Sentence repetition performance in bilingual children with SLI compared to age and language-matched peers

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Abstract

Sentence repetition (SR) tasks are a reliable clinical marker of specific language impairment (SLI). It is unknown to what extent memory and accumulated language knowledge are employed in this task and how their breakdown presents in children with SLI. It is also yet unknown whether bilingual children with SLI present with different performance patterns on these tasks compared to age and language-matched peers in terms of performance on syntactic categories of words, position of words in the phrase, and the quality of errors made (substitution or omission). The present study investigated SR task performance by scoring for success in syntactic word categories, accuracy in the first or second half of the phrase, and substitution errors. Results are reported for three large participant groups: twenty-six bilingual children with SLI (mean age=61 months), fifty-five typically developing age-equivalent children comprising monolinguals (n=18, mean age=59 months) and bilinguals (n=47, mean age=58 months) and forty-one younger typically developing children comprising monolinguals (n=17, mean age=36 months) and bilinguals (n=24, mean age=35 months). Compared with the large TD groups, the children with SLI performed significantly worse than TD groups but did not produce error patterns distinguishing them as having weaknesses in particular syntactic categories. Both the younger bilinguals and monolinguals and the SLI group showed recency effects in significantly higher performance on the second half of the phrases. The SLI group made significantly fewer errors of substitutions, with 98.6% of their errors being omissions. Matched groups showed the SLI group performing more similarly in syntactic category scores to language-matched peers than age-and-exposure matched peers. Typically developing bilinguals matched on language ability performed similarly to each other. The data support a multifaceted view of SR with memory and accumulated language knowledge playing key roles as underlying mechanisms, and may indicate that in the impediment of access to accumulated knowledge, children with SLI rely more heavily on short-term memory processes without understanding and reconstructing the phrases, as evidenced by their lack of substitution errors.

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Sentence repetition (SR) tasks are a widely used tool in language assessment that involve asking children to repeat recorded sentences of varying length and syntactic complexity and scoring for their errors. Sentence repetition tasks became an important linguistic paradigm in the late 1960s, with the work of Slobin and Welsh (1968) who argued that if an individual could repeat an utterance longer than their word span (the number of random words they could repeat) they could not be depending solely on short-term memory (STM) but must also be using syntactic knowledge by using representations in the long-term memory (LTM) to recall the sentences (Slobin & Welsh, 1968). Studies since then have suggested that during SR task performance, children reconstruct the stimulus from information in the LTM, while also using numerous cognitive processes such as phonological STM (pSTM) (Willis & Gathercole, 2001) and working memory (WM) (James W. Montgomery, Magimariaj, & Finney, 2010)

Sentence repetition tasks emerged as a diagnostic clinical marker for specific language impairment (SLI) due in part to Conti-Ramsden, Farragher, and Botting's 2001 study comparing the diagnostic accuracy of several linguistic tasks: nonword repetition (NWR), tense marking ability (Marchman's elicitation task, Marchman, Wufleck, & Weismer, 1999) and a sentence repetition task. The SR task used was the recalling sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (CELF-Revised). The results of this study found that the SR task was the most diagnostically accurate, with 90% sensitivity and 85% specificity, and overall accuracy of 88%. Prior to this study, SR tasks were unknown for their high sensitivity and specificity for clinical diagnosis. The authors found a significant positive correlation between the nonword

repetition task and the sentence repetition task. Overall, their analyses did not attempt to investigate the underlying mechanisms at play, but they argued that they would be common between NWR tasks and SR tasks, and involve limitations in short-term memory. They did also note that they believed NWR tasks involved greater use of the phonological short-term memory and SR tasks had not only STM involvement, but also involvement of the child's prior language knowledge residing in the long-term memory. To corroborate these arguments, they indicated that SR task success was correlated with linguistic tense tasks where NWR was not. These tasks of linguistic repetition have since been found to be excellent clinical markers for identifying SLI with high sensitivity and specificity scores for monolinguals and also bilinguals (Girbau & Schwartz, 2008; Elin Thordardottir & Brandeker, 2013). Although sentence repetition tasks prove difficult for children with language impairment, the exact mechanisms the task taps into are yet unknown.

Uncovering the Processes of Sentence Repetition

Sentence repetition tasks involve both cognitive processes (involvement of the STM, pSTM, LTM, and working memory) but also accumulated linguistic knowledge. Syntactic and semantic representations located in the LTM are recruited when the STM cannot support the recall of phrases, but it is not yet known to what extent each mechanism is involved nor whether different groups of children (those with language impairment, younger or older children, or bilinguals) use different strategies of reliance on each. This study benefits from having several different large groups of linguistically diverse children from which to draw from and match participants in a way that isolates

factors potentially influencing SR performance. The inclusion of two matched groups analysis in this study allows for more specific comparisons between typically developing monolinguals and bilinguals of differing ages with bilinguals who have documented language impairment.

The first matched group comparison included bilingual children with documented SLI matched by age, language exposure (percent waking hours exposed to French), and MLU to TD peers. This comparison was chosen to isolate the potential effects of cognitive abilities, SLI diagnosis, and accumulated language exposure on SR task performance. Within this matched group, the children with SLI are pairwise matched to the Older bilinguals by age and exposure. This match was chosen because despite being the same age and having similar exposure patterns to the language of the task, these participants differ in their language development patterns and thus it is hypothesized that their performance will be impacted primarily by the presence or absence of a diagnosis of SLI. Because they are of similar age and IQ level, these two groups are thought to have similar cognitive abilities and memory capacities. The children with SLI are also pairwise matched to younger bilinguals by their MLU. This match was chosen because by equating participants on their accumulated linguistic knowledge, it will be possible to see how younger children with TD and children with SLI approach the same task, and if their similar levels of accumulated language knowledge causes them to perform similarly on the task.

The second matched group comparison compared older and younger TD bilinguals matched by their language proficiency (measured by MLU word) in order to

control for their accumulated linguistic knowledge and investigate how SR task performance varied by age. This match takes advantage of the availability of samples from bilingual children with varying amounts of exposure. Thus, it is possible to match younger children with high exposure levels to older children with lower exposure levels, resulting in children of different ages with equivalent language knowledge. The analyses of the performance in this matched group could implicate the role of memory and cognitive abilities in SR task performance, given that the participants have acquired the same amount of the language but differ in their cognitive development.

Because SR tasks implicate more linguistically meaningful material than NWR, it is possible that this test could be further exploited for a finer representation of the child's linguistic and cognitive skills, resources, and weaknesses and whether they lie in the domains of cognitive skills (processing and memory) or linguistic skills (their accumulated knowledge). By identifying the extent to which SR tasks are tapping into memory abilities versus linguistic knowledge, it may be possible to gain a better understanding of where a child's problems lie when they fail to perform well on this task. Studying children who have wide variation in their accumulated language knowledge due to their varying overall language learning ability (arising from their diagnosis of language impairment), exposure to each language, and age can provide perspective on how these factors influence performance. Research using the analysis of SR task performance and errors has helped to implicate these underlying mechanisms and background factors.

Errors on SR tasks may reflect the inefficiency of the working memory, STM, and pSTM. Memory and processing components work together intricately – the ability for the

child to hold and manipulate speech material in the STM and WM permits them to establish long-term phonological connections in the LTM. We know that monolingual children with SLI exhibit significant deficits in their WM and processing skills (James W. Montgomery, et al., 2010). The working memory refers to the mental processes that allow information to be held in a temporarily accessible state during cognitive processing, involves concurrent storage and processing of information. Having a deficit in these skills would very likely impact the success of a child on a task of sentence repetition.

Literature Review

A study by Montgomery (2010) in online sentence processing abilities and how the working memory is implicated found that the immediate processing of subject-verb-object (SVO) forms by monolingual English children does not entail significant working memory, even with children who have SLI. They surmised that simple SVO sentence forms place little demand on the WM. In processing offline sentences of short and long SVOs, results showed that the children with SLI have less functional verbal working memory capacity (the ability to coordinate both storage and processing functions) than their typically developing peers. They also have greater difficulty managing their working memory abilities and general processing abilities than both age and language matched peers when performing a complex offline sentence processing task. The offline processing task involved the subject correctly recalling all of the words on a list in a particular order. There were conditions of no-load (recalling as many words as possible at each list length, regardless of order), single load (correct response scored as number of words recalled and properly ordered by size), and dual-load (correct response defined as

the number of words properly grouped by semantic category and properly ordered by size when recalled). The dependent variable in the comprehension task was the number of sentences correctly comprehended under each sentence type condition. Results indicated that the children with SLI performed similarly to their peers in the no-load and single-load conditions, but performed more poorly under the dual-load condition. However, the children with SLI and their language-level matched peers performed similarly to one another on all three conditions. Analyses also showed that children with SLI showed decreased recall with increase of processing load. This could indicate that on a task of sentence repetition, when the length or complexity of the sentence increases, children with SLI may have a harder time remembering the words. Similar to this task by Montgomery, tasks of sentence repetition require reproducing words in the correct order and the list length (length of the sentence) varies throughout the task. The difference, however, is that the words in a sentence repetition task are in a coherent order and processing them would involve tapping into the long term memory of accumulated linguistic knowledge to understand the meaning of the sentence.

Conti-Ramsden et al. (2001) implicated the role of pSTM in these repetition tasks by finding a significant positive correlation between nonword repetition and SR scores, with NWR being considered a task of pSTM based on the work by Gathercole et al. (1990). Riches (2012) found evidence to support LTM as an underlying mechanism – their results corroborated previous studies (Devescovi & Caselli, 2007; Potter & Lombardi, 1998) to indicate that syntactic complexity of the phrase affected error rates regardless of the sentence length in words. Riches (2012) found data implicating

syntactic knowledge, working memory, and short-term memory in sentence repetition tasks. Data showing a strong association between NWR and SR for children with SLI, but weak association with the NWR in the monolingual group indicated children with SLI might be more dependent on pSTM than typically developing children. Further, the SLI group showed a significant effect of latency, or the time between the stimulus and the prompted response to it, suggesting involvement of memory processes. If SR tasks were solely tapping into the LTM, with the child encoding and reconstructing the phrase from their LTM, one would not expect to see a latency effect as it suggests a heavier reliance on memory strategies.

These findings could indicate that if the children with SLI rely more heavily on their STM than their syntactic knowledge (because it is limited), their SR scores could reflect recollection of latent words and/or be more subject to primacy and recency effects. Riches' 2012 study on the underlying mechanisms of SR tasks also included qualitative analysis of errors and it was found that SR errors made by children with SLI were similar in quality to the errors they made in other production tasks, such as Word Structure from the CELF-Preschool (Wiig et al. 1992) and the Renfrew Action Picture Task (RAPT) (Renfrew 1997). They also found that a priming task (the experimenter described one picture as an example, and the child was encouraged to describe a different structure – going beyond the input to describe it in a similar way) was the greatest predictor of SR performance for all groups. They found a qualitative overlap between SR errors and errors made in spontaneous narrative settings, thus, deficient syntactic presentations in LTM such as particular grammatical structures or morphemes may be difficult for the

child to access for repetition due to a lack of adequate representation of these structures in the LTM. This deficiency may affect the child's ability to manipulate the information in the WM or their ability to access their LTM: if a child didn't already possess the syntactic representation of a structure in their underlying linguistic knowledge, they might not be able to repeat it correctly. If this were the case, it would implicate a much deeper level of processing required to perform a sentence repetition task beyond simple memorization skills.

Despite these studies providing a wealth of knowledge about potential linguistic mechanisms accessed by SR and NWR tasks, they are done using monolingual participants whose language background and development can differ vastly from bilinguals. Additionally, differences in performance profiles between groups (monolinguals, bilinguals, and children with SLI of varying ages) may reflect differences in the strategies each group is using for success. While typically developing (TD) children may be able to exploit their WM resources to process and reproduce each phrase, children with language impairment may rely more heavily on STM skills to make up for their WM and LTM deficiencies due to their diagnosis. Additionally, it is not yet known how a typically developing child with low language exposure and low proficiency would perform in terms of linguistic knowledge and memory.

Scoring Methods

Although many studies have explored the different facets of sentence repetition and its potential underlying mechanisms, the exact sentence repetition task as well as the method through which said tasks have been scored has varied widely between studies.

Conti-Ramsden et al (2001) used the SR task from the CELF-R, whose scoring method counts the number of errors made per sentence. This method is not qualitative in nature and uses a pass/fail approach. Meyers and Volgert (2000) used the ST task by Spreen & Strauss (1998) that also used a pass/fail approach – any error in repetition resulted in a score of O for that test item. As studies began to investigate underlying mechanisms more closely, more elaborate scoring methods were developed. Seeff-Gabriel, Chiat, & Dodd (2010) used the SIT-61 test, which provides scores in several different manners: words in the stimuli are coded as content words, function words, and inflections, and their total for each category is given. The total score is also shown as a percentage of the total target morphemes in each category. This method provides closer insight to the kinds of errors children are more likely to make.

Stokes, Wong, Fletcher, and Leonard (2006) employed four different scoring mechanisms for their SR task and compared them, seeking the ones that provided the highest specificity and sensitivity for identifying SLI in Cantonese speaking children. The methods used were: complete sentence correct (pass/fail); core elements correct; counting the number of errors in each sentence; and the percent of syllables correct. They found counting the number of errors, and the percentage of syllables repeated correctly to be the best methods for identifying SLI, however, this study was conducted in Cantonese, where scores of NWR and SR have differed from French and English norms. Finally, Riches (2012) employed a new computer algorithm technique for scoring called the Levenshtein Distance in Words (LDw). This algorithm counts the minimum number of words that must be added, substituted, or omitted to transform one sentence into another with a

different meaning. The example of this transformation provided in the study shows "There's the horse that pulled him" became "There's the cow that he pulled" yielded an LDw of 4 – one omission, two substitutions, and one addition.

Error analyses and their implications

A study by Maillart, Leclercq, and Quemart in 2012 began to investigate the theoretical contribution of understanding the kinds of errors made on sentence repetition tasks. They believed that SR tasks could be used as a more accurate assessment tool for differential diagnoses, by being able to objectify the dissociation between treatment levels of verbal morphology and the activation of semantic representations. They first tested the diagnostic validity of the task with French-speaking children with and without documented language impairment. Beyond that, they also tested the relevance of a more detailed analysis of the SR scores, and they did this by scoring for different measures such as scores for semantics, function words, lexicon, and conjugation. They found that the targets of morphosyntactic ability were the best measures of sensitivity to the threshold of SLI (better than the global measures), and that children with SLI showed weaknesses in grammar mastery, but they did not provide sufficient evidence to identify potential subtypes of SLI, with evident weaknesses in different areas.

The idea of a differential diagnosis of SLI, with language impairment manifesting in different linguistic weaknesses across a population of children, is a concept that could potentially employ SR tasks to identify. If SR tasks were able to highlight specific linguistic weaknesses through the kinds of errors made by children with SLI, the tasks could be tailored to include targets that could more clearly show frequent problem areas.

Sentence repetition tasks are unique in that we know them to be diagnostic, but we do not yet understand exactly how the repetition of phrases taps into these underlying mechanisms that hinder children with language impairment from succeeding on them.

Beyond looking at measures of syntax, the potential exploitation of SR measures to assess morphosyntax in children with severe speech difficulties have also been conducted. Seeff-Gabriel, Chiat, & Dodd (2010) presented a new sentence imitation test (The Sentence Imitation Test SIT-61) in order to see whether distinct profiles of performance amongst children with language impairment existed when compared to typically developing peers. The test itself was developed such that the phonotactic structure, segmental phonology, and length of words were kept as developmentally simple as possible. While their scoring method included content and function words as well as inflections, it also involved scoring that included morphemes the child attempted even if they were mispronounced. Their study involved four groups of children between the ages of 4 and 6 years – 33 children with TD, 13 children with language impairment, and two groups of 14 children with different speech disorders: consistent phonological disorder, and inconsistent phonological disorders (all monolingual English participants). The authors found differences in performance between the group of TD participants and the three language impaired groups. They also found specific morphosyntactic weaknesses in the language-impaired groups, finding that all three performed better on content words than function words and inflections. This study was investigating the manifestation of language and speech disorders and whether or not they are co-morbid or related, and how they manifest in the kinds of errors children make on tasks of sentence

repetition. Although it does not comment on the potential underlying mechanisms used by the task, it does indicate that sentence repetition tasks have the potential to demonstrate and highlight the strengths and weaknesses of a child with language impairment not only in syntactic error analyses but also morphosyntactic error analyses.

It is important to consider bilinguals when investigating the underlying mechanisms of tasks such as SR and NWR, because bilinguals present a unique perspective on the relationship between linguistic knowledge and processing. Studies have shown that overall language acquisition is strongly affected by amount of language exposure in monolingual as well as bilingual children (de Houwer, 2007; Elin Thordardottir, 2011; Fernandez, Pearson, Lewedeg, & Oller, 1997; Pearson, 2007). This effect is often seen vocabulary and in grammatical development (Elin Thordardottir et al., 2006). Elin Thordardottir and Brandeker's 2013 study sought to investigate the impact of language exposure on the diagnostic accuracy of SR and NWR tasks. Their study was two-fold: The first study used 84 bilingual 5-year-olds learning French and English simultaneously who differed in their exposure to each language but were equated on age, nonverbal cognition, and socio-economic status. They were tested on sentence imitation, nonword repetition, and tests of receptive and expressive vocabulary. This study found that both processing measures but especially NWR were less affected by language exposure than vocabulary measures. In the second study, monolingual and bilingual children with and without Primary Language Impairment (PLI, a term used synonymously with SLI) (4 groups with 14 participants in each) were assessed using NWR, SR, and receptive vocabulary in French to determine the diagnostic accuracy of

the tests. It was found that NWR and SR tasks correctly distinguished children with PLI from typically developing peers regardless of bilingualism. The results of the first study are compelling because they indicate a difference in the ways NWR and SR tasks are accessing language abilities. Sentence repetition tasks involve more meaningful linguistic material, as they comprise full sentences that hold meaning and convey a story, whereas nonwords are meaningless. The fact that SR was more greatly influenced by previous language exposure than NWR confirms its greater reliance on accumulated linguistic knowledge. At the same time, SR had far greater diagnostic accuracy for bilingual children than did vocabulary alone – which also suggests that SR does not rely on accumulated linguistic knowledge to the same degree as vocabulary tests, but may tap more into memory capabilities, or that SR taps into some specific ability that is impaired in SLI. Learning vocabulary words requires encoding words and meanings in the LTM as well as accessing them. Repeating phrases in SR tasks is possible without accessing linguistic meaning, the same way it is possible to memorize a string of digits without interpreting them as one long number or quantity. However when the STM capacity is reached, it makes sense that a child would instead use the strategy of comprehending the phrase, condensing it to its meaning, and then recreating it upon repetition drawing from the LTM for the linguistic properties of phrase construction and the STM for the individual words in the sentence. The child's ability to access these two processes may be influenced by their proficiency in the language, age, and cognitive ability. When studying bilinguals, it is important to keep in mind the great variation in language exposure

bilinguals often possess, which affects vocabulary levels as well as overall proficiency in each of their languages.

Komeili and Marshall's 2013 study used a more in-depth error analysis in order to determine whether bilingual children produced error patterns more similar to children with SLI or typically developing monolinguals. This study used 36 TD participants – 18 bilinguals and 18 monolinguals of mean age 8,8, with ages ranging between 6,2 and 11,1. They scored the SASIT-E32 test, which at the time of testing was yet to be standardized. It consists of 32 English sentences made up of eight different sentence types, and one point is given for a completely correct sentence, and 0 for an incorrect, in order to attain an "overall score". Additionally, the authors scored for total number of function words, content words, and inflections. This took the analysis a step further by calculating the quality of the errors in the function/content words (omissions, additions, or substitutions, as well as word order errors). However, the scope is limited in its ability to generalize error patterns across groups (monolingual, bilingual, monolingual SLI and bilingual SLI) as they used only typically developing participants. They found that bilingual children did not perform in a way that is characteristic of children with SLI, which they indicated from existing literature was the omission of function words. Though their study mentions addition and substitution errors, their scoring method of content and function words does not allow for a deeper analysis of these errors, such as what words are most susceptible to substitution, where participants often make errors, and whether there is an identifiable pattern in the words children exchange for the target words. Beyond this, the study does not mention what kinds of words in the target sentence are most vulnerable to omission

errors beyond the label of content or function, and while it identifies the children as being simultaneous bilinguals (exposure to their second language before the age of 3) they do not extensively document the child's waking hour exposure to each language or equate them linguistically. Thus, we cannot make conclusions about the true role of language exposure on these data in terms of the quality of errors made. Also, despite comparing bilingual and monolingual SR performance to children with SLI, their study does not include any participants with SLI and the SR task they use is not the same as the study with SLI children that they cite as reference.

Previously the scoring for the SR task used in this study ("Le Grand Déménagement"), was done by tallying up the number of words the child repeated correctly, the number of words the child repeated regardless of order, and the number of omission errors. This provided a well-rounded score of the child's overall ability to repeat sentences, however it does not take into account the quality of the child's repetition. Also, there are some phrases in the task that are more linguistically complex than others – some have only two or three words, whereas others have several subjects or clauses. For this study, the scoring rubric sorts each word into its syntactic category, as well as the different structures within the phrase. Thus, instead of simply receiving a score of "2" for repeating "Regarde ça" correctly, the score sheet now shows that the child correctly recalled a lexical verb and a direct object pronoun.

Goals of study

The present study scores for the nature of errors by classifying each word by syntactic category, as well as scoring for substitution errors. It also investigates primacy

and recency effects by looking at recall accuracy on the first and second half of phrases. What this study aims to contribute to the current literature is a more in depth analysis of sentence repetition data by looking at the task in several different ways and with different groups of children. The first is by looking at the task in terms of the kinds of words involved to see if any syntactic categories (for example, determiners, subjects, lexical verbs, conjunctions, adjectives, and direct objects) are more vulnerable to errors by each of the different groups, and how these scores relate to other measures of underlying linguistic competence (such as receptive and expressive vocabulary scores). If the children with SLI produce error patterns very different from the typically developing groups, it could mean that SLI diagnoses manifest in different linguistic weaknesses. For example, if children with SLI perform significantly more poorly in two syntactic categories of words (such as verbs and determiners), it may be possible that their diagnosis makes it difficult for them to interpret and subsequently access those kinds of words from their LTM.

Secondly, this study will also look at where in the phrase the children make errors, such as the first or second half of the phrase, and how each group (bilingual SLI, bilingual TD, younger bilingual TD) differs from one another in these analyses. The purpose of looking at the first and second part of the phrase was to see if any groups of children experience primacy and recency effects. Primacy and recency effects are a memory strategy, where the first part of the phrase is recalled with higher accuracy because it is heard first and is therefore more salient, or the second part is better recalled due to decay of the first part. If all groups perform equally well on the first half versus the

second half of the phrases, it would mean that these effects were not in play. If one group performed significantly better on the first or second half of the phrase, it could indicate that the children are relying more heavily on memory processes to recall the phrase (much in the same way they would a string of digits) rather than their linguistic knowledge. One would argue that if the child processed and understood the target phrase in its entirety, the placement in the sentence of the individual words would be inconsequential and no primacy or recency effects would be noted.

Finally, this study will look at the errors made in the form of substitutions - where the child attempts to repeat the target but rephrases it in a meaningful way – in order to draw conclusions about the kinds of substitutions made and which groups are more likely to make them. When a child repeats a sentence correctly, or makes errors of omission, it is hard to know how deeply the sentences are being processed – the child may be using rote memorization, or simply recalling words or sentence fragments that they found most salient. However, when a child makes a substitution error it indicates that the child has necessarily processed the meaning of the sentence and accessed their LTM. Thus, groups of children who make substitution errors in addition to errors of omission demonstrate a clear reliance on linguistic processing and comprehension in addition to memory processes, compared to those who do not make substitutions.

Methodology

Participants

Participants included three groups of children (total n= 132), 1) bilingual children with SLI, mean age 60.85 months (n=26, SD=4.61) (Bilingual SLI group), 2) bilingual and monolingual children with typical language development of mean age 58.4 months (n= 65, SD=4.17) (Older TD group), and 3) bilingual and monolingual children with typical language development of mean age 35.4 months (n = 41, SD=3.81) (younger TD group). All language exposure was documented via parent report forms developed and used by Dr. Elin Thordardottir in her 2011 study that surveyed language use in the home and in school or daycare for every year of the child's life. The questionnaire included information on who spoke to the child, which language was spoken, and how often these interactions occurred. The children varied in where they gained their exposure – some received both languages at home, some had one language at daycare and another at home. From these data, a number was computed to represent the percentage of the child's waking hours since birth spent in exposure to French over their lifetime, and the remaining waking hours were spent in exposure to another language. All bilingual children were considered simultaneous bilinguals as they had begun regular bilingual exposure before the age of 3 years, and all spoke French but differed in their other language. Children from the two TD groups had English as their other language, but the SLI group included other minority languages (Spanish, Punjabi, Japanese, Arabic, Singhalese, Dutch, Russian, Urdu, and Tamil). This discrepancy occurs because French-English bilingual children with SLI are rare in recruitment in Montreal, as these children

are typically channeled toward one language or the other when they begin to show signs of difficulty in development. Other background information was gathered by parent report questionnaire. Socio-economic status was indexed by the number of years of maternal education. Nonverbal cognition was measured by the Brief IQ scale of the Leiter International –Revised (Roid & Miller, 1997). The children's hearing was screened at 20dB HL at .5, 1. 2 and 4 kHz with a portable audiometer. Background characteristics are reported in Table 1. In the table, the TD groups have been separated into monolingual and bilingual children. The table includes Mean Length of Utterance in words (MLUw) scores for the groups, a measure used as a matching variable in further analyses. MLUw in French was derived from spontaneous conversational language samples collected and analyzed in the original studies in which the children participated (Elin Thordardottir, 2014; Elin Thordardottir et al., 2011; Elin Thordardottir, Cloutier, Ménard, Pelland-Blais & Rvachew, in press).

Table 1. Background characteristics of all participants

	Bilingual SLI Group	Older TD Monolinguals	Older TD Bilinguals	Younger TD Monolinguals	Younger TD Bilinguals
N	**26**	**18**	**47**	**17**	**24**
Age (Months)	**60.85**	**59**	**58.15**	**35.71**	**35.21**
Std.Dev	4.61	4.70	3.97	3.23	4.23
Mat.Education	**17.39**	**16.17**	**17.49**	**16.59**	**17.37**
Std.Dev	14.72	2.30	2.70	3.53	3.53
Nonverbal Cognition	**90.19**	**104.71**	**104.25**	**111.82**	**116.29**
Std.Dev	9.28	12.56	13.80	13.59	15.43
French Exposure	**18.72**	**94.11**	**53.18**	**98.52**	**52.29**
Std.Dev	14.64	20.86	26.73	2.34	17.88
MLUw French	**2.42**	**4.02**	**4.25**	**3.25**	**3.06**
Std.Dev	0.706	0.867	1.11	0.718	0.865

These 132 children were drawn from previous studies in which all were administered a series of common language measures using identical procedures, including the documentation of background characteristics and the Sentence Repetition test (Elin

Thordardottir, 2014; Elin Thordardottir, Rvachew, and Menard, 2010b; Elin Thordardottir, Cloutier, Menard, Pelland-Blais & Rvachew, in press). Descriptive data on Sentence Repetition are reported for each of these groups to investigate effects of age, bilingualism and language impairment on SR scores. In order to investigate the potential effects of key variables such as age, exposure to French, and language proficiency on sentence repetition performance, two types of subgroups of participants were formed: the first, age-matched SLI and TD, comprised 15 children with SLI and 15 TD children matched to them on age (and French exposure). The second, MLU matched TD, comprised 13 older TD participants matched by mean length of utterance in words to 12 younger participants. The age-matched comparison allowed for the variable of language impairment to be isolated, as it assumes these children have had similar opportunities to acquire knowledge of the given language (spent the same amount of time exposed to it) and have similar cognitive capacities given their age, but differ in their typical vs. atypical development. The MLUw-match allows for the variable of accumulated language knowledge to be isolated, as it assumes that despite being different in age and exposure, both groups have reached the same level of linguistic complexity and competency in their utterances. Finally, the older and younger TD bilingual children were matched to each other by MLU in a second subgroup. This comparison allows for overall proficiency in the language to be isolated from the effect of mere age and its effect on SR task performance in TD children to be studied.

One-way ANOVA of the age-matched SLI and TD group revealed significant differences between all groups on age ($F(2,45)=212.85$, $p=0.000$), maternal education

(F(2,43)=5.137, p=0.010), nonverbal IQ (F(2,43)=19.19, p=0.000), MLUw in French (F(2,45)=6.192, p=0.004), and French Exposure (F(2,45)=25, p=0.000) Fischer LSD post-hoc results are presented in Tables 2 (for the age matched groups) and 3 (for the MLU matched groups). The age and exposure matched SLI group and older bilinguals did not differ significantly on age (p=0.113), maternal education (p=0.077), IQ (p=0.344), or exposure to French (p=0.738), but the SLI group had significantly lower mean length of utterance in French than the age-matched TD group (p=0.003).

Table 2. Results of Fischer LSD post hoc tests for Age & Exposure-Matched SLI group and Older Bilinguals

Means	Bilinguals with SLI	Older Bilinguals	Significance
n	15	15	n/a
Age in months	60.40	58.00	.113
Maternal Education	14.62	16.87	.077
Nonverbal Cognition	90.20	94.86	.344
Percent Exposure to French	20.73	23.40	.738
MLUw French	2.55	3.79	**.003**

The SLI group an d younger children matched on MLUw differed significantly in their age ($F(1,23)=328.29$, $p=0.000$), IQ ($F(1,23)=45.23$, $p=0.000$), percent exposure to French ($F(1,23)=36.25$, $p=0.000$), as shown in Table 3. The children with SLI were significantly older and had lesser exposure to French in terms of percent of their time since birth spent in French environments than the MLU-matched group, as well as significantly lower maternal education. However, these two groups did not differ on MLUw.

Table 3. Results of Fischer LSD post hoc tests for SLI group and younger MLU-matched TD group

Means	Bilinguals with SLI	Younger Bilinguals	Significance
n	15	15	n/a
Age in months	60.40	34.47	**.000**
Maternal Education	14.62	18.33	**.003**
Nonverbal Cognition	90.20	118.21	**.000**
Percent Exposure to French	20.73	71.00	**.000**
MLUw French	2.55	2.60	.867

The second comparison, MLU-matched TD, was formed by a MLUw match of older and younger bilingual and monolingual children with TD (n=25 total). This match is possible because of the diversity in each group in terms of amount of exposure to French, such that both age groups comprise children with a range of MLU levels (the younger group has spent a significantly greater percentage of their time in French than the older group, see Table 2). One-way ANOVA revealed significant differences between groups (presented in Fig.4) showing that the two groups did not differ significantly in their MLUw ($F(1,23)=0.355$, $p=0.557$) or maternal education ($F(1,23)=0.555$, $p=0.464$) but were significantly different on age ($F(1,23)=173.726$, $p=0.000$) and nonverbal cognition ($F(1,23)=11.078$, $p=0.003$). It should be noted however, that both groups were well within normal limits on nonverbal cognition. The older group had a lower mean overall than the young group.

Table 4. MLU-matched Older and Younger TD Bilinguals group differences

Means	Older TD Bilinguals and Monolinguals	Younger TD Bilinguals and Monolinguals	Significance
n	13	12	n/a
Age in months	58.23	36.08	**.000**
Maternal Education	17.85	17.17	.464
Nonverbal Cognition	97.67	119.09	**.003**
Percent Exposure to French	34.69	77.08	**.000**
MLUw French	3.81	3.53	.557

Children in the typically developing groups were reported to have had normal language and cognitive development, without any hospitalizations or major illnesses reported by their parents. Children with SLI were identified and diagnosed as part of the original study in which they participated, and which focused on the effectiveness of language intervention (Elin Thordardottir et al., in press.). These children were referred to that study based on previous identification by certified Speech-Language pathologists, within a major hospital and public school.

Procedure

Trained research assistants, who were native speakers of Quebec French and spoke only French during the evaluation session, assessed children individually. Children were given a battery of measures, including the background measures, vocabulary and spontaneous language measures, and the outcome measures of greatest interest for this study, sentence repetition. Results of the bilingual TD children's vocabulary scores were reported in Elin Thordardottir (2011), their MLU and morphosyntactic production in Elin Thordardottir (2014). Overall results on their SR scores were reported in Elin Thordardottir and Brandeker (2013). In these studies, a particular focus was on the relationship between performance in these areas of language and varying degrees of bilingual exposure.

The sentence repetition task used is "Le grand démenagement". This test is an adaptation in Québecois French from the subtest of "Recall of Sentences in Context" from the CELF-Preschool (Wiig, Secord & Semel, 1992). The administration of this test requires the use of the original booklet from the subtest of the CELF-P. This French adaptation and the norms were created by the Language Development and Disorders Lab of the School of Communication Sciences and Disorders of McGill University (Royle & Elin Thordardottir, 2003; Elin Thordardottir et al.,2010; 2011). The examiner shows the child the storybook and reads the story. The child is asked to repeat selected phrases, and the target phrases increase in length, syntactic complexity, and number of propositions as the story progresses.

The scoring method for this SR task used in the initial study (as reported in Elin Thordardottir & Brandeker, 2013) was modified from the original CELF-P test to reflect the percentage of words repeated correctly, regardless of their order (the original scoring in the CELF-P test uses a system of 1, 2 or 3 points). For the purpose of this study, the scoring method was modified further as reported below to look at 1) the syntactic function of omitted words, 2) the effect of early versus late position in the sentence, and 3) the frequency nature of substitution errors (as opposed to omissions).

The SR tests were originally scored online by examiners and rescored by the author using the modified scoring rubric and transcription records of the tasks. Ten percent of the SR tasks were randomly selected and rescored by independent scorers for a reliability check, and inter-rater accuracy was found to be 96%.

Coding System

Overall sentence repetition score. The child received a score of 1 for each word that was correctly repeated. The maximum possible score is 115 points, and the child's final score has been converted to a percentage.

Syntactic function

Every word in each sentence was identified based on its syntactic function into one of 17 categories. They are:

1. Conjunctions (7)
2. C'est (2)
3. Est-ce que (2)
4. Subject – Clitic (17)
5. Determinant (10)
6. Lexical Subject (3)
7. Adjective (8)

8. Auxiliary Modal Verb (12)
9. Lexical Verb (21)
10. Subject Complement (2)
11. Direct Object – Lexical (10)
12. Direct Object – Clitic (2)
13. Direct Object – Pronoun (2)
14. Reduplicated Pronoun (1)
15. Adverb – Location (8)
16. Apostrophe (2)
17. Negation (4)

The entire SR score sheet appears in Appendix A showing the syntactic classification of each word. To document the syntactic function of omitted words, the child had a score for each of the above 17 categories of words – these were converted to percentages and represent the child's repetition accuracy for each category over the entire test (i.e. the child may have repeated 6 out of 7 total conjunctions over the course of the SR task, regardless of what phrase contains the conjunctions; this would have resulted in a score of 86% for this child's conjunction accuracy). For descriptive purposes, results are reported for each of the 17 categories.

For the purpose of statistical analyses comparing groups, some categories were collapsed to create core categories. This was done to limit the number of statistical comparisons to be run. These were chosen based on their function and use as important aspects of syntax:

1. All Subjects (Subject Clitic + Subject Complement)
2. All Verbs (Auxiliary Modal + Lexical)
3. All Direct Objects (Lexical, Clitic, Pronoun, and Adverb)
4. All Adjectives
5. All Conjunctions
6. All Determiners

For these analyses, each child's performance in each of these categories was computed in the same way as described above for the 18 categories, yielding a percent correct score for each of these 6 categories.

Position in the sentence. In order to assess the effect of items occurring early or late in the sentences, the 18 target sentences were split down the middle in order to assess the child's accuracy in repeating the first half vs. the second half of the phrase. Sentences were split in half regardless of length (so 2-word sentences had 1 word in each half, an 8 word sentence had 4 words in each half) and the child was given a percentage correct score for the first half and the second half of all phrases. The first half percentages were averaged for an overall accuracy score for the first half and second half of all phrases, regardless of length.

Substitution errors. The repetitions the child produced were assessed for substitution errors, by manually scanning the score sheets. This analysis looked for instances in which the child did not repeat the item correctly nor omit it, but rather supplied another word in the place of the target word. Although the actual substitutions made by the children varied throughout, the kinds of substitutions were all found to fall within one of the 10 categories below (no substitution errors that were found were excluded):

1. Conjunction substitution (si for et)
2. Lexical verb for <u>related</u> lexical verb (terminer for finir)
3. Lexical verb for <u>unrelated</u> lexical verb (réveiller for finir)
4. Change of conjugation tense (grandit for grandira)
5. Noun for <u>related</u> noun (crème glacée for dessert)
6. Noun for unrelated noun (affairs for assiette)
7. Change of subject (tu for je)

8. Change of auxiliary (j'ai to je suis)
9. Determiner substitution (la for un)
10. Adjective for related adjective (bleu for rose)

Substitution errors are reported as the raw number of such errors. The substitution errors are also reported as percentages, referring to what percentage of the errors made by the child on the SR task were substitutions. When group comparisons are made, the number of errors produced by all children in the group is divided by the n of the group to produce the mean number of substitution errors per child in the group.

Results

Results are reported first for direct comparisons: (1) age and exposure matched older TD and SLI participants, MLU-matched younger TD and SLI participants, followed by (2) MLU-matched TD participants. The results of the three large groups from which the matched participants were drawn (5 year-old children with SLI, 5-year-old children with TD and 3-year-old children with TD) follow these results, and included are correlational analyses and error analyses for each group.

Results for each of the groups (with the TD groups divided into monolingual and bilingual children) are reported below as overall percentage correct on the SR task as well as the child's percentage scores in each of the relevant syntactic categories. These categories include subjects, direct objects, verbs, "c'est" and "est-ce que" (combined and titled "other"), determiners, adjectives, and conjunctions.

Matched Groups Analyses

Children with SLI matched by age to same age bilinguals; by MLU to younger bilinguals. The means for each of the three matched groups are reported in Table 10 for the variables Total SR percent correct, and percent correct for subjects, other, verbs, direct objects, conjunctions, and determiners. One-way ANOVA analysis was used to compare the performance of the three groups of children, followed by post hoc Fischer LSD tests. A significant group difference was found for Total SR Score ($F(2, 45)=8.149$, , $p=0.001$,), Subjects score ($F(2, 45)=8.834$, $p=0.001$), Verbs score ($F(2, 45)=4.419$, $p=0.018$), Direct Objects Score ($F(2, 45)=6.054$, $p=0.005$), Conjunctions ($F(2,45)=3.571$, $p=0.036$), Determiners ($F(2, 45)=5.981$, $p=0.005$), and Adjectives ($F(2,45)=4.574$, $p=0.016$). The groups did not differ significantly in the score of Other ($F(2, 45)=2.533$, $p=0.092$). Post-hocs revealed that the age and language matched group differed significantly in their performance from the SLI group on all measures. For the SLI and age matched groups, post hocs were as follows: Total SR score ($p= 0.000$), subjects ($p=0.000$), Other ($p=0.035$), Verbs ($p=0.006$), Direct Objects ($p=0.002$), Conjunctions ($p=0.011$), Determiners ($p=0.002$) and Adjectives ($p=0.006$). The MLU-matched group differed significantly from the SLI group in Total SR score ($p=0.017$), Subjects ($p=0.044$), Verbs ($p=0.025$), Direct Objects ($p=0.005$), Determiners ($p=0.043$) and Adjectives ($p=0.042$) but did not differ significantly in scores of Other ($p=0.125$) or Conjunctions ($p=0.89$). Means for the TD bilinguals matched by MLUw are displayed in Table 12. The two groups were compared by one-way ANOVA. Results revealed that the

groups did not differ significantly on Total SR Score ($F(1,23)=3.0$, $p=0.097$), Subjects ($F(1, 23)=1.398$, $p=0.249$,), Verbs ($F(1,23)=1.667$, $p=0.209$), Direct Objects ($F(1, 23)=2.744$, $p=0.111$), Conjunctions ($F(1, 23)=3.033$, $p=0.095$), Determiners ($F(1,23)=3.050$, $p=0.094$), or Adjectives ($F(1, 23)=1.613$, $p=0.217$). The groups differed significantly only in their scores of Other ($F(1, 23)=7.657$, $p=0.011$), where the older group performed significantly better than the younger group.

Table 5. Sentence Repetition Task scores, Age/Expo and MLU matched groups

	TotalSR %	Subjects %	Other %	Verbs %	D.Obj %	Conj. %	Det. %	Adj. %
Age and Exp. Matched Older Group	75.85 (25.34)	74.23 (28.63)	73.08 (29.68)	75.52 (27.62)	78.46 (25.84)	61.54 (37.52)	71.54 (34.60)	75.96 (27.23)
SLI Group	30.24 (21.78)	27.50 (23.53)	36.11 (35.58)	32.15 (22.70)	34.44 (21.72)	14.29 (20.20)	13.33 (19.70)	34.03 (28.37)
MLU Matched Younger Group	49.47 (23.32)	45.56 (25.83)	48.61 (31.47)	50.67 (24.30)	55.56 (20.32)	30.16 (32.09)	36.67 (29.90)	53.47 (26.01)

Figure 1 presents the results of the 3 matched groups in terms of the kinds of words involved in omission errors. Performance patterns across all three groups emerged: The Older and Younger TD children all scored highest in the categories of Direct Objects and Adjectives. The SLI group also scored highest in Direct Objects, but

their second highest score was in the category of Other, where they did not perform lower than the MLU matched younger participants. Additionally, all three groups scored lowest in the categories of Conjunctions and Determiners.

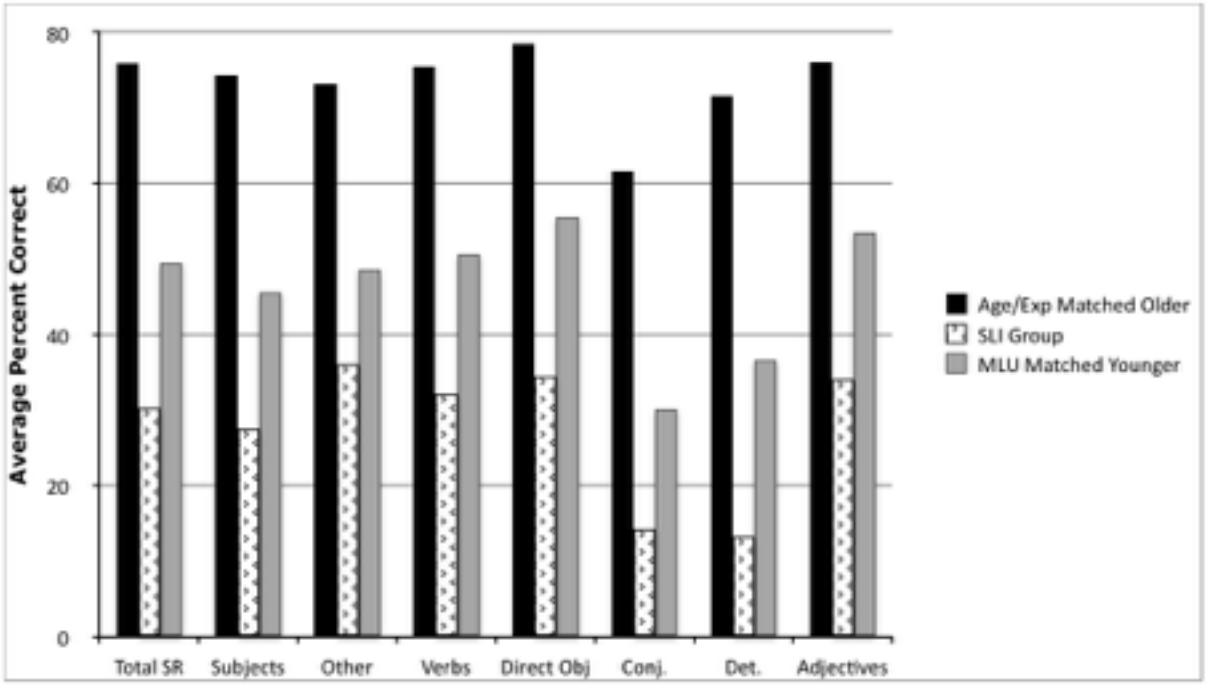

Figure 1. SR Performance of Age/Expo and MLU-matched groups in percentages

Results in Table 6 show performance of the three matched groups in terms of percent correct repetition performance of the first versus the last part of the sentences. All groups had slightly higher accuracy on the second half of the phrases. The Older bilinguals had only marginally different scores, meaning they performed just as well on the first half as the second half of the phrase. The children with SLI performed slightly better on the second half of the phrases. The performance of the three groups was compared by ANOVA, treating the first and last parts of the sentences as repeated measures. This analysis revealed a significant effect of group ($F(1, 46)=35.830$,

p=0.000), and a significant group x sentence part interaction (F(1, 46) =5.239, p=0.000). Post hoc Tukey HSD tests revealed a significant difference between the first and second half of sentences for the younger TD group and the SLI group at the 0.05 level, but not for the older group).

Table 6. First half and Second half of sentences

	Average correct of first half of all sentences	Average correct of second half of all sentences
SLI Group Mean N Std. Deviation	28.4% 15 20.57%	38.2% 15 20.18%
Younger MLU Matched Group Mean N Std. Deviation	54.2% 15 26.17%	67.9% 15 19.74%
Older Age/Expo Matched Group Mean N Std.Deviation	65.6% 15 26.67%	70.33% 15 24.47%

Older and younger TD bilinguals matched on MLU. The second set of comparative matched-groups analyses was done with typically developing older and younger participants matched by MLUw in French. In order to match children of different ages on MLU, the younger children generally include children who have spent an overall a greater percentage of their time in French than the older children. The

younger group includes monolingual and bilingual children, whereas the older group includes only bilingual children.

Table 7 shows the scores on sentence repetition measures by the MLU-matched older and younger bilingual groups. Overall, the Older TD bilinguals performed higher in all categories, however both groups scored highest in Adjectives (Older: 75.96%, Younger: 63.54%) and Direct Objects (Older: 78.46%, Younger: 63.33%) and lowest in Conjunctions (Older: 61.54%, Younger: 38.10%).

Table 7. Sentence Repetition Task Scores, MLU-matched Bilinguals

	TotalSR	Subjects	Other	Verbs	D.Obj	Conj.	Det.	Adj.
TD Older	75.85% (25.34)	74.23% (28.63)	73.08% (29.68)	75.52% (27.62)	78.46% (25.84)	61.54% (37.52)	71.54% (34.60)	75.96% (27.23)
TD Young	59.57% (21.28)	61.67% (24.05)	41.67% (26.83)	62.88% (20.48)	63.33% (18.96)	38.10% (28.78)	48.33% (31.56)	63.54% (20.96)

Figure 6 shows these data in chart format for comparison, demonstrating the performance differences among the older and younger participants.

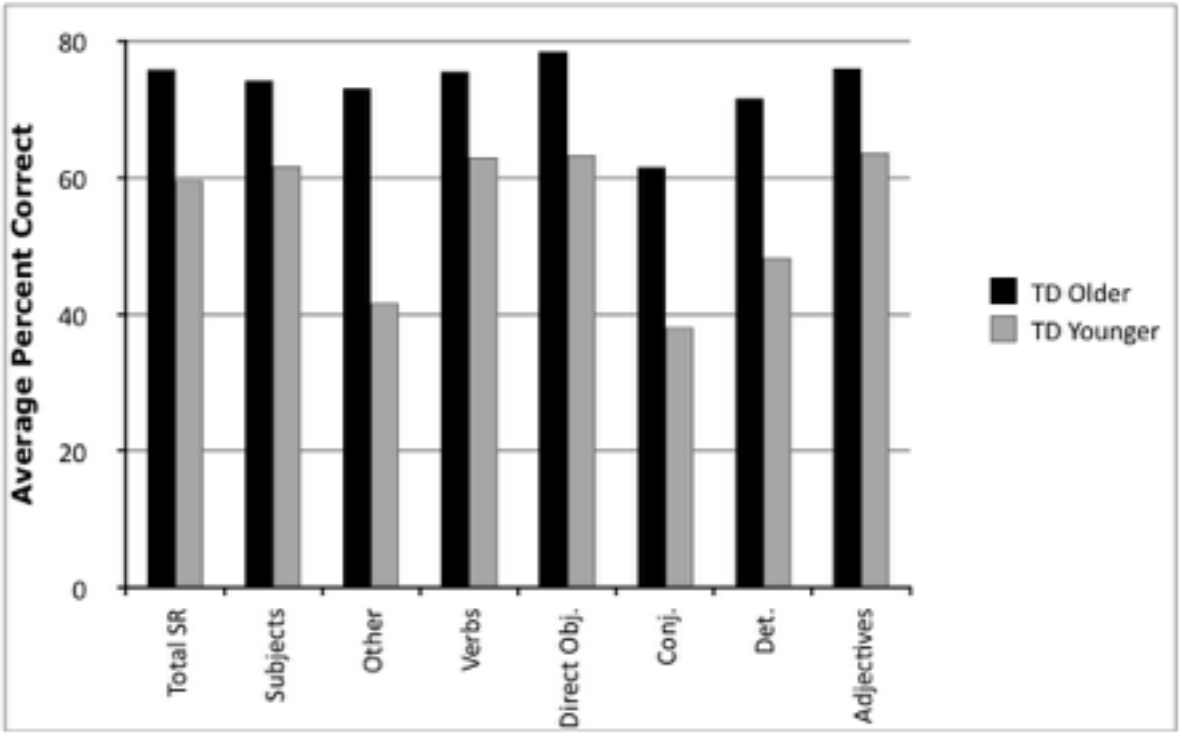

Figure 2. Sentence Repetition Performance, MLU-Matched TD Bilinguals

Group comparison on performance on the first versus last part of the sentences (showed in Table 8) revealed both groups scored higher on the second half of the phrases. The older bilinguals differed very slightly in their scores, whereas the younger bilinguals had a larger discrepancy in the first vs. second half scores, as was also seen in the results of the larger groups.

Table 8. First and second half of sentences, MLU-Matched Older and Younger Bilinguals

	Average correct of first half of all sentences	Average correct of second half of all sentences
Older Group		
Mean	78.15%	81.08%
N	13	13
Std. Deviation	21.82%	20.48%
Younger Group		
Mean	58.33%	73.17%
N	12	12
Std. Deviation	68.64%	18.70%

Large Groups Analyses

Five-year-old children with SLI. Descriptive results for this group of children are reported in Table 9. These participants had overall accuracy of 31.3% with their lowest scores occurring in the categories of Determiners (13.9%) and Subjects (29.3%). Their highest scores occurred in the syntactic categories of Other (40.4%)) and Direct Objects (34.9%). They scored higher on the second half of the phrase (35.7%) than the first half (28.2%).

Five-year-old children with TD. The older typically developing children consisted of both monolinguals (n=18) and bilinguals (n=47). On average, the monolinguals scored higher than the bilinguals on all categories, with an overall score of 88.5% (versus 76.8%). They scored highest in the categories of Subjects (92.4%) and Verbs (88.5%) and lowest in the categories of Determiners (83.3%) and Direct Objects

(84.8%). The bilingual group had an overall score of 76.8%, with their highest syntactic category scores occurring in Subjects (79.5%) and Other (79.3)%, and their lowest scores in Determiners (71.7%) and Adjectives (75.5%). Both the bilinguals and monolinguals scored slightly higher on the second half of the phrases than the first half. Statistical analyses are not made within these groups because the bilingual group is heterogeneous in their amount of exposure to French and subsequent knowledge of the language, and so correlational analyses are performed below.

Younger children with TD. The younger children with typical development consisted of bilinguals (n=24) and monolinguals (n=17). On average, the bilingual group scored slightly higher than the monolingual group in all categories. The bilingual group's overall average score was 55.2%, with their highest scores occurring in the categories of Adjectives (60.4%) and Direct Objects (58.3%). Their lowest scores were in the categories of Conjunctions (35.7%) and Determiners (42.9%). The monolingual group had an overall score of 51.8%, with their highest scores also in the categories of Adjectives (58.1%) and Direct Objects (57.3%), and their lowest scores also in Conjunctions (28.6%) and Other (38.2%). The Younger bilingual children had the largest difference in their scores on the first half vs. second half of the phrases, as they scored on average 68.1% on the second half compared to 50.7% on the first half. The monolinguals had a slightly smaller discrepancy, scoring 53% on the first half and 66.4% on the second half.

Table 9. SR Task Results by Group reported as % of words correctly repeated

	Bilinguals with SLI	Older TD Biling.	Older TD Monoling.	Younger TD Bilingual	Younger TD Monoling.
Total SR Score	31.3% (21.9)	76.8% (26.2)	88.5% (14.7)	55.2% (24.9)	51.8% (22.5)
All Subjects	29.3% (23.8)	79.5% (26.8)	92.4% (12.3)	57.0% (27.4)	52.7% (26.8)
All Direct Objects	34.9% (20.9)	76.2% (24.8)	84.8% (14.6)	58.3% (19.6)	57.3% (20.6)
All Verbs	32.8% (22.5)	75.6% (28.6)	88.7% (16.4)	55.7% (25.9)	54.0% (22.7)
Other	40.4% (34.7)	79.3% (27.2)	87.5% (17.7)	45.0% (33.7)	38.2% (19.9)
Determiners	13.9% (19.4)	71.7% (33.3)	83.3% (25.2)	42.9% (34.7)	42.4% (28.4)
Adjectives	32.2% (28.3)	75.5% (28.1)	87.5% (17.7)	60.4% (26.2)	58.1% (22.5)
Conjunctions	14.3% (19.8)	63.2% (36.4)	78.6% (22.5)	35.7% (33.7)	28.6% (27.7)
First Half of Phrase Accuracy	28.2% (21.8)	78.3% (25.5)	89.1% (14.1)	50.7% (29.1)	53.2% (24.4)
Second Half of Phrase Accuracy	35.7% (19.9)	82.7% (20.7)	90.7% (11.5)	68.1% (21.7)	66.4% (19.1)

Category scores for all groups presented above are shown in Figure 1, to demonstrate performance comparatively by syntactic category. There is a greater performance difference between monolinguals and bilinguals in the older TD group – monolinguals perform better than the bilinguals on all categories, whereas in the younger group they all perform very similarly with the bilinguals performing slightly better. Across the categories, monolinguals and bilinguals appear to follow the same trends in terms of success within each category, with higher scores in Direct Objects and Subjects and lower scores in Determiners and Conjunctions. Compared to the larger groups of typically developing bilinguals and monolinguals, the group with SLI performs overall at a much lower level, but this group appears to struggle more with Determiners than the other groups

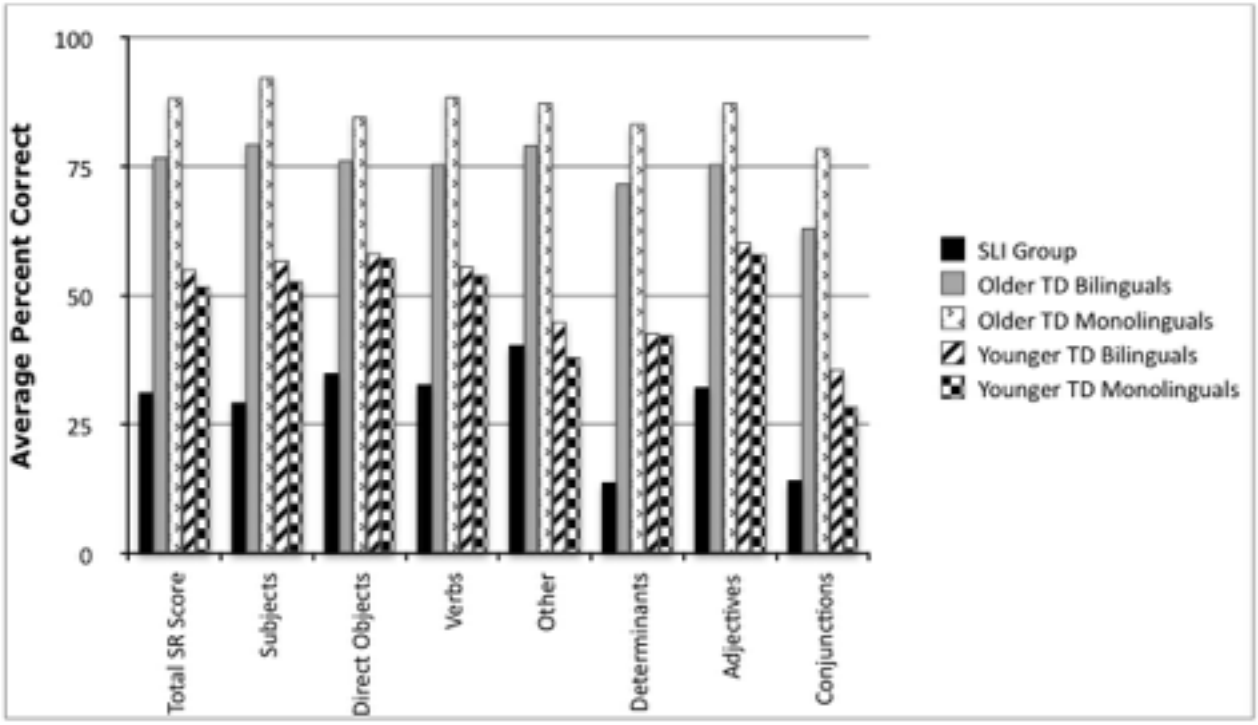

Figure 3. Group means for large group SR percentage correct scores

Correlational Analyses

In order to further explore the effect of various variables on SR performance, correlational analyses were performed within the larger groups. Because the groups vary significantly in their exposure to French and knowledge of the French language (as reported on in previous studies of these children's vocabulary and syntactic scores), statistical analyses directly comparing these groups were not possible but correlational analyses show potential relationships between variables of interest and sentence repetition performance. The variables of greatest interest were percent exposure to French (given that the bilingual children within each age group varied along this dimension and that percent exposure has previously been shown to be highly correlated with vocabulary

and morphosyntax) as well as overall performance on Sentence Repetition (Elin Thordardottir, 2011; 2014; Elin Thordardottir & Brandeker, 2013). Percent exposure thus represents amount of experience with the French language and has been shown to be systematically related to linguistic knowledge in the language to which the child was exposed. MLU is used here as a more direct measure of linguistic proficiency in French in the production modality.

Correlational analyses were run to examine the association between MLUw, and exposure to French with the total SR score as well as syntactic category scores to see if any relationships emerged. Results for the older TD bilinguals and monolinguals in Table 6 revealed significant positive correlations between the Total SR score and all syntactic category scores. Significant positive correlations were also found between MLUw scores and overall SR score, as well as all categories except Subjects and Other, which were only significant at the 0.05 level. In addition, significant positive correlations were found between French Exposure and all measures of sentence repetition, with the strongest correlations being present in the overall score (r=0.527) and the score of verbs (r=0.534).

Table 10. TD Older Bilinguals and Monolinguals Correlations

	MLUw	Tot.SR	Fr.Expo	Subj.	Other	Verbs	Dir.Obj	Adj.	Conj.	Det.
MLUwr	1	**.427****	.095	**.358***	**.310***	**.367****	**.364****	**.435****	**.504****	**.427****
Sig.	--	.002	.527	.011	.029	.009	.009	.002	.000	.002
Tot.SRr	**.427****	1	**.527****	**.969****	**.650****	**.991****	**.937****	**.906****	**.907****	**.949****
Sig.	.002	--	.000	.000	.000	.000	.000	.000	.000	.000
French Expo	.095	**.527****	1	**.515****	**.31***	**.534****	**.468****	**.486****	**.512****	**.468****
Sig	.527	.000	--	.000	.014	.000	.000	.000	.000	.000
N	65	65	65	65	65	65	65	65	65	65

**Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level.

Within the SLI group, no significant correlations were found to exist between MLUw or French exposure and any SR scores – overall or in syntactic categories. However, similar to the Older Group, strong positive correlations were found between overall SR score and syntactic category scores. The highest correlation found was

between overall SR score and the Subjects score, with the weakest being between total SR score and the score of Other (C'est + Est-ce que). No significant correlations were found to exist between the variables of French exposure and any SR scores or MLUw.

Table 11. SLI Group Correlations

	MLUw	Tot.SR	French Exposure	Subj.	Other	Verbs	Dir.Obj	Adj.	Conj.	Det.
MLUwr	1	-.127	0.229	-.023	-.110	-.143	-.310	-.115	0.029	-.021
Sig.	--	.614	0.376	.831	.663	.572	.210	.649	.909	.933
Tot.SRr	-.127	1	0.099	**.967****	**.683****	**.981****	**.898****	**.865****	**.704****	**.847****
Sig.	.614	--	0.697	.000	.000	.000	.000	.000	.000	.000
French Exposure	0.229	0.099	1	0.175	-0.081	-0.079	0.32	0.335	-0.02	-0.051
Sig.	0.376	0.697	--	0.486	0.749	0.754	0.195	0.174	0.937	0.839
N	26	26	26	26	26	26	26	26	26	26

**Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level.

The younger bilinguals and monolinguals were also given correlational analyses between MLUw, French Exposure, and their sentence repetition task scores. Within the group of younger monolinguals and bilinguals (shown below in Table 8) there were no correlations significant at the 0.01 level between MLUw and SR scores. There was a correlation significant at the 0.05 level between MLUw and the score of Subjects. Between Total SR scores and syntactic category scores, similar to the SLI group, significant positive correlations existed in all cases. The strongest correlation was again between Total SR and Subjects, and the weakest between Total SR and the score of Other. No significant correlations were found between the variables of French exposure and MLUw or any SR performance scores.

Table 12. Younger Bilinguals and Monolinguals Correlations

	MLUw	Tot.SR	French Expo	Subj.	Other	Verbs	Dir.Obj	Adj.	Conj.	Det.
MLUw	1	.266	.222	.363*	-.005	.317	.111	.275	.141	.182
Sig.	--	.148	.23	.044	.978	.083	.551	.134	.448	.328
Tot.SR	.266	1	-.82	**.959****	**.634****	**.978****	**.861****	**.845****	**.879****	**.919***
Sig.	.148	--	.61	.000	.000	.000	.000	.000	.000	.000
French Expo.	.222	-.082	1	-.25	-.068	-.005	-.018	-.134	-.05	-.11
Sig	.23	.61	--	.115	.671	.973	.913	.405	.756	.495
N	31***	41	41	41	41	41	41	41	41	41

***MLUw data was unavailable for some participants
**Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level.

Substitution Errors

The number and kinds of substitutions each group made are presented below for the large groups of children. As discussed in the Methods section, the kinds of errors were all found to fall within one of the 10 categories below, and the child was given a point per phrase with each substitution. The categories (with common examples found) were:

1. Conjunction substitution (si for et)
2. Lexical verb for related lexical verb (terminer for finir)

3. Lexical verb for unrelated lexical verb (reveiller for finir)
4. Change of conjugation tense (gradit for grandiras)
5. Noun for related noun (crème glacee for dessert)
6. Noun for unrelated noun (affairs for assiette)
7. Change of subject (tu for je)
8. J'ai to je suis
9. Determiner sub (la for un)
10. Adjective for related adjective (bleu for rose)

Table 9 reports the substitution errors of each of the three large groups of children in terms of raw number of total substitution errors for the group, the average number of substitutions per child, and the average percentage of all errors that were substitutions (with all other errors being omissions). This last measure was found by dividing the number of substitutions the child made by the total number of errors they made on the task.

The older TD groups had the highest percentage of substitution errors from all errors made, with the monolinguals having over a quarter of their errors being substitutions (total group: 20.11%, bilinguals: 16.94%, monolinguals: 28.69%). On average the older TD group made 1.12 substitution errors per child. Of all errors made by the SLI group, on average only 1.33% of them were errors of substitution (or 0.42 average substitutions per child), with the remaining 98.66% being errors of omission. Although the younger TD children made the most substitution errors per child (total: 1.24, bilinguals: 1.0, monolinguals: 1.59), overall substitutions only accounted for an average of 6.19% of their total errors, with bilinguals and monolinguals having very similar scores (bilinguals having 6.24% substitutions and monolinguals having 6.12%).

Table 13. Substitution Errors By Large Groups

	Total Substitutions	Average Errors Per Child	Average Percent of All Errors that were Substitutions
Older TD Group	73	1.12	20.11%
Bilinguals	54	1.14	16.94%
Monolinguals	19	1.05	28.69%
SLI Group	11	0.42	1.33%
Younger TD Group	51	1.24	6.19%
Bilinguals	24	1.0	6.24%
Monolinguals	27	1.59	6.12%

Nature of Substitutions

Older TD bilinguals and monolinguals. The types of substitution errors made by the older TD bilinguals and monolinguals are displayed in Figure 2. The bilinguals made the most substitutions per child (1.14 vs. 1.05 for the monolinguals). The bilinguals most frequently made errors of conjugation (13 errors), conjunction substitutions (9 errors), and nouns for related nouns (7 errors) versus subject substitutions (3), adjective substitutions (3) and determiner substitutions (5). They did not make any errors of nouns for unrelated nouns and substituted subjects very rarely. The monolinguals also made conjugation errors most frequently, followed by conjunction substitutions and nouns for related nouns.

Examples of these errors include:

"Si tu finis ta assiette, tu vas avoir la crème glacée aussi." (Si tu finis ton assiette, tu auras du dessert toi aussi.)

"Demain on va finir les caisses et le gros camion va venir." (Demain on va finir le travail et le gros camion va venir)

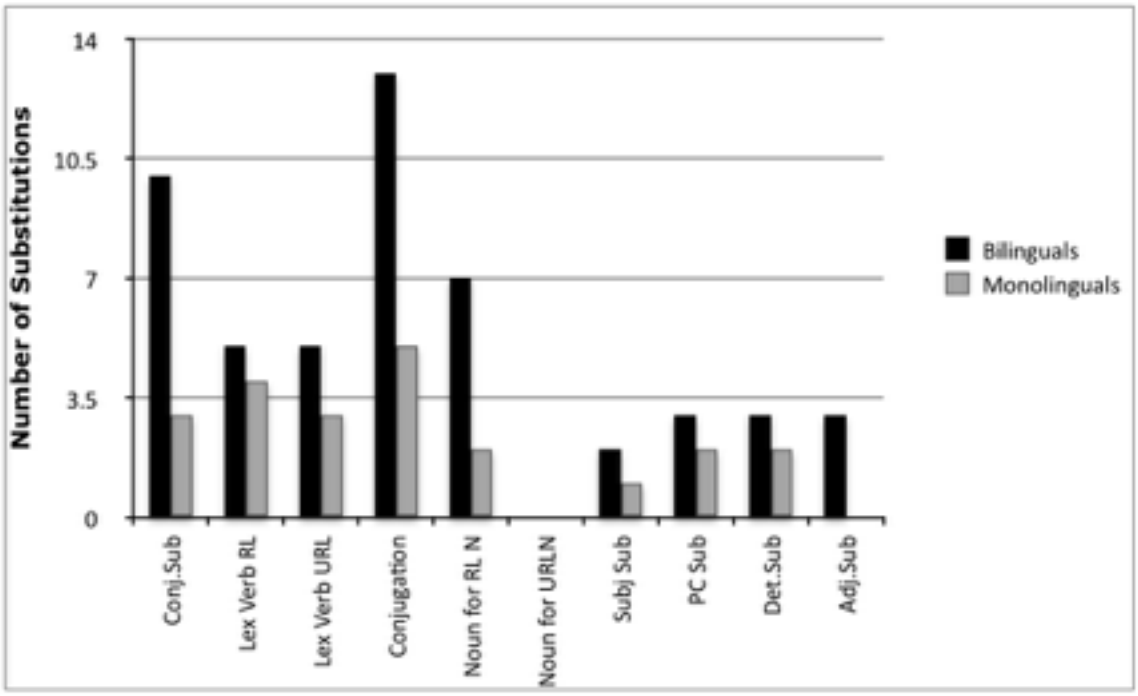

Figure 4. Types of substitutions made by all older TD bilinguals and monolinguals
Conj.Sub = Conjunction substitution
Lex Verb RL = Lexical verb substitution for Related Lexical Verb
Lex Verb URL = Lexical verb substitution for Unrelated Lexical Verb
Conjugation = Conjugation substitution
Noun for RL N = Noun for Related Noun
Noun for URLN = Noun for Unrelated Noun
Subj Sub = Subject Substitution
PC Sub = Passé Composé Substitution
Det Sub = Determiner Substitution
Adj Sub = Adjective Substitution

SLI group. The SLI group made very few substitution errors (only 0.42 substitutions per child), and most of them were in the category of subject substitution

(9/11 errors) shown below in Figure 3. The SLI group thus showed a clear outlier in the category of subject substitutions, making 9 errors in this category versus lexical verb for related lexical verb substitutions (1), determiner substitutions (1), or conjugation substitutions (1). Closer analyses of this outlier revealed that one participant subbed "moi" for "je" throughout the SR task and accounted for all 9 of these subject errors. Examples of these errors include:

"Moi pas travailler toute seule." (Je ne veux pas travailler toute seule)

"Moi tombé moi fait mal" (Je suis tombé et j'ai mal)

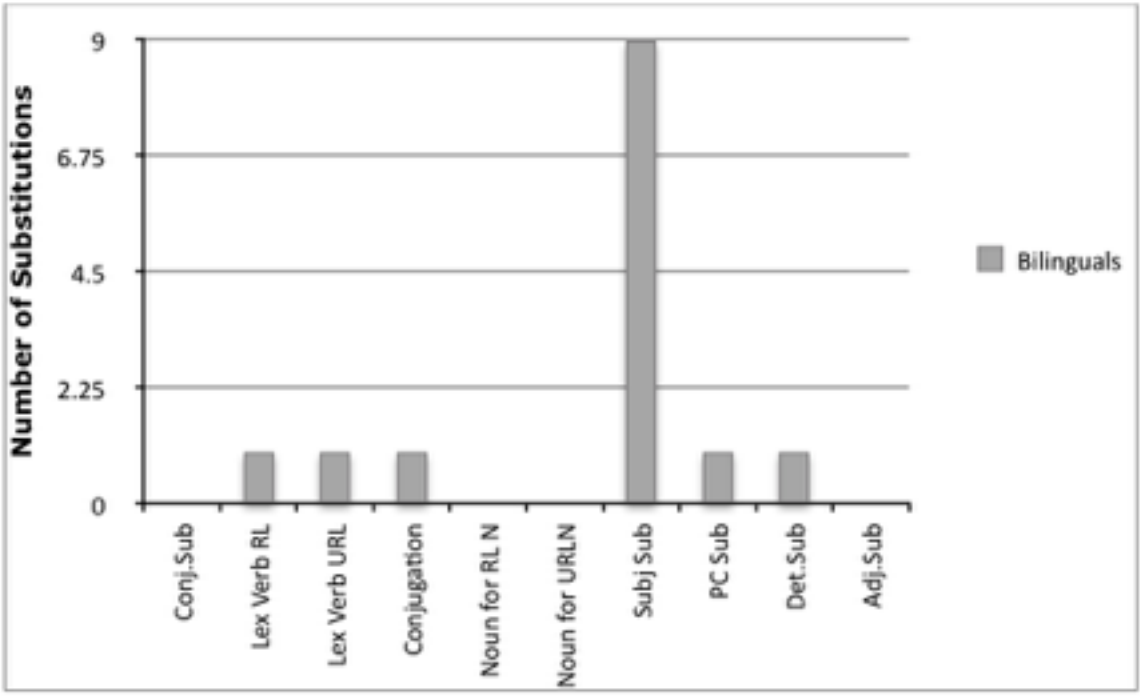

Figure 5. Substitutions made by bilinguals with SLI
Conj.Sub = Conjunction substitution
Lex Verb RL = Lexical verb substitution for Related Lexical Verb
Lex Verb URL = Lexical verb substitution for Unrelated Lexical Verb
Conjugation = Conjugation substitution
Noun for RL N = Noun for Related Noun
Noun for URLN = Noun for Unrelated Noun
Subj Sub = Subject Substitution

PC Sub = Passé Composé Substitution
Det Sub = Determiner Substitution
Adj Sub = Adjective Substitution

Younger bilinguals. As shown in figure 4, the younger bilinguals and monolinguals are the groups that make the most substitution errors on average (1.24 substitution errors per child) with the younger monolinguals making the most (1.59 sub.errors per child) and the bilinguals making 1.0 errors per child. Closer analysis reveals that the younger monolinguals make passé composé and related lexical verb swaps most frequently, whereas the bilinguals make determiner and related noun errors much more frequently than the monolinguals – 11 and 8 errors per category respectively, vs. 4 and 3 errors for the monolinguals.

Examples of these errors include:

"Si tu manges tout ton assiette, tu auras du dessert" (Si tu finis ton assiette, tu auras du dessert toi aussi)

"Crème glacée aussi." (Si tu finis ton assiette, tu auras du dessert toi aussi.)

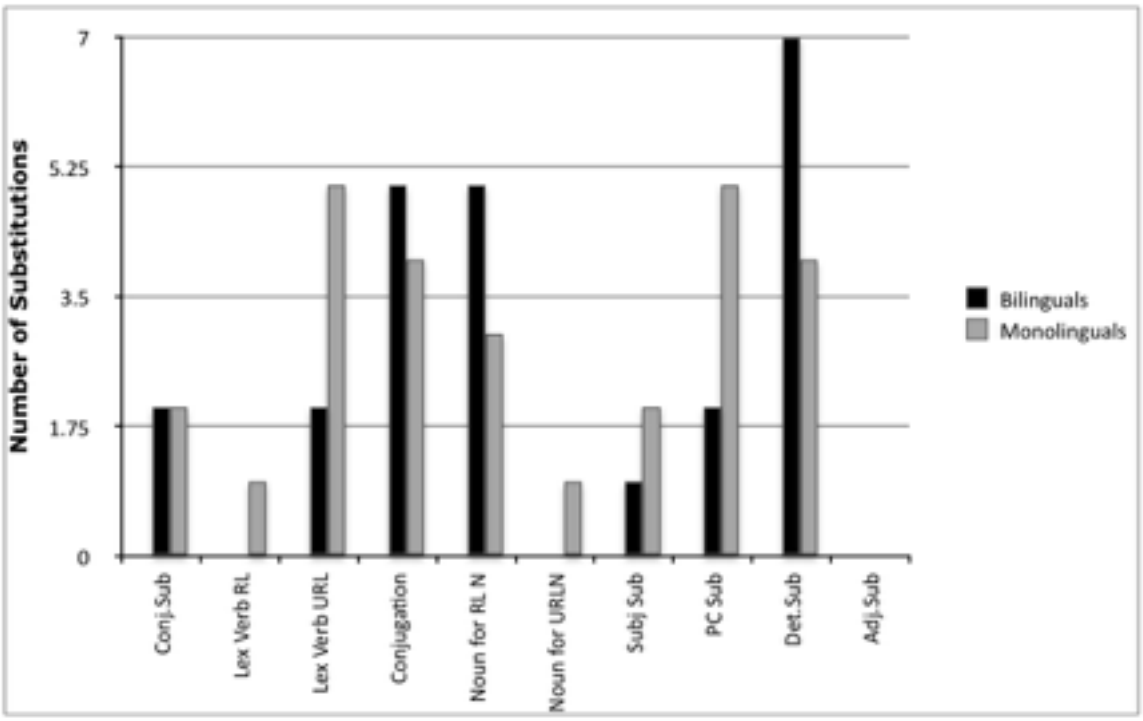

Figure 6. Substitutions made by younger bilinguals and monolinguals

Conj.Sub = Conjunction substitution
Lex Verb RL = Lexical verb substitution for Related Lexical Verb
Lex Verb URL = Lexical verb substitution for Unrelated Lexical Verb
Conjugation = Conjugation substitution
Noun for RL N = Noun for Related Noun
Noun for URLN = Noun for Unrelated Noun
Subj Sub = Subject Substitution
PC Sub = Passé Composé Substitution
Det Sub = Determiner Substitution
Adj Sub = Adjective Substitution

Discussion

This study investigated performance on a sentence repetition (SR) task in typically developing monolingual and bilingual children and children with SLI by using a syntactically qualitative scoring rubric. By including both typically developing monolingual and bilingual children of different ages along with children with SLI, a unique analysis as to the effects of language impairment, bilingualism, and age on a more qualitative scoring of SR tasks was possible. This study was done in an exploratory manner with the intention of uncovering (1) whether sentence repetition tasks can tell a different story when scored qualitatively rather than only quantitatively, and (2) to uncover evidence as to whether SR tasks tap more into a child's accumulated language knowledge or memory abilities. A qualitative scoring mechanism was used to attempt to view patterns in the kinds of words children are able to successfully repeat on these tasks, and to isolate potentially vulnerable syntactic categories for children with lower language ability or a diagnosis of SLI. This study is unique in that it involves comparison groups comprising both children with TD and children who are diagnosed with SLI, as well as children varying in age and exposure hours to French. The first matched comparison comprising SLI children both age and exposure matched as well as MLU matched to peers allowed for the isolation of the potential effects of their SLI diagnosis as well as their accumulated language knowledge. The second matched comparison of older and younger TD bilinguals by their language proficiency allowed for the variable of their accumulated linguistic knowledge to be controlled while investigating how performance

on the SR task differs by age, with age affecting such variables as cognitive capacity, memory, and processing ability.

The question of whether more diagnostically relevant information can be gleaned from qualitative SR scoring has been addressed prior to this study - Maillart et al. (2013) undertook a study that attempted to investigate the possibility of a differential diagnosis of SLI using SR tasks. They did this differently than the present study in that they used a qualitative scoring method that used measures such as semantics, function words, lexicon, and conjugation and attempted to see if these measures could provide higher sensitivity to the threshold of diagnosis for SLI. They found that measures of function words and syntax provided higher sensitivity to the diagnosis of SLI than typically used global methods (the overall SR task score). They also postulated that these two categories being the most important implicated specific weaknesses for children with SLI in the mastery of grammar. The scoring rubric developed and used in this study allows for a sentence-by-sentence analysis of the task but also allows for overall analysis by syntactic category while keeping in mind that the words are repeated within the meaningful context of the sentences. In this way it is possible to see how accurate the child is at repeating the core components of sentences (such as verbs, subjects, and conjunctions) and their accuracy on each category as a whole, rather than in the context of each individual phrase of the test.

Age, Exposure, and MLU-Matched Analyses and Implications

In the age and exposure match of typically developing bilinguals with children with SLI, both groups scored highest in Direct Objects and Adjectives, and lowest in

Conjunctions and Determiners. In this grouping, the differences between scores of TD and children with SLI were all significant, indicating that having a similar exposure background does not help the group with SLI perform similarly to the TD groups – having a similar level of language proficiency does. This would indicate children with SLI learn in a qualitatively similar way as TD children, but they are significantly delayed in their linguistic development and perform more like children with matched language development than matched age and exposure. This delay seems to impact the way children with SLI approach language specific tasks, forcing them to rely on non-linguistic strategies (such as STM abilities) to perform. In the second matched group analyses with older and younger bilinguals matched by MLUw, despite groups being significantly different in age, IQ, and exposure to French, the TD older and younger participants performed very similarly on the SR task. Their syntactic category scores differed significantly only in the category of Other – the next largest gap in scores was found in Conjunctions and Determiners, but these differences failed to reach significance. Their overall SR scores did not differ significantly.

This demonstrates that regardless of age, IQ, and exposure to French, language-level matched TD children perform very similarly on all nearly all included measures of sentence repetition, implicating accumulated linguistic knowledge as a very influencing factor on performance of SR tasks. In this comparison, the younger group actually had a significantly higher IQ, which could mean that the reason they were able to get a comparable MLU to the older group was not solely based on their greater French exposure, but also their greater cognitive capacity. It appears that amount of exposure,

IQ, and subsequent language development can make up for the discrepancy in age between the two groups. The younger group, being only three years old , would have less time spent in the language overall (being that they've been alive two fewer years). However, using their cognitive ability and higher exposure, were able to gain proficiency and mastery of the language that allowed them to perform similarly.

Using a qualitative scoring rubric allows for the child's errors to be sorted by syntactic category, and also by the quality of the error – omission or substitution. Substitution errors on a task of sentence repetition give valuable information as to the child's performance, because employing them means using a strategy requiring higher functioning and processing than simply parroting back the word. A child capable of making substitutions demonstrates they have not only processed and comprehended the phrase, but in not being able to access the target word from their memory decided to search their lexicon for a replacement rather than omit the word or phrase entirely. Across the three main groups of all participants, 63% of the older group (bilinguals + monolinguals), 44% of the younger group (bilinguals + monolinguals), and 27% of the bilingual SLI group made substitutions at least once. The older monolinguals made 28.69% of all errors substitutions, and the older bilinguals made 16.94%, compared to the younger TD groups who only made substitution errors approximately 6% of the time, with the rest being omissions. Going back to their total scores, the older monolinguals made the fewest total errors, but these results show that when they did make an error, they were the most likely to make a substitution rather than an omission.

By contrast, the SLI group made the most errors overall but 98.6% of these errors were omissions. The TD groups and SLI group appear to use different strategies – despite having lower memory abilities, children with SLI rely heavily on memory rather than their linguistic processing, as evidenced by their very rare substitutions. By contrast, the TD groups are necessarily processing the entire phrase and reconstructing it from their LTM – in order to make a substitution, they indicate that they are not relying simply on rote memory but are encoding and repeating the phrase from accessing their LTM, and when they are unable to recall the exact words needed from their STM they search for an alternative.

The kinds of substitution errors made by the TD children varied greatly, both between groups (older and younger) and within groups (bilinguals vs. monolinguals). The older bilinguals made the most errors in conjugation, where they kept the same word but conjugated it in a way unlike the target word. They also made many substitutions of conjunctions and nouns for related nouns. The monolinguals made fewer substitutions overall (as they made fewer errors overall), but as the data above showed, when they made an error on the test they were more likely to use a substitution than all other groups. Similar to the bilinguals, the monolinguals also made conjugation substitutions most frequently, showing that they understand there are different possible conjugations in grammar and were able to recall the correct verb, but not the correct tense. The younger bilinguals made the most substitutions in determiners, followed by conjugation and related nouns. This could indicate that the younger bilinguals are more likely to get tripped up by the large variation of possible determiners (la/le/les) and where to use them

than the older group. The younger monolinguals make the most errors in subbing lexical verbs for unrelated lexical verbs, meaning they substituted verbs that did not maintain the meaning of the phrase.

One could surmise from these substitution data as well as the overall category scores that for TD children, substitution errors are more likely and more frequent with increased ability in the language and increased age. Of words substituted, determiners are difficult to recall and more easily interchangeable, whereas for children with SLI they are almost exclusively errors by omission. The older bilinguals and younger monolinguals made the most substitution errors per child (with the older bilinguals making 1.14 average substitutions per child, and the younger monolinguals making 1.59), and these two groups are also the two groups with the highest average MLUw. The older bilinguals had an average MLU of 4.24 (vs. older monolinguals having 4.02) and the younger monolinguals had an average of 3.25 (with the bilinguals having 3.02). This could indicate that having a higher level of linguistic proficiency also makes errors of substitution more frequent. Using a qualitative scoring rubric for substitution errors could be a beneficial addition, as it could help to disentangle the difference between a poorly performing TD child and a child with SLI of similar MLU. The overall SR score of these two children could be similar, but taking a closer look at the kinds of errors made (substitutions vs. omissions) could provide more information as to whether the child is struggling linguistically or with the memory load aspect of the task.

Montgomery et al.'s 2010 review on the role of the working memory in SR tasks found that the immediate processing of SVO forms in a sentence comprehension task

didn't entail significant working memory mechanisms, even in children with SLI. Children with SLI were found to have less functional verbal working memory capacity (coordinating both storage and processing at the same time, which SR tasks employ) than their TD peers. These overall weaknesses found in children with SLI would corroborate the results found in the present study – that children with SLI perform similarly to TD peers in terms of syntactic performance, but demonstrate a global weakness manifesting in significantly worse scores overall. Because children with SLI have such known problems with processing and grammar, one could hypothesize that these problems might manifest in error patterns on SR tasks that are qualitatively different from those of TD children– with evident weaknesses, such as dropping verbs, recalling only very salient content words like subjects or nouns. However, these results do not demonstrate either of these to be true: Overall, the children with SLI pattern very similarly to the age and language matched TD children, they simply perform lower across the board. These results would indicate that in terms of sentence repetition performance, having a diagnosis of SLI does not indicate certain aspects of syntax are harder to process or are represented in a qualitatively different way – it seems to indicate SLI as a very severe delay on typical language development. This is further indicated from this study due to the inclusion of both older and younger TD peers, because we can see from the MLUw-match of older and younger bilinguals that the younger bilinguals pattern very similarly to the older bilinguals but at a lower level. One could surmise from these results that in terms of underlying mechanisms being accessed by SR tasks, and the effect of language impairment on how those are accessed by these tasks, it appears to manifest as a global

delay encompassing processing and memory, but especially affected by accumulated linguistic knowledge.

Performance of SLI and TD groups

The qualitative scoring method was evaluated using large groups of typically developing bilinguals and monolinguals of two different age groups, to assess performance based on their exposure patterns to French as well as their differing age. It was also used to compare the SLI group with all TD monolinguals and bilinguals, before matching of key variables was done. Within the older bilingual and monolingual group, the monolinguals scored higher on all measures of sentence repetition, which one would presumably attribute to their higher exposure to French (monolingual exposure mean = 94% of time spent in French, bilingual exposure mean = 53% of time spent in French). However, in the younger TD group, the bilingual group scored higher than the monolinguals despite having a similar discrepancy in exposure (monolingual exposure mean = 98% of waking hours in French, bilingual exposure mean = 52% of waking hours spent in French). Correlational analyses revealed a significant positive correlation between French exposure and TotalSR score for the older group ($r=0.527$, $p=0.000$) but not for the younger group ($r=-0.082$, $p=0.610$), which further supports this difference between the younger and older children in the relationship between exposure and SR performance. By contrast, the SLI group did not show any significant correlations, but this may be related to the fact that this group is much smaller and comprises a smaller range of French exposure and MLU scores - there are no monolinguals and because there just is a smaller range. From looking at the scores of these groups across the syntactic

categories, it appears that qualitative analysis reveals trends in successes and weaknesses within and across groups – older bilinguals and monolinguals perform similarly to each other in their error patterns across syntactic categories, as do younger bilinguals and monolinguals. Across the two groups, the older and younger participants perform significantly different, with older participants scoring much higher. The SLI group had the lowest scores across the board – their overall SR score was 31.3% (compared to the older bilinguals with 76.8%, and the younger bilinguals with 55.2%), and their syntactic category scores ranged from 13.9% to 40.4%. However, similarly to the younger TD participants, their total SR score did not correlate significantly with their French exposure or MLUw.

Comparing children with SLI to same-age peers demonstrates children with SLI do not appear to perform in a different way than TD children – their patterns of success on the syntactic categories of the sentences are significantly lower overall, but pattern similarly to those of TD children of the same age. Emerging patterns across large groups showed success in categories of direct objects, adjectives, and verbs, and failure in determiners and conjunctions. Looking at the matched groups, patterns in the repetition accuracy of particular syntactic categories emerged. In the first matched group, children with SLI were matched to younger bilinguals based on their mean length of French utterances in words, as well as to older bilinguals by their age and exposure to French. For the MLUw matched children with SLI and younger bilinguals, their lowest scores were found in the categories of Conjunctions, Determiners, and Other (C'est + Est-ce que). It has been documented previously that children with SLI have more trouble

repeating function words than content words (Chiat & Roy, 2008; Seeff-Gabriel et al., 2010) but it is interesting to see their results corroborated while also patterned alongside those of language and age-matched TD children, where it is clear the pattern is not unique to the children with SLI. Although the younger MLUw-matched TD participants scored higher on all measures than the SLI group, their scores of Other and Conjunctions were not significantly different from those of the children with SLI. Compared to the overall TD group MLUw mean (Overall group mean = 3.13, MLU-match group mean = 2.61) this could indicate that younger bilingual children with low MLUw in this group may perform similarly to children with SLI on repetition of function words. The pattern of SLI performance appears to be similar to that of the TD children but at a lower MLUw level.

Accumulated Language Ability and Cognitive Processes as Underlying Mechanisms of Sentence Repetition Performance

This study also attempted to look more closely at how sentence repetition tasks tap into accumulated language knowledge and memory abilities, and which is relied on most heavily. To do this, several factors were investigated. The first was the effect of age on performance, as increased age indicates increased cognitive and memory capacity. The second was the accuracy of the child when looking at the first vs. second half of the phrase, to see whether children experienced primacy or recency effects when trying to parrot the phrases back to the examiner. Comparing the groups by age it is seen that there is an overall trend for performance increase with increasing age and cognitive ability. Correlational analyses revealed no significant relationship between age and Total SR score for the older group ($r=0.212$, $sig=0.09$). The younger group showed a significant

correlation between age and Total SR score (r=0.456, sig=0.003). This discrepancy in correlations could indicate that it is individual language mastery that is affecting the increase of scores, as within these large groups there is a wide variance in language exposure and proficiency. Also, the range of ages within each group is very small, which could explain the lack of a correlation with age in the older group. Performance trends of children with SLI by syntactic category show that for the most part they performed similarly to the TD groups in terms of error patterns, just significantly lower in nearly all categories.

The purpose of looking at performance on the first half vs. the second half of the phrase was to ascertain whether mere position in the sentence (beginning or end) had a significant effect on performance, regardless of the kinds of words in the sentence. If so, this would indicate, that children experience primacy and recency effects, which would be related to their memory capabilities. If the first part of the sentence is remembered more accurately, this might suggest a limitation on how much information can be successfully encoded. If the second part is remembered more accurately, this might indicate decay of the first part, or failure to maintain it in memory for a sufficient time period. The older TD group did not show any significant difference in their scores of the first half or second half of phrases, whereas the younger TD groups and SLI groups scored significantly higher on the second half of the phrases than the first half. This result indicates that only the older TD children were unaffected by position in the sentence and that the other two groups experienced a recency effect, or decay of the first part of the sentence. Because the SLI group and the older TD group did not differ significantly in

age or IQ, this difference would more likely be attributed to their SLI diagnosis or their significantly lower MLUw. A number of previous studies have shown that children with SLI exhibit significant weaknesses in verbal memory (e.g. Montgomery et al., 2010). The younger group also had lower MLUw than the older TD group (3.15 vs. 4.13) but also a lower IQ, so these effects for TD children could be attributable to lower age and cognitive ability as well as lower language proficiency.

Accumulated Language Knowledge and SR Task Performance

Using a qualitative assessment of this SR task allowed, to some extent, an assessment of how much linguistic knowledge was used. From these data, along with the substitution error data previously discussed, it appears the SLI group relies much more heavily on their memory capacity rather than their linguistic knowledge compared to their TD peers. They very rarely make errors of substitution (choosing instead to omit the parts of the phrase where their memory fails them), and they experience a recency effect when trying to recall the phrase as a whole. Although they perform more similarly to MLU-matched peers than age and exposure matched peers (as discussed above), their qualitative performance does not indicate that they are using the same strategies to succeed as their TD peers. In terms of linguistic ability, despite being MLU matched to the younger group, they make significantly fewer errors of substitution. Further, the recency effects noted in the younger TD group appear to be something they grow out of as they age (as noted by the lack of recency effect in the older group) and yet the SLI group experiences them as well. It appears that cognitively, the SLI group performs more similarly to the younger group in their memory strategies employed (i.e. higher accuracy

on the second half of the phrase) but despite being MLU matched to them they do not have the same level of access to their linguistic knowledge as the TD group, and cannot use the strategy of substitution when their memory fails them. It appears that the younger TD group processes and understands the phrase but their memory ability can get overloaded, causing them to experience a recency effect or make substitution errors based on their overall understanding of the phrase.

By contrast, the SLI group appears to not grasp the meaning of the phrase enough to use any strategy beyond attempting to parrot it back, and when they get overloaded (either in trying to understand the phrase or in their memory reaching its capacity) they omit what they cannot remember. For this reason, using a qualitative assessment of the SR task that incorporates substitution errors may help to differentiate a child with SLI and a low-MLU child with typical development. While children with SLI do seem to pattern themselves in a similar way as TD children across syntactic categories (i.e. they do not appear to struggle with any specific aspect of the phrase in general and instead present with a global delay manifesting in lower scores across the board) they do differ qualitatively in that their errors are omissions 98.6% of the time.

Overall, this study presents evidence that sentence repetition tasks are highly influenced by underlying linguistic competency, and that different groups of children appear to use different strategies for success. In terms of what is really required to be successful in a task of sentence repetition, it's different for different groups. The groups with the highest success on the task (older typically developing monolinguals and bilinguals) seem to use a mixture of linguistic processing and memory abilities, and these

both manifest in their lack of primacy and recency effects and their ability to substitute meaningful words when the target words evade them. It appears that children with language impairment do perform more similarly to language-ability matched peers (by MLUw) than age and exposure matched peers, in their overall syntactic category performance and their accuracy on the first and second half of phrases, but not in their likelihood to make substitution errors. Typically developing children who differ in age, exposure, and IQ but who have similar MLUw are also able to perform very similarly to one another in terms of syntactic category and overall scores, however they still employ different strategies, with the younger group experiencing recency effects and making fewer errors of substitution.

These data suggest that a qualitative scoring of SR tasks could give useful information for clinicians, especially in terms of substitution errors where children with SLI perform very differently than age and language matched peers. It does not appear from these data that a qualitative syntactic assessment could be diagnostically relevant for clinicians, as children with SLI perform at a significant global delay without any apparent syntactic weaknesses that could be interpreted as clinical markers or evidence of differential diagnoses for SLI. Looking across all groups, there are trends of weaknesses – namely function words like determiners and conjunctions – where all children seem to struggle the most, but there does not appear to be particular syntactic category where children with SLI perform in a qualitatively different manner.

Directions for Future Study and Limitations

Future studies are needed to explore in more depth the other measures of linguistic processing that could be tapped into using SR tasks, as well as measures including more linguistically diverse populations. This study was limited in its exclusion of one population - monolingual children with SLI - and they would add valuable information to the study of how monolingual vs. bilingual children with and without SLI perform on SR tasks. The future inclusion of monolinguals with SLI could seek to demonstrate whether or not only focusing on one language when presenting with SLI improves SR task scores, as well as whether or not they rely on the same techniques when performing the task as bilinguals did in the present study.

The heavy reliance on the linguistic component of the task for success could be why SR tasks are so indicative of impairment – children with SLI are at a significant language delay and this presents as a global problem in their mastery and production, which makes their performance suffer. However, their lower memory capacity is also demonstrated to be easier to rely on for these tasks than their lower language ability. In the face of impending failure, the children with SLI resort to memory strategies (recency effects and omissions) over linguistic strategies (substitutions). Finding mean length of utterance is a factor that can match language impaired and typically developing children on this task is not surprising – MLU is a measure of syntax, and having a larger MLU indicates an ability to make more complex and meaningful phrases that are not simply stringing words together, but include content and function words. As the child develops their overall ability to produce and comprehend language, they seem to be better prepared to process, encode, and repeat complex phrases that contain words they recognize and

have already developed a mastery of. However these data suggest that despite having achieved a similar MLU, children with SLI are still not equipped to use that linguistic ability as a strategy for repetition in the same way the younger TD group does, otherwise we would expect children with SLI and MLU-matched peers to make similar amounts of substitution errors, when this was not found to be the case.

It can be speculated that children with language impairment may be hearing phrases that are phonetically meaningful but linguistically not meaningful or only partially meaningful because they may not yet be part of their mastery of the language accessible to them. This is similar to tasks of nonword repetition, because NWR tasks are both meaningless and meaningful. They are meaningless in terms of words that have been given a definition and meaning in a language, but meaningful in that they follow the rules of the language and are phonetically plausible. Children with SLI struggle to repeat them, and this could be due to the fact that they do not have a metalinguistic knowledge that is developed enough to be able to extrapolate from their existing lexicon and encode words that aren't meaningful to them. In sentence repetition tasks, they also struggle to encode and repeat words and phrases that aren't meaningful to them because they are not yet able to process and understand them linguistically, and this ability is dependent not on exposure, age, or diagnosis of SLI but on the child's own proficiency of the language of the task.

The results of this study implicate a heavier reliance on memory strategies for SR task performance in children with SLI, which could mean that the language impaired child approaches a sentence repetition task much like a digit span task. This could also be

the case for tasks of nonword repetition. Future study in the realm of sentence repetition could include more data on the memory capacity of children with SLI, as well as data on their nonword repetition performance included the child's error quality – whether substitution errors and primacy/recency effects are noted. This could shed light on whether the performance noted in this study is a trend across repetition tasks for children with SLI. If the children with SLI make fewer substitution errors and experience recency effect on NWR tasks, and typically developing children perform similarly in NWR tasks as they do SR tasks it may be possible to further corroborate the findings from this study that different groups of children use different strategies for success depending on their mastery and proficiency of their accumulated language knowledge and their cognitive capacity and processing.

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Appendix A. Scoring of the Sentence Repetition Task

1. Regarde ça

Lexical verb + Direct Object Pronoun

2. C'est quoi ça?

C’est + Subject Complement + Reduplicated Subordinate Clause

3. Je peux la porter

Subject Clitic + Auxiliary/Modal Verb + Direct Object Clitic + Lexical Verb

4. C'est quoi là dedans

C’est + Subject Complement + Adverb Location

5. Je suis tombé et j'ai mal

Subject Clitic + Auxiliary/Modal Verb + Lexical Verb + Conjunction + Subject Clitic + Auxiliary/Modal Verb + Lexical Verb

6. De où viennent ces choses?

Adverb Location + Lexical Verb + Determiner + Lexical Subject

7. Voici tes vieux souliers roses

Adverb Location + Determiner + Adjective + Lexical Subject + Adjective

8. Tu peux mettre ce vieux manteau

Subject + Auxiliary/Modal Verb + Lexical Verb + Determiner + Adjective + Direct Object Lexical

9. Je ressemble à Maman avec ça

Subject Clitic + Lexical Verb + Direct Object Adverb

10. Est-ce que je peux mettre ces vielles bottes brunes?

Est-ce que + Subject Clitic + Auxiliary/Modal Verb + Lexical Verb + Determiner + Adjective + Direct Object Lexical + Adjective

11. Est-ce qu'on peut arrëter et aller jouer Maman?

Est-ce que + Subject Clitic + Auxiliary/Modal Verb + Lexical Verb + Conjunction + Auxiliary/Modal Verb + Lexical Verb + Apostrophe

12. Je ne veux pas travailler toute seule.

Subject Clitic + Negation + Auxiliary/Modal Verb + Lexical Verb + Adverb Location

13. J'ai tellement faim que je vais en manger deux.

Subject Clitic + Auxiliary/Modal Verb + Direct Object Lexical + Conjunction + Subject Clitic + Auxiliary/Modal Verb + Lexical Verb + Direct Object Lexical

14. Je mets du ketchup et de la moutarde dans mon hamburger

Subject Clitic + Lexical Verb + Determiner + Direct Object Lexical + Conjunction + Determiner + Direct Object Lexical + Adverb Location

15. Si tu finis ton assiette, tu auras du dessert toi aussi.

Conjunction + Subject Clitic + Lexical Verb + Determiner + Direct Object Lexical + Subject Clitic + Lexical Verb + Determiner + Direct Object Lexical + Apostrophe

16. Tu ne grandiras pas si tu ne manges pas

Subject Clitic + Lexical Verb + Negation + Conjunction + Subject Clitic + Lexical Verb + Negation

17. Demain on va finir le travail et le gros camion va venir

Adverb Location + Subject Clitic + Auxiliary/Modal Verb + Lexical Verb + Determiner + Direct Object Lexical + Conjunction + Determiner + Adjective + Direct Object Lexical + Auxiliary/Modal Verb + Lexical Verb

18. Je n'ai pas peur d'aller a notre nouvelle maison demain.

Subject Clitic + Auxiliary/Modal verb + Negation + Direct Object Lexical + Lexical Verb + Adjective + Direct Object Pronoun + Adverb Location