out a sentence repetition task (including relative clauses with a range of syntactic roles) with four year old English and German speaking children and found a similar pattern of responding in both language groups. Children performed best on subject relatives, followed by object relatives, indirect object relatives, oblique relatives and, finally, genitive relatives. They also noted one very common type of mistake — when children were given object relatives they often converted them to subject relatives (37).

37. **Target:** This is the girl (N) who the boy (N) teased (V) at school this morning.

    Response: *This is the girl (N) that teased (V) the boy (N) at school this morning.*

They noted that these errors were not consistent, sometimes the children repeated the relative clauses correctly and other times they repaired the conversion error before the end of the sentence. Diessel and Tomasello (2005) concluded therefore that the bulk of the conversion errors did not result from insufficient grammatical knowledge, rather that children activated subject relatives more easily than other types of relative clauses because they have the same word order (NVN) as simple sentences i.e. children prefer to pursue subject-extracted interpretations because they have a preference to build simple structures (based upon their considerable experience with simple non-embedded sentences).

Diessel and Tomasello (2001) presented a detailed study of the development of relative clauses in 4 English-speaking children between 1;9 and 5;2 years. All data was taken from the CHILDES database (McWhinney & Snow 1990) and there were a total of 329 relative clause constructions in the corpus. Following their investigation, Diessel and Tomasello (2001, 2005) assert that among the earliest relative clauses to occur are those in presentational constructions, consisting of a somewhat formulaic copular clause and a subject gap relative clause with an intransitive verb (38). They further support the NVN hypothesis when they assert that subject relatives are dominant in early child speech because they are similar to simple sentences when they occur in these presentational constructions i.e. they involve the same sequence of nouns and verbs, as in (39). Less frequently children attached their early relative clauses to an isolated noun phrase (40). Although both these constructions are biclausal they contain only a single proposition and can be paraphrased by a single clause (41).

38. This is the sugar that goes in there

39. The sugar goes in there.

40. A meal that you eat

41. You eat the meal.

42. This is my doggy cries.

43. Mammy saw the dog that's standing on the bed.

44. Mammy saw the dog. The dog is standing on the bed.

While the presentational copular clause includes a verb, it does not denote an independent state of affairs, it serves only to present a referent in focus position, such that it can be elaborated by the relative clause. Further analysis of Diessel and Tomasello's corpus data (2001) revealed many similar sentences that contained a copular clause and a verb phrase but without a relativizer (42). These could be analysed as a relative clause in which the relative pronoun is absent and have been noted previously by Lambrecht (1988) in certain non-standard varieties of adult speech. He did not consider these structures to be ungrammatical but referred to them as 'presentational amalgam constructions'. Lambrecht (1988) considered them to be truncated relative clauses in which the predicate nominal of the copular clause also serves as the syntactic subject of the clause final verb phrase. He classifies these amalgam constructions as a sub-type of the presentational construction, in which the relative clause and the matrix clause are merged into a single unit. Fox and Thompson (2007) also note these amalgam relatives and suggest that the more the main and relative clause are integrated with each other the less likely we are to find a relativizer used and the more seperate the two clauses the more likely the relativizer will be included. Diessel (2004) considers these amalgams to serve as a precursor to the presentational relative construction. In

contrast, the relative constructions produced by older children denote two situations in two separate full clauses and cannot be paraphrased by a single clause (43) and (44). Based on this, Diessel (2004) argues that relative clauses develop via clause expansion, from those that denote a single situation to constructions in which two situations are expressed in two full clauses. Following further analysis of the corpus data, Diessel and Tomasello (2001) also suggest that the relative clauses used in spontaneous child speech are easier to process and less complex than those that have been used in most experiments. They have noted that the relative constructions used in most comprehension experiments included two transitive clauses, the arguments of which were expressed by common nouns. They quote an example from Goodluck & Tavakolian (1982)(45).

45. The lion kisses the duck that hits the pig.

But only 27% of the relative constructions in their data contained two transitive clauses and the majority of arguments were expressed by pronouns that kept track of previous discourse topics.

As outlined in section 2.6, if we considered all combinations of the syntactic roles of head and gap there would be a possibility of thirty relative clause constructions. However, the corpus data analysis carried out by Diessel and Tomasello (2001) (on 4 English-speaking children between 1;9 and 5;2) showed that these children actually produced fourteen different types of relative clauses. The following are examples given by Diessel (2004) of each relative clause type produced. Table 2.1 shows the coding scheme that was used to classify the children's relative constructions.

46. Here's a tiger that's gonna scare him. (Nina 3;1) (PN — subject)

47. These are my duties I have to do. (Sarah 4;10) (PN — object)

48. It's the one you went to last night. (Peter 2;10) (PN — obl)

49. People dat can jump in there. (Adam 4;10) (N — subj)

50. A meal dat you eat (Adam 4;1) (N — obj)

51. Those little things that you play with. (Adam 4;10) (N — Obl)

52. I want to see some ducks that do that too. (Nina 3;2) (OBJ- subj)

53. I gon draw everything I like. (Adam 3;5) (OBJ — obj)

Table 2.1: Classification of relative clause constructions

Head of Relative Clause	Gap of Relative Clause
SUBJ = subject	subj = subject
OBJ = object	object = direct object
OBL = oblique	obl = oblique
PN = predicate nominal	io = indirect object
N = isolated noun(phrase)	gen = genitive

54. You left this toy I'm playing with. (Peter 3;1) (OBJ — obl)

55. The person who puts dem on...... has to. (Adam 3;11) (SUBJ-subj)

56. The first thing we have to do (is to) put dis in. (Adam 3;11) (SUBJ — obj)

57. I wanna go to the zoo that has those animals. (Nina 3;2)(OBL — subj)

58. Change it to the very one you love best. (Adam 4;4)(OBL — obj)

59. What happened to the thing that I went to? (Adam 4;3)(OBL -obl)

On average, 70% of all the relative clauses produced by these children expressed a single proposition and could therefore be paraphrased by a single sentence — 47% of the relative clauses that the children produced modified the predicate nominal of a copular presentational clause (46 — 48) and a further 22.5% were headed by an isolated noun phrase (49 — 51). These types of relatives are also very similar to simple sentences in that they express new and unfamiliar information in the position after the initial noun. OBJ relatives accounted for a further 22.5% of the relative clauses in their data (52 — 54). There were almost no SUBJ relatives — .7% (55 — 56) and very few OBL relatives occurred — 5.6% (57 — 59). Looking in more detail at the OBJ relatives, more than half of the earliest relative clauses followed an imperative main clause where 'look' functioned as the main clause verb (60 — 61). Diessel (2001) argues that these sentences are functionally very similar to the presentational relative constructions previously described in that they do not contain a full proposition but serve to focus the listener's attention on a new referent that will then be elaborated on by the relative clause. Again, they could be paraphrased by a single clause. These early object relatives have not been used in previous studies of relative clause acquisition.

60. Look at all the chairs a Peter's got. (Peter 2;5)

61. Look at dat train (pause) Ursula bought. (Adam 2;10)

Brandt, Diessel & Tomasello (2008) also investigated the development of relative clauses in one German speaking child (Leo) aged 2 to 5 years. The earliest relative clauses were a little different from the English data in that they tended to occur in topicalization constructions consisting of a relative clause and an isolated head noun rather than a relative clause and a copular clause (Diessel & Tomasello, 2001). Despite these differences Brandt et al (2008) argue that Leo's data is in keeping with their hypothesis that the development of relative clauses follows a pattern that can be applied cross-linguistically i.e they originate from simple non-embedded sentences that gradually evolve into complex sentence constructions.

As described in section 2.7.5 previous studies analysing object relatives have reported them to be more difficult to process than subject relatives. These results have either been explained by the suggestion that object relatives are more syntactically complex (Friedmann & Novogrodsky, 2004; Miyamoto & Nakamura,

2003), or that they are more cognitively demanding to process (Gibson, 1998).

However, research by Kidd, Brandt, Lieven & Tomasello (2007), showed that when children are tested on object relatives they most often say and hear, and that followed the necessary discourse and semantic constraints, the subject/object asymmetry was not replicated. Diessel (2004) and Fox and Thompson (1990) point out, that while object relatives are more frequent than subject relatives in naturalistic speech, they occur within the context of definite discourse and semantic constraints. The processing difficulty of an object relative is affected by the type of subject it includes as well as the animacy of the head noun. That is, in natural discourse, object relatives are most often characterized by inanimate heads, (62 – 63) with a discourse-old referent, (such as a pronoun) as the subject of the relative clause. Fox and Thompson (1990) give the following examples:

  62. the problem [I have] is my skin is oily . . . (SO)

  63. the car [that she borrowed] had a low tyre. (SO)

They argue that in natural discourse subjects are most often animate and since animate nouns are most often agents, they prime the use of a subject relative clause when they occur in a NP-relative pronoun sequence. Whereas objects are most often inanimate and are themes of conversation, they therefore prime the use of an object relative clause. Furthermore, according to preferred argument structure (Bois, 1987), subjects are most often referred to using pronouns. In object relatives however the pronoun serves a different function. It links the information contained within the relative clause (which is already established in the discourse) to the new information contained in the main clause. These arguments are also supported by studies of adult sentence processing which have shown that the difficulty ascribed to object relatives is reduced when the head noun is inanimate (Mak, Vonk, & Schriefers, 2002, 2006; Traxler, Morris, & Seely, 2002; Traxler, Williams, Blozis, & Morris, 2005) and that object relatives are easier to process when the relative clause subject is a pronoun or proper noun (Gordon, Hendrick, & Johnson, 2001a; Reali & Christiansen, 2007).

Kidd, Brandt, Lieven, & Tomasello (2007) investigated English and German speaking children's early use of object relative clauses in naturalistic speech. The data for the English-speaking children (8 in total) showed that 75% of the head nouns were inanimate and 86.6% of the subject slot of relative clauses were made up of first and second person pronouns. The German corpus study was made up of one German speaking child — 77% of his object relatives had an inanimate head and over half of the relative clause subjects were first and second person pronouns (62%). They then tested 3 and 4 year old English and German speaking children on object relatives using a sentence recall task. They manipulated the animacy of the head noun and the type of subject noun phrase within the relative clause (personal pronoun or lexical noun phrase). Children were also presented with subject

relatives that were manipulated for the animacy of the head noun. They compared the children's performance on object relatives to subject relatives and found that both the 3 and 4 year old children performed better when object relatives contained inanimate head nouns, and when the relative clause subject was a pronoun. Both age groups performed better on subject relatives that contained an animate head noun than those that contained an inanimate head. Kidd, Brandt, Lieven & Tomasello (2007) interpret their findings to suggest that distributional frequency information plays an important role in the acquisition of relative clauses and that children's productions are constrained by the knowledge that (a) relative clauses often encode old information, (b) previously mentioned referents can be referred to using anaphoric pronouns, and (c) pronouns most often stand for subjects (Du Bois, 1987). They also argue that the subject-object relative clause asymmetry previously reported in the literature derives from violating processing constraints rather than constraints on syntactic derivation.

Recent studies have shown that the processing load of object relatives, is also affected by semantic and pragmatic aspects that have been ignored in earlier research. In 2009, Diessel reported data from a new corpus study in which the meaning and use of subject and non-subject relatives in spontaneous child language were examined. The study shows that while non-subject relatives are structurally different from simple SV(O) sentences, they are usually expressed by prototypical transitive clauses, where the verb denotes a physical or cognitive activity. He cites the examples at (64 – 66). Diessel (2009) found that 95.1% of children's non subject relatives were transitive and only 4.9% occurred with copular or intransitive verbs.

64. Where's the balloon [I made]? *Abe 3;1*

65. No, the one [you found....] *Abe 3;9*

66. Those are bugs [that I throw]. *Adam 3;7*

Subject relatives on the other hand consist of a variety of constructions including transitive, intransitive and copular verbs. Although subject relatives have the same word order as SV(O), semantically they often deviate from an ordinary in/transitive clause. For example, while the majority of children's simple clauses include a first or second person pronoun, subject relatives are exclusively used with third person subjects, often newly introduced into the discourse. Diessel (2009) cites the following examples (67 – 69).

67. The doggie that runs away. *Adam 3;8*

68. Look at that big truck [(dat) going some place]. *Adam 3;0*

69. The wheel that's broken. *Abe 3;10*

Whereas subject relatives comprise a diverse group of constructions with unusual semantic and pragmatic properties, object relatives are usually expressed by a

prototypical transitive construction, with a pronominal animate subject functioning as the agent or experiencer of the verb and an inanimate object functioning as the theme or patient. Diessel (2009) argues that these predictable properties of prototypical transitive clauses may help children to bootstrap in to the grammar of these non-subject relative clauses. This view considers grammatical development to be an incremental process whereby children learn new constructions based on structures they already know.

In summary, the development of relative clauses could be described as a process of clause expansion whereby a simple sentence is gradually transformed into a bi-clausal construction (Diessel, 2004). In generalizing across the aforementioned studies we might hypothesize that this is a cross-linguistic pattern of development. Many of the earliest relative constructions are syntactic blends (or amalgams) in which the relative clause and the main clause are merged into a single unit. These are followed by presentational constructions that consist of a copular clause and a relative clause including a transitive verb. Although they are bi-clausal they only denote a single situation and could be paraphrased by a simple sentence. In contrast the relative constructions produced by older children consist of two fully fledged clauses and denote two situations. Early full relative clauses are more likely to have an object head and a subject relative clause which would follow the NVN-schema hypothesis.

However more recent research has refined this hypothesis and illustrates how it could not always be applied across languages — In the Diessel and Tomasello study (2005) the English and German speaking children performed similarly on the sentence recall task even though German does not have a canonical NVN schema, suggesting that there were other factors influencing the children's productions. Diessel and Tomasello (2005) posit that children's preference for subject relative clauses also derives from semantic constraints — i.e. the fact that children expect relativised nouns to take the thematic role of agent and that the first noun in the relative clause would encode the agent. Historically, research has indicated a discrepancy between children's understanding of subject and object relatives (the latter reported as more difficult), however, recent research by Kidd et al., (2007), showed that when children were tested on object relatives that they most often say and hear and that followed the necessary discourse and semantic constraints, this subject/object asymmetry reported in the literature, disappeared.

Overall, it would seem that frequency and similarity of structures (particularly relating to word order) are of the greatest important in the acquisition of relative clauses. Every time a child hears a structure in the ambient language it leaves a trace in memory reinforcing its mental representation (the level of entrenchment) which in turn facilitates the activation of the expression in future language use. (Tomasello, 2005; Diessel, 2007). As simple sentences are extremely frequent in the ambient language, Diessel (2009) argues that children's comprehension and

production of relative clauses are strongly influenced by the structural overlap between the relative clause and the simple sentence.

2.9 Relative Clauses in SLI

2.9.1 English

Although the comprehension and acquisition of relative clauses in English have been extensively investigated in typically developing children as we have seen, relatively little is known about the way relative clauses emerge in the grammars of children with SLI. And only a restricted range of relative clause types have been scrutinised.

We know that in TD children the earliest relatives to appear are syntactic blends where the main clause and the relative clause are merged into one syntactic unit (1;6 years +). These are followed by 'presentational' clauses (2 years +), where the main clause is semantically empty – it does not add any additional information but serves to focus the listeners attention to the element of interest. Finally, children learn to formulate sentences in which the main clause and the relative clause constitute two propositions (3 years +). We know that young TD children show a preference for relative clauses with a subject gap, which are rarely marked with a relative pronoun. The omission of a relativizer is also a characteristic of the 'presentational amalgams'. When presented with more complex relative clause types e.g. object, oblique, (that did not follow the NVN word order) young TD children often tended to convert them to a subject relative clause. We also know from the literature that before TD children can produce two proposition relative clauses they may produce the information in two separate syntactic units or link them by co-ordination (70). They may also produce reduced relatives (71) (which contain a non-finite verb and no relative pronoun) (McKee, McDaniel, & Snedeker, 1998).

70. **Target:** There is the girl whose juice spilt in the kitchen.

    Response: *There's the girl, the girl spilt the juice in the kitchen.*

71. **Target:** Anne helped the woman who cooked the dinner last night.

    Response: *Anne helped the woman cooking the dinner last night.*

As yet we have relatively little information about the developmental features of early presentational or mature relative clause constructions in the SLI population. However, one characteristic that has been specifically noted in children with SLI is the omission of compulsory relative markers (Schuele & Nicholls, 2000; Schuele & Tolbert, 2001; Schuele & Dykes, 2005).

In standard UK and Hiberno-English, subject relative clauses require an obligatory relative marker, such as *that* or *who* (72). In contrast, the object, (73) oblique, (74) or indirect object relatives, (75) do not. The use of a marker in these cases is optional. The grammaticality therefore of a subject relative (in standard English) is dependent on the inclusion of the relative marker.

72. I saw the girl that kissed the boy.

73. I saw the girl (that) the boy kissed.

74. Emma spoke to the man (who) the horse ran away from.

75. There is the horse (that) the girl gave a drink to.

However, there are non-standard varieties of English in which the relativizer can be omitted from a subject relative. The relative clause is usually attached to a presentational construction and follows a human or animate antecedent.(Ball, 1996). The *Survey of English dialects* showed that there was considerable variation in British English with respect to the use of relative markers in subject relative clause constructions, as well as some regional and social variation in the United states. Ball (1996) cites the following examples (76 – 77).

The woman next door says: The work in this garden is getting me down.

76. **Response 1:** Well, get some help in. I know a man ⎯⎯ will do it for you.

77. **Response 2:** I know a chap ⎯⎯ could help.

Many of the influences in Hiberno-English come from the Irish language. Hickey (1984) contrasts Irish and English syntactic constructions and in relation to relative clauses does not document any omission of relative markers in subject relative clauses in Irish. The omission of the relativizer in subject relatives is not considered a dialectal influence in the current study.

As previously noted the omission of compulsory relative markers has been specifically observed in children with SLI. Schuele and Dykes (2005) carried out a longtitudinal case study of a boy with SLI (referred to as MM) between the ages of 3;3 and 7;10 in which they analysed a dozen samples of conversational speech. The data confirmed the persistence of grammatical marker omission within relative clauses as they developed. From the ages of 4;8 to 7;10, MM produced 22 subject relative clauses and the relative marker was omitted in 100% of obligatory contexts. A further 50% of the subject relatives produced were presentational, such as (78) and another 23% were attached to an isolated noun phrase (79). Only five of MM's subject relatives, all produced after 6;5 years of age, were truly biclausal relatives. Unlike typically developing children, MM omitted obligatory relative markers even in the advanced relative productions.

78. This is all the people not got hurt

79. I'm trying kill (tho*) that thing is bothering me.

Data from Schuele and Nicholls (2000) provide further examples of subject gap relative marker omission (80 – 82).

80. She's got all the dishes _____ need to be washed.

81. We got one girl _____ have a birthday in March.

82. (There's baby) theres my baby _____ wants to go in train.

They studied three children with SLI as part of a longtitudinal case study, two between the ages of 6;5 and 8 years and the third from age 3;0 to 7;11. The SLI children began to use relative clauses at an older age than TD children. They initially went through a stage of omitting the relative marker and this was followed by a period of inconsistent use before the markers were used consistently. This vulnerability was confirmed by Schuele and Tolbert, (2001) who explored the production of subject relative clauses by children with SLI, on an elicitation task. They compared a group of twenty children with SLI, aged 5;0 to 7;11 years and a younger TD group aged 3 to 5 years. While the younger TD children never left out the marker from subject relatives, the children with SLI omitted them 63% of the time, (83 – 84). They also noted the use of the reduced relative and consider this a developmental step prior to the production of full relative clauses.

83. Point to the one _____ is walking

84. Point to the girl _____ fall down.

More recent research was carried out by Hesketh (2006) on sixty-six UK children with language impairment, between 6 and 11 years. This study examined the use of relative clauses (by children with language impairment) in an elicitation task and a narrative task. In the elicitation task the child heard the relative clause construction modelled by the researcher and was required to describe a given picture by formulating an utterance using the same grammatical structure. The relative clauses were left branching — they involved post-modification with in the subject of the main clause and the modified noun phrase was also the subject of the relative clause. Hesketh (2006) cites the following examples (85 – 88).

85. **Stimulus 1:** The girl who is holding the flowers is thin and .....

86. **Target:** The man who's holding the umbrella is fat.

87. **Stimulus 2:** The woman who's wearing the red scarf is a nurse and.....

88. **Target:** The woman who's wearing the yellow scarf is a dentist.

The language impaired children did not show the marked pattern of obligatory relativizer omission from subject relative clauses (only 6% of responses) which has been previously described by other authors such as Schuele and Tolbert (2001). While the children in the Schuele and Tolbert (2001) research were younger overall,

their 6 and 7 year old participants continued to omit a much higher proportion of relative markers (57%) than the UK children of the same age (16%). The UK children also used the 'reduced relative' construction much more frequently (14% of responses) than their US counterparts (Schuele & Tolbert, 2001). The younger language impaired children often tended to avoid the relative clause construction, producing single proposition or single clause statements instead. These accounted for almost half of the spontaneous productions which is in keeping with that proposed by Diessel and Tomasello (2001) with regard to younger TD children. Importantly, this study included many more participants than any of the previously quoted research of relative clauses in SLI and therefore provides a more complete picture of performance patterns in these children.

A recent study carried out by Riches (2010), investigated relative clauses in adolescents with SLI and those with autistic spectrum disorders (ASD) plus language impairment. Fourteen individuals with SLI (mean age 15;3) and sixteen individuals with ASD plus language impairments (mean age 14;8), took part in the study. The participants were required to repeat sentences containing subject and object relative clauses that increased in syntactic complexity but where length remained constant. Relative clauses were combined with adjectives to create four conditions SM – subject relatives with adjectives in the main clause, SR – subject relatives with adjectives in the relative clause, OM – object relatives with adjectives in the main clause, and OR – object relative with adjectives in the relative clause. The use of the adjectives in this manner affected the length of the dependency in the object relative clauses but not the subject relatives. While Riches study was a comparative study somewhat, he does note some error patterns in the relative clauses produced by the individuals with SLI — particularly the use of passivization as a strategy to avoid producing object relatives but yet maintain the thematic relationships. He cites the example (89).

89. **Target:** the granny that the thief robbed....

   Response: *the granny that was robbed by the thief*

This type of relative clause was not included in the current study. However, similar to the current study, Riches (2010) took independent measures of short-term and working memory and found that the CNRep, digit recall and backward digit recall all correlated significantly with sentence repetition performance.

2.9.2   Other Languages

Problems with relative clauses for children with SLI are also reported for languages other than English. Hakansson and Hansson (2000) investigated the relationship between the comprehension and production of relative clauses in Swedish children. They analyse language from a generative perspective and argue that structures

involving dependency relations are particularly difficult for children with SLI. The study was carried out longitudinally — ten children with SLI and ten younger TD children were tested twice — six months apart. The children with SLI comprehended 62% of the subject relatives correctly at age 4;0 or 6;3 and 75% correct six months later. On initial assessment the children with SLI also showed a significant discrepancy between their performance on the comprehension and production of relative clauses. While they showed particularly good comprehension on the act out test, all of the children omitted the relativizer (most consistently) in the production tasks. Some children also changed the subordination in to co-ordination. Hakansson and Hansson (2000) argue that this shows evidence of an understanding of the structure without being able to produce it. When assessed six months later there was no longer any significant difference between comprehension and production. For the younger TD group there was no difference between the comprehension and production of relative clauses on initial assessment. Hakansson and Hansson (2000) propose that as these children were language matched with the children with SLI, the relative clause is therefore a structure where children with SLI have selective problems — namely the insertion of the relative marker.

A study by Stavrakaki (2001) tested the comprehension of reversible relative clauses by eight Greek-speaking children with SLI aged 5;4 to 9;3. There were two TD control groups, age matched and language matched (LM). An act out task was used. The performance of the children with SLI was qualitatively different from both age-matched and language-matched control groups. The performance of children with SLI decreases under the effect of the processing load whereas the processing demands of the test sentences do not seem to have an effect on the LM controls (except for SO relatives). They suggest that this is due to the fact that TD children have knowledge of linguistic principles and tend to follow them in most cases. They attempt to attribute the deficit of the children with SLI to competence rather than performance factors supporting a syntactic deficit rather than a processing one.

Friedmann and Novogrodsky (2004) compared the comprehension of subject and object relative clauses in ten Hebrew speaking children with syntactic — SLI (S-SLI) and two groups of younger TD children. Their study included children with SLI who were older than those in most previous studies (7;3 to 11;2 years). It is established in the literature that typically developing children already perform well on relative clauses at these ages. Three types of sentences were used, simple sentences, right branching subject relatives and right branching object relatives. It is also worth noting that all relative clauses used were the more basic 'presentational relatives' (as discussed by Diessel and Tomasello, 2005). They noted particular difficulties with object relatives for the S-SLI group. Although 6 year old TD children showed an understanding of the object relatives, the 11 year old SLI children were continuing to perform at chance level. The performance of the children with S-SLI on subject relatives was similar to the 6 year old TD children and better than the TD 4 year olds.

This study is limited in that the sample size is small, it only shows comprehension difficulties of object relatives and has been carried out with the small subgroup of children known as syntactic SLI. The focus of Friedmann and Novogrodsky (2004) is on the syntactic construct of movement and they argue that their results point to a deficit in the representation of movement and to the strategy children adopt in order to assign a thematic role to the moved element. They also suggest that their findings are consistent with the RDDR theory advocated by van der Lely and Battell (2003). Interestingly the children with S-SLI performed well on both simple sentences and subject relatives (both of which follow a canonical word order) and while Friedmann and Novogrodsky (2004) argue this as evidence supporting the movement based account it could also be interpreted as support of a usage based account in line with that put forward by Diessel and Tomasello (2001).

A further study was carried out by Novogrodsky and Friedmann (2006) on the ability of Hebrew speaking children with syntactic-SLI to produce relative clauses. Eighteen children with S-SLI, (9;3 to 14;6) and twenty-eight TD children (7;6 to 11;0) took part in the study and two structured elicitation tasks were used. The results on both tasks indicated that the children with S-SLI had a difficulty in the production of object relatives. Their production of subject relatives was better, although it was still below the performance of the TD group. Certain responses were produced exclusively by the S-SLI group. These were the conversion of object relatives into subject relatives, the use of simple sentences in lieu of a an object relative, thematic role errors and thematic role reduction (the omission of verb arguments). Significantly the children with S-SLI did not omit relativizers, nor did they make any other structural errors. Again, Friedmann and Novogrodsky (2006) argue that these children do not experience a structural difficulty with embedding, rather they have a deficit in assigning the appropriate thematic role to moved constituents. It would seem that consistently subject relatives are less problematic than object relatives, for Hebrew speaking children with S-SLI.

More recently Novogrodsky and Friedmann (2010) investigated whether children with syntactic SLI are impaired in all types of dependency / movement. They found that while the children with syntactic SLI were impaired in the comprehension and production of sentences derived by Wh movement, they showed intact performance in the interpretation of pronouns and reflexives. No significant difference was found between the children with SLI and the control group or between the pronouns and reflexives. These results suggest that the difficulty in syntactic SLI is specific to a certain type of dependency (they argue for Wh movement) and does not extend to all types of dependencies. One of the initial advantages of the CGC (Computational Grammatical Complexity) proposed by van der Lely (2005) — see section 2.2, was that by focusing on the syntactic construct of dependency / movement, it could link apparently unconnected phenomena such as relative clauses, agreement, pronominal reference and wh-questions. This research suggests that this is not the case, at least for Hebrew.

2.9.3   Summary

In summary, studies carried out on the production and comprehension of relative clauses in children with SLI could be divided into those carried out in the English language and those carried out in other languages. While cross-linguistic studies are very beneficial in attempting to apply current theories it is also sometimes difficult to make direct comparisons if the structures show significant variation e.g. relative clauses in Greek versus relative clauses in English. There may also be discrepancies in the performance of children from different English speaking countries e.g. the United Kingdom versus the United States. Having reviewed the literature the omission of the relativizer in subject relative clauses would seem to be much more common among children from the US in comparison to those from the UK. Children from the UK on the other hand used the reduced relative construction more readily than those from the US. Right branching relatives would seem to be favoured cross linguistically as well as a preference for subject relatives over object relatives in both comprehension and production.

Perhaps the most significant study previously outlined is that carried out by Hesketh (2006) — both for its content and the relative size of the study. Interestingly she reports the use of single propositional statements and an avoidance of the relative clause construction, as well as a strong preference for right branching relative clauses. Her results did not show the marked pattern of obligatory relativizer omission (from subject relative clauses) found in other studies. Patterns noted in other languages were the use of co-ordination instead of subordination and the omission of the obligatory relativizer (Swedish), the conversion of object relatives to subject relatives, the use of simple sentences and thematic role errors (Hebrew).

2.9.4   Previous Methodologies

As can be seen from the aforementioned studies, researchers have used a variety of methods in assessing the problems children with SLI have with relative clauses. Relative clauses are rare in the spontaneous speech of older children with SLI (Schuele & Nicholls, 2000) as well as in younger typically developing children (Tager-Flusberg, 1989). The challenge therefore is in finding the optimal methodology that is reflective of the child's true language abilities and that allows for an analysis of an adequate corpus of data.

Much of Schuele's work has been based on a longitudinal familial case study (Schuele & Nicholls, 2000; Schuele & Dykes, 2005) — while Schuele and Tolbert (2001) used an act out play task adapted from Hamburger & Crain (1982). Stavrakaki (2001) also used an act out procedure in her analysis of the comprehension of relative clauses. Friedmann and Novogrodsky (2004) used a

binary sentence picture-matching task in their comprehension study and used two structured elicitation tasks (a preference task and a picture description task) in their 2006 study. Hakansson and Hansson (2000) used a number of different methodologies — children's comprehension was tested using picture pointing, act-out and oral response tests and their production was tested using elicited imitation and sentence completion tests. Marinellie (2004) used conversation language sampling and Hesketh (2006) used a narrative and picture supported elicitation task. In more recent years, response tasks using video and computer software have also been explored. Hestvik, Schwartz, and Tornyova (2010) examined automatic on-line gap-filling in relative clauses, as well as off-line comprehension of the same stimulus sentences.

Over the last number of years, there has been renewed interest in sentence recall as a reliable methodological tool to investigate syntax in children with SLI, particularly following research carried out by Conti-Ramsden et al., (2001), where sentence recall was found to be a highly discriminating marker of children with SLI. As mentioned in section 2.9.1, sentence repetition was used in a recent study by Riches (2010), where he investigated complex syntax in children with Autistic spectrum disorders as well as those with SLI. Seeff-Gabriel, Chiat, and Dodd (2010) introduce the Sentence Imitation Test (SIT-61) and report on its ability to discriminate between children who are diagnosed as having SLI and those who are typically developing, as well as providing information on their morphosyntactic strengths and weaknesses. In this study, sentence recall is used as the methodological tool to investigate the control of complex syntax — specifically relative clauses by children with SLI. It allows us to elicit the full range of relative clause targets which would be extremely difficult in spontaneous language production. It also allows us to maintain the sentence length while manipulating the syntactic complexity of the relative clause. Sentence recall does not facilitate the avoidance of complex structures that can occur in spontaneous language production and exposes the child's full range of errors — therefore providing a full picture of the child's linguistic skills and limitations.

This leads us to the types of relative clauses used in the sentence recall task in the current study. As Diessel and Tomasello (2001) have highlighted for TD children, there is a great need to extend the range of constructions containing relative clauses in research studies for children with SLI. No research has been carried out with children with SLI where both the syntactic role of the main clause and that of the relative clause are varied. Friedmann and Novogrodsky (2004) used presentational clauses in subject and object form but most other studies used two propositional relatives only. It is also the case that most studies have only analysed children's comprehension or production of relative clauses with a subject or object gap.

We have used a developmental approach based on the work carried out by Diessel and Tomasello (2001; 2005). In their work were two types of main clause – relative

clauses were attached to the predicate nominal of a copular clause, or to the direct object of a transitive clause. This resulted in right branching relatives only and reflect the relative clauses that occur in naturally developing child speech. As highlighted in section 2.6 the syntactic role with in the relative clause can also vary and we included relative clauses covering a range of syntactic roles ; subject, object, oblique, indirect object, genitive subject and genitive object.

Most of the reported studies have indicated that relatives with a subject gap are less problematic for children with SLI than those with an object gap. However as outlined in section 2.8 the processing difficulty of an object relative is affected by the type of subject it includes as well as the animacy of the head noun (Kidd et al., 2007). In natural discourse, object relatives are most often characterized by inanimate heads, with a discourse-old referent, (such as a pronoun) as the subject of the relative clause. Research studies with children with SLI have not used the object relatives that reflect natural discourse. As indicated earlier, when studies with TD children used the object relatives that followed these discourse and semantic constraints, the discrepancy between object and subject relatives disappeared. We do not know if this would also be the case for children with SLI. In this study both types of object relative are used.

This leads us to our research questions:

1. How well do children with SLI control the full range of constructions containing relative clauses in English?

2. Do children with SLI differ from their age matched counterparts and from younger TD children in their control of relative clauses?

3. If we exclude minor grammatical and lexical errors, do the children with SLI differ from their age matched counterparts and from younger TD children in their control of relative clauses?

4. Is the hierarchy of intransitive subject (S), transitive subject (A), object (P), oblique (Obl), indirect object (Io), genitive subject (GenS) and genitive object (GenO) seen in the relative clause acquisition of TD children reflected in the performance of children with SLI in the sentence recall task?

(4a.) In relation to the SLI group are the relative clauses attached to a presentational copular clause easier than those attached to the direct object of a transitive clause?

(4b.) Can the children with SLI deal with object relative clauses with an inanimate head noun and a personal pronoun subject, with greater ease than those with an animate head noun and a subject noun (typically used in previous research)?

(4c.) Do they have a tendency to simplify relative clauses that they find difficult in the NVN direction?

(4d.) Were relative clauses with stranded prepositions particularly difficult for

children with SLI?

(4e.) Do the children with SLI find subject relative clauses with an intransitive verb easier to process than subject relative clauses with a transitive verb?

5. Are the error patterns used by children with SLI in the current study similar to those described in previous research (1) in children with SLI (2) in younger TD children?

6. What role do short-term memory and working memory play in the control of relative clauses by children with SLI?

7. Does their language status play a role in the control of relative clauses by children with SLI?

Chapter 3

Methodology

3.1 Participants

Eighty four children took part in the study — thirty two children with SLI, thirty two typically developing age matched control children (AM-TD) and twenty younger typically developing children (YTD). The children in the SLI and AM-TD groups were between the ages of 6;0 and 7;11 years, with mean ages of 6;10 (SLI) and 6;11 years (AM-TD). Each group of thirty two children consisted of twenty two boys and ten girls. The younger typically developing (YTD) included twelve boys and eight girls, ranging in age from 4;7 to 4;11 years, with a mean age of 4;9 years. Because children with SLI perform more poorly than age-matched controls on almost any selected measure of language (the AM-TD group often approaching ceiling), the inclusion of younger typically developing children allows for comparisons to be made regarding error patterns in normal development versus those that are specific to children with SLI. Children with SLI tend to perform at the level of approximately two years younger than their chronological age in many areas of language development, therefore the YTD group included in this study were a mean age of 4;9 years.

All of the children were native English speakers in Ireland. The majority of children were from similar socio-economic areas (middle-class/lower middle-class), as reported by their teachers (based on parental education). However, there were four children with SLI from a lower socio-economic background. An equal number of children from a a lower socio-economic background were therefore included in the two control groups. These were recruited according to the schools they attended and through information from their teachers, based on parental occupation.

The children with SLI were identified by their performance on the Clinical Evaluation of Language fundamentals (CELF-4 — Semel, Wiig & Secord, 2003). They were included in the SLI sample if they scored below -1.5 standard deviations (SD) on two of the three receptive language subtests. The two subtests, were Concepts

Table 3.1: Receptive Language Scores for each of the three groups

	Mean	Standard Deviation	Range
SLI	60.7	8.86	44 — 73
AM-TD	107.8	8.87	92 — 125
YTD	108.5	6.22	96 — 120

Table 3.2: Expressive Language Scores for each of the three groups

	Mean	Standard Deviation	Range
SLI	82.3	12.01	55 — 105
AM-TD	112.9	8.5	91 — 126
YTD	117.3	9.5	100 — 130

and Following directions and Sentence Structure. Following initial testing it was found that the third subtest, Word Classes, tended to positively skew the overall performance of the children with SLI. This subtest is a measure of semantic knowledge and tends to be both an area of initial therapeutic focus, and one in which children have a disproportionately positive response to therapy. A composite receptive language score was calculated by averaging the two receptive subtests administerd. As outlined in Table 3.1 the receptive language standard scores for this group of children ranged between 44 and 73 (mean= 60.7, SD = 8.86). Two of the three expressive subtests of the CELF 4 were also administered but the results were not used as inclusionary/exclusionary criteria for the study. A composite score was calculated by averaging the two expressive subtests administered. The expressive language standard scores for each of the three groups are outlined in Table 3.2.

The language identification criteria for SLI vary somewhat throughout the literature. Consistent with that described by Tomblin et al. (1997) is a performance of at least 1.25 standard deviations below the mean on two of four language measures, one of which must be a receptive measure. On the the other hand, Deevy and Leonard (2004) used 1 standard deviation below the norm on two expressive language tests to identify children with SLI in their study. In a study by Redmond (2005), the identification criterion was a performance of at least 1 standard deviation below the mean on a minimum of two of the six core subtests from the test of Told- P3 (Newcomer & Hammill, 1997), however the breakdown of receptive versus expressive subtest requirements was not specified.

It is important to acknowledge within the Irish context that to be identified as having SLI, and thereby receive the specific educational resources aimed at remediating these language difficulties, a child must perform at least 2 standard deviations below the mean on one or more of the main areas of speech and language development (receptive and/or expressive). However, in order to make this study applicable outside the Irish context a 1.5 standard deviation cut off was deemed an appropriate criterion.

All other usual exclusionary criteria for SLI were also applied, i.e. a diagnosis of

Attention Deficit Hyperactivity Disorder, Autistic Spectrum disorder, major physical disabilities, intellectual disability and hearing impairment. Children with verbal articulatory dyspraxia or any significant phonological problems were also excluded. This was due to the fact that a sentence recall task was the investigative method used in this study and it was important that the children did not have articulatory difficulties that would obscure their syntactic potential. The children with SLI were recruited by contacting speech and language therapists around Ireland and informing them of the inclusionary criteria for the study, as outlined above. A questionnaire was completed by all speech and language therapists who were working with, or had access to the files of each potential participant, in order to ensure that these exclusionary criteria were adhered to. The speech and language therapists working with each child also requested permission from the parents for the researcher to make initial contact and give them further information about the study. Four parents did not agree to their children participating. Three children were excluded from the study as they were unable to complete the sentence recall task and a further three children were excluded as a result of their receptive language scores being too high. The Raven's test of Progressive Matrices was administered to children to ensure adequate cognitive ability. Children were required to achieve a standard score of 85 or greater on this test in order to be included in the study. The children with SLI either attended a language unit, attended for therapy in the health service, or had been assessed and were wait-listed for Speech and Language Therapy.

The children participating in the control groups were recruited from schools with similar demographic profiles to the schools attended by the group with SLI. The AM-TD group were matched to the group with SLI on gender and age, with the mean age difference between both groups at one month. The YTD group were proportionally matched for gender. These children had no reported history of speech, language or hearing problems or any type of exceptional needs. A discussion took place with each class teacher to ensure that none of these difficulties existed. All children in both the AM-TD and YTD groups, scored within 1 standard deviation of the mean for their age on the receptive and expressive language measures implemented. The language age for the AM-TD group was determined using the CELF-4 (Semel, Wiig & Secord, 2003)(as outlined with the children with SLI). The receptive language standard scores ranged between 92 and 125 (mean= 107.8, SD = 8.87). The language age of the YTD group was determined using the CELF-Preschool-2 (Semel, Wiig & Secord, 2004) and the decision to use different tests was determined by the younger age range of this group. Their receptive language standard scores ranged between 96 and 120 (mean= 108.5, SD = 6.22).

Ethical approval for the study was obtained from the Cork Teaching Hospitals Clinical Research Ethics Committee. Following receipt of signed consent and assent forms from the families (examples in Appendix A), the researcher carried out all

testing to identify the children with SLI and to locate the two groups of typically developing children. The researcher is a senior Speech and Language therapist with eighteen years experience working with children with speech, language and communication difficulties and is therefore very familiar with administering, standardized and informal assessment procedures.

3.2   Materials

Following receipt of informed written consent from each family, the school principals were contacted to request permission to assess each child in their respective school (example of letter in Appendix B). Children were assessed individually, in a quiet room and each child was seen three times with normal school breaks.

3.2.1   Sentence Recall Task

The sentence recall task used in this study was a newly constructed task, including 52 complex sentences containing relative clauses and 17 filler sentences. Both the relative clause constructions and the filler sentences included roughly the same number of words and syllables (the number of words varied between 10 and 12 and the number of syllables varied between 10 and 13). The filler sentences were simple active declarative sentences following canonical word structure. They were randomly inserted in the list of relative clause sentences and were matched for length with the complex structures.

The sentence recall task was finalized following a pilot study, the purpose of which was to ensure that both typically developing children and children with SLI could perform the task. Ten children participated in the pilot study - 4 children with SLI and 6 AM-TD children. The children with SLI ranged in age from 5;6 years to 7;11 years. All children could perform the task with the exception of the youngest child, who presented with receptive language skills more than 3 standard deviations below the mean. This child was unable to repeat the relative clause constructions and was subsequently excluded from the pilot study. Following the pilot study, genitive relative clauses with a subject gap were added and the number of filler sentences were reduced from 24 to 17 in order to reduce the overall length of the task. No other changes were made to the sentence recall task.

The sentence recall task was also based on acquisitional work carried out by Diessel and Tomasello (2005), in that it included relative clauses that young children use in spontaneous speech and that reflect a developmental hierarchy. The relative clauses were attached to either the predicate nominal of a copular clause (1), like the great majority of children's early relative clauses, or to the direct object of a

transitive clause (2), like some of children's later relative clauses (see Diessel & Tomasello 2001, Diessel 2004, chap.6). Center-embedded relative clauses, that is, relative clauses that are attached to the main-clause subject (3), were not included in the materials because they are essentially absent from naturally occurring child speech.

1. There's the boy who Peter teased at school this morning.

2. Mary found the yellow car that he played with in the garden.

3. The girl that fell off the bike walked to school.

In contrast to many previous studies which only considered relative clauses with a subject or object gap, this study included those representing the full range of syntactic roles — subject, object, oblique, indirect object, and genitive. A distinction was made between transitive and intransitive subject relatives, as previous studies have shown that transitivity can affect children's comprehension of relative clauses (Hamburger & Crain, 1982; Goodluck & Tavakolian, 1982b). There were also two types of object relative. (1.) Those that have been typically used in previous comprehension studies, where the head noun is animate and both the head noun and relative clause subject are realized as common nouns. (2.) Those that follow the discourse and semantic constraints noted in the literature (Kidd et al., 2007). That is, they included an inanimate head noun and a discourse-old referent, (such as a pronoun) as the subject of the relative clause. Two types of genitive relative clauses were also included in the study — subject genitives and object genitives. As outlined in section 2.6 a genitive relative clause is one in which the noun that is post modified is the possessor of a nominal modified by the relative pronoun. In a genitive relative clause the link between the head noun and the relative clause is realized by a genitive attribute such as, *whose*. A subject genitive relative clause is one in which the noun phrase containing the genitive functions as the subject and an object genitive relative clause is one in which the noun phrase containing the genitive functions as the object.

Children were asked to repeat 14 different types of relative attached to the two main clause types described above. Examples of each relative clause type are shown in 3.3.

3.2.1.1   Relative Clause Types — Coding Adapted from Diessel and Tomasello (2005)

S-relatives : relative clauses with an intransitive verb and a subject gap;

A-relatives : relative clauses with a transitive verb and a subject gap;

Table 3.3: Examples of Relative Clause types

S-relative	. . . the rabbit that jumped.
A-relative	. . . the woman who cooked the dinner.
P-relative	. . . the book that you read in school.
Io-relative	. . . the girl who Eddie baked a cake for.
Obl-relative	. . . the picture that the girl looked at.
Gen-S-relative	. . . the girl whose Mammy ran in the race.
Gen-O-relative	. . . the girl whose bag Anne took to school.

P-relatives : relative clauses with a direct object gap;

IO-relatives : relative clauses with an indirect object gap;

OBL-relatives : relative clauses with an oblique gap;

GEN- relatives : relative clauses with a genitive relative pronoun;

GEN- S : the noun phrase containing the genitive functions as the subject;

GEN-O : the noun phrase containing the genitive functions as the object;

There were four of each relative clause type presented except for the Gen-S relatives where there were two examples of each. This resulted in fifty-two relative clauses and sixty-nine test sentences in total. In all complex sentences, the relative clauses were introduced by one of the relative markers, *who, that* or *whose*. In each condition, two of the four sentences included a copular main clause and the other two sentences included a transitive main clause in which the direct object served as the head of the relative clause. Combining the above main clause and relative clause types, table 3.4 gives an example test sentence for each of the fourteen conditions. The sentence length was kept constant by adding adverbials to the ends of the sentences (e.g. *yesterday, last summer*), by pre-modifying the head nouns and less frequently by adjectival modification of the relative clause nominal constituents (e.g. *tennis-ball*) (the latter two only in the case of the fillers. Unlike Diessel and Tomasello (2005) where all noun phrases in main and relative clauses denoted animate referents, four out of eight of the head nouns of the object matrix clauses were inanimate, with a pronominal relative clause subject. This was consistent with the research carried out by Kidd et al., (2007). The full list of sentences used in the recall task appears in Appendix C.

The vocabulary used throughout the newly devised sentence recall task was cross referenced with the MacArthur-Bates Communicative Development Inventory

Table 3.4: Example test sentences for each condition

PnS	There is the man who drove the car in the garden.
DoS	The girl cleaned up the milk that spilt in the fridge.
PnA	There is the sheep that drank the water this morning.
DoA	Eddie met the girl who broke the window last week.
PnP	There is the picture that you drew on the wall last week.
DoP	The boy rode the horse that Anne put in the field.
PnIo	There is the dog that the man kicked his football to.
DoIo	Anne fed the baby who Emma sang a song to.
PnObl	There is the tree that the car crashed into last night.
DoObl	Anne painted the picture that the girl looked at today.
PnGenS	There is the girl whose juice spilt in the kitchen.
DoGenS	Anne saw the farmer whose cow fell in the shed.
PnGenO	There is the girl whose toy Anne broke in the garden.
DoGenO	Emma met the girl whose bag Anne took to school.

(Fenson, 2007) to ensure that the vocabulary would be familiar to the children in the study.

3.2.2   Working Memory Test Battery for Children (WMTB-C)

In order to explore the role of phonological short-term memory and working memory in the performance of children with SLI, on the sentence recall task, appropriate subtests of The Working Memory Test Battery for Children (WMTB- C, Gathercole & Pickering, 2001) were administered to all children. This test was designed to reflect the three component structure of the working memory model proposed by Baddeley and Hitch in 1974. Each component is specialised and deals with a different aspect of working memory. The components include a central executive (CE) and what are referred to as two 'slave systems'. The slave systems are known as the Phonological loop (PL), which is responsible for holding verbal information for short periods, and the Visuospatial Sketchpad (VSSP) which holds information in visual and spatial form. The CE is involved in the overall control and regulation of the working memory system. The WMTB-C includes

4 measures of PL function

Digit recall, Word list matching, Word list recall and non-word recall

2 measures of VSSP function

Block recall and Mazes memory

3 measures of CE function

Listening Recall, Counting Recall and Backwards digit recall

All subtests of the WMTB-C were administered to the children with SLI and the AM-TD group. The YTD group completed all of the subtests relating to Phonological Loop function, one of the VSSP measures (Block Recall) and one

measure of the Central executive. However, the lower age limit of 5;7 years precluded them from completing three subtests: Listening Recall, Counting Recall (CE) and Mazes Memory (VSSP).

Immediate serial recall is considered a paradigm that is highly sensitive to individual differences in phonological short-term memory. Three of the four subtests above are examples of this paradigm- *Digit recall, Word list recall* and *Non-word recall.* However, there has been some controversy in the past regarding the purest measure of phonological short-term memory. It was initially thought that non-word repetition provided a more accurate measure of phonological storage quality than serial recall measures that use real word stimuli. The thinking was that because non-words do not activate lexical representations, the lexically based reconstruction process of redintegration cannot compensate for any deficits in phonological storage. However, there is now evidence that previous language knowledge directly influences the accuracy of non-word repetition. Repetition accuracy is significantly associated with the rated word-likeness of non-words, with higher levels of performance for the non-words judged to be most word-like (Gathercole, 1995; Gathercole, Willis, Emslie, & Baddeley, 1991). Non-word repetition is also enhanced when non-words contain segments or sequences of segments with high phonotactic frequencies (Munson, Kurtz, & Windsor, 2005; Munson, Edwards, & Beckman, 2005; Vitevitch & Luce, 2005) or syllables that are themselves lexical units (Dollaghan et al., 1993). Children's vocabulary size is also an important predictor of non-word repetition accuracy (Munson, Kurtz, & Windsor, 2005).

The fourth subtest of phonological loop function is *word list matching* and although this has been less widely researched, it was included as part of this battery, on the basis of evidence that it is much less influenced by the contribution of long-term memory / previous language knowledge than recall based measures (Gathercole, Pickering, Hall, & Peaker, 2001). So while none of the subtests of PL functioning are completely free from language knowledge, the use of all four subtests provided a reasonably comprehensive assessment of each child's phonological short-term memory.

3.3   Procedure

A toy farm, toy people and some other common objects were placed on the table beside the children. They were familiarized with the toys and were permitted to play with them for a short period. The children were then told that my puppets and I would like to play a game with them, in which they had to repeat sentences like a parrot. The toys on the table were represented in the vocabulary of the target sentences. There was more than one toy for each type of referent, in order to ensure that the relative clauses were produced in a somewhat pragmatically appropriate

context (Hamburger & Crain, 1982). The child and the researcher were each assigned a glove puppet. Before the game began, there was a warm up session in which the child was required to repeat four sentences. These were simple sentences, initially short and then equal in length to the test sentences but structurally less complex, *Joe went to school on the bus, The horse jumped over the big fence on the farm.* It was important to begin the activity with these simple sentences to encourage the children to continue with the game. During this time the children wore the glove puppet and familiarized themselves with the activity. Following the warm up, both the researcher and the child put their respective puppets on a stand. This was to rule out any possible interference from the physical activity of moving the puppet, on the processing and memory task of recalling the sentence. Once the children were finished playing with the toys and the puppets were placed on the stand, there was no further interaction by the child with the toys.

The sentence recall task was divided into three batteries, with each battery including twenty-three sentences. The sequence of sentences was randomized such that there were two orders of presentation for each battery. The task was administered in one session with breaks between each test battery. In order to make the activity as engaging as possible the sentences were not pre-recorded, but were presented in real time. Given that the researcher repeated the task eighty-four times, it was felt that the presentation was consistent in sentence inflection, rate of speech, and tone of voice. Positive feedback was given after each response, regardless of the child's performance. If a child became distracted, and was clearly not listening to the test sentence, the researcher repeated the sentence once, waited for a response and then moved on to the next item. If a child did not respond to a test sentence, the researcher continued with the following eight sentences, and then repeated the sentence again. Each session was recorded using a Zoom H4 audio recorder. The responses were then stored on a Mac Air for transcription and analysis. All transcription was carried out orthographically, including mazes and hesitations *e.g. Emma saw her friend eh ..... today and she bring her bag to school.*

5% of transcripts from each group were re transcribed by an independent Speech and Language Therapist — transcription reliability was computed for word level accuracy (M = 97%; range = 94% — 100%) Interrater measures were also obtained for the scoring scheme for the sentence recall data. A linguist familiar with child language data, and provided with details of the scoring criteria (see section 3.4), re-analysed 5% randomly selected responses. For all scored responses, the agreement rate was 92.7%. For responses given a score of 10, 9 or 8, the agreement rate was 97%.

3.4   Scoring

The scoring method used in this study allowed for both quantitative and qualitative analysis to be carried out. It was important to have a qualitative aspect to the analysis which would go beyond total scores and total error counts, would investigate error rates across different kinds of relative clauses and would code for different kinds of errors. In this way, the study would have the the potential to identify differences in language profiles specific to SLI, where studies investigating raw error rates would not discriminate. In Diessel and Tomasello's work (2005), a three tiered scoring system was implemented. Children's responses were assigned a score of 1, 0.5, or 0. A response was assigned a score of 1 if it was essentially correct. A response was assigned the score of 0.5 if it included a lexical mistake or a minor grammatical error that did not affect the structure of the relative clause and a response was assigned a score of 0 if the structure or meaning of the test sentence was changed or if the whole sentence was ungrammatical. If a child did not respond or produced an incomplete utterance, the response was also assigned a score of 0. While this scoring system provided adequate information when analysing data from typically developing children, the range of responses from children with SLI could not be reflected in a three tiered system. For children with SLI, the range of response similarity and or difference to the target utterance, meant that the scoring system needed to be expanded. Children's responses were therefore assigned a score ranging from ten down to one, with a higher score representing a more accurate performance. The scoring system is outlined below.

The implementation of the scoring system as described, meant that if the child's responses were scored as either eight, nine, or ten, they had maintained the overall structure of both the matrix clause and the relative clause construction. Errors involving tense morphemes, for example, the omission of past tense *-ed*, over-regularizations, or aspectual auxiliary errors, for example, *was wearing*, were considered relatively minor and were assigned a score of eight or nine (depending on the specific error). This is because, for children with SLI, the likelihood of making these errors may be influenced by the phonological/phonotactic properties of the verb stem (Marshall & van der Lely, 2006), and verb regularity. These two factors have not been controlled for in the current study. It is also well recognised in the literature that problems with tense are a particular difficulty for children with SLI (Leonard et al., 2003; Conti-Ramsden, 2003; Oetting & McDonald, 2001) and given the theoretical focus of the current study on clause-level abilities it was appropriate that these errors were scored accordingly. Errors involving changes in the indefinite article, for example, *a to an, an to a*, were also scored as a minor error (assigned a nine) as they were dependent on a rule of phonological agreement and are therefore not related to syntactic difficulties. The remaining scores, ranging from seven to zero, were to allow for a complete documentation of how children with SLI approximate relative clause constructions in a diverse range of ways. These

scores were based on what has been previously documented in the literature for children with SLI and moved from more complex utterances to simple sentences as the scores decreased. A score of seven indicated two strategies (1.) the child produced an amalgam of both clauses, (in a subject relative) omitting the obligatory relativizer or (2.) produced both clauses and added a resumptive pronoun or noun phrase. A score of six indicated that the child produced another type of relative clause construction than the target. A score of five was given when the child produced other types of complex sentences. Responses given a score ranging from four to zero could not be categorized as complex and ranged from the use of co-ordination, ungrammatical relative clauses, simple sentences to uninterpretable responses. This detailed scoring system facilitated an analysis of how the strategies of the children with SLI related to the ways in which TD children develop towards the production of correct relative clause constructions.

10. Correct

A score of ten was given if the sentence was correct with no errors. Mazes were disregarded.

> There is the pig that climbed into the box yesterday.
>
> *There is the pig who went in … climbed into the box yesterday.*

Responses given a score of 10

> Eddie met the girl who broke the window last week.
>
> *Eddie met the girl who broke the window last week.*
>
> There is the man who drove the car in the garden.
>
> *There is the man who drove the car in the garden.*

9. Minor lexical /Minor Grammatical errors

A score of nine was given if the response maintained the structure and content of the stimulus sentence but contained a single minor lexical error or a single minor grammatical error.

Minor Grammatical Errors

Changes in definiteness: For example, the substitution of a definite article for an indefinite one.

> There is the girl who the cat played with in the kitchen.
>
> *There is a girl that the cat played with in the kitchen.*

Changes in number: For example, when the plural of any noun is substituted for the singular, or the singular substituted for the plural.

> There is the girl who the cat played with in the kitchen.

There are the girls who the cat played with in the kitchen.

Grammatical Relativizer substitution: For example, *that* is substituted for *who* or *who* is substituted for *that* with an animate object.

There is the sheep that drank the water this morning.

There is the sheep who drank the water this morning.

Replacement of relativizer that / who by what

The girl ate the sweets that you brought to the party.

The girl ate the sweets what you brought to the party.

The replacement of a noun phrase by a pronoun

Joe watched the cat that chased the mouse in the garden.

Joe watched the cat that chased him in the garden.

Appropriate relativizer omission : For example in the case of an object relative (PnP or DoP), an oblique relative (PnObl or DoObl) or an indirect object relative (PnIo or DoIo) the relativizer is not necessary to form a grammatical relative clause.

The girl ate the sweets that you brought to the party.

The girl ate the sweets ____ you brought to the party.

Over generalization of regular past tense

This is the toy that broke in the box last week.

This is the toy that broked in the box last week.

Presentational pronoun substitution: The demonstrative pronoun that opens the presentational clause is substituted for another demonstrative pronoun.

There is the pencil that fell on the ground in school.

This is the pencil that fell on the ground in school.

Minor lexical errors

The substitution of one noun for another

Emma saw the man who patted the dog on the back.

Emma saw the man who patted the dog on the lap.

The substitution of one verb for another where the argument structure of the relative clause is maintained

Joe rubbed the cat that the goat stood on last week.

Joe rubbed the cat that the goat stepped on last week.

Note: If the lexical substitution changes the argument structure of the target sentence then it is not considered a minor error.

Adverbial substitution /Addition/Omission

> This is the boy who Emma danced with all day.

> *This is the boy who Emma danced with last week.*

8. Grammatical Errors (not minor) — More than one minor grammatical and /or minor lexical error

A score of eight was given if the response maintained the overall structure of the stimulus sentence but contained a more significant grammatical error or more than one minor grammatical and /or minor lexical error.

Significant grammatical errors

The omission of determiners:

> There is the horse that the girl gave a drink to.

> *There is the horse that the girl gave ____ drink to.*

Changes in tense (Including Copula tense change)

> The girl ate the sweets that you brought to the party.

> *The girl ate the sweets that you bring to the party.*

Prepositional substitution/addition — The replacement of one preposition for another or the addition of a preposition in the information following the relative clause.

> There is the pencil that fell on the ground in school.

> *There is the pencil that fell in the ground in school.*

This category excludes the PnIo / DoIo-relatives and the PnObl/DoObl as the prepositions in these cases are intrinsic to the relative clause. In the case of PnIo/DoIo and PnObl/DoObl relatives preposition addition, omission or substitution is considered an ungrammatical relative clause and scored accordingly.

> This is the boy who Emma danced with all day.

> *This is the boy that Emma danced ____ last year.*

A score of eight was also assigned to the child's response if there was more than one minor inflectional and or lexical error – up to a maximum of four errors per sentence – substitutions within a prepositional phrase after the relative clause are treated as one error, adverbial omission, substitution or addition is also treated as one error.

More than one minor grammatical error (structure maintained)

Anne found the book that you read in school today.

And I found the book who I read in school today.(4 errors)

More than one minor lexical error

There is the dog that the man kicked his football to.

There's a man that the farmer kicked his ball to.(4 errors)

Noun transpositions

Anne fed the baby who Emma sang a song to.

Emma fed the baby who Anne sang a song to.(2 errors)

A combination of lexical and grammatical errors/omissions (maximum four)

This is the pencil that you broke in school today.

There's the pencil what you broked in school yesterday.(4 errors)

Omission of noun phrase

There is the man who drove the car in the garden.

There was the man that drove _____ in the garden.(3 errors)

Omission of prepositional phrase

There is the pencil that fell on the ground in school.

There is the pencil that felled _____ in school. (4 errors)

Use of got or do auxiliary with verb

This is the man who Joe wrote a letter to.

Joe… This is the man that Joe did write the letter to.(4 errors)

The replacement of that by who when used with an inanimate object

Anne found the book that you read in school today.

Anne found the book who you read in school today.(1 error)

7a. Relativizer Omission

Children's responses were assigned a score of seven (coded 7a.)

- If they maintained the overall structure of a subject relative clause but omitted the relativizer (this rule does not apply to those relative types where it is grammatical to omit the relativizer)

- If they omitted the relativizer with minor lexical errors or an alteration of tense.

Relativizer omission in subject relatives (ungrammatical)

Emma saw the man who patted the dog on the back.

Emma saw the man patted the dog on the back.

Relativizer omission with minor lexical errors

The cat caught the mouse that ran around the garden.

The man caught the cat ran around the garden.

7b. Resumptive pronouns or noun phrases

Children's responses were assigned a score of seven (coded 7b.) if they used a resumptive noun phrase or pronoun.

Anne painted the picture that the girl looked at today.

Anne painted the picture that the girl looked at it today.

Note: Minor lexical and or grammatical errors can co-occur.

6. Grammatical Relative Clause Conversions

Children's responses were assigned a score of six

- If they successfully converted the relative clause test sentence into another type of relative clause.

- If the conversion contains a minor inflectional error then it is still considered grammatical and is scored as such.

- If the conversion is grammatical up to and including the relative clause but is ungrammatical in the prepositional phrase or adverbial information that follows.

Successful Conversion

Eddie saw the man whose horse Joe rode in the field.

There's the horse who Joe rode in the field. (Conversion to PnP)

Conversion with minor lexical error

This is the boy whose coat fell on the floor.

This is the boy's coat who fell on the floor. Conversion to PnS

Conversion with ungrammatical prepositional phrase

There is the girl whose toy Anne broke in the garden.

There's a girls toy that broke in to the garden.

5. Other complex sentences

A child's response was given a score of five if they produced another complex sentence type — this included catenative complements / non-finite clauses, subordinate clauses and reduced relatives.

Reduced Relatives

Eddie smiled at the girl who Joe read a book to.

Joe smiled at the girl reading the book.

Catentative complements / Non-finite clause

Anne helped the woman who cooked the dinner last night.

Anne helped the woman cook the dinner last night.

Subordinate clause

Anne kissed the baby whose face Joe cleaned with a towel.

Mammy kissed the baby when Joe washed the little baby's head.

4. Co-ordination / Two independent clauses

A child's response was given a score of four

- If the response consisted of two grammatical co-ordinated clauses.

- If the child produced two grammatical independent clauses.

Note: An error in tense was not considered ungrammatical.

Co-ordination

The girl cleaned up the milk that spilt in the fridge.

The girl drinked the milk and it spilt again.

Two independent clauses

This is the boy whose coat fell on the floor.

This is the boy . . . his coat fell.

3. Ungrammatical conversions / Ungrammatical containing a relative clause

A child's response was assigned a score of three

- If the child attempted to convert the target relative clause in to another relative clause type but the structure was ungrammatical in some way. (ungrammatical conversion)

- If the target sentence is reproduced with the relative clause mainly in tact but with a key ungrammatical aspect. This category is similar to above but there is no attempt at converting the target relative clause in to another relative type.

- The category ungrammatical containing a relative clause also applies to sentences that do not include a relativizer but that have two finite verbs and a subject for each verb.

Ungrammatical Conversions (coded as 3a.)

Conversion with transitive verb but no object

Joe liked the girl whose dog Anne found in the park.

Joe liked the dog [that . . .] who found in the park.

Conversion with only one complete clause

This is the boy who Emma danced with all day.

[Emma who dance . . .] the boy who danced with Emma all day.

Omission of verb

The girl ate the sweets that you brought to the party.

This ___ the sweets the girl gave to the woman.

Argument structure not meaningful

Anne helped the girl who Eddie baked a cake for.

Anne made the cake that Eddie baked for.

Ungrammatical — containing a relative clause (coded as 3b.)

Preposition Omission in Obl and Io-relatives

There is the dog that the man kicked his football to.

There is the dog who he's kicked his football ___ .

Noun-Verb incompatability

This is the farmer who fed the cow in the shed.

This is the farm who fill the cow in the farm.

Relativizer substitution /omission in genitive relative clauses

This is the boy whose coat fell on the floor.

This is the boy that his coat fell on the floor.

Omission of relativizer with two finite verbs

Joe liked the girl whose dog Anne found in the park.

Joe saw the girl (may) . . . has the dog last year.

2. Simple sentence, Pn + simple sentence and ungrammatical complex sentence.

A score of two was assigned

- If the child's response is a grammatical simple sentence.

- If the child's response consists of a presentational opening followed by a grammatical simple sentence — no relativizer is produced.

- If the child's response is an ungrammatical complex sentence. (An attempt at a co-ordination must include one full clause and a co-ordinator, followed by a sequence that can be interpreted as a constituent.)

This is the toy that broke in the box last week.

There's the toy broke in the box last week.

Simple sentences (coded as 2a.)

Anne found the girl whose Mammy ran in the race.

The Mammy ran in the race.

Pn+ simple sentence (coded as 2b)

There is the rabbit that the girl chased in the park.

There was the girl chase the rabbit in the park.

Ungrammatical complex sentence (coded as 2c)

Subordinate Clause — ungrammatical

Eddie saw the man whose horse Joe rode in the field.

Eddie saw the man when the horse Joed in the road.

Non-finite clause — ungrammatical

Joe saw the rabbit that jumped in the big field.

Joe use the rabbit to jump over the fence yesterday.

Co-ordination — ungrammatical

Joe liked the girl whose dog Anne found in the park.

Joe's liked the dog and the dog found in the park.

1. Ungrammatical simple sentence / Pn+ ungrammatical simple sentence

Children's responses were assigned a score of one

- If the simple sentence produced is ungrammatical

- If the response has a presentational opening followed by a complete but ungrammatical simple sentence.

Responses given a score of 1.

Anne painted the picture that the girl looked at today.

There is the picture looked at today.

Anne bought the knife that the woman used in the kitchen.

Anne bought the knife in to the kitchen.

0. Uninterpretable

Responses were given a score of 0

- if the responses are uninterpretable — this includes

- an inability to hear/interpret part of the child's response

- a difficulty imposing a syntactic framework on the response

Responses given a score of 0

Anne bought the knife that the woman used in the kitchen.

Anne give the dog the . . . in the kitchen.

Eddie saw the man whose horse Joe rode in the field.

Eddie saw a man lishing on the wheel.

Following the scoring of all sentences for each of the children in the three groups, the sentences and their corresponding values were transferred into an Excel file. They were then ordered according to main and relative clause type *e.g. PnS, DoS, PnA, DoA etc.* before statistical analysis. The values were then entered into an SPSS file for statistical analysis.

Chapter 4

Results

4.1 Group Differences

4.1.1 Total Sentence Recall Score

The first set of results relate to the research questions concerning the overall control of relative clauses by the three groups of children (research question 1) and any differences between the groups (research question 2). Statistical analyses were completed to investigate the differences between the three group's performance overall on the task. The total sentence recall score (SR) was the dependent variable used in the initial analysis. Table 4.1 gives the descriptive statistics for each of the groups on total SR score.

Analyses were also performed to ensure that there was no violation of the assumptions of normality prior to the application of inferential statistics. As the data was essentially normally distributed, a one way analysis of variance (ANOVA) was completed. This indicated that the groups differed significantly ($F = 114.8, df = 2, 81; p < .001$). Post hoc tests (Tukey-B) indicated that the differences between all three groups were statistically significant. The children with SLI (mean score 216, out of a possible score of 520) showed significantly greater difficulty than the AM-TD group (mean = 441) and the YTD group (mean = 355). The range of scores are indicated in the boxplot at figure 4.1. (The length of the box is the interquartile range and contains 50 per cent of the cases. The line across the inside of the box represents the median value. The whiskers protruding from the box represent the upper and lower limits of the distribution. Small circles with

Table 4.1: Descriptive Statistics for total SR Score

	Mean	Standard Deviation
AM-TD	441	33.5
YTD	355	69.8
SLI	216	72.4

Figure 4.1: Between group differences in SR scores
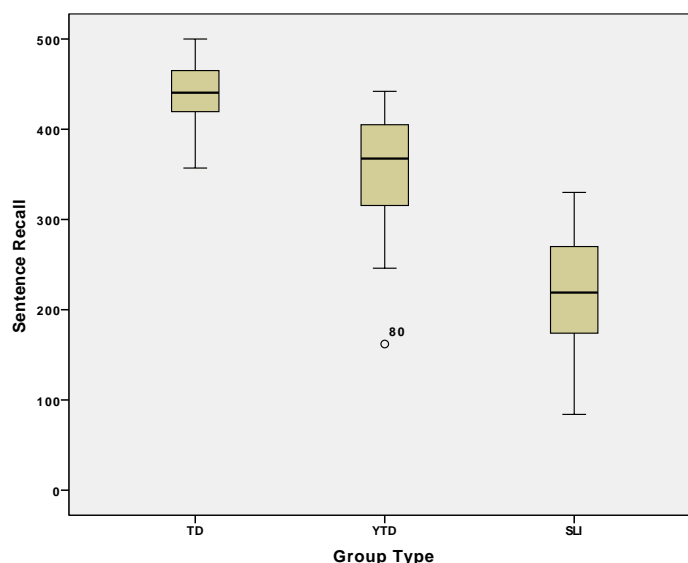
numbers attached, represent cases with scores that are quite different from the rest of the sample and are considered outliers).

4.1.2   SR scores on correct sentences (10, 9, 8 only)

In order to evaluate differences between the groups on sentences which maintained the overall structure of the stimulus construction, except for minor grammatical and lexical errors, another measure of performance on the sentence recall task was calculated by combining the three highest scores (10, 9, and 8) for each group. This set of results relates to research question (3). Further statistical analysis was carried out using the total number of 10's, 9's and 8's as the dependent variable. However, as these scores were not normally distributed the Kruskal-Wallis Test was used — this is the non-parametric alternative to a one way between-group analysis of variance. Again, there was a significant difference in performance between the three groups. Table 4.2 shows the descriptive statistics for each group. Post hoc tests (Mann Whitney for post hoc differences) were used to investigate the pairwise differences and all three groups of children performed at significantly different levels. The children with SLI showed the greatest difficulty (median score 9, out of a possible score of 52) followed by the YTD group, (median = 30.5) and the AM-TD group showed the least difficulty in their responses (median = 41). The box plot at

Table 4.2: Descriptive Statistics for total SR Score on correct sentences (10, 9, 8 only)

	Median	**Range**
AM-TD	40.4	27 − 50
YTD	30.5	5 − 41
SLI	9	0 − 28

Figure 4.2: Between-group differences in total number of 10's, 9's and 8's
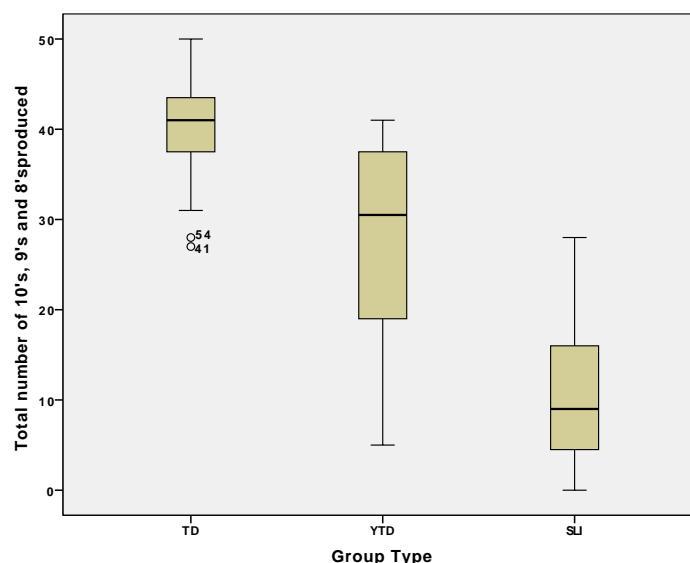
figure 4.2 illustrates the variation between the three groups.

4.1.3   Presentational compared to Direct Object Sentences

One of our research questions addresses the relative ease of presentational copular clauses (Pn) compared to direct object clauses (Do) for each group of children (research question 4a). As outlined in section 2.6 it was expected that Pn sentences (1.) would be easier to process than Do sentences (2.).

1. Pn Sentence

There is the sheep that drank the water this morning.
This is the man who Joe wrote a letter to.

2. Do Sentence

Eddie met the girl who broke the window last week.
Anne found the book that you read in school today.

Following on from the acquisitional work carried out by Diessel and Tomasello (2005), statistical analysis was completed to investigate how the children responded on the relative clauses attached to the Predicate nominal of copular clause (Pn relatives) in comparison to those attached to the direct object of a transitive clause (Do relatives). The mean for each group on both main clause types is shown in table 4.3 and figure 4.3 illustrates the between group differences. As illustrated, each group achieved a higher mean score on the presentational relatives than those attached to the direct object of a transitive clause, suggesting that the syntactic function of the head is an important determinant of the development of relative clauses. As the scores were normally distributed, a one way ANOVA was carried out to compare the three groups with respect to the magnitude of the differences

Figure 4.3: Between group differences in Presentational and Direct Object Relatives
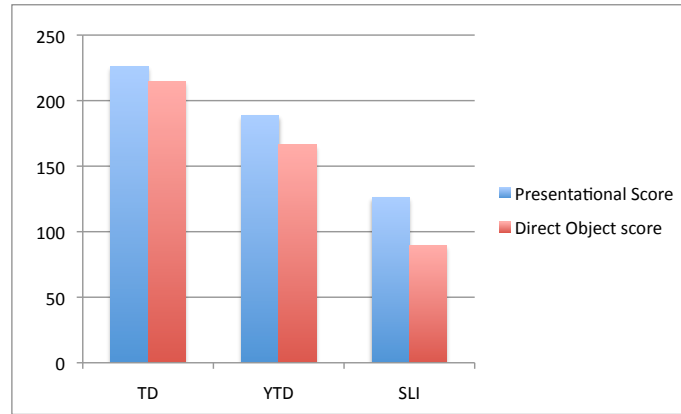
between the Pn scores and the Do Scores. The three groups differed significantly (F $= 17.8$, df $= 2, 81$; $p < .001$). The post hoc tests (Tukeys HSD test) showed that the children with SLI differed significantly from both the AM-TD group ($p < .001$) and the YTD group ($p = .012$), with the greatest difference between the group with SLI and the AM-TD group. The difference between the AM-TD and YTD groups was not significant ($p = .065$).

Paired sample t-tests were used to compare the mean presentational and direct object scores within each group. For the AM-TD group the paired t-test showed a significant difference between these two types of relative clause construction (mean = 11.3), ($t = 5.01$, df $= 31$, $p < .001$). For the YTD group, the difference between both types of relative clause construction was greater than the AM-TD group (mean difference = 22.5). This was also statistically significant ($t = 5.3$, df $= 19$, $p < .001$).The children with SLI showed the greatest difference between the Pn and Do relative constructions. On average the presentational score was 36.8 higher than the direct object score. This was highly significant ($t = 10.6$, df $= 31$, $p < .001$).

4.1.4 Pn and Do Sentences across Relative Conditions

This set of results also addresses research question 4a (in relation to the SLI group are the relative clauses attached to a presentational copular clause easier than those attached to the direct object of a transitive clause?). As mentioned in section 2.6 it was expected that the Pn sentences would be easier than the Do sentences. Both

Table 4.3: Presentational and Direct Object Scores

	Pn Mean (SD)	Do Mean (SD)
AM-TD	226 (14.4)	214.7 (20.9)
YTD	188.6 (31.6)	166.2 (40.1)
SLI	126 (41.7)	89.4 (32.8)

Figure 4.4: AM-TD — Mean SR Score for each Relative Clause Type in Pn and Do conditions

Table 4.4: AM-TD Group — Pn and Do t-test Results for each Relative Clause Type

	Mean Pn Score	**Mean Do Score**	**Mean Differences**	**95%CI**	**t**	**df**	**Corrected p value**
S	38.6	36.0	2.6	$1.4 - 3.8$	4.6	31	$< .001^*$
A	39.1	35.7	3.4	$2.0 - 4.9$	4.8	31	$< .001^*$
P	38.4	36.3	2.1	$.73 - 3.4$	3.1	31	$.028^*$
Io	36.1	34.2	1.9	$.24 - 3.5$	2.3	31	$.182$
Obl	36.3	33.7	2.6	$1.0 - 4.1$	3.4	31	$.014^*$
GenS	29.7	32.8	-3.1	$-6.7 - .54$	-1.7	31	$.651$
GenO	22.8	21.5	1.3	$-.74 - 3.3$	1.3	31	1.00

main clause types were further analysed within each relative clause type, as defined by the syntactic role of the relativizer. Figures 4.4 – 4.6 show the mean SR score for each relative clause type in Pn and Do conditions for all three groups. As this data was normally distributed, paired t-tests were used to ascertain if the SR scores on Pn and Do sentences for each relative clause type differed significantly. A Bonferroni correction was made on all t-tests carried out for each of the three groups.

For the AM-TD group the sentences containing a presentational main clause caused fewer problems than those containing a transitive main clause, in six out of seven of the relative clause conditions. The AM-TD group scored higher on the DoGenS-relatives than the PnGenS-relative types (figure 4.4) The average Pn and Do scores differed significantly on the S-, A-, P- and Obl-relatives. However, although they are significant the magnitude of the differences is quite small. The differences were not significant between the two main clause types on Io- ($p = .182$), GenS- ($p = .651$), or GenO-relative types ($p = 1.00$). The results of the t-tests for the typically developing group are outlined in Table 4.4.

Figure 4.5 shows the Pn and Do main clause performance across each relative clause type for the YTD group. Paired t-tests administered revealed that the Pn and Do scores differed significantly only on the S-, A- and P-relative types, however the

Figure 4.5: YTD — Mean SR Score for each Relative Clause Type in Pn and Do conditions
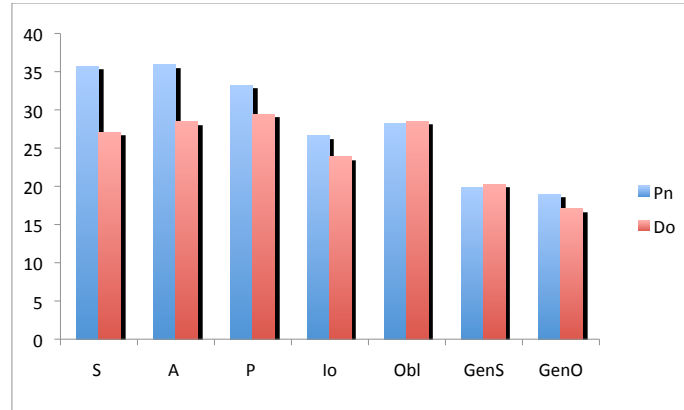
Table 4.5: YTD Group — Pn and Do t-test Results for each Relative Clause Type

	Mean Pn Score	Mean Do Score	Mean Differences	95%CI	t	df	Corrected p value
S	35.7	27.1	8.6	5.1–12.1	5.2	19	$< .001^*$
A	36.0	28.5	7.5	4.1–10.9	4.6	19	.001*
P	33.3	29.5	3.8	$1.8 - 5.8$	4.0	19	.007*
Io	26.6	23.9	2.8	$-.19 - 5.7$	2.0	19	.455
Obl	28.2	28.5	-.3	$-.33 - 2.7$	-.21	19	1.0
GenS	19.9	20.3	-.4	$-5.0 - 4.2$	-.18	19	1.0
GenO	19.0	17.1	1.9	$-1.4 - 5.2$	1.2	19	1.0

magnitude of the differences are greater than for the AM-TD group. The YTD children performed marginally better on the DoObl- and DoGenS-relatives than on their Pn counterparts. The results of the t-tests are illustrated in Table 4.5.

The children with SLI scored higher on sentences containing a Pn main clause than those containing a transitive main clause for all relative clause conditions. Again Paired t-tests, with Bonferroni correction, were carried out to analyse the differences between the two main clause types across each relative clause condition. For the group with SLI, the SR scores on Pn and Do sentences differed significantly, except with respect to the GenS-relatives ($p = .46$). The magnitude of the differences are far greater for the SLI group than for either of the other two groups of children. The results of the t-tests are outlined in Table 4.6.

4.1.5 Comparison of SR Scores on correct sentences (10, 9 and 8 only) by Syntactic Role

This set of results addresses the question of whether the developmental hierarchy seen in the relative clause acquisition of TD children is reflected in the performance of the children with SLI (research question 4). Figure 4.7 shows the median

Figure 4.6: SLI — Mean SR Score for each Relative Clause Type in Pn and Do conditions
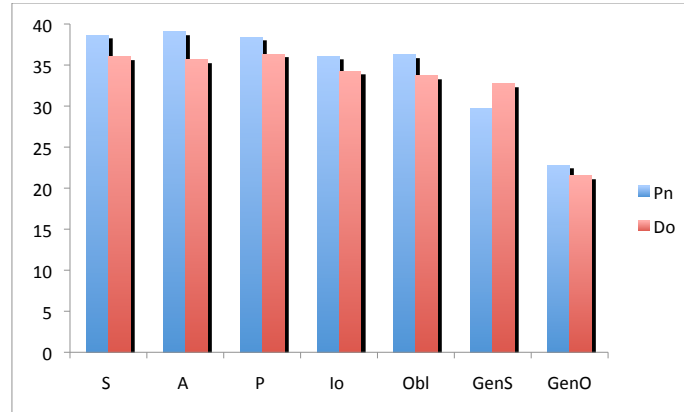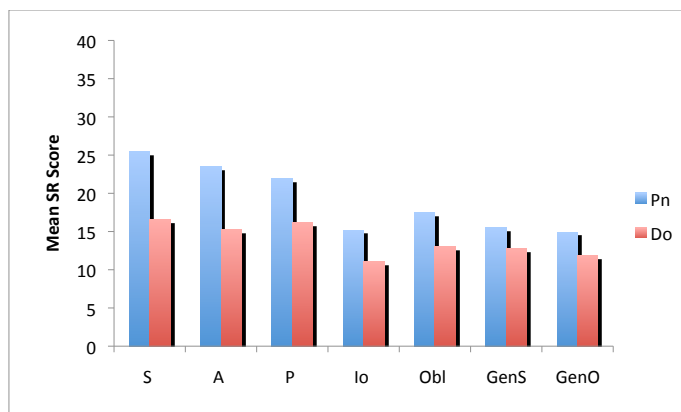

Table 4.6: SLI Group — Pn and Do t-test Results for each Relative Clause Type

	Mean Pn Score	Mean Do Score	Mean Differences	95%CI	t	df	Corrected p value
S	25.5	16.6	8.9	$6.7 - 11.0$	8.5	31	$< .001*$
A	23.5	15.2	8.3	$5.8 - 10.7$	6.9	31	$< .001*$
P	21.9	16.2	5.8	$3.3 - 8.2$	4.8	31	$< .001*$
Io	15.2	11.1	4.1	$1.7 - 6.5$	3.5	31	$.014*$
Obl	17.4	13.0	4.4	$1.8 - 7.1$	3.4	31	$.014*$
GenS	15.5	12.8	2.7	$-.19 - 5.9$	1.9	31	$.46$
GenO	14.9	11.9	3.0	$1.1 - 5.0$	3.2	31	$.028*$

percentage of 10's, 9's and 8's in each group's responses to the various types of relative clause constructions, defined by the syntactic role of the relativized item. This data was not normally distributed and therefore Friedman's two way analysis of variance was used to test whether there was significant variation in the % of 10, 9, 8 responses (out of a possible four in 6 of the conditions and 2 in the GenS condition) to S-, A-, P-, Io-, Obl-, GenS- and GenO-relatives. Friedman's anova revealed a significant effect of the relativized syntactic role ($p < .001$) for all three groups.

Pairwise comparisons were made on the twenty one pairs of relatives using the Wilcoxon Signed Rank Test for each group. In order to adjust for multiple comparisons a Bonferroni correction was made. Table 4.7 shows the adjusted p value for each pairwise comparison for the AM-TD group. There is a significant difference between the AM-TD groups performance on S, A, P, Io, and Obl relatives and their performance on either GenS or GenO-relatives. There is also a significant difference between their performance on GenS and GenO-relatives. While the differences between P-relatives and Obl relatives approached significance ($p = .063$), the differences between all other relative types were not significant.

Table 4.8 shows the adjusted p value for each pairwise comparison for the YTD group. Again there is a significant difference between the YTD groups performance

Table 4.7: AM-TD Group Relative Clause Pairwise Comparisons

	A	P	Io	Obl	GenS	GenO
S	1.00	1.00	.126	.147	$< .001^*$	$< .001^*$
A	—	1.00	1.00	.399	$< .001^*$	$< .001^*$
P	1.00	—	.609	.063	$< .001^*$	$< .001^*$
Io	1.00	.609	—	1.00	$< .001^*$	$< .001^*$
Obl	.399	.063	1.00	—	$< .001^*$	$< .001^*$
GenS	$< .001^*$	$< .001^*$	$< .001^*$	$< .001^*$	—	$< .001^*$
GenO	$< .001^*$	$< .001^*$	$< .001^*$	$< .001^*$	$< .001^*$	—

Table 4.8: YTD Group — Relative Clause Pairwise Comparisons

	A	P	Io	Obl	GenS	GenO
S	1.00	1.00	.168	.168	$< .001^*$	$< .001^*$
A	—	1.00	1.00	.189	$< .001^*$	$< .001^*$
P	1.00	—	.378	.084	$< .001^*$	$< .001^*$
Io	1.00	.378	—	1.00	.021*	$< .001^*$
Obl	1.00	.084	1.00	—	$< .001^*$	$< .001^*$
GenS	$< .001^*$	$< .001^*$	.021	$< .001^*$	—	.105
GenO	$< .001^*$	$< .001^*$	$< .001^*$	$< .001^*$	.105	—

on S, A, P, Io and Obl relatives and their performance on both GenS and
GenO-relatives. The differences between S and Io, S and Obl, A and Obl and P and
Obl were all initially significant but with the Bonferroni correction this was no
longer the case. This also applied to the YTD group's performance on the two
Genitive relative clause types (GenS and GenO) -following the Bonferroni
correction they were no longer statistically significant.

Table 4.9 shows the adjusted p value for each pairwise comparison for the group of
children with SLI. For the children with SLI there were significant differences
between S and Io-relatives ($p < .001$), S and Obl relatives, ($p < .001$), S and
GenS-relatives, ($p < .001$) and S and GenO-relatives, ($p < .001$). A-relatives and
P-relatives also showed statistically significant differences between Io, Obl, GenS

Figure 4.7: Median % of 10's, 9's and 8's Produced in each Relative Clause Type
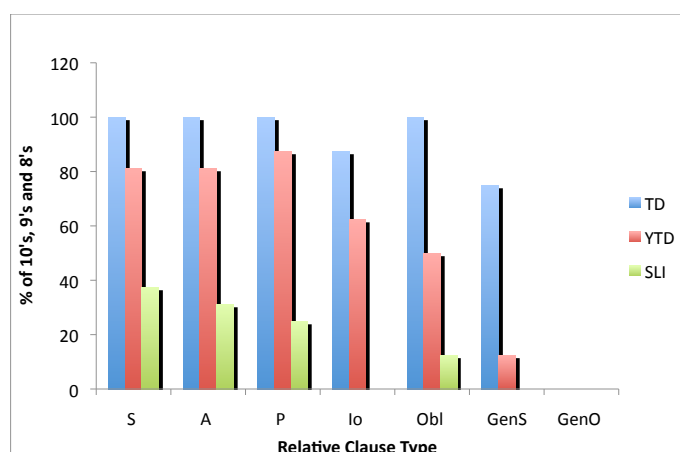
Table 4.9: SLI Group — Relative Clause Pairwise Comparisons

	A	P	Io	Obl	GenS	GenO
S	.4	1.00	< .001*	< .001*	< .001*	< .001*
A	—	1.00	< .001*	< .001*	< .001*	< .001*
P	1.00	—	< .001*	< .001*	< .001*	< .001*
Io	< .001*	< .001*	—	1.00	1.00	.021*
Obl	< .001*	< .001*	1.00	—	.819	< .001*
GenS	< .001*	< .001*	1.00	.819	—	.483
GenO	< .001*	< .001*	.21	< .001*	.483	—

and GenO-relatives respectively. There was no significant difference between S relatives and P-relatives ($p = 1.00$) or A-relatives and P-relatives ($p = 1.00$). On initial analysis it appeared that there was a significant difference between S relatives and A-relatives ($p = .02$) but with the Bonferroni correction this was no longer the case, ($p = .4$). The differences between Io and Obl relatives ($p = 1.00$), Io and GenS-relatives, ($p = 1.00$) Obl and GenS-relatives ($p = .82$) and GenS and GenO-relatives were also not significant ($p = .483$). The differences between Io and GenO ($p = .021$), and Obl and GenO-relatives were significant($p < .001$).

4.1.6   Subject versus two object relative types

In line with research carried out by Kidd et al., (2007) our research question 4b. is concerned with whether children with SLI would process object relative clauses with an inanimate head noun and a personal pronoun subject (1) with greater ease than those with an animate head noun and a subject noun (2).

1. Anne found the book that you read in school today.

2. The boy rode the horse that Joe put in the field.

Table 4.10 gives the descriptive statistics (median and range) for each of the groups on both types of Object Relative Clause.

Figure 4.8 illustrates the median scores on both types of object relative for each group (out of a possible score of 40) This data was not normally distributed and therefore the Wilcoxon Matched Pair Signed Rank test was carried out to compare the differences between each type of object relative clause within each group.

Table 4.10: Descriptive Statistics for two types of Object Relative Clauses

	Inanimate head/ Pronominal subject	Range	Animate head/ Nominal subject	Range
AM-TD	39	29 – 40	37	30 – 40
YTD	31.5	14 – 40	35	9 – 40
SLI	21	6 – 34	18	3 – 36

Figure 4.8: Median Object Relative Scores for each group
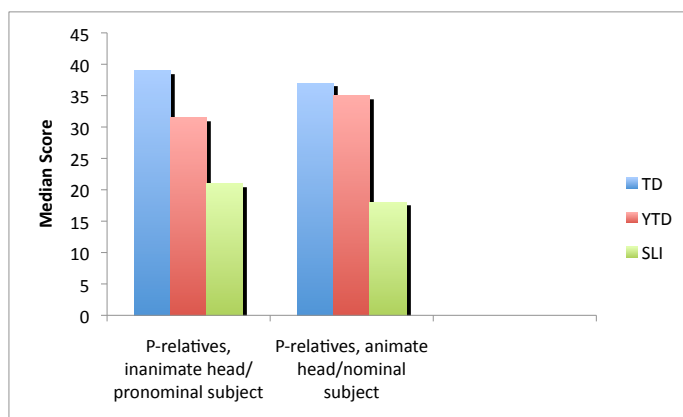
The TD children performed significantly better on the more natural relatives than on those more typically used in research in the past ($p = .001$). The difference between both types of object relative for the YTD group was not significant ($p = .572$). While the difference between the performance of the children with SLI on both types of object relative was significant($p = .004$), the magnitude of the difference was small.

Given the research carried out by Kidd et al., (2007) we were also interested to know whether children with SLI would perform equally well on subject and object relatives, if the object relatives were those that followed the natural discourse rules. Pairwise comparisons were made on the six pairs of relatives using the Wilcoxon Signed Rank Test for each group. In order to adjust for multiple comparisons a Bonferroni correction was made. S-relatives were compared to P-relatives (including both types of object relative), S-relatives were compared to the inanimate/natural object relatives and S-relatives were compared to the animate object relatives which have been used in many research studies in the past. The same comparisons were made for the A-relatives.

Altering the type of object relative did not affect the performance of the AM-TD group or the YTD group. There were no significant differences between either type of subject relative (S or A) and any of the object relative clauses. Tables 4.11 and 4.12 show the adjusted p value for each pairwise comparison for both groups of children. The original p value is given in brackets.

Table 4.13 shows the adjusted p value for each pairwise comparison for the group of children with SLI — again the original p value is given in brackets.

Table 4.11: AM-TD Group — Subject and Object Relative Clause Pairwise Comparisons

	P	Inanimate Obj Rel	Animate Obj Rel
S	1.0(.185)	1.0(.875)	.21(.035)
A	1.0(1.0)	.39(.065)	1.0(.240)

Table 4.12: YTD Group — Subject and Object Relative Clause Pairwise Comparisons

	P	**Inanimate Obj Rel**	**Animate Obj Rel**
S	1.0(.832)	1.0(.548)	1.0(.849)
A	1.0(.653)	1.0(.689)	1.0(.708)

Table 4.13: SLI Group — Subject and Object Relative Clause Pairwise Comparisons

	P	**Inanimate Obj Rel**	**Animate Obj Rel**
S	.66(.110)	1.0(.308)	.024(.004)*
A	1.0(.859)	.072(.012)	.198(.033)

As illustrated for the children with SLI, there was no significant difference between the S- and P-relatives ($p = .66$) or between S- and the natural object relatives with an inanimate head noun and a pronominal subject. There was however a significant difference between the S-relatives and the object relatives with an animate head noun and a pronominal subject ($p = .024$). This is in keeping with the research carried out by Kidd et al., (2007). As before there was no significant difference between A- and P-relatives. The children with SLI actually performed better on the 'natural object relatives' than on the A-relatives and although this was initially significant ($p = .012$) this was no longer the case following Bonferroni correction ($p = .072$). Finally, the difference between the A-relatives and the object relatives which have been typically used in past relative clause research (with an animate head noun and a nominal subject), was initially significant ($p = .033$) but again following Bonferroni correction the result was no longer significant ($p = .198$).

4.1.7 Conversion Types

This set of results addresses research question 4c - Do children with SLI have a tendency to simplify relative clauses that they find difficult in the NVN direction?) When attempting to repeat the relative clauses presented, each group of children used a number of different strategies. As mentioned in section 3.4 each strategy or error type was assigned a score ranging from ten (for a perfect response) to 0 (for an uninterpretable response). One particularly frequent type of error was the production of a different type of relative clause than the one in the task presented. This was classified as a conversion and was assigned a score of six. In most cases conversion errors altered the word order of the given relative clause, which could occur in two directions : A-relatives were converted to P-relatives and P-, Io-, Obl-, GenS- and GenO-relatives were converted to S/A-relatives (3. – 8.). This set of results relates to the research question concerning whether children with SLI have a tendency to simplify relative clauses that they find difficult in the NVN direction.

3. A to P

> **Target:** This is the farmer who fed the cow in the shed.
> **Response:** That is the farmer that the cow fed in the shed.

4. P to A

Target: There is the rabbit that the girl chased in the park.
Response: That is the rabbit who chased the girl in the park.

5. Io to A

Target: There is the horse that the girl gave a drink to. PnIo
Response: There was the girl who gave the drink to the horse. PnA

6. Obl to A

Target: Joe rubbed the cat that the goat stood on last week. DoObl
Response: Joe rubbed the cat that stood on the goat last week.

7. GenS to A

Target: Anne saw the farmer whose cow fell in the shed. DoGenSub
Response: Anne saw the cow who fell in the shed

8. GenO to A

Target: Eddie saw the man whose horse Joe rode in the field. DoGenO
Response: Eddie saw the man who rode in the field. DoS

Previous research on the acquisition of relative clauses showed that for young children, there is a strong tendency to convert a sequence of (NP rel NP V) to (NP rel V NP)(Bever, 1970). By contrast conversions from (NP rel V NP) to (NP rel NP V) occurred very infrequently. Five paired Wilcoxon tests were performed on the number of these two changes for each group and Bonferroni corrections were made. The tests were initially carried out on the AM-TD group of children. Figure 4.9 shows a comparison of the conversion types for the AM-TD group. The colours on each bar represent the percentage of children who converted from 0 up to 5 relatives (out of a possible 8) in each condition.

The first test compared the number of A-relatives converted to P-relatives to the number of P-relatives converted to A-relatives. There were an equal number of conversions — the difference was therefore not significant ($p = 1.0$), (corrected $p = 1.0$). The second test which compared the number of A-relatives converted to P-relatives to the number of Io-relatives converted to A-relatives also indicated a difference that was not significant ($p = .739$), (corrected $p = 1.0$). The third test compared the number of A-relatives converted to P-relatives to the number of Obl relatives converted to A-relatives. The difference was almost significant before correction ($p = .054$), but not following the Bonferroni (corrected $p = .27$). The fourth test which compared the number of A to P conversions to the number of GenS to A conversions, again showed a difference that was not significant ($p = .025$), (corrected $p = .125$). The last test which compared the number of A-relatives converted to P-relatives to the number of GenO-relatives converted to A-relatives indicated a significant difference ($p = .006$), (corrected $p = .03$).

Figure 4.9: A comparison of conversion types for AM-TD children
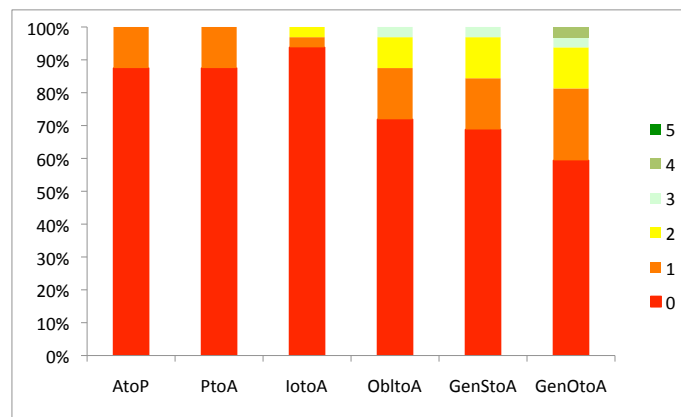
Figure 4.10: A comparison of conversion types for YTD children
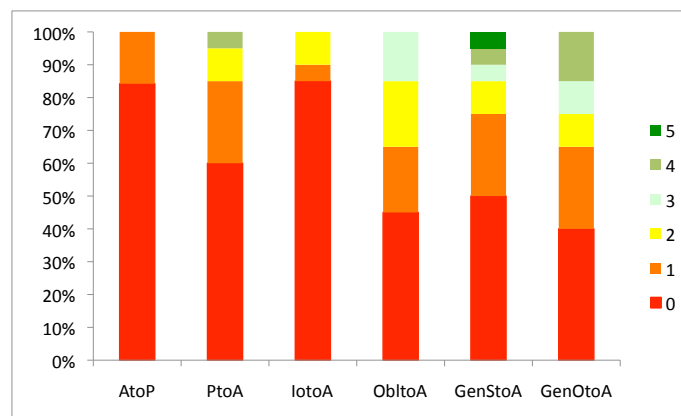
Figure 4.10 shows a comparison of the conversion types for the YTD group. The Paired Wilcoxon tests (Bonferroni corrected) did not show a significant difference between any of the conversion types for the the YTD group. On initial assessement there was a significant difference between the number of conversions from A to P and the number of conversions from Obl to A ($p = .043$), (corrected $p = .215$). There was also an initial significant difference between the number of A-relatives converted to P-relatives and the number of GenO-relatives converted to A-relatives ($p = .022$), (corrected $p = .11$). All other comparisons were not signifcant i.e. A to P versus P to A ($p = .271$)(corrected $p = 1.0$), A to P versus Io to A ($p = .931$)(corrected $p = 1.0$), and A to P versus GenS to A ($p = .056$)(corrected $p = .28$).

Figure 4.11 shows a comparison of the conversion types for the group with SLI.

For the children with SLI, paired Wilcoxon tests were again performed on the conversions representing both types of word order (i.e. NP rel V NP and NP rel NP V). The first compared the number of A-relatives converted to P-relatives to the number of P-relatives converted to A-relatives. The test indicated a significant difference, ($p = .001$), (corrected $p = .005$). The second test compared the number of A-relatives converted to P-relatives to the number of Io-relatives converted to

Figure 4.11: A comparison of conversion types for children with SLI
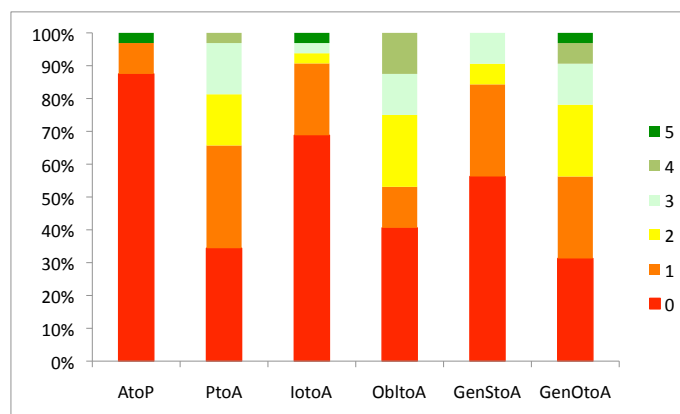
A-relatives. This was not significant ($p = .170$), (corrected $p = .85$).

As noted in Diessel and Tomasello's acquisitonal work (2005), with Io-relatives, young children often tended to leave out the subject of the relative clause which resulted in utterances with the same word order as S/A-relatives. This was also the case for the children with SLI — these conversions were then categorised as ungrammatical and therefore were not included in this category (9.). There were also usually other errors in the responses from children with SLI(10.).

9. Io to A (ungrammatical)

Target: There is the dog that the man kicked his football to. PnIo
Response: There's the dog who kicked the football to.

10. Io to A (ungrammatical with other errors)

Target: There is the horse that the girl gave a drink to. PnIo
Response: There is the horse who gave the girl to.

Therefore although the children with SLI attempted to make many more Io to A conversions than A to P conversions the difference was not significant as they were often unsuccessful. Both Io- and Obl-relatives include what are known as 'stranded prepositions'. When a preposition is stranded it 'occurs in the absence of an associated element which would normally accompany it and which is required for its interpretation' (Trask, 1993 p.260). For example in the sentences *Who were you talking to?* and *There is the girl who Joe bought some flowers for*, the prepositions *to* and *for* are stranded. As children with SLI seemed to have a particular difficulty with stranded prepositions, they will be discussed further in section 4.1.8 as well as in the error analysis when looking at ungrammatical conversions (section 4.3).

Again addressing the issue of word order, the third test compared the number of A-relatives converted to P-relatives (NP rel V NP) to (NP rel NP V) to the number of Obl relatives converted to A-relatives (NP rel NP V) to (NP rel V NP). The difference was statistically significant ($p = .002$), (corrected $p = .01$). The fourth test compared the number of A to P conversions to the number of GenS to A conversions. This was

initially significant ($p = .027$) but following a Bonferroni correction this was no longer the case (corrected $p = .135$). The final test compared the the number of A to P conversions to the number of GenO to A conversions. The difference was significant ($p < .001$), (corrected $p =< .001$)

Overall the results indicated that word order was much more difficult for children with SLI than for either of the other two groups. As shown in Figure 4.9 the TD children made very few conversions from A to P as they had no difficulty with A-relatives. Their difficulties were primarily with the Genitive relatives (particularly the GenO-relatives) and although 12% of their conversions were from GenO-relatives to A-relatives (11.), 41% of their conversions were from GenO-relatives to P-relatives (12.) This indicating that although the Genitive structure caused difficulty for these children, they did not show a word order preference towards (NP rel V NP), rather, they produced an utterance that more closely matched the target utterance word order.

11. GenO to A

Target: Emma met the girl whose bag Anne took to school.
Response: Emma met the girl who took the bag to school.

12. GenO to P

Target: Joe liked the girl whose dog Anne found in the park.
Response: Joe liked the girl who Anne found in the park.

This was also the case for the YTD group whose conversions included 16.1% of GenO-relatives to A-relatives and 27.4% of GenO-relatives to P-relatives. The SLI group however continued to show a strong word order preference for (NP rel V NP) despite the fact that the P-relative word order more closely resembled the word order of the GenO relative. The conversions from the group of children with SLI included 19.5% of GenO to A-relatives and 12.9% of GenO to P-relatives.

4.1.8   Stranded Prepositions

This set of results relates to research question 4d - Were relative clauses with stranded prepositions particularly difficult for children with SLI?. As outlined in section 4.1.7, stranded prepositions are a feature of both Io (13.) and Obl relatives (14.) and on initial analysis it seemed that they were particularly difficult for the children with SLI.

13. Stranded Prepositions — Io relative

Target: There is the horse that the girl gave a drink to.
Response: There is the horse who give the drink to.

14. Stranded Prepositions — Obl relative

Target: Emma spoke to the man who the horse ran away from.
Response: Anne talked to the man that the horse runned away.

Figure 4.12: Median % of Stranded Preposition Difficulties for Each Group Type
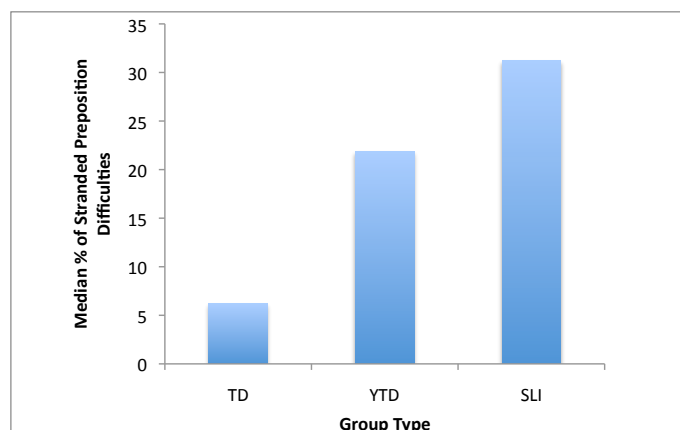
Each child was given a score for the total number of problem stranded prepositions produced. A between group analysis of stranded prepositions was completed. The data was not normally distributed and therefore the Kruskal Wallis analysis of variance was administered. This showed that there was a statistically significant difference in the number of stranded preposition difficulties between the groups ($p < .001$). Figure 4.12 illustrates the median percentage scores for each group. As can be seen the group with SLI show the greatest number of difficulties (median % = 31.25). The YTD group also show difficulty with this type of structure (median% = 21.86) and the AM-TD group have the least number of problems with stranded prepositions (median % = 6.25). The Mann-Whitney U Test was used to test for the differences between each pair of groups. The differences between the group with SLI and the AM-TD group were highly significant, $p < .001$, as were the differences between the AM-TD group and the YTD group ($p = .004$). The differences between the group with SLI and the YTD group just reached the level of significance, ($p = .05$).

4.1.9   Transitive and Intransitive Verbs

This set of results addresses research question 4e - Do the children with SLI find subject relative clauses with an intransitive verb easier to process than subject relative clauses with a transitive verb?. As described in section 3.2.1 relative clauses including a subject gap were divided into two types: transitive (A-relatives) and intransitive subject relatives (S-relatives) (15 –16).

15. Joe saw the rabbit that jumped in the big field.

16. Eddie met the girl who broke the window last week.

Table 4.14 gives the descriptive statistics for each of the groups on Intransitive and Transitive Subject Relatives. The values represent the average total SR scores on these relative clause constructions. Figure 4.13 illustrates the mean scores on

Table 4.14: Descriptive Statistics for Intransitive and Transitive Subject Relatives

	Mean Intransitive (SD)	**Mean Transitive (SD)**
AM-TD	74.4 (3.5)	74.8 (4.9)
YTD	62.8 (11.3)	64.4 (11.6)
SLI	42.1 (14.5)	38.7(13.9)

Figure 4.13: Mean SR Score on Intransitive and Transitive Subject Relatives for Each Group Type
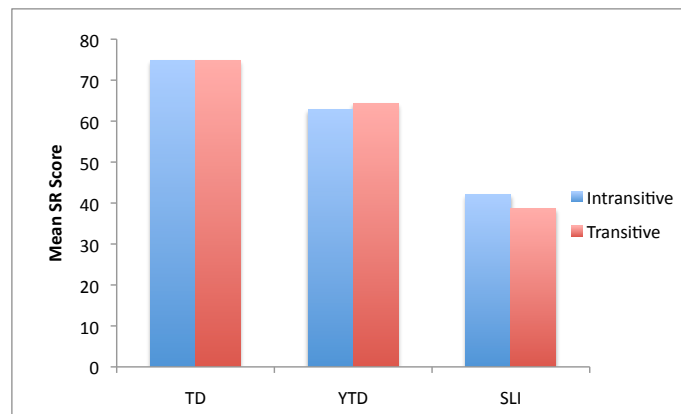
intransitive and transitive subject relatives for each group (out of a possible score of 80).

A paired t-test was carried out to compare the differences between the children's performance on intransitive and transitive subject relatives within each group. The differences between the two subject relative types for both the AM-TD group and the YTD group were not significant (AM-TD — $t = .12,\ \mathrm{df} = 31, p = .903$), (YTD — $t = .87, \mathrm{df}\ = 19, p = .395$). There was a lot more variation in the performance of the children with SLI and while there was a trend towards significance $(t = 1.88, \mathrm{df}\ = 31, p = .069\ )$ the differences did not reach the .05 level.

4.2   Relationship questions

Our final two research questions addressed the role of short-term memory, working memory and language status in the control of relative clauses by each group of children. This set of results pertains to these questions (i.e. research questions (6) and (7). Tables 4.15, 4.16 and 4.17 give the descriptive statistics for each group of children on each memory and language variable.

4.2.1   Correlation – SR Scores and Memory / SR Scores and Language

The relationship between Sentence Recall and each of the independent variables (phonological memory, visuospatial memory, the central executive, receptive

language and expressive language) was initially investigated for each group of children, using Pearson product-moment correlation co-efficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. In general the distribution of scores was broadly in line with that of a normal distribution. However there were some exceptions, specifically the Central Executive scores for the children with Specific Language Impairment. Given the language load of the Listening Recall subtest in particular, there were some children who did not understand what was required in the task and as a result could not complete it. They were then attributed the lowest possible score on this subtest. Because of this distribution pattern, Spearman's rho non parametric correlation was also carried out. The results for each test were similar and therefore only the Pearson correlation co-efficients are reported. The correlation results are outlined in the tables below.

Tables 4.18 and 4.19 show the correlation profiles for the AM-TD and YTD groups respectively. The strongest positive correlations for the AM-TD group were between phonological memory and sentence recall, $r = .64, p < .001$, 41% shared variance, and receptive language and sentence recall, $r = .54, p = .001$, 29% shared variance. There was a moderate positive correlation between central executive scores and sentence recall for the AM-TD group, $r = .31, p = .080$ and a low positive correlation between expressive language and sentence recall $r = .24, p = .192$. Neither was significant. This is in contrast with the performance of the children with SLI (shown in 4.20). It may be the case that as the typically developing children are very skilled in terms of their expressive language abilities, there may not be enough variation in their expressive language scores to allow a relationship to exist. As might be expected, no relationship existed between visuospatial abilities and sentence recall, $r = .04, p = .844$ in the typically developing group. As the age of the YTD group precluded them from carrying out all of the tasks there were fewer variables to examine in this group. Preliminary analysis indicated a strong positive linear correlation between sentence recall and each of the other variables — phonological

Table 4.15: Memory and Language scores for the AM-TD group

	Mean	Standard Deviation	Range
Phonological Memory	112.4	15.97	70 — 145
Visuospatial Memory	94.3	13.5	77 — 127
Central Executive	101.5	14.2	74 — 141
Receptive Language	107.8	8.87	92 — 125
Expressive Language	112.9	8.5	91 — 126

Table 4.16: Memory and Language scores for the YTD group

	Mean	Standard Deviation	Range
Phonological Memory	110.1	9.2	98 — 133
Receptive Language	108.5	6.2	96 — 120
Expressive Language	117.3	9.5	100 — 130

Table 4.17: Memory and Language scores for the children with SLI

	Mean	Standard Deviation	Range
Phonological Memory	79.47	13.5	55 — 105
Visuospatial Memory	88.41	12.5	62 — 131
Central Executive	66.53	8.6	55 — 88
Receptive Language	60.7	8.65	44 — 73
Expressive Language	82.3	12.01	55 — 105

memory and sentence recall, $r = .62$, receptive language and sentence recall, $r = .59$ and expressive language and sentence recall , $r = .52$.

Table 4.20 shows the Pearson product-moment correlation co-efficient and p value for the group of children with SLI.

For the group of children with SLI, the strongest correlation was demonstrated between expressive language and sentence recall, $r = .59, p < .001$, with high expressive language scores associated with high scores on the sentence recall task and expressive language accounting for 35% of the variability in sentence recall performance.There was a moderate positive correlation between phonological memory and sentence recall ($r = .33$), the former accounting for 10.6% of the variability in the latter. This was not significant, $p = .069$. There was also a moderate but negative correlation between visuospatial memory and sentence recall, $r = -.38$, $p = .034$, with higher scores on visuospatial memory tasks associated with lower scores on the sentence recall task. The correlation between the central executive and sentence recall was small, $r = .22$, indicating 4.7% of shared variance. Surprisingly, the weakest correlation was between receptive language and sentence recall, $r = .18$.

Table 4.18: Correlation between Memory and SR scores and Language and SR scores for AM-TD children

	Pearson Correlation	P value
Phonological Memory	.64	$< .001$*
Visuospatial Memory	-.036	.844
Central Executive	.314	.080
Receptive Language	.542	.001*
Expressive Language	.237	.192

Table 4.19: Correlation between Memory and SR scores and Language and SR scores for YTD Children

	Pearson Correlation	P value
Phonological Memory	.614	.004*
Receptive Language	.581	.007*
Expressive Language	.506	.023*

Table 4.20: Correlation between Memory and SR scores and Language and SR scores for children with SLI

	Pearson Correlation	**P value**
Phonological Memory	.33	.069
Visuospatial Memory	-.38	.034
Central Executive	.22	.236
Receptive Language	.18	.324
Expressive Language	.59	< .001*

4.2.2 Correlation – SR Scores on 10,9,8 sentences and Memory / SR Scores on 10,9,8 sentences and Language

This set of results also addresses research questions (6) and (7). Following on from the investigations into possible relationships between the SR score and each of the independent variables, all correlations and regressions were re-investigated using the number of 10, 9, 8's scored for each child as the dependent variable. Again, the data was analysed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. While the data was for the main part normally distributed, there was some departure from normality, in that the results for the group with SLI were slightly negatively skewed and the results for the YTD group were mildly positively skewed. Both parametric (Pearson) and non parametric (Spearman rho) assessments were completed and the results showed little variation. Only the Pearson correlation co-efficients are reported. The results are outlined in the following tables.

Table 4.21 shows the Pearson product-moment correlation co-efficient and p value for the AM-TD group. The results for the AM-TD group (using the number of 10, 9, 8's as the dependent variable) were similar to those using sentence recall score as the dependent variable.The two significant correlations are consistently between phonological memory and the number of 10, 9, 8's scored ($r = .58, p = .001$) and receptive language and the number of 10, 9, 8's scored, ($r = .54, p = .002$). Using the number of 10, 9, 8's scored as the dependent variable resulted in a low correlation between sentence recall and central executive scores for the AM-TD group, $r = .22, p = .23$ and an even lower correlation between sentence recall and expressive language $r = .16, p = .36$. There was no correlation between visuospatial memory and the number of 10's, 9's and 8's produced for the AM-TD group

Table 4.21: Correlation between Memory and number of 10,9,8 scores and Language and number of 10,9,8 scores for AM-TD Children

	Pearson Correlation	**P value**
Phonological Memory	.58	.001*
Visuospatial Memory	-.095	.604
Central Executive	.22	.23
Receptive Language	.54	.002*
Expressive Language	.169	.355

Table 4.22: Correlation between Memory and number of 10,9,8 scores and Language and number of 10,9,8 scores for YTD Children

	Pearson Correlation	**P value**
Phonological Memory	.59	.006*
Receptive Language	.61	.004*
Expressive Language	.51	.023*

Table 4.23: Correlation between Memory and number of 10,9,8 scores and Language and number of 10,9,8 scores for children with SLI

	Pearson Correlation	**P value**
Phonological Memory	.34	.06
Visuospatial Memory	-.34	.06
Central Executive	.17	.34
Receptive Language	.22	.22
Expressive Language	.47	.007*

$r = -.095, p = .604$.

Table 4.22 shows the Pearson product-moment correlation co-efficient and p value for the YTD group. Again the correlations using the number of 10's, 9's and 8's as the dependent variable are very similar to those using the SR score for the YTD group. The analysis indicated a strong positive linear correlation between the number of 10's, 9's and 8's produced and each of the other variables — phonological memory and the number of 10's, 9's and 8's, $r = .59$ receptive language and the number of 10's, 9's and 8's, $r = .61$ and expressive language and the number of 10's, 9's and 8's, $r = .51$.

Table 4.23 shows the Pearson product-moment correlation co-efficient and p value for the group of children with SLI.

Similar to the results above using sentence recall score as the dependent variable, the strongest correlation existed between the dependent variable (number of 10, 9, 8's) and the expressive language scores for the children with SLI, $r = .469, p = .007$, this was statistically significant. As before, there was also a moderate positive correlation between the number of 10, 9, 8's and phonological memory $r = .34, p = .61$ and a moderate negative correlation between the number of 10, 9, 8's and visuospatial abilities, $r = .34, p = .060$. These were close to significance. The correlation found between the central executive and the number of 10,9,8's was again low, $r = .173, p = .344$. There was a slightly stronger correlation between the number of 10, 9, 8's and receptive language than that found between the SR score and receptive language. However, on the reanalysis ($r = .223$, indicating a low correlation), this was not significant, $p = .221$.

4.2.3   Regression

Further analysis was carried out for each group using simple linear regression followed by stepwise multiple regression (research questions (6) and (7). Stepwise was carried out because of the limited sample size. The assumptions were verified using a normal probability plot of the residuals and constant variability by plotting the residuals against the predicted values. This model was also verified for collinearity and the residual diagnostics did not indicate any concerns for these assumptions. The dependent variable in the regression was total Sentence Recall (SR) score and the variables entered were Phonological Memory, Visuospatial Memory, Central Executive, Receptive Language and Expressive Language. The Visuospatial Memory and Central Executive were omitted for the YTD group as due to their age, they were unable to carry out these tasks.

For the AM-TD group, phonological memory was the first variable entered into the regression equation, explaining 40.9% of the sentence recall score. The equation was statistically significant $(F = 20.8), df = 1, 30; p < .001)$. Receptive language was then added into the equation explaining a further 12.5% of the variance but expressive language scores did not contribute.

For the YTD group, phonological memory was the only variable entered in to the regression equation, it explained 37.7% of the SR score. The regression equation was statistically significant $(F = 10.9, df = 1, 18; p = .004)$. All other variables were excluded from the regression equation as their contribution to the SR score was not significant.

For the group of children with SLI, the co-efficient of determination (r^2) indicated that 35.3% of the variation in the total SR score could be explained by the expressive language score. The regression equation was highly significant $(F = 16.36, df = 1, 30; p < .001)$. None of the other variables contributed significantly to the SR score.

Stepwise multiple regression was also calculated using the number of 10's, 9's and 8's as the dependent variable. The assumptions were again verified using a normal probability plot of the residuals and constant variability by plotting the residuals against the predicted values. For the AM-TD group, phonological memory was the first variable entered into the regression equation, explaining 33% of the 10, 9, 8 score. Receptive language was then selected into the equation explaining a further 13.8% of the variance. Finally, the Central Executive was added into the equation. This accounted for a further 8.2% of the variation in the 10, 9, 8 score. The final regression equation was highly statistically significant $(F = 11.4), df = 1, 30; p < .001)$.

The multiple regression results for the YTD group using the 10, 9, 8 score as the dependent variable were in contrast to those using the SR score in that receptive

Table 4.24: Memory subtest scores for the AM-TD group

	Mean	**Standard Deviation**	**Range**
Digit Recall	102.3	17.53	72 — 142
Non-word Recall	101.7	19.3	72 — 141
Word list recall	102.3	14.37	75 — 132
Word list matching	108.4	11.3	86 — 130
Listening recall	108.6	10.56	86 — 130
Counting recall	98.8	12.6	75 — 129
Backward digit recall	96.2	15.9	72 — 141

language was the only variable to be entered into the equation. Receptive language explained 37.1% of the 10, 9, 8 score and the equation was statistically significant $(F = 10.6), df = 1, 18; p = .004)$.

For the group of children with SLI, the co-efficient of determination (r^2) indicated that 22% of the variation in the 10, 9, 8 score could be explained by the expressive language score. The regression equation was statistically significant $(F = 8.4, df = 1, 30; p = .007)$. All other variables were excluded from the regression equation as their contribution to the 10, 9, 8 score was not significant.

4.2.4 Correlation – SR Scores and Memory Subtests

As outlined in section 4.2.1 initial analysis involved an examination of the effect of each of the independent variables on the total sentence recall score. A more detailed analysis of two of the independent variables was then completed (addressing research question (6)). Of particular interest was the relationship between SR and the four independent subtests of phonological short-term memory. Previous research indicates a strong correlation between SR and non-word repetition (Conti-Ramsden et al., 2001; Riches et al., 2010). The relationship between SR and the subtests of the central executive were also analysed. These subtests represent working memory i.e. they require the child to process and remember information at the same time. There is much discussion in the literature regarding the working memory abilities of children with SLI and the particular difficulties they have in this area. Correlations have been shown in other research studies between Backward digit recall and SR abilities (Riches et al., 2010). Tables 4.24, 4.25, and 4.26 give the memory subtest descriptive statistics for each of the three groups.

The relationship between each of the memory subtests and the sentence recall score was initially investigated for each group of children, using Pearson product-moment correlation co-efficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. In general the distribution of scores was in line with that of a normal distribution. As outlined earlier the listening recall subtest is particularly

Table 4.25: Memory subtest scores for the YTD group

	Mean	Standard Deviation	Range
Digit Recall	109.1	9.03	93 — 129
Non-word Recall	110.2	10.12	84 — 128
Word list recall	106.6	12.7	86 — 129
Word list matching	104.8	10.6	84 — 123
Backward digit recall	90.7	9.3	55 — 101

Table 4.26: Memory subtest scores for the children with SLI

	Mean	Standard Deviation	Range
Digit Recall	86.2	13.66	56 — 108
Non-word Recall	86.4	14.46	62 — 113
Word list recall	83.5	10.51	61 — 105
Word list matching	83.3	17.8	56 — 119
Listening recall	70.8	12.66	55 — 101
Counting recall	77.3	9.29	61 — 92
Backward digit recall	77.5	9.01	56 — 96

complex and requires a minimum level of language comprehension in order to be able to complete it. For this reason, many of the children with SLI were unable to carry out this task and as a result, were attributed the lowest possible score on this subtest. The results for each group are outlined in the following tables.

Table 4.27 shows the Pearson product-moment correlation co-efficient and p value for the AM-TD group of children. The strongest correlations for the AM-TD group were between word list recall and SR, ($r = .44, p = .011$), 19.4% shared variance and digit recall and SR, ($r = .424, p = .016$), 17.9% shared variance (both moderate). There was also a moderate correlation between non-word recall and SR, ($r = .390, p = .027$) and counting recall and SR, ($r = .327, p = .068$), however the latter was not significant. Each of the other three correlations were low, word list matching, ($r = .229, p = .208$), listening recall, ($r = .205, p = .259$) and backward digit recall, ($r = .164, p = .369$). These were not significant.

Table 4.28 shows the Pearson product-moment correlation co-efficient and p value for the YTD group of children. Due to age constraints the YTD group were unable to carry out two of the three central executive subtests (listening recall and counting

Table 4.27: Correlation between Memory Subtests and SR scores for AM-TD children

	Pearson Correlation	P value
Digit Recall	.424	.016*
Word List Matching	.229	.208
Word List Recall	.44	.011*
Non-Word Recall	.390	.027*
Listening Recall	.205	.259
Counting Recall	.327	.068
Backward Digit Recall	.164	.369

Table 4.28: Correlation between Memory Subtests and SR scores for YTD children

	Pearson Correlation	P value
Digit Recall	.617	.004*
Word List Matching	.388	.091
Word List Recall	.315	.176
Non-Word Recall	.377	.102
Backward Digit Recall	.021	.928

Table 4.29: Correlation between Memory Subtests and SR scores for children with SLI

	Pearson Correlation	P value
Digit Recall	.448	.01*
Word List Matching	.200	.271
Word List Recall	.210	.249
Non-Word Recall	.176	.334
Listening Recall	.399	.024*
Counting Recall	-.144	.432
Backward Digit Recall	.110	.548

recall). This resulted in five remaining independent variables — the four subtests representing phonological memory and the one remaining subtest of the central executive (backward digit recall).

The strongest correlation for the YTD group was between digit recall and SR, ($r = .617 p = .004$) with digit recall accounting for 38% of the variability in SR score. This was the only strong correlation shown between any of the memory subtests and the children's performance on the SR task for all three groups. There was a moderate correlation between word list matching and SR, ($r = .388, p = .091$), non-word recall and SR, ($r = .377, p = .102$), and word list recall and SR, ($r = .315, p = .176$). However these were not significant. There was no correlation between backward digit recall and SR for the YTD group, ($r = .021, p = .928$).

Table 4.29 shows the Pearson product-moment correlation co-efficient and p value for the group of children with SLI.

For the group of children with SLI, the strongest correlation was between digit recall and sentence recall, $r = .448, p = .01$. High digit recall scores were associated with high scores on the sentence recall task and digit recall accounted for 20% of the variability in sentence recall performance. There was also a positive correlation between listening recall and sentence recall ($r = .399$), the former accounting for 15.9% of the variability in the latter. This was also significant, $p = .024$. All other correlations between the memory subtests and SR were low for this group, word list recall, ($r = .210, p = .249$, word list matching, ($r = .200, p = .271$, non-word recall, ($r = .176, p = .334$) and backward digit recall, ($r = .110, p = .548$) and were not significant. There was a small negative correlation between counting recall and SR ($r = -.144, p = .432$). Given the results of previous research studies (Conti-Ramsden et al., 2001; Riches et al., 2010) it was surprising that among the weakest

correlations were those between non-word recall and SR and backward digit recall and SR respectively.

4.2.5 Correlation – SR Scores on 10,9,8 sentences and Memory Subtests

Following on from the investigations into possible relationships between the SR score and each of the memory subtest independent variables, all correlations and regressions were re-investigated using the number of 10,9,8's scored for each child as the dependent variable (research question 6). Again, the data was analysed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. As outlined in section 4.2.2 for the initial analysis (using the number of 10,9,8's scored for each child as the dependent variable), there was some departure from normality, in that the results for the group with SLI were slightly negatively skewed and the results for the YTD group were mildly positively skewed. Therefore both parametric (Pearson) and non parametric (Spearman rho) assessments were completed. However, the results showed little variation and therefore only the Pearson correlation co-efficients are reported. The results are outlined in the following tables.

Table 4.30 shows the Pearson product-moment correlation co-efficient and p value for the AM-TD group of children. The results for the AM-TD group (using the number of 10, 9, 8's as the dependent variable) were similar to those using sentence recall score as the dependent variable. The three significant correlations were consistently between digit recall and the number of 10, 9, 8's scored $(r = .494, p = .004$, 24.2% shared variance), non-word recall and the number of 10, 9, 8's scored, $(r = .472, p = .006$, 22.2% shared variance) and word list recall and the number of 10, 9, 8's scored, $(r = .441, p = .012$, 19.5% shared variance). In contrast to the SR score correlations, using the number of 10, 9, 8's scored as the dependent variable indicated a stronger but still low correlation between backward digit recall and sentence recall scores for the AM-TD group, $r = .291, p = .106$. As before there was a moderate correlation between counting recall and the number of 10, 9, 8's scored, $(r = .300, p = .096)$ and a small correlation between word list matching and the number of 10, 9, 8's scored, $(r = .246, p = .174)$ and listening recall and the

Table 4.30: Correlation between Memory Subtests and SR scores on correct sentences (10, 9, 8, only) for AM-TD children

	Pearson Correlation	P value
Digit Recall	.494	.004*
Word List Matching	.246	.174
Word List Recall	.441	.012*
Non-Word Recall	.472	.006*
Listening Recall	.185	.311
Counting Recall	.300	.096
Backward Digit Recall	.291	.106

Table 4.31: Correlation between Memory Subtests and SR scores on correct sentences (10, 9, 8, only) for YTD children

	Pearson Correlation	P value
Digit Recall	.607	.005*
Word List Matching	.381	.098
Word List Recall	.260	.268
Non-Word Recall	.405	.077
Backward Digit Recall	.156	.511

Table 4.32: Correlation between Memory Subtests and SR scores on correct sentences (10, 9, 8, only) for children with SLI

	Pearson Correlation	P value
Digit Recall	.489	.004*
Word List Matching	.182	.318
Word List Recall	.226	.213
Non-Word Recall	.154	.401
Listening Recall	.428	.014*
Counting Recall	-.148	.418
Backward Digit Recall	.039	.834

dependent variable, ($r = .185, p = .311$).

Table 4.31 shows the Pearson product-moment correlation co-efficient and p value for the YTD group of children. The correlations using the number of 10's, 9's and 8's as the dependent variable are quite similar to those using the SR score for the YTD group. As before the analysis indicated a strong positive significant correlation between digit recall and the number of 10's, 9's and 8's produced ($r = .607, p = .005$), with moderate correlations showing for non-word recall ($r = .405, p = .077$) and word list matching ($r = .381, p = .098$) and the number of 10's, 9's and 8's scored. These were not significant. In contrast to the previous analysis there was a low correlation between word list recall and the number of 10, 9, 8's scored ($r = .607, p = .005$). As before the weakest correlation was between backward digit recall and the number of 10, 9, 8's scored ($r = .156, p = .511$).

Table 4.32 shows the Pearson product-moment correlation co-efficient and p value for the group of children with SLI.

Similar to the results where sentence recall score was used as the dependent variable, the strongest correlation existed between digit recall and the dependent variable (number of 10, 9, 8's) for the children with SLI, ($r = .489, p = .004$). This was statistically significant, with digit recall accounting for 23.9% of the variance in the dependent variable. As before, there was also a moderate positive correlation between listening recall and the number of 10, 9, 8's ($r = .428, p = .014$) and this was also significant. Consistent with the previous analysis, all other correlations were low — between word list recall and the number of 10, 9, 8's ($r = .226, p = .213$), word list matching and the number of 10, 9, 8's ($r = .182, p = .318$) and non-word recall and the number of 10, 9, 8's ($r = .154, p = .401$). As before the low correlation

between counting recall and the number of 10, 9, 8's was negative
($r = -.148, p = .418$). There was no correlation between backward digit recall and
the number of 10, 9, 8's produced ($r = .039, p = .834$).

4.2.6   Regression — Memory Subtests

Further analysis was carried out for each group using simple linear regression
followed by stepwise multiple regression (research question 6). As before the
assumptions were verified using a normal probability plot of the residuals and
constant variability by plotting the residuals against the predicted values. This
model was also verified for collinearity and the residual diagnostics did not indicate
any concerns for these assumptions. On initial analysis the dependent variable in
the regression was total Sentence Recall (SR) score and the variables entered were
digit recall, word list matching, word list recall, non-word recall, listening recall,
counting recall and backward digit recall. The listening recall and counting recall
subtests were omitted for the YTD group as due to their age, they were unable to
carry out these tasks.

For the AM-TD group, word list recall was the only variable to be entered into the
regression equation, explaining 19.5% of the sentence recall score. The equation
was statistically significant ($F = 7.252$), $df = 1, 30; p = .011$). Although digit recall
was the closest variable that would have next been entered into the regression
equation, no other variable was entered for the AM-TD group.

For the YTD group, digit recall was the only variable entered in to the regression
equation, it explained 38% of the SR score. The regression equation was statistically
significant ($F = 7.25, df = 1, 18; p = .011$).

For the group of children with SLI, the co-efficient of determination (r^2) indicated
that 20% of the variation in the total SR score could be explained by the digit recall
score. The regression equation was highly significant ($F = 7.52, df = 1, 30; p = .010$).
Listening recall was then entered into the equation, explaining a further 11% of the
variance $p = .039$. Counting recall was the final variable to be entered into the
equation and accounted for a further 14% of the variance in the SR score,
($p = .011$) — 45% of the variance in total.

Stepwise multiple regression was also calculated using the number of 10's, 9's and
8's as the dependent variable. The assumptions were again verified using a normal
probability plot of the residuals and constant variability by plotting the residuals
against the predicted values. In contrast to the analysis using SR score as the
dependent variable, digit recall was the only variable entered into the equation for
the AM-TD group of children. The co-efficient of determination (r^2) indicated that
24% of the variation in the 10, 9, 8 score could be explained by the digit recall score.
The regression equation was statistically significant ($F = 9.69, df = 1, 30; p = .004$).

Figure 4.14: Mean number of each score assigned for each group
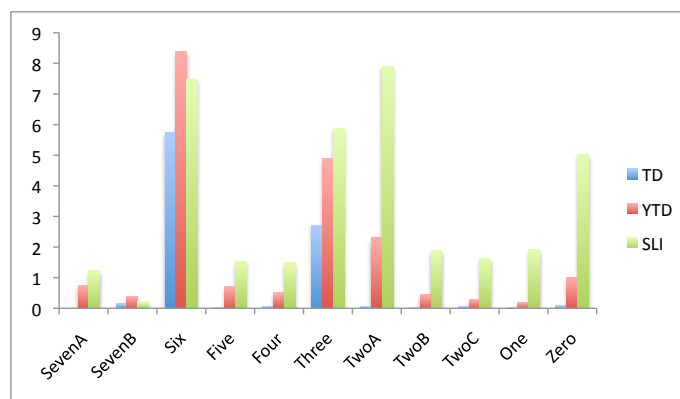
All other variables were excluded from the regression equation as their contribution to the 10, 9, 8 score was not significant for this group.

The multiple regression results for the YTD group using the 10, 9, 8 score as the dependent variable were in keeping with those using the SR score, in that digit recall was the only variable to be entered into the equation. Digit recall explained 37% of the 10, 9, 8 score and the equation was statistically significant $(F = 10.5), df = 1, 18; p = .005)$.

For the group of children with SLI, the co-efficient of determination (r^2) indicated that 24% of the variation in the 10, 9, 8 score could be explained by the digit recall score. Listening recall was then selected into the equation, explaining a further 13% of the variance. Finally, counting recall was added into the equation. This accounted for a further 16% of the variation in the 10, 9, 8, score (53% of variance in total). The final regression equation was statistically significant, $(F = 10.45), df = 1, 30; p = .004)$.

As outlined in section 3.4 each child's response was assigned a score ranging from 10 down to 0, with a higher score representing a more accurate performance. A score of ten was given if the target sentence was recalled with no errors and a score of zero represented an uninterpretable response. Scores of 9 and 8 were attributed if the response included minor lexical or grammatical errors only — this is outlined in detail in section 3.4. Therefore, if a child was attributed one of the three highest scores (10, 9, or 8) they were considered to have knowledge of the syntagmatic structure of the particular relative clause construction. Children's scores of 10, 9 and 8 in each group have been analysed in sections 4.1.2 and 4.1.5. However, other non random errors were observed that reflected children's difficulties with relative clauses. These errors were also represented by a score and the mean number of each score given for each group is outlined in figure 4.14.

4.3   Other Errors

One of our research questions was concerning the error patterns used by children with SLI and whether they would be similar to those described in previous research. The following set of results addresses this question (research question 5).

4.3.1   Relativizer Omission

A score of seven A was given if a child maintained the overall structure of a subject relative clause but omitted the relativizer, (1–1a.) (This rule did not apply to those relative types where it is grammatical to omit the relativizer). The omission of grammatical markers, such as the obligatory relative marker in subject relative clauses, has been reported as a feature of young children's relative clauses (2 – 4;3 years) (Diessel & Tomasello, 2001) and those produced by children with SLI (Schuele & Tolbert, 2001; Schuele & Dykes, 2005).

1. The cat caught the mouse that ran around the garden.

1a. *The cat caught the mouse ran around in the garden.*

The children with SLI showed the greatest number of relativizer omissions – 40 out of a possible 256 (15.6%), where as the YTD group omitted the relativizer in 15 out of a possible 160 responses (9.4%). These figures represent only the relativizer omission in subject relative clauses where there were no other major syntactic errors. While the YTD group tended to recall the sentence accurately (with the relativizer omitted), the children with SLI tended to make other lexical errors or the omission of constituents as well as the omission of the obligatory relativizer (2–2a, 3–3a). This was not an error that occurred in the AM-TD children's responses (0%).

2. There is the pig that climbed into the box yesterday.

2a. *This is the pig climbed in the box.*

3. There is the pencil that fell on the ground in school.

3a. *There is the pencil fell in school.*

The omission of relativizers in other relative clause types will be discussed in sections 4.3.6 and 4.3.8.

4.3.2   Resumptives

A score of seven B was assigned if a child used a resumptive NP or a resumptive pronoun in lieu of a gap (4 – 4a.). A resumptive pronoun is a pronoun in a relative clause which refers to the antecedent of the main clause. The use of resumptives has been noticed in previous work and has been central to debates over the

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structure of children's early relative clauses (Labelle, 1990; Pérez-Leroux, 1995; McKee et al., 1998; McKee & McDaniel, 2001).

4. Anne painted the picture that the girl looked at today.

4a. *Anne painted the picture that she looked at the picture today.*

Although it is shown in figure 4.14 that this was not a common error type for all three groups, this score was assigned solely if this was the only syntactic error that the child made in the sentence and therefore does not include those responses where a child changed other aspects of the sentence. It was often the case for the children with SLI and for the YTD group, that they would include a noun phrase in the gap as one of a number of errors. This was then categorized as an ungrammatical relative clause. As a result the mean number of Seven B's attributed is an under representation of this error type. This will be discussed further in the analysis of ungrammatical relative clauses.

Twenty four out of the thirty two children with SLI did not produce any of this type of response. In fact there were only seven resumptives (.4%) in the total data from children with SLI. Resumptives accounted for .8% of the YTD groups responses and .3% of the responses from the AM-TD group.

4.3.3 Relative Clause Conversions

A score of six was assigned if a child converted the target relative clause into another relative clause type (5 – 5a.).

5. This is the boy whose Dad Anne met in school.

5a. *This is the Dad who Anne's mum met this morning.*

Conversion types (what each relative clause has been converted to) have been analysed in detail in section 4.1.7. As can be seen in figure 4.10, the YTD group made the greatest number of conversions. If however we combine the grammatical with the ungrammatical conversions it becomes apparent that the children with SLI attempted to make an equal number of conversions as the YTD group but were unsuccessful. The conversions made by the AM-TD group were primarily as a result of difficulties with the Genitive relative clauses. In total the AM-TD group converted 11% of the target relative clauses presented to them, however in 8.4% of their conversions the target relative clause was Genitive. Therefore the AM-TD group converted only 2.6% of the other relative clause types. The YTD group converted 16.2% of their responses to other relative clause types and in 10.6% of these, the target relative clause was genitive. Therefore they converted 5.6% of other relative clause types. The children with SLI converted 14.5% of the relative clauses presented to them, however in only 6.4% of these the target clause was genitive. Therefore, they converted 8.1% of other relative clause types.

4.3.4   Other Complex Sentences

A score of five was given if the child converted the target relative clause into another complex sentence type (6 – 6a). This included catenative complements, non-finite clauses, subordinate clauses and reduced relatives. As can be seen from figure 4.14 this was not a common strategy for any group of children. It accounted for 2.9% of the responses from the children with SLI, 1.4% of the YTD group's responses and was not a feature of the AM-TD group (.06%).

6. Joe saw the rabbit that jumped in the big field.

6a. *Joey saw the big cow jump over the fence.*

In the group of children with SLI there were two children who used this strategy more than most, thirteen children who produced only one complex sentence and eight children who did not produce any complex sentences (apart from the relative clauses presented). Of the complex sentences produced the reduced relative was the most common (7 – 7a). This consists of a non-finite verb and no relative pronoun and are a common construction in U.K and Hiberno-English.

7. Anne fed the baby who Emma sang a song to.

7a. *Anne fed the baby singing the song.*

4.3.5   Co-ordination and Unconnected Clauses

A score of four was assigned if the child used co-ordination or two unconnected clauses (8 – 8a, 9 – 9a). This strategy accounted for 2.9% of the responses from the children with SLI, 1% of the YTD group's responses and again this was not a feature of the AM-TD groups responses. (.12%).

8. The boy rode the horse that Anne put in the field.

8a. *The boy rided the horse and put him in the field.*

9. This is the boy whose coat fell on the floor.

9a. *This is the boy his coat fall on the floor.*

One child in particular used the strategy of co-ordination in trying to re-produce the relative clauses presented to him. In almost 20% of his responses he used co-ordination successfully, however in a further 30% of his responses he was unsuccessful and instead produced an ungrammatical attempt at co-ordination. This was categorized under ungrammatical complex syntax and will be discussed in section 4.3.9. Seven children used co-ordination or unconnected clauses only once and a further thirteen did not use them throughout their responses.

4.3.6   **Ungrammatical Relative Clauses**

A score of three was given if the child attempted a relative clause but it was ungrammatical — this included both responses where the child was given one type of relative clause and they attempted to convert it to another (10 – 10a.) and responses where the child attempted the same type of relative clause as the target clause but again it was ungrammatical (11 –11a).

  10. Joe liked the girl whose dog Anne found in the park.

10a. *Joe liked the dog who found in the park.*

  11. Anne kissed the baby whose face Joe cleaned with a towel.

11a. *Anne kissed the baby who face Joe cleaned.*

The AM-TD group's responses included 9.7% of ungrammatical relative clauses. However 6.6% of these were an attempt at a Genitive relative clause, indicating 3% of ungrammatical relatives from other relative clause types. The YTD group had a total of 15.5% of ungrammatical relative clauses and almost half of these (7.6%) were an unsuccessful attempt at a Genitive relative clause. Therefore indicating 7.9% of ungrammatical relatives from other relative clause types. The SLI group had a total of 19.7% of ungrammatical relatives but only 5% of these were an attempt at a genitive relative clause. Therefore, the children with SLI responded with ungrammatical relatives from 14.5% of other target relative clause types.

Although it was primarily the genitive relative clauses with which the AM-TD group had difficulty, they also showed a little difficulty with Io-relatives and to a lesser extent Obl relatives. There were some error patterns within the ungrammatical relatives that were common to all three groups. The omission of an object following a transitive verb (12–12a), difficulty with stranded prepositions particularly in the case of Io-relatives (13 –13a.) and the inclusion of a noun phrase in the gap (14 –14a.). The inclusion of a noun phrase in the gap was almost always in the case of genitive relatives and this occurred in 1.56% of their responses. The AM-TD group were more likely to maintain the overall structure of the target relative clause but their response was categorized as ungrammatical if they were no longer meaningful (15–15a.). This occurred most often in the case of the genitive ungrammatical relatives, the overall structure was maintained but the incorrect relativizer was substituted (16–16a.).

  12. Joe liked the girl whose dog Anne found in the park.

12a. *There is the dog that found in the park.*

  13. Emma watched the girl who Joe gave some sweets to.

13a. *Joe watched the girl who gave the boy some sweets to.*

  14. There is the cat whose kitten Emma found last week.

14a. *There is the cat who she found the kitten last week.*

15. Emma fed the baby who Anne sang a song to.

15a. *Anne fed the baby who Anne said a song to.*

16. This is the boy whose coat fell on the floor.

16a. *This is the boy that the coat fell on the floor.*

As we might expect the YTD group began to show errors at an earlier stage than the AM-TD group, in that their performance was not as consistently accurate on the S, A, and P-relatives. They had greater difficulty with the Obl relatives than the Io-relatives and had the greatest difficulty with the genitive relatives. The patterns causing the relative clauses to be ungrammatical were very similar to the AM-TD group but were in much greater volume. Although relatively rare, the YTD group also showed some new patterns in that they engaged in verb restriction violation (17 –17a.), omitted relativizers (particularly the genitive relativizer *whose* (18 –18a.), made ungrammatical relativizer substitutions (19 –19a.) and produced some N relatives (a relative clause that is attached to an isolated head noun) (20–20a.). They also tended to combine more errors in a given response (21 – 21a, shows verb restriction violation and a NP in the gap). The YTD group sometimes omitted relativizers when attempting to convert to another relative clause type, however this was rarely the only error in a conversion and was not a common error pattern. (22 – 22a, shows the omission of the relativizer in conjunction with a transitive verb with no object.)

17. Emma met the girl whose bag Anne took to school.

17a. *Emma met the girl that the bag took to school.*

18. Anne saw the farmer whose cow fell in the shed.

18a. *Anne saw the farmer cow fell into the shed.*

19. The girl wanted the rabbit that Anne bought in town.

19a. *The girl chased the rabbit with the Anne wanted in town.*

20. Anne saw the farmer whose cow fell in the shed.

20a. *The farmer whose cow fell in the shed.*

21. Anne found the book that you read in school today.

21a. *Anne read the book who read the book in school today.*

22. Joe rubbed the cat that the goat stood on last week.

22a. *Joe rubbed the cat stepped on last week.*

The children with SLI showed many similar patterns to the YTD group in their ungrammatical relatives. However, as noted earlier, if we exclude the genitive

relative clauses the children with SLI produced almost double the number of ungrammatical relatives as the YTD group (across all other relative clause types). Errors that were relatively rare in the YTD group (verb restriction violation, the omission of obligatory relativizers, ungrammatical relativizer substitutions, and particularly multiple errors) were common place for the children with SLI. The children with SLI also showed particular problems with prepositions (23 – 23a.), article omission (24 – 24a.), phonological intrusion (25 – 25a.), were more likely to use N relatives (26 – 26a.), or omit the main clause or relative clause subject (27– 27a, 28 – 28a.), would sometimes omit the main clause or relative clause verbs altogether (29 – 29a, 30 – 30a.) or omit the entire main clause and recall only the second clause (not necessarily accurately (31 – 31a.)).

23. There is the sheep that drank the water this morning.

23a. *This is the sheep with drank that drank with morning.*

24. Emma spoke to the man who the horse ran away from.

24a. *Anna talk to the man horse ran away from.*

25. This is the man who Joe wrote a letter to.

25a. *This is the man who Joe wretter to.*

26. Anne found the book that you read in school today.

26a. *The teacher who ... em worked in school today.*

27. Joe liked the girl whose dog Anne found in the park.

27a. *Joe liked whose dog found in the park.*

28. Emma spoke to the man who the horse ran away from.

28a. *Emma spoke to the man who run away from.*

29. Anne painted the picture that the girl looked at today.

29a. *And she the picture who she painted today.*

30. This is the boy whose coat fell on the floor.

30a. *This is the boy who coat on the floor.*

31. Anne found the girl whose Mammy ran in the race.

31a. *Whose Mammy ran in the race.*

32. The cat caught the mouse that ran around the garden.

32a. *The dog catch the mouse what all around the garden.*

One pattern which was evident to varying degrees in the three groups' responses, was the substitution of the *what* relativizer (32 – 32a.). This was scored a nine if it was the only error in the response and a three, if there were other errors making the

relative clause ungrammatical. Flynn and Lust (1980) also noted this type of error in their data and argued that children tend to replace *that* with *what* because *what* is commonly used in headless relative clauses, which children seem to master before they master headed relative clauses (Hamburger, 1980). A headless relative is one in which 'the relative clause has no lexical head and thus constitutes a noun phrase by itself' — e.g. *whoever did that* in the sentence *whoever did that is in trouble* (Trask, 1993 p.107). The use of the*what* relativizer is also a well-attested non-standard form. About 20% of the AM-TD children substituted the *what* relativizer for *who* or *that* but only one child did it with any great consistency. While just over half of both the YTD group and the group of children with SLI used the *what* relativizer in place of *who* or *that* at some point in their sentence output.

Some strategies were particular to individual children regarding ungrammatical relative clauses. One child tended to produce N relatives(sometimes using a proper noun rather than a noun phrase) followed by an unconnected clause (33–33a, 34–34a.).

   33. Anne found the girl whose Mammy ran in the race.

 33a. *Anne who ran in the race she won the race.*

   34. The girl who found in the book in the school she read it.

 34a. *The girl who found in the book in the school she read it.*

Overall the variety of ungrammatical relative responses from the children with SLI, reinforces the fact that this is an extremely heterogenous group. However there are some consistent errors that are present in almost all of these children's responses — These are

Difficulty with the use of verbs

Both verb restriction violation (shown in 21 — 21a) and the use of transitive verbs with no proceeding object

Difficulty with prepositions

As mentioned in the quanitative analysis stranded prepositions pose particular difficulties for children with SLI, however this seems to be more evident in Io-relatives than in Obl relatives. Therefore this may reflect the argument structure as well as the use of the prepositions. This will be discussed in more detail in section 5.6.4.

Difficulty with verb particles

Reasons for each of these difficulties will be considered in the discussion chapter. While some of these errors are evident in the YTD group data they are not as common and tend not to appear as combined errors.

4.3.7 Simple Sentences

It is well documented in the literature that the use of simple sentences precedes the development of more complex syntactic structures such as relative clauses. In their acquisitional work, Diessel and Tomasello (2001) advocate that the development of relative clauses begins with S relatives in copular constructions, as these are most similar to simple sentences. In this study a score of two A was given if the child converted the target relative clause in to a simple sentence (35 – 35a).

  35. Anne found the girl whose Mammy ran in the race.

 35a. *The Mammy ran in the race.*

In total the children with SLI converted 15.2% of their responses to simple sentences, compared to the YTD group who converted only 4.4% of their responses (almost half of the YTD children did not convert any relative clauses into simple sentences). This pattern did not exist in the AM-TD group data (.12%). The profiles were again quite mixed with in the SLI group. There were two children who had extremely limited knowledge of relative clauses and converting the relative clause into a simple sentence was their primary strategy for dealing with the complex syntax presented — almost half of their responses were simple sentences. A further ten children produced between 20 and 30% of their responses as simple sentences and only two of the children with SLI did not convert any relative clauses into simple sentences.

4.3.8 Presentational + Simple sentence

A pattern that emerged between the stage of a simple sentence and a presentational relative clause was the production of a copular main clause followed by a simple sentence but with no intervening relative pronoun. This was categorised as Pn + simple sentence and a score of two B was assigned to this response (36 – 36a.). These syntactic amalgams were similar to the early relative clauses discussed by Diessel and Tomasello (2001) and are only slightly dissimilar to simple sentences in that they contain a single proposition and express the actor by the initial noun phrase. They could be analysed as a relative clause in which the relative pronoun or complementizer is absent, (Lambrecht, 1988). The children with SLI produced 3.61% of utterances with this structure, compared to .87% for the YTD group and .06% for the AM-TD group.

  36. There is the rabbit that the girl chased in the park.

 36a. *There was the girl chase the rabbit in the park.*

While eleven (out of 32) children with SLI did not produce this structure and a further ten children produced only one Pn + simple sentence, this appeared to be a strategy for five of the children with SLI (all of whom produced this structure at least

10% of the time.) The same pattern existed with a full main clause, (37 – 37a, 38 – 38a.) however this was categorized as an ungrammatical relative and was less common.

37. Emma met the girl whose bag Anne took to school.

37a. *Emma met the girl took the bag.*

38. The boy rode the horse that Anne put in the field.

38a. *Anne rode the horse put in the field.*

4.3.9 Ungrammatical Complex Sentences

A score of two C was given if the child attempted to convert the relative clause into another complex sentence or attempted a co-ordination but they were ungrammatical (39 – 39a. and 40 – 40a.). Overall the children with SLI attempted other complex structures unsuccessfully in 3.1% of responses. Half of the children with SLI did not have any unsuccessful attempts at other complex syntax. The YTD group produced other ungrammatical complex sentences in .58% of utterances, compared to the AM-TD group (.12%) where this pattern did not exist.

39. Joe saw the rabbit that jumped in the big field.

39a. *Joe use the rabbit to jump over the fence yesterday.*

40. Joe liked the girl whose dog Anne found in the park.

40a. *Joe's liked the dog and the dog found in the park.*

4.3.10 Ungrammatical Simple Sentences

A score of one was given if the child converted the relative clause into an ungrammatical simple sentence (41 –41a.). This accounted for 3.7% of the responses from children with SLI. While 25% of two children's responses were ungrammatical simple sentences, twelve children did not produce any ungrammatical simple sentences.

41. The girl ate the sweets that you brought to the party.

41a. *The girl gave some sweets to a party.*

One of the two children with 25% of ungrammatical simple sentences was also noted in section 4.3.6. for his use of grammatical simple sentences (the two accounting for 70% of his responses). This was a child who did not have the ability to produce any relative clauses. His simple sentences were ungrammatical as a result of using transitive verbs with no objects, difficulty with prepositions and using articles with proper nouns. The other child with such a high proportion of

ungrammatical simple sentences also produced a number of grammatical simple sentences (the two accounting for 50% of her responses). Again she could not deal with the relative clause structure and successfully recalled only two (from a total of fifty two). She also had a difficulty with prepositions (42 –42a.), transitive verbs and the appropriate use of articles (43 – 43a.).

42. The girl ate the sweets that you brought to the party.

42a. *Sweets …. A girl is eatin the sweets to a party.*

43. There is the girl who the cat played with in the kitchen.

43a. *Girl play with a cat with a kitchen.*

In contrast ungrammatical simple sentences accounted for only .38% of the YTD groups responses and .6% of the AM-TD groups responses.

4.3.11   Uninterpretable Responses

A score of zero was assigned if the response was uninterpretable (44 –44a.). This included an inability to hear/interpret part of the child's response or a difficulty imposing a syntactic framework on the response. Of the responses from the children with SLI, 9.7% were uninterpretable, compared to 2% of the YTD groups responses and .18% of the responses from the AM-TD group.

44. There is the picture that you drew on the wall last week.

44a. *Draw a wall on last week.*

At times when the children with SLI struggled to recall the sentences given, they substituted words with weak unintelligible forms that consisted largely of /ə/. This was also documented in repetition work carried out by Chiat (2000, chap.10 p.176). If the complete utterance was not audible then it was impossible to analyse the syntactic structure. Other responses had a combination of errors such that it became impossible to be clear regarding what syntactic framework the child was trying to impose (45 –45a.). It was also the case that these responses often bore little resemblance to the target item (46 – 46a.).

45. Emma spoke to the man who the horse ran away from.

45a. *A man … Emma talk with a man the horse ran horse gone.*

46. Anne painted the picture that the girl looked at today.

46a. *A girl draw egg today.*

Twenty-eight out of the thirty-two children with SLI produced uninterpretable responses. Twenty-five percent of the responses from four children were uninterpretable. These were as a result of inaudibility, word order issues, verb

restriction violation, verb omission, preposition difficulties, lack of article use and the sentences being completely meaningless and unrelated to the target sentence.

Chapter 5

Discussion

In broad terms, the aim of this study was twofold (1) To investigate the control of complex sentence syntax, (specifically, relative clauses) by Irish school-age children with SLI, using a sentence recall task and (2) to discover how well children with SLI could control relative clauses across the full range of syntactic roles. Using two types of matrix clause (presentational and direct object), we asked how the performance of the children with SLI compared with their age peers and with children who were on average two years younger. Via an analysis of their performance profiles, we also sought to determine if a developmental hierarchy of control of syntactic roles could be identified, and if their error patterns would be similar to those found in previous research.

The discussion chapter is broken down in to nine main sections. The overall differences between the performance of the three groups is initially considered. This is followed by a discussion of the effect of the main clause and the effect of the relativized syntactic role. The next section outlines the possible differences between transitive and intransitive relative clauses. This is followed by a discussion of the conversion errors that were made by the three groups of children and the implications of these. Other error patterns are then outlined and possible explanations are posited. The role of short-term and working memory in the control of relative clauses for children with SLI is then reviewed, followed by the role of children's language status. Finally, the clinical implications of the study and possibilities for further research are discussed.

5.1   Group Differences

The study aimed to answer the question regarding how well children with SLI could control relative clauses when compared to AM-TD children and YTD children who were on average two years younger. The data was analysed in two ways: the first analysis used the total sentence recall score (SR) as the dependent variable and

statistical analysis showed that there were significant differences between the three groups' performance overall on the task. The children with SLI showed significantly greater difficulty than the AM-TD group and the YTD group. The mean score for the AM-TD group was 441 (out of a possible 520) — an average deficit of 15% of SR score. As can be seen in chapter 4 (figure 4.4) the AM-TD group performed almost at ceiling on the S-, A-, P-, Io- and Obl- relatives. There were some children who began to show difficulties at the level of the Io-relative but these were relatively rare. Their main difficulties were with the Gen-relatives — GenO- relatives causing significantly more difficulty than GenS-relatives. This follows the developmental hierarchy that we might expect — as outlined by Diessel and Tomasello (2005) when analysing data from younger TD children. The AM-TD children were also quite systematic in their approach to GenS- and GenO-relatives. They often maintained the structure of the sentence but made an ungrammatical relativizer substitution (1.). They also tended to successfully convert the GenO-relatives to PnP- or DoP-relatives and would mark the possession aspect of the construction in some way (2.).

1. **Target:** There is the girl *whose* toy Anne broke in the garden.

   Response: *There is the girl that the toy Anne broke in the garden.*

2. **Target:** This is the boy whose Dad Anne met in school.

   Response: *This is the boy that Anne's Dad met in school.*

The YTD group showed a much more varied profile. They scored an average of 355 (out of a possible 520) — an average deficit of 32% SR score. This is twice the deficit of the AM-TD group. The YTD group demonstrated the most control of the S-, A- and P-relatives, followed by the Obl- and Io- relatives and lastly the GenS- and GenO-relatives. Broadly speaking, this also follows the developmental hierarchy that we expect. The YTD group showed the strongest performance on P-relatives which are more frequent in child directed ambient language than S- or A-relatives (Diessel & Tomasello, 2001). This frequency bias may no longer be the case for the AM-TD children, who are 6;0 and 7;11 years and who have now been exposed to more written language in a school setting. The YTD children were quite varied in their performance, with some children showing few difficulties apart from the Gen-relatives and others showing problems on the S- and A-relatives. The YTD children also had significantly more difficulty with Obl- and Io- relatives than the AM-TD group — they showed more grammatical and ungrammatical conversions and had difficulty with stranded prepositions. They were also more likely to make minor grammatical or lexical errors than the AM-TD group (scoring 8 on constructions on which the AM-TD group would consistently score a 10). Despite their qualitative differences in performance on the S-, A-, P-, Io and Obl- relatives, differences between scores on these categories were not statistically significant. The only significant differences were between all other relative types and GenS-relatives

and all other relative types and GenO-relatives. Unlike the AM-TD group there was no significant difference between the Gen-relative types — the YTD group finding both of these Genitive types particularly difficult.

The children with SLI scored an average of 216 (out of a possible 520) — an average deficit of 58.5% of SR score. This represents a significantly greater difficulty with relative clause constructions than both the AM-TD and the YTD groups. On initial analysis, the SLI group showed a similar hierarchy to the other two groups, performing best on S-, A-, and P-relatives, followed by Obl- and Io-relatives and lastly GenS- and GenO-relatives. However, despite this similar developmental hierarchy the SLI group showed significant differences between relative clause types at a developmentally lower level than the other two groups. The AM-TD group only showed significant differences between the GenO-relatives and all other relative clause types. The YTD group showed significant differences between both Gen-relatives constructions and all other relative clause types. The SLI group however, showed significant differences between two groups of relative clause constructions — (1) there was a significant difference between their performance on S-, A-, and P-relatives and their performance on Obl-, Io-, GenS- and GenO-relatives and (2) there was a significant difference between how they performed on Io- and Obl-relatives and their performance on GenO-relatives. The children with SLI showed many more errors than either of the other two groups. The variation in their profiles was even more evident than in the YTD group and they tended to use simpler constructions. Omitting the genitives, they attempted to convert twice the number of relative clauses as the YTD group but were often unsuccessful. They also had significant difficulty with constructions that included stranded prepositions and produced significantly more uninterpretable responses than either of the other two groups. The qualitative differences between the three groups will be discussed in detail below.

In order to evaluate differences between the groups in their ability to maintain the syntagmatic structure of the sentences they were required to recall, except for minor grammatical and lexical errors, another measure of performance on the sentence recall task was calculated by combining the three highest scores (10, 9, and 8) for each group. The second statistical analysis used the total number of 10's, 9's and 8's as the dependent variable. Again statistical analysis revealed significant differences in the performance between all three groups, with the children with SLI showing significantly greater difficulty than both of the other two groups.

These results further reinforce the differences between the three groups and underline the limitations in the control of these constructions by the children with SLI . A score of 10, 9, or 8 represents 76% of the responses from the AM-TD group, 54% of the responses from the YTD group and 19% of the responses from the children with SLI. If we break this down further and look at the number of 10's scored (representing a perfect response) — these account for just over half of the

AM-TD responses (53%), 21% of the YTD responses and a mere 3% of the responses from the children with SLI. This shows that the YTD children were much more likely to make minor grammatical or lexical errors than the AM-TD and the children with SLI almost always made some kind of error in their production of the relative clause constructions.

As can be seen from figure 4.2 (chapter 4) there is no overlap between the number of 10's, 9's and 8's produced by the AM-TD group and the group of children with SLI and the lowest level performance for the AM-TD group approximates the median value for the YTD group. The box plot at 4.2 further reinforces the considerable variation in the performance of the YTD group, particularly in the interquartile range — showing that there is quite a range of performance within normal development at this age. Despite this, the lowest level of the interquartile range for the YTD group does not overlap with that of the children with SLI — again reinforcing the significant difficulties that the majority of these children have with relative clause constructions, even when compared to TD children who are on average two years younger than they are.

These findings in relation to complex syntax, are in keeping with previous morphological studies comparing children with SLI, with AM-TD children and YTD children, who are usually language matched and or two years younger than the children with SLI. It is well documented that children with SLI omit tense and agreement inflections from their language long after age-matched children with typical language development show consistent production of these elements (Leonard, 1998; Rice, Wexler, & Hershberger, 1998; Norbury, Briscoe, & Bishop, 2001). In terms of morphology, the differences between children with SLI, YTD children matched for mean length of utterance (MLU) and AM-TD children, are differences in degree of use (Leonard, 2009). It is rarely the case that children with SLI fail to use particular morphological forms altogether and when these morphemes are used they are nearly always applied in appropriate contexts i.e. productions such as *They walks a lot* are rare. These findings suggest that in spite of their limited use of tense and agreement morphemes in obligatory contexts, children with SLI possess knowledge of their grammatical function and where to use them and where not to use them.

Relative clauses are of course not obligatory, but nevertheless are an important part of the repetoire of complex sentence structures in English. How children with SLI control relative clauses in comparison to YTD children in this study, appears to be a very significant difference of degree. At this point we cannot be definitive about whether there is more involved than degree of use. Children with SLI showed many common error patterns in relation to the YTD children, however there were also differences in their responses, — particularly in their uninterpretable responses, their use of unintelligible weak phonological forms and their inability to suppress irrelevant information. The implications of these differences will be considered at

the end of the discussion.

We have established that there are significant differences in the control of relative clauses by children with SLI when compared to AM-TD children and YTD children who are on average two years younger. We now need to consider in detail, how these differences manifest in terms of the effect of the main clause and the effect of the relativized syntactic role. We will also discuss the error patterns that exist for each group of children and what the implications of these errors are in terms of a developmental hierarchy of relative clause constructions.

5.2   The effect of the main clause

Based on acquisitional work carried out by Diessel and Tomasello (2005) with young TD children (4;3 to 4;9 years) — it was hypothesized that in this study, relative clauses attached to the predicate nominal of a copular clause (presentational constructions — Pn) would cause fewer problems than those attached to the direct object of a transitive main clause (Do). This hypothesis was borne out by the data. The AM-TD group, the YTD group and the children with SLI, all performed significantly better on sentences including a copular main clause than on sentences including a transitive main clause. This developmental hierarchy is therefore evident for all three groups. However, it is the magnitude of the differences that is more revealing than the statistical significance. If we look more closely at the mean scores, there is a mean difference of 12 between the two types of main clause for the AM-TD group, a mean difference of 22 for the YTD group and a mean difference of 37 between relative clauses attached to Pn and Do sentences for the group of children with SLI. Therefore the greatest effect of the main clause is for the children with SLI, followed by the YTD group and the main clause had the least impact on the performance of the AM-TD children. We might therefore conclude that as children's control of relative clause constructions develops the structure of the main clause will have less impact on their performance. Because the children with SLI are much lower on the developmental hierarchy of relative clause development (than both the AM-TD group and the YTD group) — the structure of the main clause has the greatest impact on their performance.

As outlined in section 2.5 there are two types of presentational construction — the regular presentational relative construction in which the relative clause is syntactically separated from the rest of the sentence (3.)(the relativizer is present), and its ungrammatical precursor, 'the amalgam construction' in which the relative clause and copular clause are merged into a single unit (4.) (the relativizer is absent). Lambrecht (1988) considers these to be 'truncated relatives'.

3. This is the toy that broke in the box last week.

4. This is the toy broke in the box last week.

Since the amalgam construction is usually the first relative construction that children learn and since the occurrence of this construction becomes very infrequent once the regular presentational relative has emerged, Diessel and Tomasello (2001) consider it to be a precursor to the regular presentational relative. As children grow older they begin to use more complex relative constructions in which the relative clause is attached to a noun in a fully fledged main clause. The question was asked as to whether this developmental pattern of clause expansion would be represented in the responses of the children with SLI. This pattern was reflected in the results of this study. The children with SLI, who showed greater difficulty with presentational relative clauses than the other two groups, used amalgam constructions in 7.2% of their presentational responses. In contrast the AM-TD group who had good control of the regular presentational relatives did not use any amalgam constructions and the YTD group, also with well developed control of the regular presentational relatives used the amalgam constructions in less than 2% of their responses. This is consistent with the profile found by Diessel and Tomasello (2001) when looking at younger TD children (aged 1;9 — 5;2). They noted that as the regular presentational relative emerges the frequency of the amalgam construction diminishes.

In their discussion of the acquisition of relative clauses with young TD children, Diessel and Tomasello (2001, 2005) suggest a number of influences that might explain why the earliest relative clauses are embedded in copular constructions. If we apply a delayed maturational approach, these arguments could equally be applied to children with SLI.

Firstly, these constructions are semantically very simple — although they consist of two clauses they contain only a single proposition. The copular clause does not indicate an independent situation; rather, it serves to focus the listener on a referent which then becomes available for further specification/elaboration expressed in the relative clause. The whole structure represents a single situation and can therefore be paraphrased by a simple sentence (5 – 7).

5. **Target:** This is the bird that slept in the box all night.

   Response: *The bird slept in the box all night.*

6. **Target:** This is the pencil that you broke in school today.

   Response: *You broke the pencil in school today.*

7. **Target:** This is the boy whose coat fell on the floor.

   Response: *This boy's coat fell on the floor.*

They argue that the early use of relative constructions involves a very simple procedure by which the child combines a somewhat formulaic (main) clause (i.e., of the form *That's X, There's X, It's X*) with a second component. The second component is either a verb phrase, as in the amalgam construction, or a full relative

clause, as in the regular presentational constructions. They argue therefore that relative clauses are built on item-specific constructions that are deeply entrenched when children begin to use them.

It is also argued that these regular presentational constructions are very frequent (Diessel, 2004, Chap.6) because they are pragmatically useful for parent child speech. In conversation together both adults and children tend to talk about items in their environment. The function of the presentational main clause is to focus the listener's attention on these items — which are then further elaborated on in the relative clause. Pragmatically, this makes them very useful in parent-child conversations.

The propositional content of children's early relative clauses is not usually pragmatically presupposed as in prototypical subordinate clauses or transitive clauses (8.). In fact, Diessel and Tomasello (2001) point out that in most instances the relative clause contains new and unfamiliar information about the referent established in the copular clause. Therefore, like simple sentences, children's early relative constructions express new and unfamiliar information in the position after the (main) verb (i.e. the verb of the relative clause)(9 – 10). (Examples taken from Diessel, 2004). Pragmatically presupposed information is not usually verbalized in young children's speech, making prototypical relative clauses more difficult for young children.

8. The apartment he lives in….. (he is discourse old)

9. Thats the horse sleeping in the cradle… 2;8

10. This is the sugar that goes in there. Nina 3;0

In contrast to the regular presentational construction where Diessel and Tomasello (2001) found that both parents and children made frequent use of this construction, they found few examples of the amalgam construction in the speech of adults involved in their study. They suggest a semantic motivation for the use of the amalgam construction and posit that 'children create the amalgam construction in an attempt to match the syntactic structure of presentational relatives with their meaning' (Diessel & Tomasello, 2001, p.144). Because regular presentational relatives express a single proposition, children tend to merge the two clauses of the construction into a single syntactic unit. In line with Lambrecht (1988), Huddleston and Pullum (2002, p.1055) also mention that 'some varieties of English' allow *that* to be omitted from clauses with realtivised subjects under certain conditions. They give the example, *There's someone at the door wants to talk to you* and comment that this example falls at 'the boundary between very informal and non-standard' English. This has been described in more detail in section 2.9 and is not noted as a feature of Hiberno-English. The omission of the relativizer in subject relatives is therefore not considered a dialectal influence in the current study.

Finally, Diessel and Tomasello (2001) propose that processing plays an important

role in the acquisition of relative clauses, suggesting that it restricts children's early use of relative clauses to simple constructions. In discussing young TD children, they posit that children under three years of age tend to avoid relative constructions including two propositions (one subordinated) because the processing load of these constructions would exceed their processing capacity at this early age. They quote further research that they carried out in 2001 in support of the role that processing plays in the acquisition of complex syntax. In examining the development of finite complement clauses, they found that like relative clauses, complement clauses emerged in propositionally simple constructions in which the matrix clause was a formulaic construction which functioned as an 'attention getter'.

As discussed in section 2.4, there is a significant amount of research supporting a reduced processing capacity for children with SLI. Therefore we might consider that this same processing limitation is leading older children with SLI to avoid the use of bi-clausal relative constructions. If we were to apply the concept of a slower processing speed, we might also suggest that children with SLI have greater difficulty processing two propositions than a single propositional clause. If we consider that children with SLI have a limited resource allocation, — difficulty in dividing their attentional resources between the processing and retrieval of information from memory as well as the maintenance of the item representations, then we might argue that the cognitive load of relative constructions with two propositions is exceeding their abilities at this point. The processing of two fully fledged clauses would increase the time frame for which attention is switched away from maintenance to retrieval during a particular period. In contrast, the processing of a single propositional clause would result in a reduced cognitive load and allow for more time in focussing on the maintenance rather than the retrieval of the structure.

In summary, children with SLI have significantly less difficulty with presentational relative clauses which express a single proposition than with fully fledged bi-clausal relatives that occur later in child speech. The impact of the type of main clause (Pn versus Do) on their ability to produce a relative clause is far greater for the children with SLI than for either of the other two groups — this is because the children with SLI are lower on the developmental hierarchy of relative clause development. A number of factors have been suggested in an attempt to explain why relative clauses attached to Pn sentences cause fewer problems than those attached to Do sentences: (1) the semantic simplicity of the sentences, (2) their frequency in the ambient language (3) the pragmatic functionality of these structures, (4) the processing limitations of children with SLI.

5.3   The effect of the relativized syntactic role

In the application of van der Lely's theory (outlined in section 2.2) a number of studies have suggested that the acquisition of relative clauses is determined by the varying distance between the filler and the gap / the length of the dependency. van der Lely (2005) posits that children with SLI have difficulty computing long distance syntactic dependencies between different sentence constituents that include any kind of syntactic movement — such that the processing load of the relative clause is determined by the varying distance between the filler and the gap. Consistent with this theory, the results of this study indicate that the children with SLI performed best on S and A-relatives, followed by P-relatives, Obl relatives and then Io-relatives. Although the differences between each relative type were not all significant (S/A and P, Obl and Io) this order in performance reflects a progressive distance between the filler (in italics below) and the gap (indicated by the parentheses) in each relative clause type (11 – 15).

11. This is the *toy* that (⎯⎯) broke in the box last week. PnS

12. There is the *sheep* that (⎯⎯)drank the water this morning. PnA

13. This is the *pencil* that you broke (⎯⎯) in school today. PnP

14. There is the *girl* who the cat played with (⎯⎯) in the kitchen. PnObl

15. There is the *dog* that the man kicked his football to (⎯⎯). PnIo

16. There is the *girl* whose (⎯⎯) juice spilt in the kitchen. PnGenS

Furthermore, S and A-relatives involve the same distance between the filler and gap and there was no significant difference between the SR scores (on correct sentences, 10, 9, 8, only) produced for both types of relative clause. The distance between the filler and the gap is also greater for Obl and Io-relatives than for P-relatives and there were significant differences between both P and Obl relatives and P and Io-relatives. However, much of the data was not explained by the filler gap hypothesis. The distance between the filler and the gap is greater for P-relatives than for S or A-relatives but there were no significant differences in the SR scores (on correct sentences, 10, 9, 8, only) in response to these three relative clauses. The distance is also greater for Io-relatives than Obl relatives but again no significant differences were evident. Although Gen-relatives involve a relatively short distance between filler and gap (especially if the head of the genitive functions as the subject (16)), there were no significant differences between GenS-relatives and Io-relatives or GenS-relatives and Obl relatives.

One could argue that the children with SLI could cope with the distance between the filler and the gap up to the level of the object relative clause (P) but beyond this the distance is too great for them to process or to maintain the relevant noun phrases in their memory before semantically and syntactically integrating them

with the following verb phrase. However, van der Lely's account does not allow for the contribution of memory. Nor does this theory account for the genitive results which leads us to consider alternate explanations for the data.

As noted by Diessel and Tomasello (2005) in the interpretation of their study results on relative clauses, the number of animate referents can also affect children's interpretation of relative clauses (Goodluck & Tavakolian, 1982a; Hamburger & Crain, 1982; Corrêa, 1995a). The relative clauses used in the current study are defined such that they contain different numbers of referents. If we disregard the additional adverbial referents, S relatives contain one referent, A, P, Obl and Io-relatives include two referents and Gen-relatives include three referents. Diessel and Tomasello (2005) suggest that the varying distance between the filler and the gap may be confounded by the number of animate referents and could therefore be masking its affect. There is also the added complication that as a result of research carried out by Kidd et al., (2007) this study includes both animate and inanimate referents in the P-relatives. However as A, Io and Obl relatives include the same number of animate referents, the affect of distance in three types of relative clause in which distance and animacy are not confounded, can be examined. If distance has a significant effect on the children's performance then the results should be significantly different for all three relative types. While there were significant differences between A and Obl relatives and A and Io-relatives, there were no significant differences between the Io and Obl relatives. We can therefore conclude that the number of animate referents is not masking any effect of distance on the performance of children with SLI.

In looking towards other explanations to account for the data, Diessel and Tomasello (2005) suggest that the acquisition of relative clauses is determined by multiple factors affecting different types of relative clauses. They posit that TD children's good performance on S/A-relatives could be at least partially explained by the fact that they are more easily activated than other types of relative clauses. This same argument could also be applied for children with SLI who showed the least difficulty with S/A-relatives. One significant factor discussed in the literature which affects ease of activation is frequency. The theory being that the more frequently a grammatical construction occurs, the more entrenched its mental representation becomes and the easier it is to activate in language use (Bybee, 1985, 1995; Bybee & Hopper, 2001). However, although subject relatives are among the earliest relative clauses children produce (Diessel 2004: chap 6), in natural discourse they occur as frequently as direct object relatives (Fox & Thompson, 1990). In fact, in child speech Diessel and Tomasello (2005) report that children between 4 and 5 years produce object relatives more frequently than subject relatives. This is consistent with the data from the YTD group in the current study, who performed better on the object relatives than the subject relatives (although not significantly). Diessel (2004: chap 6) also notes the dominance of object relatives in child directed speech in English: 57.9 percent of the mother's relative clauses in his data are direct object relatives,

34.3 percent are subject relatives, and 7.9 percent are oblique relatives; there were no examples of indirect object relatives and genitive relatives in the data. Brandt, Diessel, and Tomasello (2008) reported similar frequency distributions in the ambient language of a German speaking boy. Diessel and Tomasello (2005) interpret these findings as suggestive that input frequency alone does not explain the ease with which subject relatives are activated.

The performance hierarchy shown by children with SLI in this study (S-, A-, P-, Obl-, Io-, GenS-, GenO) reflects the frequency distribution in the ambient language reported by Diessel (2004: chap 6) except for the subject relatives which are reported to be less frequent in the ambient language but which the children with SLI produce with the least difficulty (though not significantly). However, as outlined in section 3.2.1, there were two types of object relative used in the current study and when the subject relatives were compared with the object relatives that more accurately reflect those used in natural discourse, any apparent asymmetry between the two disappeared. This is consistent with the research carried out by Kidd et al., (2007). Furthermore, the children with SLI performed better on the 'natural object relatives' than they did on the transitive subject relatives. Therefore, if we discriminate between the different types of object relative, the SLI performance reflects the frequency distribution outlined by Diessel (2004: chap 6) even more closely than it initially seemed. The only significant difference between subject and object relatives for children with SLI, was found between the intransitive subject relatives and the object relatives which were not considered to reflect those used in our general spoken language. It would seem that this further supports the theory regarding the importance of the frequency of distribution for children with SLI, which in turn facilitates ease of activation.

In contrast, the type of object relative did not impact on the performance of the other two groups of children — there were no significant differences between either type of subject relative (S- or A-) and either type of object relative for either the AM-TD group or the YTD group. We might therefore argue that as both the YTD and the AM-TD children are further up the developmental hierarchy of relative clause development, the frequency distribution in the ambient language is less influential on their ability to produce relative clause constructions.

In further explaining the results of their study, Diessel and Tomasello (2005) argue that their 4 to 5 year old TD children produced approximately the same amount of errors in response to direct object relatives, indirect object relatives, and adverbial/oblique relatives because these three types of relative clauses involve the same word order. As shown in (17 – 19) direct object relatives, oblique relatives and indirect object relatives, include the same sequence of constituents (i.e. ...NP(rel) NP V...). This is in contrast with the constituent order in both subject and genitive relatives (20 – 21). Even though direct object relatives are much more frequent than oblique and indirect object relatives they argue that the structural similarity is

over-riding the fact that the children have little experience with the oblique and indirect object relatives.

17. **object relative:** Anne found the book that you read in school today.

18. **oblique relative:** Eddie painted the picture that the girl looked at today.

19. **indirect object relative:** Emma watched the girl who Joe gave some sweets to.

20. **subject relative:** The girl cleaned up the milk that spilt in the fridge.

21. **genitive (object) relative:** Emma met the girl whose bag Anne took to school.

In the case of the AM-TD group and the YTD group, the current study is in keeping with this data in that there were no significant differences between these three relative types in the performance of both groups. However this was not the case for the children with SLI. For these children, there were significant differences between direct object and indirect object relatives and between the direct object and oblique relatives, there were no significant differences between the oblique and indirect object relatives. This suggests that the frequency of the structure in the ambient language may be more important for the children with SLI than for a younger TD child. It could also be argued that the processing load of an oblique and indirect object relative is greater than that for an object relative. Both relative types include stranded prepositions increasing the syntactic complexity of the utterance and requiring the child to store more information in working memory before a complete interpretation of the sentence can be applied.

Diessel (2009) argues that there may also be other influencing factors affecting children's processing of object relatives. In a study looking at the role of frequency and similarity in the acquisition of subject and non-subject relative clauses, he argues that 'the prototypical meaning of non-subject relatives helps the child to bootstrap into this type of relative clause'(Diessel 2009: p. 263). While subject relatives tend to consist of a variety of constructions, such as transitive, intransitive and copular verbs with various combinations of animate and inanimate nouns, non-subject relatives usually consist of a prototypical transitive clause. They usually comprise a dynamic verb denoting a goal directed activity, followed by a pronominal subject serving as the agent or experiencer. While this 'prototypical' structure may indeed assist the children with SLI in processing the non-subject relatives at object level — it does not compensate for the extreme difficulty that they have with indirect object and oblique relatives. Nor does it negate the strong word order preference in the NVN direction, shown by the children with SLI in converting target relative clauses to another relative clause type (discussed in section 5.5).

The children with SLI had the greatest difficulty with Io, GenS and GenO-relatives. One of the reasons why they had the greatest difficulty with these relatives may be that all three are extremely rare in the ambient language. Gen-relatives are also very different from all other relative clause types in that they establish the link between

the main and relative clause through a genitive attribute that is coreferential with the noun modified by the relative clause and semantically associated with the subsequent noun.There was no significant difference between the performance of children with SLI on the Io and GenS-relatives but their performance on Io and GenO-relatives was significantly different. This may also be a reflection of structural similarities between relative clauses. Both Io- and GenS-relatives show the same N(rel)NV word order (22 –23), whereas GenO-relatives are extremely different from all other types of relative clause. In fact the word order in GenO-relatives is like no other structure, N(rel)NNV (24), therefore there is no prototypical structure from which children can acquire this schema.

22. **indirect object relative:** This is the man who Joe wrote a letter to.

23. **genitive (subject) relative:** This is the girl whose Mammy ran in the race.

24. **genitive (object) relative:** There is the cat whose tail Joe caught in the door.

In summary, the ease with which children with SLI deal with relative clauses is significantly affected by the syntactic role of the relative clause. This in turn is affected by the frequency distribution of the relative clause in the ambient language and the structural similarity between the relative clause type and simple sentence structures. It would seem that as children are further up the developmental hierarchy of relative clause development, the frequency distribution in the ambient language is less influential on their ability to produce relative clause constructions.

5.4   Transitive versus Intransitive subject relatives

Past literature has indicated that TD children tend to avoid transitive verbs in their early relative clauses (Jisa & Kern, 1998). Research by Hamburger and Crain (1982) also indicated that three to five year old TD children have more difficulty interpreting transitive relative clauses than relatives that include an intransitive verb. The number of arguments in a sentence affects the number of lexical items that must be retrieved, the number of thematic roles that have to be assigned and the amount of information that must be held in working memory. We would therefore expect that the fact that transitive relative clauses have two arguments and two referents, would make them more difficult to produce than their intransitive counterparts. Based on previous research the question was asked as to whether children with SLI would show greater difficulty with transitive relatives (A-relatives) than intransitive relatives (S-relatives). The current data suggested that this was not the case. Although there was a trend towards significance, the difference between the S and A-relatives was not statistically so.

This may have been influenced by the overall structure of the intransitive subject relative clauses used in this study. In order to control the length of each sentence

containing a relative clause the intransitive verbs were followed by a prepositional phrase and some adverbial information. An example of the type of transitive and intransitive relatives that were included in this study is shown in (25 – 28).

25. This is the toy that broke in the box last week. **PnS**

26. There is the pig that climbed into the box yesterday. **PnA**

27. Joe saw the rabbit that jumped in the big field. **DoS**

28. Eddie met the girl who broke the window last week **DoA**

The use of additional prepositional phrases increased the similarity between the two types of subject relatives, for example in some cases the transitive verb required a prepositional phrase as part of the following argument, (26). The addition of prepositional phrases also affected the number of lexical items that had to be retrieved and held in working memory, therefore increasing the processing load of the structure. This in turn may have negated the affect of the argument structure of the transitive subject relatives.

5.5   Conversion errors

As outlined in section 4.1.7 one of the most common error patterns for each group of children was the conversion of the target relative clause into another type of relative clause. The conversion errors occurred in two directions: S/A-relatives were converted to P-relatives, and P, Obl, Io and Gen-relatives were converted to S/A-relatives. Given the research findings from Diessel and Tomasello (2005) where young TD children showed a preference for converting relative clauses in the NVN direction, the question was asked as to whether the children with SLI would show this same preference. The NVN word order preference was strongly borne out in the current data. Furthermore, this word order preference was not shown for either the AM-TD group or the YTD group.

In explaining their data (from young TD children), Diessel and Tomasello (2005) argued that these conversion errors occurred in an NVN direction, because subject relatives are more easily activated than other types of relative clauses and because of their structural similarity with simple sentences. The role of frequency in ease of activation has already been discussed and it would seem that frequency of a structure is an important factor in the acquisition of relative clauses for children with SLI. As posited by Diessel and Tomasello (2005) for young TD children, it can also be argued that structural similarity is highly influential for children with SLI. Subject relatives involve the same sequence of subject, verb, and object as simple sentences whereas non-subject relatives deviate from the familiar SV(O) pattern.

The suggestion that similarity with simple sentences plays an important role in the acquisition of relative clauses has also been put forward by Bever (1970); Villiers et

al. (1979) and has been outlined in section 2.7.1. Bever (1970) asserted that English speaking children acquire a canonical sentence schema based on a prototypical transitive clause. The argument put forward was that subject relatives involve a NVN sequence which allows the child to use the canonical sentence strategy in interpreting the sentence, whereas object relatives involve a sequence of nouns and verbs that does not match the NVN-schema and are therefore more difficult to interpret.

Although the NVN word order preference is clearly shown for children with SLI, in the significant difference between the number of conversions from A to P versus P to A, A to P versus Obl to A and A to P versus GenO to A, there was no significant difference between the number of conversions from A to P versus Io to A. As was the case with the young TD children in Diessel and Tomasello's acquisitional work (2005), the children with SLI often tended to leave out the relative clause subject in the Io relatives. Although this resulted in utterances with the same word order as S/A-relatives, the structure was ungrammatical and therefore was not included in this category. Therefore, there was in fact a word order preference in the NVN direction within the Io relatives but the children were unsuccessful in their attempt to formulate the relative clause grammatically.

Overall the AM-TD group showed very good control of the relative clauses presented in the task (excluding the Gen-relatives). Therefore, excluding the genitive relatives, there were few conversions in their data (2.6%) and no NVN word order preference was evident. This finding was further substantiated by the GenO relative conversions, unlike the other two groups the AM-TD group had a far greater tendency to convert from GenO to P-relatives (41% of their conversions) rather than GenO to A-relatives (12%). Therefore they tended to produce an utterance that more closely resembled the target response than one that fitted the NVN pattern. At this stage in relative clause control it seems that word order is not a significant issue for children of this age.

While the YTD group carried out approximately twice as many relative clause conversions (excluding genitives) as the AM-TD group, there was no significant difference in the types of conversions and therefore no word order preference evident in their data. This was in contrast to the Diessel and Tomasello (2005) results, where the children converted P, Io and Obl relatives significantly more often to S/A-relatives than A-relatives to P-relatives. The children in their study ranged in age from 4,3 to 4,9 (mean 4,7), while the YTD group in the current study ranged from 4,7 to 4,11 years (average 4,9). It is therefore unlikely that age contributed in any significant way to the differences in the two sets of results. With regard to the P-relatives, it may be the case that the word order preference was diminished as a result of using both types of object relative in the current study. As the children performed better on the object relatives that followed the semantic constraints of natural discourse there wasn't the same tendency to convert them to a simpler

structure. As was the case with the children with SLI, the Io-relatives were more difficult than the P relatives for the YTD group. Many of their conversions were unsuccessful, resulting in ungrammatical relative clauses and therefore reducing the difference in the number of conversions made in the direction of A to P versus those from Io to A. The comparisons between A to P versus Obl to A, and A to P versus GenO to A, were initially significant but following Bonferroni correction this was no longer the case. This indicated that there may have been some word order preference for the YTD group in an NVN direction but this was not a strong preference.

Because conversion errors are often inconsistent, Diessel and Tomasello (2005) argue that they are not always the result of a lack of grammatical knowledge. They suggest that these errors can be explained by the fact that certain types of relative clauses are more easily activated than others i.e. that conversion errors are due to the activation of the wrong grammatical pattern. We might consider that the further up the developmental hierarchy of relative clause development the less likely the incorrect grammatical pattern will be activated — the current data substantiates this theory, with the AM-TD group showing no word order preference in the NVN direction, the YTD group showing some (but not a substantial) preference and the children with SLI showing a strong word order preference in the NVN direction — readily activating this grammatical pattern. Diessel (2009: p 259) also suggests that 'relative clauses constitute a family of constructions that children acquire in an incremental fashion such that new relative clauses are learned based on structures the child already knows. As both the AM-TD group and the YTD group have stronger control of relative clauses than the children with SLI, relative clauses with different word order patterns will be more easily activated for these two groups of children and they are less likely to revert to the NVN pattern in their conversions.

In summary:

- The frequency of a syntactic structure would seem to play a key role in the acquisition of relative clauses for children with SLI.

- The similarity between the relative clause structure and the simple sentence would also seem to be influential in the acquisition of relative clauses for these children.

- When compared to object relatives that do not follow the semantic constraints of natural discourse, subject relatives cause the least difficulty for children with SLI, however this is no longer the case when compared with object relatives that children actually say and hear.

- As well as the frequency of these 'natural object relatives', the children with SLI may be further assisted in their successful production of object relatives by the bootstrapping effect of 'the prototypical transitive clause' in which they occur.

- While the structural similarities between object, oblique and indirect object

relative are cited as key to the processing and development of these
constructions in the early stages of TD grammatical development, the
children with SLI showed significant differences between object relatives and
both oblique and indirect object relatives. This is interpreted as further
support for the importance of the frequency of the structure in language use
for children with SLI over and above the structural similarity.

- The ease of activation of subject relatives is particularly evident in the
  conversion errors made (in the NVN direction) by children with SLI. This is
  accounted for by the fact that subject relatives have the same word order as
  simple sentences.

- As the AM-TD and YTD groups do not exhibit the strong word order
  preference in the NVN direction, this is considered to reflect the fact that they
  are further up the relative clause developmental hierarchy than the SLI group
  and can more easily activate relative clauses with different word order
  patterns.

- The children with SLI had the greatest difficulty with Io, GenS and
  GenO-relatives because they are extremely rare in the ambient language.

5.6   Other Error Patterns

5.6.1   Omission of Obligatory Relativizer

As outlined in section 2.9.1 a marked pattern of obligatory relativizer omission from
subject relatives has been previously outlined in literature describing children with
SLI. This was particularly the case in studies of children with SLI from the USA
(Schuele & Nicholls, 2000; Schuele & Tolbert, 2001) and from Sweden (Hakansson &
Hansson, 2000). These studies were in contrast to work carried out by Hesketh
(2006) who found that 6 - and 7- year old children with SLI from the UK, showed an
omission rate of 16% (four omissions out of twenty five subject relative clauses) in
comparison to the 6- and 7- year old children from the U.S.A (Schuele & Tolbert,
2001) who omitted obligatory markers on 57% of occasions (fifty-six omissions out
of ninety-nine relative clauses). The current study is in support of the data from
Hesketh (2006). The children with SLI show obligatory relativizer omission in 15.6%
of the subject relatives (forty omissions out of two hundred and fifty-six subject
relative clauses). This is in comparison with the YTD group who show an omission
rate of 9.4% (fifteen omissions out of one hundred and sixty subject relative clauses-
where over half of the omissions came from one child) and the AM-TD group who
do not omit any obligatory subject relative markers (0%).

Hesketh posits a number of contributory factors that may account for the difference
in the data from the UK versus that from the U.S.A. Firstly, there were linguistic

differences in the target sentences across the studies. The target sentences in the Schuele and Tolbert (2001) study were all imperative constructions with the modified noun phrase at the end of the sentence. In contrast, Hesketh's study (2006) included sentences where the relative clause was attached to the main clause subject (i.e. the relative clause was embedded within the sentence). The current study did not include any relative clauses attached to a main clause subject and as such, more closely resembled the target sentences of the Schuele and Tolbert (2001) study. However, the current study also included relative clauses of the presentational form and as these are considered cognitively easier to process, this may have diluted the tendency of the children with SLI to omit the obligatory relativizer.

Secondly, Hesketh (2006) cites the number of relative clauses elicited, as a possible contributory factor in accounting for the differences between both studies. The current study elicits more relative clauses than both of these previous studies described, but the data remains in keeping with Hesketh's results.

Thirdly, Hesketh (2006) suggests that the children included in different studies may be drawn from 'different disordered populations'. She describes the children included in her study as having ' a language disorder of sufficient severity and discrepancy from other cognitive abilities to be placed in a language unit for education' (Hesketh 2006; page 544). She also outlines the fact that grammatical difficulties were not primary for all children in her study and that there was variation within the group in both the severity and the sub-type of their language problems. In contrast, the Swedish children in Hakansson and Hansson's (2000) study were all diagnosed as having SLI with language production and grammatical problems and those in Schuele and Tolbert's (2001) research had expressive difficulties that were particularly evident in the area of grammaticality. The current study includes children with a more varied profile, the children were not controlled for in terms of their expressive skills and they did not belong to one specific sub-group. The children in this study would therefore be considered to more closely resemble those in the Hesketh (2006) study than either of the other research profiles. As these children are more varied in their language profiles, we can argue that they provide a broader perspective in terms of their performance patterns.

Schuele and Nichols (2000) hypothesise that initial productions of subject relative clauses are characterized by consistent omissions of obligatory relative markers followed by a period of inconsistent inclusion. They also suggest that the consistent use of obligatory markers in subject relative clauses emerges approximately two years after subject relatives first emerge. They suggest that this may be as late as 5 to 6 years. It is unclear from the current data when subject relative clauses first emerged for these children with SLI. The average age of the children with SLI in this study is 6;10. If subject relatives first emerge around 5 years of age we would expect that the omission of obligatory markers would be considerably reduced by 6;10

years. The current study also includes relative clauses attached to the predicate nominal of a copular clause which are considered to emerge earlier than the fully fledged bi-clausal relatives (Diessel & Tomasello, 2001). If we follow the developmental hierarchy put forward by Diessel and Tomasello (2005) then we consider relative clauses to emerge by a process of clause expansion — the early relative clauses are said to be 'presentational amalgam constructions' (where the relative clause and main clause are merged into a single unit) with no relativizer present and these are followed by 'full presentational relative constructions'. We could also argue that this same process occurs in the development of fully fledged subject relative clauses for children with SLI — from 'subject amalgams' to fully fledged bi-clausal subject relatives. It has been posited that subject relative clauses are the most easily activated relative clauses due to their structural similarity with simple sentences, as well as the contribution of their distribution frequency in the ambient language — however initial attempts at these clauses seem to involve the merging of the main clause in to the relative clause. As is the case with the presentational amalgams, as soon as the full subject relative clauses begin to emerge, the frequency of the amalgam subject relatives reduces significantly. This would account for the current data where most of the children with SLI (28 out of a possible 32) do show some ability to produce a full bi-clausal subject relative.

It is also important to note that in the current data, responses were coded 7a (representing obligatory relativizer omission) only in cases where there were no other major errors. Minor errors as outlined in section 3.4 were allowed. As children with SLI often tended to produce other significant errors in their productions, the prevalence of obligatory relativizer omission may not be fully represented in the current data. Responses such as those at (29) show the omission of the obligatory relativizer but they are also ungrammatical in other ways (as well as (30) showing interference from an earlier sentence) and are therefore not reflected in the responses coded as 7a.

29.   **Target:** There is the pig that climbed into the box yesterday.

      Response: *There's the pig dropped the bag from yesterday.*

30.   **Target:** There is the sheep that drank the water this morning.

      Response: *There's the sheep drank in this morning.*

Responses such as those at (31 – 32) were coded 2b (representing a presentational main clause followed by a simple sentence with no relativizer — Presentational amalgams) and conflated 'subject amalgams' were categorized as ungrammatical relative clauses. These utterances varied too much from the original target utterance to warrant being scored as a seven, however they are representative of the obligatory relativizer omission error pattern.

31.   **Target:** There is the man who drove the car in the garden.

Response: *There is the man drove in the car ...... a garden.*

32. **Target:** Joe watched the cat that chased the mouse in the garden

    Response: *There's the boy chase after the mouse.*

33. **Target:** Emma saw the man who patted the dog on the back.

    Response: *Emma saw the farmer petted on the dog's back.*

While 15.6% of the subject relative responses is not considered a very high representation of obligatory relativizer omission, over half of the children with SLI (56% — 18 out of 32) did show did this error pattern at some point (if not very often). If we include the presentational amalgam constructions (31 – 32) and the subject amalgam constructions (33) there are only eleven children (34%) who do not omit the obligatory relativizer in any of the subject relative clauses. The Pn amalgam construction was more common (representing 65% of the obligatory relativizer omissions) than its subject amalgam counterpart (which represented 35% of the omissions). The YTD group on the other hand presented a more even profile, with over half of their omissions coming from one child. It was also the case for the YTD group that a Pn amalgam construction emerged from a Pn subject relative and a subject amalgam construction emerged from a full bi-clausal subject relative. In contrast, as can be seen in the example at (32), for children with SLI it was sometimes the case that a full bi-clausal subject relative was converted to a presentational amalgam construction.

Following detailed analyses of the data, it would appear that a broad developmental pattern is emerging for children with SLI — from the use of a simple sentence, to the presentational amalgam construction, to the presentational subject relative, to the subject amalgam construction and finally the bi-clausal subject relative. Not every child with SLI demonstrated all five of these stages in their data but it was not uncommon to see four of the five stages (to varying degrees) simultaneously represented in a child's responses. As greater control of the bi-clausal subject relatives emerged there was less evidence of obligatory relativizer omission or presentational amalgam constructions, however children with SLI seem to prolong this stage in their development of relative clauses. This pattern of performance is also seen with grammatical morphemes (consistent omission, inconsistent omission, consistent inclusion).

In summary,

- A broad developmental pattern of subject relative clauses is suggested for children with SLI — from simple sentences, to presentational amalgam constructions, presentational subject relatives, subject amalgam constructions and finally full bi-clausal subject relatives.

- The pattern of obligatory relative marker use seems to parallel the pattern of performance with grammatical morphemes: consistent omission in

obligatory contexts, followed by inconsistent omission and finally consistent inclusion.

- The omission of the obligatory relativizer in subject relative clauses, was not as common an error as outlined in previous research by Schuele and Tolbert (2001).

- Although the bi-clausal type of subject relative used in the current study more closely resembled that used by Schuele and Tolbert (2001), the rate of relativizer omission was in keeping with that found by Hesketh (2006). However, it is important to note that the variation in the language profile of the children in the current study more closely resembled the children used in the Hesketh (2006) study.

- The current data may not be completely representative of this error pattern as sentences were only coded as 7a in responses where there were no other major errors.

- Although the error pattern was not very frequent, 56% of the children with SLI used the pattern at some point in their data (18 out of 32). If presentational and subject amalgams that contained other errors were included, this increased to 66%.

5.6.2   Choosing the appropriate Relativizer

In addition to the omission of relative markers another pattern which was evident to varying degrees in the three groups, was the substitution of *What* for other relativizers. This is outlined in section 4.3.6. This has been previously noted in the literature and a number of theories have been put forward as explanations. Flynn and Lust (1980) argued that typically developing children tend to replace *that* with *what* because *what* is commonly used in headless relative clauses (one in which there is no lexical head — see section 4.3.6), which children seem to master before they master headed relative clauses (Hamburger, 1980). Schuele and Tolbert (2001) argue that, as *which, who* and *whom* are allowable relativizers but also function as *wh* interrogative pronouns, it may be that children with SLI overextend *what* from its function as an interrogative pronoun to function as a relativizer. In the Schuele and Tolbert (2001) data the use of *what* as a relativizer was unique to the children with SLI. This is in contrast to the current study, where both the AM-TD and YTD groups also substituted *what* for *who* or *that*. Just over half of the YTD group and the group of children with SLI used the *what* relativizer at some point in their sentence output, while 20% of the AM-TD children used it. The differences between the Schuele and Tolbert data (2001) and the current data may be explained (at least partly) by dialect influences. The Schuele and Tolbert study (2001)was carried out with children from the U.S, in a region where the use of *what* is not acceptable in

the local dialect. While it is not standard in Hiberno-English, it could certainly be argued that there are some rural parts of Ireland where *what* may be heard as a relativizer in adult language use.

This does not account for the fact that children with SLI showed additional evidence of difficulty in identifying relative markers appropriately. It was often the case that they did not discriminate between the use of *who* or *that* when referring to an animate or inanimate head noun respectively (in 55 responses) (34). This was not an error evident in either of the other two groups. Children with SLI also occasionally used the lexical items *when, where, so* and *with* as relativizers (35 – 37). In the case of *when, where* and *so* the sentence was categorized as another complex sentence or an attempt at one.

34. **Target:** There is the pencil that fell on the ground in school.

    Response: *There is the pencil who fell at the floor in school.*

35. **Target:** This is the woman who made the dinner on Monday.

    Response: *This is the woman when make the dinner on Monday.*

36. **Target:** There is the tree that the car crashed into last night.

    Response: *There is the tree where the car crashes last night.*

37. **Target:** Eddie met the girl who broke the window last week.

    Response: *Eddie met the girl so he break the window last week.*

38. **Target:** There is the sheep that drank the water this morning.

    Response: *This is the sheep with drank that drank with morning.*

In summary

- The extent of the use of the *what* relativizer in all three groups is in contrast with previous research (Schuele & Tolbert, 2001) documented in the literature and may be accounted for by dialect differences between U.S English, U.K English and Hiberno-English.

- Dialect influences do not account for the difficulty that children with SLI experience in choosing relative markers appropriately. This difficulty appears to be specific to children with SLI. (excluding the genitive relativizer *whose*, which was difficult for all three groups).

5.6.3   Resumptives

The use of resumptive pronouns or noun phrases (NP) has been noted in previous research and has led to a debate over the structure of young children's early relative

clauses. A resumptive pronoun or NP is a pronoun or NP in a relative clause which refers to the antecedent of the main clause (39 –40), (highlighted in bold).

39. **Target:** There is the rabbit that the girl chased in the park.

    Response: *This is the rabbit who the girl chased after **it.***

40. **Target:** Anne painted the picture that the girl looked at today.

    Response: *Anne painted the picture that she looked at **the picture** today.*

There are adult grammars where resumptive pronouns appear in relative clauses, both optionally and obligatorily. While they are ungrammatical in most English dialects, they are sometimes used by individuals who get trapped in either very long or very complex relative clauses (Foss & Fay, 1975). The use of resumptive pronouns is not part of any Hiberno - English dialect and could therefore not be considered influential in the current data.

In terms of linguistic theory, based on data from French-speaking children, Labelle (1990) argues that the use of resumptives is incompatible with wh-movement. She suggests that children's early relative clauses do not involve movement but are linked to the main clause by a complementizer. McKee et al. (1998) noted the use of a small number of resumptives in their corpus data, from 28 TD children, ranging in age from 2;2 to 3;10. They document the use of seven resumptive pronouns from three children in their data and argue that they are reflective of performance demands rather than being generated in any systematic way by the grammar. As such they argue for a similar motivation to that put forward by Foss and Faye (1975) when describing resumptive use by adults. The reason for their position is that, each of the children who produced resumptive pronouns produced more relative clauses without them than with them and most of the resumptive pronouns were in object position (similar to the adult English usage). Diessel and Tomasello (2005) also note the use of resumptives in their work with 4 year old TD children — they documented six sentences in which the children either used a resumptive pronoun or a resumptive noun phrase in lieu of a gap (e.g. *This is the girl who, who the boy teased **the girl** this morning; Here is the girl who borrowed a football **from her***). In contrast the resumptives were not all in the object position in Diessel and Tomasello's (2005) data.

In any case, the use of resumptives is not a common error pattern in any of the aforementioned studies and this is also borne out in the current data, (SLI — .4%, YTD — .8%, AM-TD -.3%). However, it is worth noting that these figures do underestimate the number of instances where a child used a noun phrase in lieu of a gap. In the current data, a response was given a score of seven B, in cases where the use of a resumptive was the only error in the response or if it was accompanied by other minor errors. This was rarely the case for children with SLI who also used a noun phrase in lieu of a gap in approximately 7% of their ungrammatical relatives. While all the resumptives coded as seven B occurred in the object, oblique or

indirect object positions in the current study (41 – 42), the use of a noun phrase in lieu of the gap in other ungrammatical relatives also occurred in the subject position (43). It would therefore appear that the use of a pronoun or noun phrase in lieu of a gap may reflect a more systematic error in the responses from the children with SLI than in those from the other two groups. This also explains the apparent higher % of YTD children who used a resumptive pronoun in their responses.

41. **Target:** Emma spoke to the man who the horse ran away from.

     Response: *Emma talked to the farm who the horse ran away from **the farm.***

42. **Target:** This is the man who Joe wrote a letter to.

     Response: *This is the man who Joe writed to **him.***

43. **Target:** This is the toy that broke in the box last week.

     Response: *This box that **it** broke last year.*

It could also be argued that the use of a resumptive is memory based. As they are more likely to occur in the object, oblique or indirect object position and in relative clauses where other errors are made, it may be that as the processing demands of the relative clause increase, the child has difficulty carrying the unattached filler for the required length of time, (until the sentence can be fully integrated semantically and syntactically). We could also argue that if children with SLI have a reduced resource allocation, then they have difficulty switching from the processing of the relative clause to maintaining a representation of it — they therefore experience decay, which results in them reproducing a noun phrase or pronoun which refers to the antecedent in the main clause.

In summary

- Due to the fact that children with SLI often produce responses with multiple errors, the use of resumptives as coded seven B, is an underestimate of the prevalence of pronoun or noun phrase use in lieu of a gap.

- The use of resumptives does seem to be reflective of a more systematic error in children with SLI than with YTD children.

- Children with SLI may produce resumptives as a result of a 'reduced resource allocation' — causing difficulty in their ability to switch from processing to maintaining a representation of the utterance, thereby causing them to produce a noun phrase or pronoun in lieu of a gap.

5.6.4   Ungrammatical Relative Clauses

As outlined in section 4.3.6, the AM-TD group produced the least number of ungrammatical relatives (3%), followed by the YTD group (7.9%) and then the children with SLI (14.5%). The percentages given excluded the ungrammatical

relatives that were produced when attempting the genitive relative clauses as they caused considerable difficulty for all three groups. The patterns shown by the YTD group were very similar to the AM-TD group but were in greater volume. Different error patterns between the two groups were rare but included, verb restriction violation, ungrammatical relativizer substitutions, the inclusion of a noun phrase in the 'gap', the production of N relatives (e.g.*the book who you read today.*) and relativizer omission (particularly the genitive relativizer). They were also more likely to combine errors in a given response.

The error patterns between the YTD group and the children with SLI were in turn quite similar. However, despite this, the frequency and combination of the errors reflected a different profile. Children with SLI also produced ungrammatical relatives when attempting subject and object relatives (considered developmentally to be at a lower level). Errors that were relatively rare in the YTD group were much more common for the children with SLI. As outlined in section 4.3.6, the children with SLI also made additional errors, for example, article omission, phonological intrusion (to be discussed in section 5.7), omission of the main clause or relative clause subject. They were also more likely to use N relatives, would sometimes omit the main clause or relative clause verbs altogether or omit the entire main clause and recall only the second clause. The variation in error patterns reflects the huge variability in the performance of children with SLI.

The YTD group on the other hand were much more systematic in their responses. Almost all of their ungrammatical relative clauses occurred from Io-, Obl- and Gen-relative target utterances. They were more likely to maintain the overall structure of the target relative clause or closely resemble the structure of another relative clause type in attempting a conversion (44). The lexical items were also more likely to closely resemble those of the original utterance (45 – 46). These examples also show the use of a noun phrase in the 'gap'.

44. **Target:** There is the girl who Joe bought some flowers for.

     Response: *There is the girl what the boy bought the girl flowers for the girl for.*

45. **Target:** There is the girl whose toy Anne broke in the garden.

     Response: *There is the toy that Anne broke the toy in the garden.*

46. **Target:** Anne saw the farmer whose cow fell in the shed.

     Response: *Emma saw the farmer who a cow fell in the shed.*

An equivalent example of each of these ungrammatical relative clauses is shown for the children with SLI (47 – 49). As illustrated the responses from the children with SLI, tended to encompass more error combinations and the lexical items did not always resemble those used in the original structure.

47. **Target:** There is the girl who Joe bought some flowers for.

Response: *This is the John who got flowers for.*

48. **Target:** There is the girl whose toy Anne broke in the garden.

    Response: *There is the toy who met the garden.*

49. **Target:** Anne saw the farmer whose cow fell in the shed.

    Response: *Anne saw the farmer who throw the ball in the farm.*

As outlined in section 4.1.8, a particular difficulty for children with SLI was noted with stranded prepositions. Diessel and Tomasello (2005) also remarked on this error in their data (from young TD children). They noted that in Io relatives, children often left out the subject of the relative clause, which resulted in utterances with the same word order as S/A relatives (50). Although this type of mistake also occurred in P- and Obl-relatives, it was particularly evident in Io-relatives. While this error was also evident in the current data, the children with SLI tended to make additional errors in relation to these relative constructions. They sometimes omitted the relativizer as well as the relative clause subject (51), resulting in a 'subject amalgam relative' with the final preposition added to the end of the sentence. (52) and (53) show two more Io- relatives produced as simple sentences but with the final preposition included, (54) shows a 'presentational amalgam construction' but again with the final preposition and (55) shows a presentational subject relative again with the added preposition. Some of the Io-relatives were successfully converted to a subject relative (56 – 57).

50. **Target:** There is the horse that the girl gave a drink to.

    Response: *There is the horse who gave the drink to.*

51. **Target:** Eddie smiled at the girl who Joe read a book to.

    Response: *Eddie saw the girl read a book to.*

52. **Target:** Emma watched the girl who Joe gave some sweets to.

    Response: *Joed fed the girl the.....the...the sweets to.*

53. **Target:** Emma watched the girl who Joe gave some sweets to.

    Response: *Emma and an boy gave the sweets to.*

54. **Target:** There is the girl who Joe bought some flowers for.

    Response: *There's the Joe give him a flower to.*

55. **Target:** There is the horse that the girl gave a drink to.

    Response: *There's the horse that gave her the drink to.*

56. **Target:** There is the dog that the man kicked his football to.

    Response: *There's the man that kicked the football to the man.*

57. **Target:** Anne fed the baby who Emma sang a song to.

    Response: *Emma feed the baby who sing.....sing a song to her.*

Memory based accounts, that were originally posited to account for the subject-object relative clause processing asymmetry in adults, could also be extended to account for the findings that children with SLI have particular difficulty with stranded prepositions, (Io-relatives in particular). It was claimed that the length of time the unattached fillers must be carried for, predicts the cognitive load of the sentence (Wanner & Maratsos, 1978). Given the examples of a subject relative, object relative, oblique relative and indirect object relative shown at (58 – 61), the filler phrase 'the horse' must be carried unattached for longer in the indirect relative clause than for any of the other three relative clause types.

58. There is *the horse* that ____ drank the milk.

59. There is *the horse* that the girl rode ____ .

60. There is *the horse* that the girl rode on ____ .

61. There is *the horse* that the girl gave a drink to ____ .

While there may be a memory contribution to the Io-relative clause performance, what is most striking about the data shown in (50 – 57), is the fact that all the errors made by the children with SLI result in an NVN word order. Sometimes the indirect object is also included but the word order preference remains constant throughout, with the addition of the final preposition, which is the most recent lexical item heard from the target utterance. This serves to further reinforce the fact that children with SLI have a strong word order preference in the NVN direction and seem to activate this canonical pattern, used in simple sentences, more readily than any other structure.

In summary

- Excluding attempts at genitive relative clauses, the children with SLI produced almost twice as many ungrammatical relative clauses as the YTD group.

- Although many of the error patterns were the same for both groups, the frequency and combination of errors for the children with SLI reflected a different profile.

- The children with SLI began to use ungrammatical relative clauses at an earlier stage in relative clause development (on S-, A- and P-relatives) than the YTD group.

- The ungrammatical relative clauses produced by the children with SLI were more likely to deviate further from the target utterance in both structure and vocabulary, than those produced by the YTD group.

- The children with SLI had significantly greater difficulty than the YTD group with stranded prepositions.

- A strong word order preference in the NVN direction was evident in the ungrammatical Io-relatives produced by the children with SLI, again reinforcing the importance of structural frequency in the ambient language, for children with SLI.

5.6.5   Simple Sentences

The contribution of structural frequency to ease of activation is outlined in section 5.2 and is further substantiated by the use of simple sentences in place of relative clauses by children with SLI. The theory discussed in the literature is that the more frequently a grammatical construction occurs, the more entrenched its mental representation becomes and the easier it is to activate in language use (Bybee, 1985, 1995, Bybee & Hopper, 2001). It is suggested that subject relative clauses are more easily activated for children with SLI because of their structural similarity with simple sentences. We have also observed a strong NVN word order preference in the relative clause conversions made by the children with SLI. In a pilot study of subject relative clauses, Schuele and Tolbert (2001) found that children with SLI under 5 years of age formulated only simple sentences in response to their elicited task. Based on this and following the developmental pattern of clause expansion discussed in relation to young TD children (Diessel & Tomasello, 2001), we might expect that children with SLI (particularly those around 6 years) would replace some of the relative clauses which they find difficult, with simple sentences.

As outlined in section 4.3.7, 15.2% of target relative clauses were produced as simple sentences by the children with SLI in the current study. This was in comparison to 4.4% for the YTD group and .12% (2 responses out of 1,664!) for the AM-TD group. Many of the children with SLI demonstrated a very mixed profile in their responses. Even at the level of the subject and object relative clauses, (which the children with SLI had the least difficulty with) it was not unusual for a child to produce responses given a score of 8 (indicating that the structure of the relative clause was present) as well as those scored as 2, (representing a simple sentence) in response to the same type of relative clause. This also occurred for the YTD group but to a lesser extent. There were two children in the YTD group in particular who presented with this inconsistent profile and one of the target intransitive subject relatives seemed to be more problematic than the others, resulting in 6 of the YTD children converting it in to a simple sentence. Some of the responses from the YTD group are given below (62a -c). As can be seen in the responses from the YTD group, although they have converted the relative clause in to a simple sentence, they continue to maintain much of the semantic integrity of the sentence.

62. **Target:** The horse ate the grass that grew in the field all summer.

62a. **Response:** *The horse ate the grass in the field all summer.*

62b. **Response:** *The horse ate the grass in the field.*

62c. **Response:** *The horse eated the grass all the time in summer.*

In contrast when the children with SLI converted the same relative clause in to a simple sentence they tended to alter the meaning of the sentence such that it sometimes became meaningless (63a — d).

63. **Target:** The horse ate the grass that grew in the field all summer.

63a. **Response:** The, the ...... cow ot (eat) the grass in the field all yesterday.

63b. **Response:** The grass ate the grass in the field from yesterday.

63c. **Response:** The horse eh ... grass..... the horse went in the grass today.

63d. **Response:** The horse grew in the field in all winter.

If a child showed the ability to score 8 or more on a particular relative clause type, then the production of a simple sentence in place of the same relative clause type cannot be attributed purely to a lack of grammatical knowledge. It was often the case that the children knew how to form the relative clause despite the fact that they repeated them incorrectly. This inconsistency of performance could be explained by the fact that some grammatical patterns are more easily activated than others. As simple sentences are highly frequent in the ambient language, the production of a simple sentence in place of a subject or object relative may be as a result of activating the wrong grammatical pattern.

Diessel and Tomasello (2005) present a similar argument when discussing the inconsistency of conversion errors in relation to young TD children. They further support their argument by the fact that when presented with P-, Io- or Obl-relatives, young TD children often started with the word order of an S/A-relative but then realized that they had made an error and corrected the word order. This was not the case for the children with SLI who in contrast, did not show any ability to engage in repair strategies. Although they did show the use of mazes, once they began a structure it was almost as if there was 'no way back' and they continued to produce some response until they could find their way to the end (64 – 66).

64. **Target:** Emma spoke to the man who the horse ran away from.

   Response: *A man....Emma talk with a man the horse ran horse gone.*

65. **Target:** The cat caught the mouse that ran around the garden.

   Response: *The dog ran around the garden with the cat around.....running around the garden.*

66. **Target:** The boy rode the horse that Anne put in the field.

> **Response:** *Anne who put the horse in the field John ride the horse in to the field.*

In summary

- The production of simple sentences in place of relative clauses was the second most common error pattern for children with SLI.

- Due to their frequency in the ambient language and therefore their level of entrenchment, simple sentences are more easily activated for children with SLI.

- Even when a child showed that they had grammatical knowledge of a relative clause structure (particularly in the case of subject and object relatives), they continued to sometimes substitute the target relative clause with a simple sentence. This may be as a result of activating the wrong grammatical pattern.

- Unlike young TD children, once a grammatical pattern was activated the children with SLI did not show the use of repair strategies.

5.6.6   Other Complex Sentences

As outlined in section 4.3.4 the use of other complex sentences was not a common error pattern for children with SLI. Other complex sentences included catenative complements, non-finite clauses, subordinate clauses and reduced relatives. Complex sentences which were grammatical accounted for only 2.9% of the errors in the SLI data. Of the complex sentences used, the reduced relative was the most common. The use of reduced relative constructions has been previously documented in the literature (Hesketh, 2006; Schuele & Tolbert, 2001). Schuele and Tolbert (2001) found that they occurred in 11.5% of subject relative clauses produced from children aged from 5;1 to 7;8 years and described them as a developmental step prior to the production of full relative clauses. Hesketh (2006), found that reduced relative constructions occurred in 15% (10 out of 68) of children's responses (aged between 6;0 and 7;11 years) on her elicitation task . The UK children therefore used the reduced relative construction more frequently than their U.S counterparts.

The data in the current study is in contrast with both of these previous studies, but particularly with the Hesketh (2006) study. As the results are quoted for a similar age profile, (children aged between 6;0 and 7;11 years), age cannot be considered a contributor. However, the linguistic differences between the relative clauses used in both studies is likely to make a significant contribution to the number of reduced relatives produced.

As outlined in section 2.6, Hesketh (2006) used relative clauses of the form (SS), i.e. her stimuli involved post modification within the subject of the matrix clause and

the modified element was the subject of the relative clause (left-branching). If we compare the structural similarity between these left-branching relative clauses (using the present continuous tense) and reduced relatives, shown in (67 – 68), the child has only to omit the relativizer in order to produce the reduced relative construction.

67. **Stimulus:** the girl who's holding the flowers is thin and....

67a. **Target:** the man who's holding the umbrella is fat.

67b. **Reduced Relative:** *the man holding the umbrella is fat.*

68. **Stimulus:** the woman who's wearing a red scarf is a nurse and....

68a. **Target:** the woman who's wearing the yellow scarf is a dentist.

68b. **Reduced Relative:** *the woman wearing the yellow scarf is a dentist.*

As relatives clauses attached to a main clause subject are rare in young children's speech, (Diessel & Tomasello, 2001) these were omitted from the present study. This study uses relative clauses which are either attached to a presentational copular clause or a direct object transitive clause, as well as those that cover the full range of syntactic roles (i.e. subject, object, oblique, indirect object, and Gen). As a result there is a greater difference between the structure of the relative clauses used in the present study and that of a reduced relative (69 – 70). In the case of subject relatives the child has to change the tense ending as well as omit the relativizer and in the case of P-, Io-, Obl- and Gen-relatives, the child must also alter the word order to form a reduced relative construction. This would account for the substantial difference in the number of reduced relatives used by children with SLI in both studies. It also provides further support for the importance of structural similarity for children with SLI.

69. **Target:** Joe watched the cat that chased the mouse in the garden.

69a. **Reduced Relative:** *Joe saw the cat chasing the rat or something.*

70. **Target:** Anne helped the girl who Eddie baked a cake for.

70a. **Reduced Relative:** *Anne helped the girl making the cake.*

Not all attempts at producing other complex sentences were successful for children with SLI. Ungrammatical complex sentences accounted for a further 3.1% (52 out of 1,664) of the responses from the children with SLI. This included the complex sentences outlined above as well as ungrammatical attempts at co-ordination. This result is weighted /skewed by the performance of two children who attempted to use co-ordination as a primary strategy to avoid the production of relative clauses. These two children accounted for 23 out of 52 of the ungrammatical complex sentences and almost all were unsuccessful attempts at co-ordination (71 – 72). Over half of the children did not produce any ungrammatical complex sentences.

The performance by the children with SLI is in contrast with the YTD and the AM-TD groups, both of whom produced ungrammatical complex sentences in less than 1% of their responses. (YTD — .58%, AM-TD — .12%). This is a significant difference between the YTD group and the children with SLI. The YTD children were less likely to use other complex sentences to replace a relative clause and if they did, these complex sentences were almost always grammatical. In fact grammaticality represents one of the significant differences between the YTD group and the children with SLI. While many of the same structural patterns existed, (conversions, simple sentences etc.) the children with SLI were much more likely to be ungrammatical in their responses than the YTD children.

71.   **Target:** Anne fed the baby who Emma sang a song to.

   Response: *Anne feed the baby and she sing on the song.*

72.   **Target:** This is the woman who made the dinner on Monday.

   Response: *This is the woman and woman make a dinner day.*

In summary

- The use of complex sentences in place of relative clauses was not a common error pattern for children with SLI.

- The most common complex sentence used was the 'reduced relative', however this in no way matched the numbers of reduced relatives produced in previous studies, particularly that carried out by Hesketh (2006) involving UK children of the same age as the present study.

- The types of relative clauses used in both studies is likely to account for the differences in the children's responses e.g. left branching relatives attached to a main clause subject versus right branching relatives attached to a main clause object and covering a range of syntactic roles.

- The number of ungrammatical complex sentences is skewed by the performance of two children who are unsuccessful in their attempts to use co-ordination as a strategy when dealing with relative clauses.

- Grammaticality is emerging as a significant difference between children with SLI and YTD children.

5.6.7   Co-ordination and unconnected clauses

It has been noted in the literature that before being able to produce semantically full relative clauses, TD children may produce the pieces of information as two simple sentences, in separate syntactic units (e.g. *Once there was a house. Peter lived in the house.* (Ingram, 1975, p.112) and that this gives way to the use of co-ordination (e.g. *Once there was a little boy and he went for a walk in the woods.* (Ingram, 1975 p.112).

In TD children this is said to occur at around 3 years. The TD children in this study were significantly older (6;0 to 7;11) and the YTD group were 4;7 to 4;11, therefore we did not expect this pattern to occur for either of these two groups. We were interested in know whether this pattern would exist for the children with SLI.

The use of co-ordination and/or unconnected clauses was not prevalent in the error patterns of children with SLI and is outlined in section 4.3.5. Only 2.9% of the responses from children with SLI were coded in this category and 21% of these responses came from one child who used co-ordination as his primary strategy in dealing with relative clauses. The fact that seven children with SLI used co-ordination or unconnected clauses only once throughout their responses, and a further thirteen children did not use them at all, again highlights the variability in performance and heterogeneity in the profiles of these children.

The use of co-ordination and / or unconnected clauses was almost non existent for the other two groups — .12% for the AM-TD group (two responses in 1664) and 1% for the YTD group. Again, as the YTD group have a better control of relative clause constructions than the children with SLI, they are less likely to juxtapose the two clauses in this way.

5.6.8   Uninterpretable responses

As noted in section 4.3.11, almost 10% of the responses from children with SLI were uninterpretable. Some of these responses were coded as uninterpretable due to the combination of errors that the child imposed on the target structure, such that it became impossible to be clear regarding what syntactic framework the child was applying. Other responses were coded uninterpretable due to part of the child's response being inaudible. A number of children with SLI, substituted words with weak unintelligible forms which largely consisted of vowel sounds. The children rarely did this when repeating the practice items but as the sentences became more complex, the number of partial and unintelligible forms increased. This has been previously noted in the literature by Chiat (2000, chap. 10). Chiat (2000) observed this pattern in repetition work carried out with a child 'Travis'. She suggested that he had difficulty registering the phonological forms in the input utterance. It seemed that he registered the overall rhythm of the sentence and the phonological forms of two or three of the key words, and that he tried to 'fill in' the rhythmic slots of those he couldn't remember with phonological padding. Chiat (2000) noted that (for Travis) this was particularly evident in his production of verbs and argues that verbs are vulnerable because of their position within the sentence. Because they take arguments they rarely occur in the final position within the sentence, which has the greatest stress.

It is difficult to be clear whether this is a phonological memory issue or a speech perception problem. The current data did not indicate verbs as being particularly

vulnerable but did suggest that words with less stress were omitted more readily. While children had difficulty with stranded prepositions (discussed in sections 4.1.8 and 5.6.4), it also seemed that unstressed prepositions were likely candidates in the phonological fall out. This was evident in filler sentences as well as in relative clauses (73 – 74).

73. **Target:** Eddie played with the little boy in the park.

    Response: *Eddie play the little boy in the park.*

74. **Target:** Emma spoke to the man who the horse ran away from.

    Response: *Emma /ə/ run away from the horse.*

In many cases, the child's intonation suggested that s/he did register the overall rhythm of the sentence as well as the phonological forms of three or four key words. In the current data these words were most likely to be at the beginning and end of the sentences, strongly suggesting the psychological memory processes of *primacy* and *recency*. In some cases, the child became focussed on the adverbial information at the end of the sentence (e.g. *yesterday, this morning, last week, today)* and either repeated the same phrase in many sentences or chose an adverbial ending, which had been used in a previous sentence. As the adverbial endings were repeated throughout the SR task, there was a limited pool from which the child could choose, which made these lexical items easier to access than other words in their vocabulary. In trying to fill in the rhythmic slots, some children produced phonological forms that rhymed at the end of the sentence. The sentence *Joe rubbed the cat....* was produced *The girl will lat* and the relative *...who patted the dog on the back* was produced *....who saw the man unpack.* While not statistically analysed, the problem of decay seemed to increase as the complexity of the relative clause increased and the vocabulary used became distanced further from the target utterance (75). On a number of occasions, the child would use a phrase that was semantically associated with a previous sentence and then continue to use it in several responses. The sentences at (76) and (77) were produced consecutively.

75. **Target:** Joe rubbed the cat that the goat stood on last week.

    Response: *Ed get .... steal the cat off a goat.*

76. **Target:** Joe liked the girl whose dog Anne found in the park.

    Response: *Joe find the dog on the leg? like in a .... in the yard.*

77. **Target:** There is the man who drove the car in the garden.

    Response: *That's a man drive a car in a .... in a yard.*

Possible explanations for the use of these unintelligible phonological forms and repeated phrases will be discussed in section 5.7 when looking at the role of short term and working memory in children's performance on the task.

5.7   The role of short-term and working memory

One could argue that relative clauses are a particularly well suited area of complex syntax, in which to disentangle the role of phonological short-term memory (STM) and working memory, in that they can vary in complexity while at the same time being controlled for phonological length. As a result, error patterns in a sentence recall task, across the full range of syntactic roles cannot be accounted for by a simple deficit in phonological STM.

In terms of the sentence recall paradigm, we know from previous research (outlined in section 2.5), that while children can use their phonological short-term memory to 'parrot' short sentences without understanding them, sentences that exceed a child's STM span must be understood in order to be repeated successfully. If the sentence length is such that it cannot be supported by STM then syntactic and semantic representations in LTM are likely to play a more significant role in recalling the sentence. It has been posited in section 2.5.4, that sentence recall involves the process of reconstructing a partially decayed phonological representation so as to be consistent with the conceptual /semantic representation of the sentence while at the same time conforming to the general linguistic / syntactic constraints imposed by the language. All of the sentences being investigated in the current study are considered to be beyond the memory span of the children with SLI. Therefore we expect that both syntactic and semantic representations in long term memory will be more significant in supporting the recall of the sentence. However, if we consider composite memory scores, (reflecting the different components of Baddeley's model — see Figure 2.1, section 2.5.2), a medium association was observed between sentence repetition and phonological memory performance for children with SLI and a strong association for the other two groups of children (see section 4.2.1). Looking at memory subtests, the strongest association was observed between sentence repetition and digit recall for all three groups. This suggests that at some level, phonological STM is involved in sentence repetition. Digit Recall scores also differed significantly between the SLI group and the other two groups, with poorer performance in the SLI group, suggesting that STM may be an important influencing factor affecting the differences in the profiles among the groups.

If we reflect on the work carried out by Potter and Lombardi (1990, 1992, 1998), they propose that 'a sentence is generated in immediate recall from a representation of its meaning (in long-term memory) using recently activated words' (Potter and Lombardi, 1990, p. 633). While Potter and Lombardi (1998) suggest that the recently activated lexical items are from conceptual information in long-term memory, their phonological form must be initially stored in short- term memory in order to allow for retrieval from long-term memory. If we apply Baddeley's model (outlined in section 2.5.3) the phonological loop is said to be made up of a temporary storage

system and a subvocal rehearsal system. The temporary storage system is subject to decay within approximately two seconds. It is the subvocal rehearsal system that is said to maintain the information to prevent decay. Although the subvocal rehearsal system is said to begin developing around four years, it is not fully established until between seven and eight years. The children with SLI in the current study were in the age range 6;0 to 7;11, therefore, for many, their ability to use the subvocal rehearsal system is not yet fully established and is likely to impact on their ability to store phonological forms in short term memory. If this does not happen successfully and the phonological forms suffer some decay, then we might consider that a child is more likely to produce words that are phonologically similar (rhyming) or words that have been successfully recently activated from a previous sentence. It is at this point that a child may try to engage in the process of 'redintegration'. If the phonological decay is more substantial we might then expect the production of unintelligible vowel forms (discussed in section 5.6.8). While the ability to use their sub-vocal rehearsal system may be a contributory factor to the phonological decay shown by children with SLI, it cannot account for all of it — far fewer phonological intrusions/ partial rhyming words and unintelligible forms were produced by the YTD children, whose sub-vocal rehearsal system is also not fully established.

Interestingly, in contrast to other studies (Conti-Ramsden et al., 2001; Kamhi & Catts, 1986; Bishop, North, & Donlan, 1996), the current data showed only a small association between sentence recall and non-word repetition for the children with SLI. This may have been influenced by the particular subtest used. In the present study, the non-word repetition subtest from The Working Memory Test Battery for Children (WMTB-C), (Gathercole & Pickering, 2001), was administered. This uses monosyllabic non-words only, presented in gradually increasing numbers. In contrast, The Children's test of non-word repetition (CNRep), (Gathercole & Baddeley, 1996) has been used in other studies (Conti-Ramsden et al., 2001) and is a more substantial test of non-word repetition, including 40 non-words increasing in syllable length. In this test the researcher hides his/her lips behind a screen of paper to avoid the child using any visual supports. This test may reflect the children's difficulties more thoroughly.

It is also the case that non-word repetition is lexically mediated. It reflects the ability to store verbal material in STM as individual lexical units. But the current study focusses primarily on syntactic structure rather than semantic or phonological retrieval. It is possible to achieve a score of 8 while making semantic or phonological errors and a score of 6 is assigned for a grammatical relative clause conversion, regardless of whether there are semantic errors in the response. If we compare the sentence recall task used in the CELF-4 (Semel, Wiig & Secord, 2003) semantic errors influence the overall score more readily than in the current study. In this study the integrity of the structure is prioritized in the scoring system and semantic errors are secondary. This may have diluted any correlation between

non-word repetition and SR score.

The syntactic role of the relative clause also affected the children's performance. As outlined earlier this is highly influenced by the frequency of the structure in the ambient language, arguably increasing the level of entrenchment and making it easier to access the particular structure. As previously discussed, many researchers in the past have posited that object relatives are more difficult to process than subject relatives, but when children are tested on relatives that they say and hear this no longer appears to be the case. It is suggested that the syntactic complexity and cognitive load of a sentence is reflected in the distance between the filler and the gap or the length of the dependency. This causes difficulty in disentangling syntactic complexity from working memory. There is a gradual increase in dependency length in obj-, obl- and Io-relatives, which is reflected in a progressively poor performance by the children with SLI (although the differences are not significant between the latter two relative clause types). An increase in the length of the dependency places a greater burden on working memory, such that it dictates the length of time the 'unattached' head noun must be carried for before it can be integrated with the following verb phrase and preposition. This may affect the child's ability to process the sentence for meaning which in turn will affect their ability to repeat it.

We know that if the target sentences in a sentence recall task are beyond the child's memory span, sentence recall involves the processing of the sentence for meaning and is therefore a working memory task. In the present study, there was a moderate association between listening recall (said to reflect working memory ability) and the performance of children with SLI on the sentence recall task. This was not the case for the AM-TD group and the test was not administered with the YTD group (due to age restrictions). Both of the other complex memory span tasks (counting recall and backward digit recall) showed only a small association (counting recall being a negative one). Given that sentence recall and each of these measures of central executive functioning involve working memory, we might have expected a stronger association. However, this may be influenced by the limitations of the complex memory span subtests in the WMTB-C (Gathercole & Pickering, 2001), all of which are strongly verbal in nature. In fact it was difficult to score some of the children with SLI on the listening recall task in particular, as they did not understand what was required of them. Perhaps the association might have been stronger if all of the children understood the task at hand. Ideally, the test battery should also include non-verbal central executive tasks so that both verbal and non-verbal capacities of the central executive could be adequately tapped into.

One error pattern that was evident in the current data, was that children with SLI had difficulty suppressing irrelevant information from previous sentences (78 – 82). Sentences (78) and (79) were presented four sentences apart.

78. **Target:** The **horse** ate the grass that grew in the **field all summer**.

> **Response:** *The horse eh..... grass.... the horse went in the grass today.*

79. **Target:** The boy followed the little dog all around the garden.

    Response: *The boy fol.... eh followed eh **horsie to the field**.*

Sentences (80) and (81) were consecutive and sentence (82) was given four sentences later.

80. **Target:** Anne fed the baby who Emma **sang** a song to.

    Response: *Emma, Emma feed the baby and sing the song.*

81. **Target:** Eddie sent a card to the woman for her birthday.

    Response: *The woman **sang** the card who birthday was on today.*

82. **Target:** This is the man who Joe wrote a letter to.

    Response: *There is the girl who **sang** the girl yesterday.*

Some of the responses produced by the children with SLI showed phonological intrusion in the form of rhyming. Examples are given at (83) and (84).

83. **Target:** Eddie **smiled** at the girl who Joe read a book to.

    Response: *Joe..... Eddie **read a mile** to Joe who read the book to.*

84. **Target:** Eddie **sent a card** to the woman for her birthday.

    Response: *Eddie **went to the car** for her birthday.*

This interference has been noted in previous literature (Gillam & McFadden, 1994), where children with SLI were reported to show exaggerated recency effects and to produce irrelevant words from previous sentences or sentence positions when the required response was the final word. It has been posited in the literature that working memory is tied to attentional control in explaining individuals performance on tasks that involve distraction or interference (Barrett et al., 2004). As outlined in section 2.4.5., it is argued that working memory reflects attentional control in task switching ability (Towse et al., 1998) and in the ability to inhibit irrelevant information (Hasher et al., 1991). If we apply the task switching hypothesis (Towse & Hitch, 1995), it is suggested that individuals alternate between processing information and attempting to maintain representations of the constituent to be stored. The greater the processing demands the greater the interval between storage episodes. This results in an increase in the period of time for which representations may be lost due to decay.

As discussed in section 2.4.4, it has also been posited in the literature that children with SLI have a slow processing speed. This would also result in longer periods of time alternating between storage and maintenance and would result in a high rate of decay from working memory. An alternative account is that it is not primarily a working memory problem but that the slower real-time sentence processing is

related to inefficient lexical retrieval operations, causing children difficulties in accessing the appropriate lexical items and engaging in the redintegration process. Given that the children have shown interference in both the filler sentences and the relative clause constructions, this may be a more likely explanation than that of a pure working memory difficulty.

Because many of the sentences are semantically similar, containing lexical items that belong to the same semantic category of animal, the children may have experienced similarity based interference (Gordon, Hendrick, & Johnson, 2001b). Gordon et al. (2001) suggest that syntactic complexity can be influenced by the confusability of the referents mentioned in each noun phrase. Many of the referents used in the SR task of the current study are animals and could therefore be considered highly confusable. The sentences were also made up of four named toy people *Anne, Joe, Eddie and Emma* who were repeated throughout the task. Many errors made by the children with SLI involved naming the wrong person or animal, suggesting that similarity may play a role in processing difficulty. This is exemplified in sentences (78 and 79) which include the referents *horse* and *dog* and the places *garden* and *field*. However, this does not account for the verb interference, for example, *sang* in sentences (81) and (82).

In summary

- The strongest association was observed between sentence repetition and digit recall for all three groups, which suggests that phonological STM has a role to play in sentence repetition, even when the sentences exceed a child's memory span.

- Digit Recall scores were significantly poorer for the children with SLI than for the other two groups, suggesting that STM may be an important cognitive factor affecting the differences in the profiles among the groups.

- The ability to use the subvocal rehearsal system may be a contributory factor in explaining some (but not all) of the phonological decay in children with SLI.

- The phonological decay and reduced ability in the sentence recall task could also be accounted for by (1) poor attentional control, (2) slow processing speed or (3) inefficient lexical retrieval operations — which may be influenced by semantic similarity.

- It is difficult to disentangle syntactic complexity from working memory as the cognitive load of the sentence is said to be reflected in the length of the dependency. However, the greater the dependency length the greater the burden on working memory.

- There was a moderate association between sentence recall performance and listening recall, which may have been diluted by the children's ability to understand the listening recall task.

- Children with SLI have difficulty suppressing irrelevant information from previous sentences.

- Children's poor attentional control affects their ability to focus on thoughts relevant to the task at hand and causes difficulty in suppressing irrelevant information from previous sentences.

- Similarity based interference can occur as a result of sentences containing semantically similar referents.

5.8   The role of children's language status

Studies involving sentence recall have become more popular in recent years, despite the fact that in the past, there has been little consensus in the literature about the ability of a repetition test to evaluate children's language competence. In discussing recall tasks with TD children, some authors have suggested that they may underestimate children's linguistic abilities as a result of the involvement of verbal working memory in these tasks (Case & Kurland, 1980; Brownell, 1988) while others predict an underestimate of linguistic competency due to a lack of contextual support that would occur in conversational speech (Bloom et al., 1975; Case & Kurland, 1980). Other researchers take a different approach and suggest that sentence repetition might overestimate children's language ability. In attempting to resolve this contradiction, Bates, Bretherton, and Snyder (1991) proposed that the ability to imitate is reflected in individual differences, such that some children imitate in advance of their spontaneous language abilities while others restrict their repetitions to structures that they already produce and understand. This is supported by Maratsos (1983) who in his review of several studies using repetition tasks, noted that TD children with similar spontaneous language skills performed differently in recall tasks. Some of the children performed well while others performed poorly. The usefulness of a recall test may also be influenced by the age of the children. Vender (1981) as cited by Devescovi and Caselli (2007) carried out a recall task with children between 3;6 and 6;11 and found that the test was less sensitive as the children got older.

The fact that sentence repetition has been identified as a strong clinical marker for children with SLI (Conti-Ramsden et al., 2001) has led to increased use of this methodological paradigm. It may be the case that sentence recall is more useful as an assessment tool with children whose language is still somewhat limited, either due to age or a specific impairment. A study by Devescovi and Casseli (2007), with TD children aged 2 to 4 years showed positive correlations between free speech and sentence repetition and indicated that sentence repetition provides a reliable measure of mean length of utterance.

The current study is in support of this finding outside the realm of TD children. For

children with SLI, the strongest association was between sentence recall and expressive language abilities (expressive language scores explaining 35.7% of the variance in sentence recall). This was in contrast to the AM-TD group whose performance was near or at ceiling for most of the relative clause constructions (excluding the genitives) and who also performed consistently well on the expressive language subtests of the CELF-4 (Semel, Wiig, & Secord, 2003). There was also a strong association between sentence recall and expressive language abilities for the YTD group. We can therefore be confident that for the children with SLI and the YTD group, the ranking of syntactic knowledge that is reflected in standardized assessments (in this case the CELF- 4) is also being reflected in the SR task of the current study.

Surprisingly, this was not the case for receptive language. There was no association between sentence recall and receptive language abilities for the children with SLI in the current study. This may be a reflection of the subtests used (in the CELF- 4) to measure receptive language skills. The two subtests were Sentence Structure and Concepts and Following Directions. The former requires that the child listen to a grammatical structure and then choose (from one of four semantically similar pictures), which picture represents the structure. For example when given the sentence *The girl is being pushed by the boy* the child is also shown a picture of *the boy is being pushed by the girl, the boy and the girl pushing the bike together* and *the girl standing behind the boy on the bike.* This task involves working in two modalities simultaneously — the child must connect to the picture and hold the given sentence in memory until finding the correct picture. The second subtest — concepts and following directions, involves the processing of instructions of increasing length and complexity. The instructions contain a number of abstract concepts and require the child to remember the order the information is presented as well as scan a range of objects presented in picture format. Examples include *Point to the fourth black ball and the first white ball. Before you point to the little black shoe and the big black shoe, point to the little white ball.* Given the length of some of these instructions and the fact that they are very heavily weighted in terms of semantic concepts, perhaps it is no surprise that they do not correlate with the SR task in the current study for children with SLI.

5.9   Clinical Implications and Future Research

The findings of the current study have a number of implications for Speech and Language therapists and teachers who are responsible for the intervention needs of children with SLI. The primary implication is that children with SLI are significantly delayed in their development of relative clause constructions. Secondly, children with SLI show a developmental hierarchy in their development of relative clauses and this is broadly reflected in the distribution frequency of relative clauses, in the

ambient language (as reported by Diessel, 2004: chap 6). The developmental hierarchy is reflected in both the matrix clause as well as the syntactic role of the relative clause.

In terms of the main clause, as with younger TD children, children with SLI show the developmental pattern of clause expansion (discussed by Diessel and Tomasello, 2001). The early relative clauses are embedded in copular constructions, initially they are produced as presentational amalgam constructions, where the main clause and relative clause are merged in to a single syntactic unit (with no relativizer) and this is followed by a full presentational clause. They are semantically simple, such that the whole structure represents a single situation and can be paraphrased by a single sentence. In these structures the child combines a somewhat formulaic main clause (of the form That's x, There's x) with a second component. This pattern of clause expansion is important for therapists when working on this area of complex syntax with children with SLI.

This type of relative clause is also considered pragmatically useful for adult child speech, as in conversation together, children and adults tend to talk about items in their environment. The function of the presentational main clause is to focus the listener's attention on items in their environment, which are then further elaborated on in the relative clause. This should facilitate the ease with which therapists and teachers can reinforce these structures within the school day.

This study shows the importance of structural frequency for children with SLI. The performance hierarchy shown by children with SLI reflects the frequency distribution in the ambient language reported by Diessel (2004: chap 6) with the exception of subject relatives (S/A-relatives) which are reported to be less frequent in the ambient language but which the children with SLI produce with the least difficulty. The good performance of children with SLI on S/A relatives is explained by their structural similarity with simple sentences and by the fact that they are more easily activated than other types of relative clause. This ease of activation is facilitated by the fact that S/A relatives have the same NVN word order as simple sentences, which are highly frequent in the ambient language. This word order preference is particularly evident in the types of conversions used by children with SLI and in their continued use of a simple sentence in lieu of a relative clause.

In terms of the syntactic role of the relative clause the developmental hierarchy is presenting as intransitive subject relatives, object relatives (similar to those used in natural discourse), transitive subject relatives, object relatives (with an animate head noun and nominal relative clause subject), oblique relatives, indirect object relatives and genitive relatives. It would be important for therapists and teachers to be cognizant of this hierarchy when attempting to develop children's understanding and production of relative clauses. Therapists and teachers should also be aware of the important role of structural frequency in our everyday language use, We may sometimes focus on the use and teaching of a syntactic structure in a formal way

and not appreciate fully the extent to which our ambient language use may impact on the development of complex syntax for these children. Resources such as frequently used books or computer software could be readily adapted such that the required structure is repeated many times throughout a story or programme.

The results of this study also highlight the importance of using relative clauses that are representative of those that children actually say and hear. Consistent with the research carried out by Kidd et al., (2007), children with SLI perform better on object relative clauses that more accurately reflect those used in natural discourse. In fact, they performed better on this type of object relative than on transitive subject relatives. Thereby highlighting the importance of structural frequency for these children. Many research studies, standardized assessments and therapeutic tools have tended to use object relatives where the head noun of the matrix clause is animate and the subject of the relative clause is represented as a common noun (85). In contrast, object relatives used in natural discourse tend to have an inanimate head noun and a pronominal relative clause subject (86). It would be important for both therapists and teachers to consider this when working on this area of complex syntax.

85. The dog kicked the horse that the man rode.

86. The cake (*that*)she made was lovely.

It has been noted in the literature that measures of finite verb morphology are extremely sensitive in distinguishing young children with and without SLI. However, as children grow older, morphosyntactic deficits are no longer a highly discriminating diagnostic marker of SLI. The results of this study suggest that measures of complex syntax may serve as 'new' positive discriminators between older children with SLI and YTD children (who are on average two years younger). This is an important factor for Speech and Language Therapists to consider when assessing older children with SLI.

This study indicates that while children with SLI show a pattern of relativizer omission in their development of relative clauses, they also have difficulty choosing relative markers appropriately. Particularly, in distinguishing between the use of *that* and *who*. The choice of relative pronoun is determined by whether the relativized noun phrase is personal or non-personal (Quirk & Greenbaum, 1973; Quirk, Greenbaum, Leech, & Svartvik, 1985). For example, *who* is used with a personal noun phrase such as *the girl*, whereas *that* is used with a non-personal noun phrase such *the dog* or *the problem*. Although the relative pronoun *who* is sensitive to these features, the relativizer *that* is not sensitive. Children with SLI have difficulty with this sensitivity.

This study also aimed to explore the role of short-term and working memory in the performance of children with SLI, on the sentence recall task involving relative clauses. In terms of memory subtests, the strongest association was observed

between sentence repetition and digit recall for all three groups. This suggests that phonological STM is involved in sentence repetition at some level. Digit Recall scores also differed significantly between the SLI group and the other two groups, with poorer performance in the SLI group, suggesting that STM may be an important cognitive factor affecting the differences in the profiles among the groups. A moderate association was also evident between sentence recall performance and listening recall (a measure of working memory). Working memory is said to be linked to attentional control, the ability to suppress irrelevant linguistic material and the ability to maintain focus on the task at hand. Therapists might therefore consider the benefits of working on span tasks, both simple and complex, to develop children's phonological and working memory in parallel with more direct language work. They might also consider the length of the syntactic structures being targeted and work from shorter to longer constructions containing relative clauses.

There is a dearth of research on how children with SLI control the full range of relative clauses. It would be beneficial if the results of this study were to be replicated with a larger number of participants. A longitudinal study would also provide useful information, particularly if the elicitation task was complemented by language samples from the children. This would allow us to see how pervasive the error patterns were, which were evident in the data. In this study the young TD children were chosen within an age range to allow certain memory tasks to be performed but were not matched to the children with SLI based on their language level. Future studies might explore the production of relative clauses in children with SLI who are linguistically matched to the younger children with typical language development. It would also be interesting to extend the age range of the children with SLI upwards, particularly to focus on the more complex relative clauses (e.g. oblique, indirect object) and to research the role of memory with an older age group. It might also be useful to compare the performance of children with SLI with even younger TD children. In the current study, the average age difference was two years between the group of children with SLI and the YTD group, however for some of the children the difference was only one year. As relative clauses begin to emerge in TD children between around 3 years of age, it would be interesting to make comparisons between the performance of children with SLI (at the age in the current study) and YTD children aged around 3;6 years.

It would also be interesting to investigate how the children's production of relative clauses relates to their other oral language skills (e.g. other complex syntactic structures, mean length of utterance, use of morphology) and how their production of relative clauses on the sentence recall task relates to their comprehension of relative clauses. Future studies might also investigate whether the clinical implications discussed above, would hold in an action research situation. It would be useful to carry out an intervention study reflecting the developmental hierarchy of the relative clauses outlined and focussing on the importance of the frequency of

the structure.

Given the sensitivity of sentence recall to children with SLI and to complex syntax, it would seem to be an important paradigm in the investigation of language difficulties. But perhaps it should always be used (in research) in combination with independent measures of memory. We need to disentangle the roles of processing, memory and previous language knowledge.

Experimental studies of the development of working memory have shown that in terms of the phonological loop, memory performance changes both qualitatively and quantitatively (Gathercole, Adams, & Hitch, 1994) over time. One significant period of developmental change occurs at around the age of seven. Before this age there is little evidence that children use their sub-vocal rehearsal system, therefore the performance of children younger than seven, on phonological memory tasks, reflects the contribution of the phonological temporary storage system only. The age profile of the children in this study includes those whose subvocal rehearsal system has not yet developed (between 6 and 7 years) and those whose system may be more developed (between 7 and 8 years). This may be a confounding factor in the children's performance. We know that children with SLI have reduced phonological memory relative to their age matched peers but whether their sub-vocal rehearsal system matures at a similar stage as the TD children is not documented in the literature. From a memory perspective, perhaps it would be interesting to carry out a similar study to include children either beyond 7 years or up to 7 years of age.

Expressive language assessments are somewhat lacking in their detailed attention to complex syntax. However, an accurate description of SLI must consider the entire scope of grammatical limitations, and grammatical strengths — it must not only reflect morphological profiles, it must also consider complex syntactic development. The current work would be complemented by further in depth studies of other areas of complex syntax e.g. non-finite clauses, subordinate clauses, in attempting to provide a more complete characterization of complex syntax in children with SLI. This will allow us to more fully inform our clinical practice and provide more accurate treatment programs for this complex and heterogeneous group of children.

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Appendix A

Consent / Assent Forms

A.1 Consent form for parents of children with SLI

Please tick the appropriate boxes, sign your name and place in your child's speech folder:

Date: **Child's name:**

I am happy for my child to participate in the study 'Investigating complex sentences in children with Specific Language Impairment'.

Yes   ❐   No   ❐

I would like my child's results to be made known to me.

Yes   ❐   No   ❐

I would like my child's results to be made known to his /her school.

Yes   ❐   No   ❐

I would like my child's results to be made known to his / her current Speech and Language Therapist.

Yes   ❐   No   ❐

Signed:

A.2 Consent form for parents of typically developing children

---

Please fill in the date, your child's name, tick the appropriate boxes and sign your name. Please place in your child's school bag.

Date: **Child's Name:**

Date of Birth   **Teacher's name:**

I am happy for my child to participate in the study 'Investigating complex sentences in children with Specific Language Impairment'. My child is participating as a child who does **not** have language difficulties.

Yes ☐   No ☐

I would like my child's results to be made known to me.

Yes ☐   No ☐

I would like my child's results to be made known to his /her school.

Yes ☐   No ☐

Signed:

A.3   Assent form for all children

Assent Form for Child Participants

| Who are you? |

My name is Pauline Frizelle. I am a teacher working in a school for grown-ups.

| What do you do? |

My job is to find out more about how children learn new words.

| Why am I being asked to help? |

I'd like you to help me because you are ____ years old. I want to learn about the words that you say and how you remember things. I have spoken to your Mammy / Daddy and they have said it is o.k.for you to help me .

| If I want to help you, what happens next? |

- If you want to help me you get to come out of your class on two different days.

- We will go to a quiet room in the school, you can ask another grown up to come with us if you like.
- We will play a matching game. I will show you some lovely pictures, then I will say something and you find the picture that goes with what I say. You don't have to say anything during this game.
- Then we will play more picture games. I will ask you to tell me the names of some pictures.
- We'll also play a copying game. I'll say something and you copy me, some of the words will be silly words.
- Some of the games are for big boys and girls so don't worry if you can't do them all, it doesn't matter.

What if I have questions?

You can ask questions if you don't know what to do.

Do I have to help you?

You don't have to help me if you don't want to. If you don't want to help after we have started looking at the pictures that's ok.

Why is it a good idea to help you?

It's good to help people. If you help me with my work I can tell your teacher and your Mammy / Daddy about all the words that you know. I will also be able to help other children who find learning new things very hard
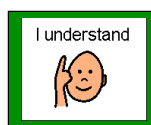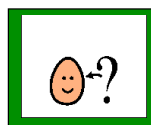
What happens at the end?

When we are finished I will write down all the things I have learned and other grown-ups will ask me some questions.
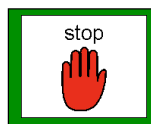
Assent Form (Pictorial version)

		Tick √
I understand what my jobs are.	I understand	
I understand that I can ask questions at any time		
I can stop if I want to	stop	
I am happy to help Pauline with her work		

Signature of Child: _____

 Date: _____

I have solicited the assent of the child.

Signature of Person Obtaining Assent:

_____

Date: _____

Consent of Parent or Guardian:

I agree with the manner in which assent was solicited and given by my child

and I agree to have my child participate in the study.

Print Name of Parent(s): _____

Signature of Parent(s): _____

Date: _____

Appendix B

Letters

B.1 Parental Letter

Note: All letters were printed on the official headed paper of University College Cork.

4th January 2010

Dear Parent,

My name is Pauline Frizelle. I am a Senior Speech and Language Therapist and I am currently carrying out research towards a PhD degree at University College Cork.

My research is in the area of Specific Language Impairment. Little is known about how children with Specific Language Impairment learn how to say complicated sentences and I am planning to investigate this further. I am hoping to have 40 children with Specific Language Impairment involved in my study. This would be the biggest study in Ireland carried out in this area.

Should you give consent for your child to enter this study, I will carry out a number of assessments, the details of which are outlined overleaf. These tests would be carried out over a few sessions so that your child would not become tired. Testing time will vary between children but each test takes approximately 30 minutes. I would hope to see your child at school so there would be no intrusion for you at home.

I have been given ethical approval to carry out this study, by the Clinical Research Ethics Committee of the Cork Teaching Hospitals. All the information I collect will be treated with strict confidentiality. The results of the assessments will not be available to any other person without your consent.

This study will result in new information on how children remember and say complicated sentences. This will help us in diagnosing these children more accurately and will help us to develop better treatments. It will also increase the

likelihood that children with Specific Language Impairment will receive the educational services that they need and deserve.

I would be extremely grateful if you would allow your child participate in this study. If you need clarification on any of the above please do not hesitate to contact me on 087 8057394.

Yours faithfully,

Pauline Frizelle
Senior Speech and Language Therapist

Details of assessments to be carried out:

Should your child become involved in this study, there are four areas of assessment.

- The first is a language assessment which would be similar to that carried out by the Speech and Language therapist working with your child.

- The second is a non-verbal IQ test. This is a short test that looks at your child's strengths in the areas outside of language.

- The third is a memory test where your child would be asked to repeat a list of numbers, words or made up words, for example woogalamic!!

- The final task is called a Sentence Recall task. This would involve a game with some puppets where my puppet will say a sentence and your child would be asked to make his/ her puppet repeat exactly what my puppet said.

B.2   Parental thank you letter

4 June 2010

Dear Parent,

Thank you for allowing your child to participate in the study 'Investigating Complex sentences in Specific Language Impairment'.

The following is a summary of your child's performance on a number of assessments. I hope that you will find this information useful. A copy of this summary has also been given to your child's class teacher (unless you have specified otherwise).

Thanks again for your help in finding out more about children such as yours, who have specific language difficulties. This information will help us in diagnosing children more accurately, in giving better treatments and in improving the educational services that children with language difficulties deserve.

Yours sincerely,

Pauline Frizelle
Senior Speech and Language Therapist

B.3   Letter to school Principals

Principal, St Mary's National School
Lamb's Cross,
Sandyford,
Dublin 18

4th February 2010

Dear ___ ,

My name is Pauline Frizelle. I am Senior Speech and Language Therapist and last year I was awarded a fellowship from the Health Research Board to carry out some research in the area of Specific Language Impairment (SLI). I am working under the supervision of Professor Paul Fletcher and Professor Fiona Gibbon at University College Cork.

I am currently carrying out the main study and Speech and Language Therapists around Ireland are very kindly helping me in sourcing some appropriate children for my study. One of these children (___ ___) is attending your school and her mother has given her consent for me to carry out some assessments with her. I would be very grateful if you would allow me to see her at your school. I would consider that she would perform better in a school setting, as she would be more used to engaging in concentrated work at school. I also feel that it would less intrusive for her parents at home.

Should you provide your consent, I am hoping to see ___ on Monday, Tuesday and Wednesday, the 1st, 2nd and 3rd of March. Should you wish to contact me regarding any of the above please do not hesitate to do so. If you do not wish me to carry out these assessments at your school you can also email me at p.frizelle@ucc.ie.

My contact number is 087 8057394.

Yours sincerely,

Pauline Frizelle
Senior Speech and Language Therapist

Appendix C

Sentence Recall Task

1. Emma saw the man who patted the dog on the back. 11w 13s DoA(trans)

2. This is the toy that broke in the box last week. 11w 11s PnS(int)

3. Eddie played football with the little boy in the park. 10w 13s F

4. Emma spoke to the man who the horse ran away from. 11w 13s DoObl

5. Anne played with the girl in the park, all afternoon. 10w 13s F

6. There is the dog that the man kicked his football to. 11w 12s PnIo

7. The dog chased the cat through the field, on the farm. 11w 11s F

8. Anne saw the farmer whose cow fell in the shed. 10w 11s DoGenSub

9. This is the woman who made the dinner on Monday. 10w 13s PnA(trans)

10. Joe rubbed the cat that the goat stood on last week. 11w 11s DoObl

11. Eddie saw the man whose horse Joe rode, in the field. 11w 12s DoGen

12. Emma watched the girl who Joe gave some sweets to. 10w 11s DoIo

13. The girl cleaned up the milk that spilt in the fridge. 10w 11s DoSint

14. Anne made a cake for the woman at the party. 10w 12s F

15. This is the farmer who fed the cow in the shed. 11w 12s PnA(trans)

16. There is the rabbit that the girl chased in the park. 11w 12s PnP

17. The man cut the grass in the field this morning. F

18. There is the girl whose toy Anne broke, in the garden. 11w 12s PnGen

19. There is the horse that the girl gave a drink to. 11w 11s PnIo

20. Eddie met the girl who broke the window last week. 10w 12s DoA(trans)

21. There is the tree that the car crashed into last night. 11w 12s PnObl

22. The farmer heard the tractor on the road, this morning. 10w 13s F

23. Anne helped the woman who cooked the dinner last night. 10ws12 DoA(tran)

24. This is the cat whose tail Joe caught in the door. 11w11s PnGen

25. Eddie ate a bowl of soup for his lunch, yesterday. 10w 12s F

26. There is the man who drove the car in the garden. 11w 12s PnS(int)

27. Joe liked the girl whose dog Anne found in the park. 11w 11s DoGen

28. The boy climbed up the big tree with a ladder. 10w 11s F

29. The girl ate the sweets that you brought to the party. 11w 12s DoP

30. This is the toy that the cat jumped on in the garden. 12w 13s PnObl

31. This is the boy whose Dad Anne met in school. 10w 10s PnGen

32. The boy followed the little dog all around the garden. 10w 13s F

33. This is the pencil that you broke in school today. 10w 12s PnP

34. Emma met the girl whose bag Anne took to school. 10w 12s DoGen

35. There is the pig that climbed into the box yesterday. 10w 13s PnA(trans)

36. The horse ate the grass that grew in the field all summer. 12w 13s DoS(int)

37. This is the man who Joe wrote a letter to. 10w 11s PnIo

38. The goat kicked the brown cow in the leg yesterday. 10w 12s F

39. This is the bird that slept in the box all night. 11w 11s PnS(int)

40. There is the girl who the cat played with in the kitchen. 12w 13s PnObl

41. Eddie sent a card to the woman for her birthday. 10w 13s F

42. Anne fed the baby who Emma sang a song to. 11w 12s DoIo

43. This is the boy whose coat fell on the floor. 10w 10s PnGenSub

44. The dog ate all the food in the press last week. 11w 11s F

45. The cat caught the mouse that ran around the garden. 10w 12s DoSint

46. There is the picture that you drew on the wall last week. 12w 13s PnP

47. Anne kissed the baby whose face Joe cleaned with a towel11w12s DoGen

48. The man carried the bucket of milk into the shed. 10w 13s F

49. There is the boy who Emma helped in the kitchen. 10w 12s PnP

50. There is the girl who Joe bought some flowers for. 10w 12s PnIo

51. The boy rode the horse that Anne put in the field. 11w 11s DoP

52. Anne found the girl whose mammy ran in the race. 10w 11s DoGenSub

53. This is the boy who Emma danced with all day. 10w 11s PnObl

54. Anne fed the big dog in the kitchen, last week. 10w 11s F

55. There is the pencil that fell on the ground in school. 11w 12s PnS(int)

56. Anne bought the knife that the woman used in the kitchen. 11w13s DoOb

57. Joe saw the rabbit that jumped in the big field. 10w 11s DoS(int)

58. Anne helped the girl who Eddie baked a cake for. 10w 11s DoIo

59. The farmer drove the red car to town, last night. 10w 11s F

60. Anne painted the picture that the girl looked at today. 10w 13s DoObl

61. There is the sheep that drank the water this morning. 10w 12s PnA(trans)

62. The woman drove Eddie to work in the car, last week. 11w 13s F

63. Anne found the book that you read in school, today. 10w 11s DoP

64. There is the girl whose juice spilt in the kitchen. 10w 11s PnGenSub

65. Joe watched the cat that chased the mouse in the garden. 11w13s DoAtran

66. The girl wanted the rabbit that Anne bought in town. 10w 11s DoP

67. There is the cat whose kitten Eddie found last week. 10w 12s PnGen

68. Eddie smiled at the girl who Joe read a book to. 10w 11s DoIo

69. The pig played with the little goat in the rain. 10w 11s F

Appendix D

Glossary

Relative Clause: A relative clause is a type of subordinate clause which serves to modify a noun phrase.

Subject relative clause: One in which the noun phrase that is modified is the subject of the relative clause.

I saw *the rabbit* that jumped over the fence.

Object relative clause: One in which the noun phrase that is modified is the object of the relative clause.

Mary has *the book* that you read in school.

Indirect object relative clause: One in which the head of the relative clause is an indirect object.

There is *the dog* that the man kicked the football to.

Oblique relative clause: One in which the head of the relative clause is the object of a preposition.

Emma saw *the man* that the horse ran away from.

Genitive relative clause: One in which the noun that is post modified is the possessor of a nominal modified by the relative pronoun.

Subject genitive relative clause: One in which the noun phrase containing the genitive functions as the subject.

I met *the woman* whose daughter lives next door.

Object genitive relative clause: One in which the noun phrase containing the genitive functions as the object.

I know *the woman* whose horse Peter saw on the farm.

Centre embedded relative clause: The noun phrase containing the relative clause is in the subject position of the matrix clause.

The girl *that fell off the bike* walked to school.

Presentational Construction (PN relative): A relative clause attached to the predicate nominal of a copular clause (where the main verb is the verb 'to be')

This is the girl I gave the key to.

N relative: A relative clause attached to an isolated noun phrase head.

People that can jump in there.

Headless relative: One in which the relative clause has no lexical head and therefore constitutes a noun phrase by itself.

whoever did that in the sentence *whoever did that is in trouble.*

Reduced relative: Relative constructions that contain a non-finite verb and no relative pronoun.

Joe smiled at the girl reading the book.

Catenative complements; A catenative verb is one which takes a following verb phrase complement, such as help, promise, want.

Anne *helped* the woman cook the dinner last night.

Non-finite complement: A complement in which the verb is not marked for tense or agreement.

Anne decided to cook the dinner.

Subordinate clause: A clause which is embedded in a higher clause.

Mammy kissed the baby *when he was asleep.*

Stranded preposition: Where a preposition occurs with no overt following object.

Emma saw the girl who Joe gave some sweets *to.*