NONWORD REPETITION ABILITY AS A PREDICTOR OF SECOND LANGUAGE LEARNING IN ESL ADULTS

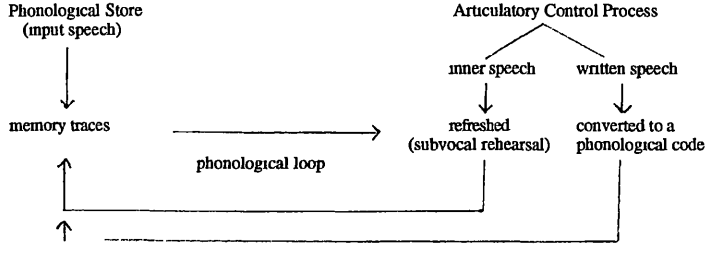
Christen M Pearson
Indiana University

Introduction

A problem that is of interest to both researchers and educators is why individual differences exist in the ability to learn a second language (Skehan 1989) This issue has been approached from several perspectives, investigating, for example, such factors as identity, motivation, status of the involved languages, and amount of input A more recent view, however, is Baddeley's (1986, 1990) theory of phonological working memory, which seeks to explain individual differences in language learning through a cognitive and/or language processing account This view hypothesizes that individual differences may reside within an individual's cognitive processing, with or without concurrent influences from environmental factors Support for this view, regarding both production and comprehension, has come from adult studies involving second language learning in a lab setting (Ellis & Beaton 1995, Ellis & Sinclair 1996)

Review of the Literature

Baddeley's theory seeks to explain how learners can hold a sequence of sounds, for example, a new word, in memory 1) long enough to repeat it back, and 2) long enough and in a stable enough representation to facilitate transfer to a long-term store, that is, the mental lexicon In order to explain this ability, Baddeley has hypothesized a memory mechanism that is termed the 'phonological loop', a working memory space that holds in-coming material in a sound-based form The material in this space, however, begins to degrade after about two seconds, a process that can be offset or delayed by subvocal rehearsal The phonological loop can be visualized as in Figure 1 In-coming speech is made into a memory trace that will decay after two seconds Before this occurs, it is passed to the articulatory control processor where it is subvocally reproduced, thereby replenishing the memory trace An everyday example would be when one needs to remember a phone number, but there is no place to write it down In this situation, one mentally repeats the number over and over again This is what is meant by inner speech and subvocal rehearsal Each time a word is refreshed in this manner it is reactivated and strengthened, but again starts to degrade, thus necessitating more rehearsal and the cycle begins again This is the 'loop' A similar pattern occurs with reading material Written words are converted to a phonological code, which in turn is made into a memory trace After two seconds, this trace starts to degrade, needs to be refreshed, and thus the loop again In brief, then, in order to learn a new word, the building block of other language areas, the following needs to occur First, a stable representation of a sound sequence is created, second, additional input reactivates this representation and strengthens it, third, over time, and with additional input, the representation is transferred to a long-term store, that is the mental lexicon, finally, the word can be accessed and/or retrieved either by similar-sounding words or by semantic links



Schematic of Phonological Loop
Figure 1

Previous studies in the area of phonological working memory and language knowledge and/or processing have involved case studies of adults with impairments, such as head trauma or stroke, monolingual children, both normal and with language impairments, second language learning in children (preschool, upper elementary, and junior high age), adults in a lab setting, using a variety of methodologies, and adults in an actual second language learning situation Early studies with adult head trauma cases (Vallar & Baddeley 1984), as well as normal adults in a lab setting (Baddeley, Papagno, & Vallar 1988), sought to find support for a multi-dimensional system of memory, rather than a unitary system From these studies, though, it was found that short-term phonological storage was crucial when learning verbal material which was unfamiliar and with which semantic links could not be made This finding initiated studies of vocabulary acquisition in both normal and language impaired children Implications were also made for second language learning, where a lack of phonologically similar forms and/or weaker semantic links are thought to decrease the ease of learning during the initial stages of language acquisition

The child studies which developed out of the early adult studies focused on a correlation between phonological working memory and vocabulary acquisition, seeking to determine if memory skills could predict later vocabulary development, a crucial building block for further language development and communication Using a nonword repetition task, which is purported to measure phonological working memory, Gathercole and Baddeley (1989) found that a high correlation did exist between verbal working memory and vocabulary knowledge in preschool-aged monolingual children Following through on this to investigate actual word learning, and using the same children, Gathercole and Baddeley (1990a) formed two groups - high repetition ability and low repetition ability - and found that children with low ability were slower in learning unfamiliar names and had less recall one day later, when compared to children with high repetition ability These findings led to similar work with Specifically Language Impaired children (SLI) (Quite briefly, SLI children experience difficulties with an assortment of language issues, yet have normal nonverbal intelligence See Watkins & Rice 1994 for a fuller description of such children) Gathercole and Baddeley (1990b) found striking impairments in SLI children's ability to repeat nonwords, compared to age- and language-matched peers, with four syllable words completely differentiating the SLI children from the control children Similar findings have also been found by others (Gillam, Cowan, and Day 1995, Montgomery 1995a, 1995b, 1996, Ellis Weismer 1996, Dollaghan and Campbell 1998)

In sum, findings from monolingual child studies over the past decade have found a reciprocal relationship, which changes over time, between vocabulary acquisition and phonological working memory Further, it is hypothesized that initially there is heavy reliance on working memory, however, as more sound sequences (i e , words) are accumulated in the long-term store, there is more reliance on phonologically similar words and semantic links, with less reliance on phonological working memory This is thought to occur by approximately seven years of age However, an exception is noted, that of foreign language learning In this situation, unfamiliar sound sequences are frequently encountered and at the same time there is a paucity of phonologically similar material and/or semantic links available In this situation, the ease of long-term learning is diminished

Based on the above noted exception, several studies have investigated whether there is a correlation between phonological working memory and second language learning in children Service (1992), in a longitudinal study of Finnish children (aged 9-12) learning English as a foreign language (EFL), found a significant correlation between nonword repetition ability and end-of-the-year final exam English scores She concluded that a strong predictive relationship exists between success in learning English and phonological working memory ability Cheung (1996), working with seventh grade Hong Kong students in an EFL setting, has also found a predictive relationship between nonword repetition ability and the ability to learn new English words and grammar However, the obtained results held only for students who had a smaller English vocabulary at the initial stages of the study Therefore, Cheung states that working memory interacts with long-term memory Gathercole, Hitch, Service, and Martin (1997), in their study with monolingual five-year-olds, also state that a relationship exists between phonological short-term memory and lexical knowledge previously acquired, with both having a significant impact on the ability to learn and retain sound patterns of new words Similar results have been found by Pearson (1999) in preschool ESL children, where amount of school accounted for the greatest amount of variance

in new word learning in the target language, thus implying, as Cheung stated, that working memory interacts with long-term memory

As child EFL studies have developed, so too have adult studies, with some of the same results Papagno, Valentine, and Baddeley (1991), using paired-associate word learning to simulate foreign language learning, found that when semantic links are not accessible, phonological working memory becomes crucial to learning unfamiliar material Ellis and Sinclair (1996) have also found phonological working memory to be critical in learning new words, grammar, and syntax, but, like Cheung (1996), found a reciprocal relationship exists between working memory and long-term memory Finally, Ellis and Beaton (1995) found that for adults in a lab setting, phonological working memory and imagery were the two best predictors of second language learning However, they challenge future investigators to move out of the lab into actual second language learning situations to explore the role of phonological working memory on language learning

Sagarra (1999) and Hummel (1999) have both attempted to meet the challenge presented by Ellis and Beaton, by investigating the role of working memory in actual second language learning Sagarra, using a reading span test as a measure of working memory, sought to explore whether working memory had any effect on lexical and grammatical knowledge, as well as reading and listening comprehension She found no effect of the reading span test (which divides ability into three levels - high, medium, and low) on any of the measures used to assess second language proficiency used by a university-based program with their second language learners (e g., lexical knowledge, grammar, reading, listening) Sagarra notes that the reading span test may not provide an accurate division of scores into levels, based on the patterns of her subjects She further notes that reading aloud, as required by the test, does not necessarily mean that processing of the material is taking place Hummel has also explored the relationship between working memory and actual second language learning, again in a university-based program, using French-speaking students with English as their second language She also used a reading span task as a measure of general working memory capacity, along with a pseudoword repetition task as a measure of phonological memory Her results indicate no significant correlation between either of the memory tasks and proficiency gain in second language learning (over a period of seven months), as measured by the Michigan Test of English Language Proficiency

In sum, results to date, with adults, have shown that phonological working memory and imagery are the two best predictors of adult second language learning in a lab setting, as mentioned above Phonological working memory has also been shown to be crucial when phonologically similar items and/or semantic links are not available, as is the case with second language acquisition Remember, though, that Ellis and Beaton also issued a challenge to explore this area of research with real-life learning situations In the few studies with actual second language learning, however, results have not matched those found in a lab setting It should be noted, though, that these variable results may have more to do with differences in populations and methodologies, than with conflicting results due to a flaw in the actual theory Quite briefly, the studies have involved different memory tests, explorations into capacity issues vs processing issues, and investigation of theoretical issues vs applied issues

In order to further investigate these variable results, a longitudinal study of nonword repetition ability as a predictor of second language learning in adults is being conducted The following research questions are addressed Does nonword repetition ability differentiate 'more rapid' from 'less rapid' second language learners, thus being a potential predictor of second language learning in the adult ESL population? And if so, are some language skills more affected than others? Based on previous studies of adult learning in a lab setting, along with studies of classroom L2 learning with older children, it is predicted that 1) nonword repetition ability will account for a significant portion of the variance in proficiency gain in learning a second language, and 2) listening and grammar will be the most affected subskill areas

Methodology

Subjects Twenty adult ESL students of various L1's, all of whom were sequential second language learners, participated in the first phase of this longitudinal study Learners were attending an academic-based intensive English program (IEP) at a large midwestern university, and were new students

placed in the first two levels of a seven level program This placement level corresponded to extremely little English proficiency to some functional English An assumption of normal intelligence was made as all participants were either high school or college graduates, with plans to attend an American university at either the undergraduate or graduate level. No learner had any history of hearing difficulties or ear infections All students were experiencing their first time in an English-speaking environment.

Group placement Each learner met individually with the investigator for questioning and assessment of nonword repetition ability in order to determine group placement An oral questionnaire was administered which asked for a language history (e g , first language, other languages known, amount of English study in home country) Following this, the Goldman-Fristoe Test of Articulation (Goldman & Fristoe 1969) was administered in order to determine systematic misarticulations due to idiolects and/or accents This was deemed important so as not to penalize a student because of accent issues, in other words, the test gave information about which sounds in their phonemic inventory were problematic and what strategies they used to deal with these (for example, deletion, substitution by another sound, etc) Upon completion of this assessment, the Children's Test of Nonword Repetition (Gathercole, Willis, Baddeley, & Emslie 1994) was given as a measure of phonological working memory, which was then used for placement into either a high repetition ability group or a low repetition ability group This test, which purportedly assesses a learner's ability to remember a string of sounds, involves 40 nonwords, ranging from 2-5 syllables and 4-13 phonemes in length As this is a British test, one modification was made nonsense words represented orthographically as having an 'er', but which were transcribed as schwa, were changed to the American midwestern dialect of hooked schwa The test was administered via audiotape to ensure that all participants heard the same pronunciation, and in order to minimize any facial/visual cues Responses were transcribed on-line, but were also audiotaped in order to be transcribed a second time, within 24 hours, as an accuracy check

Pre-test measure Data for English language proficiency upon entry into the program, for each participant, was taken from the results of the IEP standard placement exam This constituted the pre-test measure The IEP placement exam involves four subskill areas - writing, listening, grammar, and reading - and is given in a format similar to the institutional TOEFL Results are calculated by raw score, which is then converted into a level placement score, with the exception of writing, which has only a level score assignment

Post-test measure Gain scores, based on the differential between pre- and post-test scores, were obtained from the students' final exam scores given after seven weeks of intensive English study (four hours of class per day, with a goal of four hours of additional work at home) The final exams were one of the program's standard exams, and as with the placement exam, tested writing, listening, grammar, and reading, again in a format similar to the TOEFL Note that the program's placement exam and final exams have undergone rigorous statistical evaluation in order to ensure that obtained results are parallel across tests As with the pre-test measure, both raw scores and level scores were used, again with the exception of writing which only has a level score available

Analyses A repeated measures ANOVA design was used for the analyses, with nonword repetition ability (either high or low) as the independent variable and proficiency gain between pre-test and post-test as the dependent variable As explained above, these gain scores were for four subskill areas, that of writing, listening, grammar, and reading Also, as mentioned earlier, gain scores were analyzed in two ways by program level gain and by raw score gain, except for writing where only level gain was available This resulted in seven repeated measures ANOVAs being run listening proficiency gain, raw score and level, grammar proficiency gain, raw score and level, reading proficiency gain, raw score and level, and writing proficiency gain, level only Correlations were also run in order to better determine individual patterns of relationships which an analysis based on mean scores might mask.

Results

Table 1 shows the results obtained from the repeated measures ANOVAs Though significance in gain is important to look at, for the design of this study the interaction is of most importance. An interaction would indicate that group placement, that is, nonword repetition ability, was exerting an effect For writing, it can be seen that no significant gain was made during the seven week session, and that there

were no group effects Results for listening raw scores were different Proficiency gain over the seven week period was approaching significance at the 10 level Though a 05 alpha level would be preferable, since this area of study is just beginning to be explored, a 10 level is considered something to be looked at and further explored, rather than being discarded at this point The interaction between group placement and proficiency gain also approached significance at the 05 level This indicates that nonword repetition ability might be exerting an influence on proficiency gain Looking at listening level scores, a similar pattern can be seen, with proficiency gain and interaction (group effect) significant within a 10 alpha level Moving to grammar based on raw scores, it can be seen that proficiency gain is highly significant at the 000 level, with the interaction approaching significance at the 10 level A very similar pattern holds for grammar based on level placement Finally, looking at reading gain, for both raw score gain and level gain, there is a highly significant increase in proficiency, however, the interaction does not even approach significance at any justifiable alpha level, indicating that nonword repetition ability does not exert an effect It should be noted that, due to the small number of students in this phase of the study, an omnibus test could not be run, necessitating a series of repeated measures ANOVAs In order to adjust for multiple tests being run, an alpha level of 007 is needed for an adjusted 05 level (015 for an adjusted alpha level of 10) Using this criteria, gain in proficiency across both raw scores and level scores is significant for both grammar and reading, yet no interaction based on group placement approaches significance

Writing	by level	p< 258	gain
		p< 258	interaction
Listening	by raw score	p< 109	gain
		p< 057	interaction
	by level	p< 071	gain
		p< 071	interaction
Grammar	by raw score	p< 000	gain
		p< 120	interaction
	by level	p< 001	gain
		p< 113	interaction
Reading	by raw score	p< 000	gain
		p< 387	interaction
	by level	p< 003	gain
		p< 368	interaction

Table 1
Repeated Measures ANOVA Results
Proficiency Gain Across Four Subskill Areas by Raw Score Gain and by Level Gain

Legend Writing = subskill area of writing proficiency as measured by an essay exam
Listening - subskill area of listening comprehension proficiency as measured by audiotaped listening passages involving short conversations, longer conversations, and academic lecture-type material with multiple-choice-type answers
Grammar - subskill area of grammar proficiency as measured by multiple-choice-type answers
Reading - subskill area of reading comprehension proficiency as measured by multiple-choice-type answers
Level - gain in proficiency as measured by advancement to higher level in a seven level academic-based program
Raw score - gain in proficiency as measured by increase in raw test scores
Gain - increase in proficiency between pre-test and post-test
Interaction - increase in proficiency x nonword repetition ability (high or low)

In addition to running a series of ANOVAs, correlations were also run in order to obtain a clearer picture of what might be occurring without the confound of group means Significance at the 05 level was found for nonword repetition ability and grammar (r= 531), as well as grammar and listening (r= 503) Note that grammar and listening were the two subskill areas where an argument was made for further exploration, due to the newness of this area of study, even though alpha levels in the ANOVAs were fairly high A negative correlation was found for writing and age (r=- 448) This was thought to be due to older students returning to school after a period of time away from academic writing demands, with the results that such writing skills had become 'rusty' No other correlations were significant

Discussion

The obtained results indicate that for this group of L2 learners, nonword repetition ability, as a measure of phonological working memory, did not predict proficiency gain after one session, across the subskill areas of writing, listening, grammar, or reading Since, as has been noted earlier, this line of investigation is very new, it is prudent to consider a somewhat higher alpha level, not in the interest of making any claims, but simply as an indication that further study might be warranted With this view, the interactions found for the subskills of listening and grammar deserve further investigation, especially since previous studies have found significant correlations between phonological working memory and the acquisition of vocabulary, grammar, and syntax proficiency (Cheung 1996, Ellis & Sinclair 1996, Service 1992) With this in mind, and considering the significant correlations found in this study between nonword repetition ability and grammar, as well as grammar and listening, a different perspective was considered, that of practical significance to an IEP program

It is the hope of both teachers and administrators that students will make consistent and steady gains across skills throughout each session in an IEP Therefore, it is questioned whether nonword repetition ability can predict degree or rate of advancement through a language program, which may not directly map onto gain in actual proficiency in specific subskill areas Table 2 shows average gain in program level, across the four subskill areas, for both the high and low repetition ability groups It can be seen that for the high repetition group, gain was made in all four skill areas, certainly what any teacher or administrator would hope to see In contrast, the low repetition ability group did not exhibit the expected gain across the board, and in fact, made no gain whatsoever in the subskills of writing or listening One would hope for at least one level gain, or close to it, each session It is also interesting to note that the two skill areas which exhibited the largest differentials in level gain between the two groups were listening and grammar, each with a full level difference between groups Note that these were the two subskills in the ANOVA and correlation results which showed the most promise for further exploration However, the results in Table 2 are based on group means, as with the ANOVAs, which do not tell us how individual learners performed

	Writing	Listening	Grammar	Reading
High Rep Group	+0 5	+1 0	+1 5	+1 5
Low Rep Group	0	0	+0 5	+1 0

Table 2
Comparison of Groups in Gains by Level across Skills

Legend Writing = writing proficiency gain by level, assessed by essay exam
Listening = listening comprehension proficiency gain by level, as assessed by audiotaped listening passages with accompanying multiple choice questions
Grammar = grammar proficiency gain by level, assessed by multiple-choice questions
Reading = reading comprehension proficiency gain by level, assessed by multiple-choice questions
High Rep Group = high repetition ability group as assessed by a nonword repetition test
Low Rep Group = low repetition ability group as assessed by a nonword repetition test
Scores - 0 = no gain, 0 5 = one half level gain, 1 0 = full level gain, 1 5 = one and a half level gain
* Note Results based on differential score between pre-test and post-test of standard IEP placement and final exam at this university

Individual patterns of proficiency gain can be seen in Table 3 In this table, individual gain scores, indicated by each asterisk, represent the mean gain across subskills over one session for each learner Gain by level is represented in the center column, with learners in the low repetition ability group shown on the left and learners in the high repetition ability group shown on the right It can be seen that all learners in the low repetition group cluster at a low level of gain, whereas those in the high repetition group exhibit a much larger range in gain scores Specifically, those in the low group make very limited gain, with not one learner progressing to even one level gain Those in the high group are more variable, with some learners making little gain, while others make significant, even striking, gains in proficiency of up to two and a half levels The emergent pattern shown here is suggestive of something possibly going on regarding nonword repetition ability and language learning Since overlap exists, however, nonword repetition ability cannot be said to cleanly differentiate the two groups of learners regarding proficiency gained, in this particular group of learners Remember, though, that Gathercole and Baddeley (1990b) found a complete differentiation of their language impaired children and normal controls only when using the four syllable words on the nonword repetition task and removing the easier two- and three-syllable nonwords Thus, it may be that longer nonwords are needed, especially in an adult population, in order to fully stress the system and differentiate the two groups of learners

Low Rep Group	Level Gain	High Rep Group
	2 5	*
	2 0	
	1 75	
	1 5	***
	1 25	
	1 0	*
*	0 75	*
****	0 50	****
****	0 25	*
*	0 0	

Table 3
Average Gain across Skills for each Individual Learner

Legend Low Rep Group = low repetition ability group as assessed by nonword repetition test
High Rep Group = high repetition ability group as assessed by nonword repetition test
Level Gain = gain in proficiency according to level placement in seven level program
* = represents individual learner's gain during session, composite score based on gains in writing, listening, grammar, and reading

Conclusion

This study sought to determine whether nonword repetition ability, as a measure of phonological working memory, could predict English proficiency gain in a group of adult ESL learners during one session (7 weeks) in an academic-based intensive English program Results of repeated measures ANOVAs were tenuous, though since this is a fairly new line of study, an argument was made for attention to areas which approached significance at the 10 alpha level These areas, specifically listening and grammar, were found to have significant correlations in this study, as well as having significance in studies by other researchers Therefore, though it cannot be said at this point that nonword repetition ability predicts second language learning, there are indications that it might play a contributing role along with other variables Results obtained in this study support those of Sagarra (1999) and Hummel (1999) in that highly significant results were not found in a population of adults actually learning a second language However, results from this study also support work by Service (1992), Cheung (1996), and Ellis and Sinclair (1996) which have shown support for at least some type of relationship between working memory and second language acquisition in the areas of listening and grammar As noted earlier, differences in populations and methodologies confound the ability to compare these studies in a clear manner

Based upon the results found in this study, continued exploration in this area is suggested, in an effort to determine whether working memory can be used as an accurate predictor of second language learning In the future, it is hoped that an unbiased assessment measure, such as a nonword repetition task, might help in level placement decisions in IEP programs That is, when a student is on the border of two levels after a session of study, and appears to be struggling, it is often difficult to make a decision regarding whether to move the student to the next level, or to retain the student in the current level for a second session If the struggle is due to culture shock and/or socio-emotional causes, retention will have no value However, if the student is struggling due to language processing difficulties, retention in the same level would be the best choice, allowing the student to gain a firmer grounding in that level's material before moving on It is in this area to which the present line of research hopes to make a contribution With this in mind, the longitudinal study - of which phase 1 has just been reported - continues, in the hopes that a larger number of students, as well as data from several sessions representing up to a year of English study in an IEP, will contribute more to this area of investigation and more clearly illuminate what is occurring in ambiguous areas of the present data

Acknowledgments

Appreciation is given to Kathleen Bardovi-Harlig and Beverly Hartford for help in the initiation of this study, to Phil Connell for input on the analyses and helpful comments on an earlier draft of this paper, to Harry Gradman, director of the Center for English Language Training, and to Marlin Howard and Susan Greer, directors of the Intensive English Program, for allowing me to conduct this research in the program, to section coordinators throughout the year for permission to visit their classes to secure volunteers for the study, and to the students, themselves, who have participated in this study

References

Baddeley, Alan (1986) Working memory Oxford Oxford University Press

Baddeley, Alan (1990) Human memory Theory and practice Boston Allyn & Bacon

Baddeley, Alan, Costanza Papagno, & Giuseppe Vallar (1988) When long-term learning depends on short-term storage Journal of Memory and Language, 27, 586-595

Cheung, Him (1996) Nonword span as a unique predictor of second-language vocabulary learning Developmental Psychology, 32(5), 867-873

Dollaghan, Christine, & Thomas Campbell (1998) Nonword repetition and child language development Journal of Speech, Language, and Hearing Research, 41(5), 1136-1146

Ellis, Nick & Alan Beaton (1995) Psycholinguistic determinants of foreign language vocabulary learning In B Harley (ed), Lexical issues in language learning Philadelphia John Benjamins Publishing Company

Ellis, Nick & Susan Sinclair (1996) Working memory in the acquisition of vocabulary and syntax Putting language in good order The Quarterly Journal of Experimental Psychology, 49A(1), 234-250

Ellis Weismer, Susan (1996) Capacity limitations in working memory The impact on lexical and morphological learning by children with language impairment. Topics in Language Disorders, 17(1), 33-44

Gathercole, Susan & Alan Baddeley (1989) Evaluation of the role of phonological STM in the development of vocabulary in children A longitudinal study Journal of Memory and Language, 28, 200-213

Gathercole, Susan & Alan Baddeley (1990a) The role of phonological memory in vocabulary acquisition A study of young children learning new names British Journal of Psychology, 81(4), 439-454

Gathercole, Susan & Alan Baddeley (1990b) Phonological memory deficits in language disordered children Is there a causal connection? Journal of Memory and Language, 29, 336-360

Gathercole, Susan, Graham Hitch, Elisabet Service & Amanda Martin (1997) Phonological short-term memory and new word learning in children Developmental Psychology, 33(6), 966-979

Gathercole, Susan, Catherine Willis, Alan Baddeley, & Hazel Emslie (1994) The Children's Test of Nonword Repetition A test of phonological working memory Memory, 2(2), 103-127

Gillam, Ronald, Nelson Cowan & Linda Day (1995) Sequential memory in children with and without language impairment Journal of Speech and Hearing Research, 38, 393-402

Goldman, Ronald & Macalyne Fristoe (1969) Goldman-Fristoe Test of Articulation Circle Pines, MN American Guidance Service

Hummel, Kirsten (1999) L2 proficiency and working memory Paper presented at the Second Language Research Forum, Minneapolis/St. Paul, MN

Montgomery, James (1995a) Sentence comprehension in children with specific language impairment The role of phonological working memory Journal of Speech and Hearing Research, 38(1), 187-199

Montgomery, James (1995b) Examination of phonological working memory in specifically language-impaired children Applied Psycholinguistics, 16(4), 355-378

Montgomery, James (1996) Sentence comprehension and working memory in children with specific language impairment. Topics in Language Disorders, 17(1), 19-32

Papagno, Costanza, Tim Valentine & Alan Baddeley (1991) Phonological short-term memory and foreign-language vocabulary learning Journal of Memory and Language, 30, 331-347

Pearson, Christen (1999) Nonword repetition as a predictor of vocabulary learning in ESL preschool children Paper presented at the Second Language Research Forum, Minneapolis/St. Paul, MN

Sagarra, Nuria (1999) Working memory and SLA State of the art and new data Paper presented at the Second Language Research Forum, Minneapolis/St Paul, MN

Service, Elisabet (1992) Phonology, working memory, and foreign-language learning The Quarterly Journal of Experimental Psychology, 45A(1), 21-50

Skehan, Peter (1989) Individual differences in second-language learning New York Edward Arnold

Vallar, Giuseppe & Alan Baddeley (1984) Phonological short-term store, phonological processing and sentence comprehension A neuropsychological case study Cognitive Neuropsychology, 1(2), 121-141

Watkins, Ruth & Mabel Rice (1994) Specific language impairments in children Baltimore Paul H. Brookes Publishing Company