

THE RELATIONSHIP BETWEEN SOCIAL BEHAVIORS AND WORKING  
MEMORY IN SCHOOL-AGE CHILDREN WITH LANGUAGE IMPAIRMENT

by

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## ABSTRACT

### THE RELATIONSHIP BETWEEN SOCIAL BEHAVIORS AND WORKING MEMORY IN SCHOOL-AGE CHILDREN WITH LANGUAGE IMPAIRMENT

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Children with language impairment (LI) have notable social problems (Brinton & Fujiki, 2004). Research has shown that children with LI often have deficits in working memory (Kirchner & Klatsky, 1985; Stark, Poppen, & May, 1987). The relationship between working memory and social behaviors has not been clearly defined. This study examined this relationship in children with LI and typical age-matched peers by asking participants to repeat nine nonwords and correlating these results with social behaviors as rated by teachers.

The Teacher Behavior Rating Scale (TBRS; Hart and Robinson, 1996) was used to compare social behaviors of 19 school-age children with LI to 19 age-matched peers with typically developing language skills. Social behaviors were divided into two categories, withdrawal and sociability. One subtype of withdrawal (reticence) and two subtypes of sociability (prosocial and likeability) were examined. Nonword repetition is a

culturally nonbiased measurement of the ability to form phonological representation of nonwords in working memory (Edwards & Lahey, 1998). A modified version of Edwards and Lahey's nonword repetition task was used to assess working memory.

Teachers rated children with LI as demonstrating higher levels of reticence and lower levels of both types of sociability than typical children. Children with LI performed poorer on the nonword repetition task at all syllable lengths (3-syllable, 4-syllable, and 5-syllable). Analyses of covariance were performed, including all participants, to identify if there were significant relationships between social behaviors and working memory. The results indicated that working memory was a significant factor for reticence, likeability, and prosocial behaviors. Regression analyses indicated that nonword repetition scores were significant predictors of reticence, accounting for 28% of the variance, likeability, accounting for 18% of the variance, and prosocial behaviors, accounting for 11% of the variance. As working memory increased, reticence decreased and both likeability and prosocial skills increased. Further analyses showed that only likeability was significantly influenced by language group and gender. Group specific analyses indicated that likeability was predicted by working memory for typical peers but not for children with LI. Working memory was also a stronger predictor of likeability for males than females.

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## Introduction

Children with language impairment (LI) have more difficulties in social situations than typical age-matched peers (Brinton & Fujiki, 1999; Craig, 1993; McCabe & Meller, 2004; Rice, 1993; Rice, Sell, & Hadley, 1991). For example, studies have shown that compared to typical age-matched peers, children with LI have greater difficulty entering an ongoing activity (Brinton, Fujiki, Spencer, & Robinson, 1997; Craig & Washington, 1993), negotiating solutions to a problem (Brinton, Fujiki, & McKee, 1998), participating and interacting in groups (Brinton, Fujiki, & Higbee, 1998; Brinton, Fujiki, Montague, & Hanton, 2000), and sustaining interactions with peers (Fujiki, Brinton, Isaacson, & Summers, 2001; Redmond & Rice, 1998). Gertner, Rice, and Hadley (1994) stated that peer rejection for children with LI may begin as early as preschool. In typical children, these behaviors are often associated with negative outcomes, such as juvenile delinquency, school dropout rates, and academic problems that persist into adolescence and adulthood (Rubin, Bukowski, & Parker, 1998).

Language is central to most social interactions. Therefore, it has been speculated that children with LI have difficulty in social situations because their linguistic limitations hinder their ability to interact effectively. In keeping with this view, Redmond and Rice (1998) proposed the Social Adaptation Model (SAM) as an explanation of how limited language abilities may influence social competence. The SAM argues that children with LI have social problems as a result of adjustments made in social situations due to their limited language skills. For example, it was speculated that children with LI realize they have language difficulties and thus avoid social interactions where language is used, thus appearing to be withdrawn (Gertner, et al., 1994; Rice, et al., 1991).

Although limited language abilities influence social interactions, recent research has shown that language disability alone does not explain the total social picture. Current research hints that language is not the only variable influencing the social interactions of children with LI. For instance, social and behavioral problems do not consistently co-occur in all children with LI (Fujiki, Brinton, Hart & Fitzgerald, 1999; Fujiki, Spackman, et al., 2004). Studies have also shown that the severity of the LI is inconsistently correlated with the severity of language difficulties in social interactions (Fujiki, Brinton, Morgan, et al., 1999; K. Hart et al., 2004). In attempting to explain these findings, there are a number of factors that may be contributing to difficulties children with LI have in social interactions.

Even though there are many studies examining social competence in children with LI, there are few that have looked at the connection between social behaviors and distinct patterns of cognitive processing, specifically working memory. Research has shown that children with LI are significantly less accurate than their typically developing age-matched peers when completing working memory tasks, which include: nonword repetition, sentence repetition, and nonverbal memory tasks (Dollaghan & Biber, 1993; Edwards & Lahey, 1998; Gathercole & Baddeley, 1990; Kamhi, Catts, Mauer, Apel, & Montgomery, 1995; Kirchner & Klatsky, 1985; Montgomery, 1995; Stark, Poppen, & May, 1987). One prominent test of working memory is the nonword repetition task. This task is a culturally nonbiased measurement of many cognitive processes which include discriminating acoustical signals, encoding acoustical information, holding the phonological information, and planning and executing the response (Edwards & Lahey; 1998; Gathercole & Baddeley, 1990).

For many years, researchers have assumed that working memory and language ability were interconnected; however, current research has shown that this may not be the case (Donlan & Masters, 2002). Therefore, it is of particular interest to examine if some of the difficulties children with LI have in social interactions result from not being able to process all the information that is needed to interact appropriately in social situations.

Bishop (1997) suggested that poor communication skills and problematic social competence may result from a deficit in working memory and processing capacity. Bishop stated that children with LI may struggle with peer interactions as a result of not being able to process all the information that is needed to interact appropriately in social situations. The author explained that if a child with LI has deficits in working memory, they would have difficulty integrating meaning from multiple sentences and the context. This deficit would affect some forms of social interaction. For example, in order to be a skilled conversationalist, one needs to keep track of multiple utterances, infer conversational cohesiveness, and appropriately respond.

In a recent study, Donlan and Masters (2000) found that level of social skills were predicted by working memory for school-age children with communication disorders, but were not influenced by language comprehension. Working memory was assessed by having the child point to familiar words in the order read when presented with two to six words at a time. Social behaviors were rated through 14 yes/no questions which identified whether the child points out objects of interest, has a best friend, looks at his or her partner's face when talking, uses imaginative ideas, speaks in pretend voices, lacks expression in his or her speech, or imitates exact portions of talk from videos, advertisements, or books. The child's level of sociability was determined by consulting

with the caregiver, teacher, and speech-language pathologist. Because social behaviors were not differentiated into specific types, it was difficult to look at the links between working memory and the various types of social behaviors, such as withdrawal, aggression, and sociability.

The current study looked at this relationship between working memory and social behaviors in children with LI and typical age-matched peers. Specific subtypes of withdrawn and sociable behaviors were examined to determine if specific relationships between these behaviors and working memory were present. Children were asked to repeat nine nonwords heard from a recording. These results were then compared with specific social behaviors, as rated by teachers. Research questions included the following:

1. Do children with LI exhibit more reticence and poorer sociability (likeability and prosocial) behaviors than their typical age-matched peers?
2. How do children with LI compare to typical age-matched peers in the ability to repeat nonwords?
3. Is there a relationship between performance in nonword repetition and level of social behaviors? If so, how does this relationship in children with LI compare to that in typical age-matched peers?

## Review of Literature

This review of literature will begin by demonstrating that many children with LI have difficulties in social interactions and have negative outcomes from these difficulties. In particular, it will focus on two prominent social difficulties that these children display, which fall within the domain of withdrawal and sociability. Specific subtypes of withdrawal and sociability will be reviewed. Next, the possible causes of social problems for children with LI will be examined. This part of the review will focus on the idea that there may be other influential variables in addition to language abilities that are difficult for children with LI, including working memory. It will then discuss working memory in children with LI and typical peers. The review of literature will conclude by describing the potential relationship between these specific social problems, often exhibited by children with LI, and working memory.

### *Relationship between LI and Social Interactions*

Children with LI are at greater risk for difficulties in social interactions than age-matched peers with typical developing language abilities (Brinton & Fujiki, 1999; Craig, 1993; McCabe & Meller, 2004; Rice, 1993; Rice et al., 1991). Several researchers have shown that children with LI demonstrate particular problems in social interactions, including accessing and participating in a group, initiating and maintaining conversation, verbal negotiations, and other social situations. These problems are particularly concerning because poor social interactions in childhood have been found to relate to a range of negative social outcomes (Rubin et al., 1998). These negative results included juvenile delinquency, school dropout rates, and academic problems in adolescence and adulthood.

In the following subsections, research is reviewed illustrating the range of social problems demonstrated by children with LI. These problems include entering ongoing activities, participating and interacting in groups, and sustaining interactions with peers. Although not comprehensive, the reviewed research illustrates the range of social difficulties faced by these children.

*Entering ongoing activity.* The ability to access an ongoing interaction is important in the social development of typical children. Research has shown that children with LI have greater difficulty than typical developing peers in accessing an ongoing interaction. Craig and Washington (1993) observed five 7-year old children with LI, four chronological age-matched (CA) typical developing peers, and four language age-matched (LA) typical peers. Each child attempted to enter an ongoing dyadic interaction between two age-matched peers. Craig and Washington reported that all of the CA and LA peers entered an ongoing interaction easily and rather quickly. Three of the five children with LI did not enter the interactions during the 20-minute observation period. The other two children with LI who did access the interaction used nonverbal communication to do so. The authors suggested that since these children with LI had failed to access in this simple context, children with LI would likely also fail when accessing more difficult situations.

Brinton et al. (1997) found similar results when observing six children in each of these groups (LI, LA, and CA). All children were between the ages of 8 and 12 years. Two children from the group with LI did not access the interaction during the 20-minute observation, and the remaining four children with LI required varying amounts of time to access. Similar to Craig and Washington (1993), all of the CA and LA peers entered the

ongoing interaction easily and rather quickly. For the children who were able to access, the triadic interaction was examined to evaluate the child's individual participation. The children with LI who were able to access the group talked significantly less, were addressed significantly less, and collaborated less (verbally and nonverbally) than either of the other children in the group.

*Participating and interacting in groups.* Brinton, Fujiki, and Higbee (1998) compared the participation of six children with LI in a triadic cooperative work group with six CA peers and six LA peers. Each child participated in similar interactions. The CA and LA peers were highly collaborative and worked and talked together while building the project. Four of the six children with LI played very minimal roles in completing the project and their verbal and nonverbal communication was limited. Other studies, examining different contexts, have shown similar results when studying how children with LI interact with peers (Brinton, Fujiki, & McKee, 1998; Brinton et al., 2000).

*Sustaining interactions with peers.* Fujiki, Brinton, Isaacson, et al. (2001) observed the behaviors of eight children with LI and eight CA peers on the playground. Each child was recorded for 45 minutes during morning and lunch recess. The 45-minute samples were divided into five-second intervals. Each five-second segment was then placed into one of six main subcategories, including: peer interaction, adult interaction, withdrawal, aggression, victimization, or other. The results indicated that children with LI had less peer interaction than typical age-matched peers and demonstrated significantly more withdrawn behaviors. This research supported previous findings showing that children with LI participate less in peer interactions.

Brinton et al. (2000) performed a pilot study to examine how the individual social-behavioral profiles of 6 children with LI influenced their ability to work in 4 different cooperative work groups. In each interaction, the child with LI participated in an activity with 2 age-matched peers. The groups were structured to allow the child with LI to play a meaningful roll in the interaction. The results varied from child to child, indicating that the child's social-behavioral profile was a good predictor of the child's ability to work with other members in a triad for a joint goal.

#### *Withdrawal Behaviors in Children with LI*

Social interactions among children with LI are often characterized by exclusion, isolation, or solitary activity. For example, Redmond and Rice (1998; 2002) found that teachers, but not parents, rated children with LI as displaying more withdrawal behaviors than their typical age-matched peers. It is important to note, however, that not all types of solitary behavior are socially problematic. This recognition has led researchers to examine subtypes of withdrawn behavior, including: solitary-active, solitary-passive, and reticence. The following review elaborates on these subtypes of withdrawn behaviors and the relationship between withdrawal and children with LI.

Solitary-active withdrawal is characterized by children who are actively excluded by peers (K. Hart, Fujiki, Brinton, & Hart, 2004). For example, a group of children may be pretending to be police on the playground. The child exhibiting solitary-active withdrawal may also be pretending to be a policeman in the midst of the group, but is not playing with the other children. When observing typically developing children, this type of withdrawal does not occur often in free play; however, when it does occur it is highly noticeable and invites peer rejection (Coplan & Rubin, 1998).

Solitary-passive withdrawal, the second subtype of withdrawn behavior, describes the behavior of children who seem to enjoy solitude (Brinton & Fujiki, 2004). For example, the child may prefer to play alone or complete a constructive project independently rather than in a cooperative group. This type of withdrawal is more common among typical children. Teachers and parents usually are not particularly concerned about a child who prefers to work independently.

Reticence, the third subtype of withdrawn behavior, is a term used to classify children who would like to interact with other children but are fearful of the situation (Coplan & Rubin, 1998). A reticent child may watch other children without joining in the play. The child appears to want to approach the group, but is fearful of joining the group. Reticence represents a type of fearful, anxious behavior that has been associated with rejection from peers (C. H. Hart et al., 2000).

C. H. Hart et al. (2000) assessed 642 children from the United States, China, and Russia to determine whether withdrawn behaviors could be reliably identified in various cultures. Teachers from these diverse cultures were given a social behavioral rating scale to assess reticence, solitary-active withdrawal, solitary-passive withdrawal, and sociable behaviors. Peer sociometric ratings were administered to measure peer group acceptance. Multisample factor analysis of teacher behavior rating and linked peer group adjustment indicated that separate factors were requisite to represent solitary-active, solitary-passive, and reticence for each cultural setting. Due to cultural differences in subtypes, teacher discrimination needed to be accounted for in this evaluation. In the United States and Russia, teachers made finer discrimination between social behavior subtypes than in China. When controlling withdrawal subtypes in each cultural setting, reticent behaviors

were uniquely linked to lower sociometric ratings by teachers and classroom peers. It was also noted that reticence was linked to peer rejection in all three cultures. C. H. Hart et al. concluded that teachers in each of these cultural settings appeared to be able to identify solitary-active, solitary-passive, and reticence behaviors.

With respect to children with LI, Redmond and Rice (1998) completed a longitudinal study of 37 children (17 children with LI and 20 typical age-matched peers). These participants were evaluated for social behaviors over a two year period. These authors found that teachers, but not parents, rated children with LI as displaying more withdrawn behaviors than their typical age-matched peers. However, the instrument used to rate these behaviors did not separate withdrawal into behavioral subtypes.

Fujiki, Brinton, Morgan, et al. (1999) studied withdrawal in 41 children with LI and 41 typical age-matched peers in the same classroom. Teachers completed a questionnaire about each child with LI and an age-matched peer. The children were divided into two age groups: 5 to 8 years and 10 to 13 years. Boys and girls with LI demonstrated higher levels of reticence than typical age-matched peers. Teachers also rated boys with LI as demonstrating higher levels of solitary-active withdrawal than girls with LI or typical age-matched peers of both genders. There was not a significant difference when comparing solitary-passive withdrawal in children with LI to typical age-matched peers. Overall, when comparing withdrawn behaviors, children with LI had significantly higher ratings in reticence than typical age-matched peers.

As one aspect of their study, K. Hart et al. (2004) assessed withdrawal behaviors in 41 children with LI and 41 typical age-matched peers. Teachers rated children with LI exhibiting higher levels of reticence and solitary-passive withdrawal than typical age-

matched peers. Solitary-active behaviors were infrequently reported in either group and there was no difference between groups.

Fujiki, Spackman, et al. (2004) looked at the relationship between language, emotion regulation, and reticence. As one component of this study, a comparison was made between children with LI and their typical age-matched peers on reticent behavior. The comparison of teacher rating of 43 children with LI and 43 typical age-matched peers supported the previously mentioned studies. Children with LI had significantly higher reticence scores (indicating greater levels of reticence) than typical age-matched peers.

Overall, when comparing social behaviors rated by classroom teachers, children with LI demonstrated significantly higher levels of reticence than typical age-matched peers (Fujiki, Brinton, Morgan, & Hart, 1999; Fujiki, Spackman, Brinton, & Hall, 2004; K. Hart et al., 2004). Reticence has also been linked to peer rejection in a variety of cultures (C. H. Hart et al., 2000). Fujiki, Brinton, Morgan, et al., (1999) found that there was a significant difference when comparing solitary-active withdrawal, but not when comparing solitary-passive, in children with LI to typical age-matched peers. Conversely, K. Hart et al. (2004) found that children with LI demonstrated significantly higher solitary-passive behaviors, but there was no significant difference when comparing solitary-active. According to both K. Hart et al. and Fujiki, Brinton, Morgan, et al., solitary-active and solitary-passive behaviors were reported infrequently in either group. Thus, reticence appears to be the major distinctive type of withdrawal observed in children with LI (Fujiki, Brinton, Morgan, et al., 1999; Fujiki, Spackman, et al., 2004; K. Hart, et al., 2004). Due to the consistency with which reticence has been identified as problematic in these children, it was the only withdrawn behavior selected for this study.

*Sociability Behaviors in Children with LI*

When considering negative social behaviors in children with LI, it is also important to observe positive behaviors for a more accurate picture. Despite their prominence, negative behaviors, such as reticent withdrawal, comprise a relatively small proportion of children's overall behavior (Fujiki, Brinton, Morgan et al., 1999). It is also important to note that withdrawal behaviors could ideally be mediated by strong positive social skills. Some positive behaviors include offering help, sharing, comforting, and cooperating with peers. These behaviors are often grouped under the term sociability. C. H. Hart, Olsen, Robinson, and Mandelco (1997) defined two main subtypes of sociability: prosocial and impulse control (also known as likeability). Prosocial behavior consists of helping, comforting, cooperating, and sharing behaviors (Brinton & Fujiki, 2004). For example, a child displaying prosocial behaviors may offer help to a peer with problems, may comfort a friend who did bad on an exam, or may share food and other items with peers. The second subtype under sociability is likeability. The term likeability refers to child's ability to receive criticism well, control anger and emotional impulses, cooperate in rough and tumble play, and display assertive leadership skills (Brinton & Fujiki, 2004).

C. H. Hart et al. (2000) assessed 642 children from the United States, China, and Russia to determine whether social behaviors could be reliably identified in various cultures (see withdrawal section for more details). When comparing teacher reports and linked peer acceptance groups, C.H. Hart et al. found that sociability was associated with higher sociometric ratings in the United States, China, and Russia. Thus, sociability behaviors were linked to peer acceptance in all three cultures.

Fujiki, Brinton, Morgan, et al. (1999), in the same study described previously, found that teachers rated the children with LI significantly lower than typical peers on both prosocial and likeability. In a replication of this study, K. Hart et al. (2004) found that children with LI have significantly lower ratings for both likeability and prosocial behaviors than typical age-matched peers. Further analysis showed that children with less severe receptive language problems displayed higher levels of sociability than children with more severe impairment. K. Hart et al. concluded that withdrawal behaviors are not mediated by strong positive social behaviors for children with LI. In order to provide a contrast with reticence, two subtypes of sociable behavior, likeability and prosocial, were examined in the current study.

#### *Possible Causes of Social Problems*

It has been speculated that children with LI have difficulty in social situations because their linguistic limitations hinder their ability to interact effectively. Some work has suggested that the language difficulties of these children are the primary source of social problems. However, several recent studies have shown that LI does not explain all of the social problems observed in these children. Studies representing both positions are reviewed below.

Redmond and Rice (1998) presented two social models to potentially explain how limited language abilities might influence social competence. The SAM hypothesizes that children with LI have social problems as a result of adjustments made in social situations due to their limited language skills. In the SAM, behavioral adjustments are thought to be ways of compensating for limited language skills. In the second model, Social Deviance Model (SDM), there is an underlying belief that there are socioemotional traits which

structure and guide the child's social development. The SDM states that these traits are impaired or affected during the child's social development by internalizing problems which result in symptoms of social behavioral problems. According to this model, language impairment is considered an inherent defect which is manifested in social behaviors. Redmond and Rice examined the socioemotional behavior of 37 children (17 children with LI and 20 typical age-matched peers) over the course of a two year longitudinal study. Analysis and comparison of social behavior ratings and language impairment supported the SAM. Therefore, Redmond and Rice suggested that children with LI had social problems that stem from the impairment.

Gertner et al. (1994) explored the relationship between children's ability to use language and their acceptance among peers in a preschool classroom. Children were divided into three groups: children with typical developing language skills, children with speech and/or language impairment, and children learning English as a second language. Two sociometric tasks were used to measure peer popularity: positive nominations and negative nominations. Children were then divided into subgroups of liked, disliked, low impact, or mixed. The typical developing peers predominated in the liked subgroup, whereas the other two groups of children fell into the disliked or low impact subgroups. The Peabody Picture Vocabulary Test-Revised, a receptive measure of single-word vocabulary, was found to be the best predictor of peer popularity. The authors concluded that the results of this study indicate that limited language ability is associated with lower levels of social acceptance among peers in preschool. Gertner et al. speculated that children with LI realize that they have language difficulties and therefore, avoid social interactions where language is used, which supported the SAM (Redmond & Rice, 1998).

Other work has suggested that although language is important, it is not the only influential variable in regards to social behaviors. For example, Fujiki, Brinton, Morgan, et al. (1999) found that children with LI were rated as having significantly higher reticent scores than typical age-matched peers. In order to better define the relationship between reticence and LI, the authors examined the correlation between reticence and severity of LI. It was found that children with the poorest social profiles were not necessarily those with the poorest language skills. The Fujiki, Brinton, Morgan, et al. suggested that the LI was not the sole factor leading to social problems and other potential factors need to be researched.

In a later study, K. Hart et al. (2004) assessed the relationship between social behaviors and severity of LI in 41 children with LI and 41 age-matched peers. As discussed earlier, teachers rated children with LI as exhibiting higher levels of reticence and solitary-passive withdrawal than typical age-matched peers. Teachers also rated children with LI as displaying lower levels of sociable behaviors than typical peers. The children with LI were divided into subgroups of more severe and less severe LI. Comparison between severity of LI and withdrawal behaviors showed no difference for the two subgroups of children with LI, except that girls with more severe receptive LI demonstrated higher levels of solitary-passive withdrawal than did girls with less severe receptive LI. When comparing severity of LI and sociable behaviors, there was a significant difference. Children with less severe receptive LI demonstrated higher levels of sociable behaviors than children with more severe receptive LI. Therefore, severity of LI did distinguish severity of sociability. Language abilities did not, however, impact withdrawn behaviors.

Fujiki, Spackman, et al. (2004) analyzed the severity of LI, social behaviors, and added the third component of emotion regulation. The analysis showed that language and emotion regulation scores were significant predictors of reticence scores. However, when performing group specific analyses, to determine if the two predictor scales differentially predicted social problems, it was found that there was no significant difference between predictive factors. Fujiki, Spackman, et al. concluded that both language impairment and emotion regulation equally impact social behaviors. Therefore, emotion regulation appeared to be one potential factor that may contribute to the overall social difficulties that are often exhibited by children with LI

Bishop (1997) described three broad hypotheses that account for the social communication problems found in children with LI. The first explanation stated that poor communication skills and problematic social competence may result from a deficit in working memory and processing capacity. The second explanation attributed the problems observed in children with LI to inadequate opportunity for social interaction. Bishop concluded, however, that social difficulties in children with LI cannot be reduced to secondary consequences of peer reactions. The third explanation proposed that children with LI have primary deficits in the domain of social cognition, as seen in children with autism. Bishop stated that the third hypothesis does not appear to be a plausible explanation for children with LI, because the mental state of children with autism appears to be distinctly different than children with LI. Therefore, Bishop concluded by suggesting that children with LI may struggle with peer interactions as a result of not being able to process all the information that is needed to interact appropriately in social situations.

### *Working Memory*

There are a number of potential factors that might influence social interactions, including the child's ability to process language information. One factor that may contribute to social behaviors is the child's ability to temporarily code, process, store, and retrieve newly gained information, known as working memory (Owens, 2004). As noted previously, children with LI are significantly less accurate than their typically developing age-matched peers when completing a range of working memory tasks (Adams & Gathercole, 2000; Botting & Conti-Ramsden, 2001; Edwards & Lahey, 1998; Gathercole & Baddeley, 1990; Kamhi et al., 1995; Kirchner & Klatsky, 1985; Marton & Schwartz, 2003; Montgomery, 1995; Sahlin, Reuterskiold-Wagener, Nettelbaldt, & Radeborg, 1999; Stark et al., 1987).

One way that has been established to assess working memory is to have children repeat nonwords. The nonword repetition task is a culturally nonbiased measurement of many cognitive processes, including discriminating acoustical signals, encoding acoustical information, holding the phonological information in working memory, and planning and executing the response (Edwards & Lahey, 1998). Dollaghan and Biber (1993) stated that the nonword repetition task reflects the child's phonological processing independent of lexical knowledge. Montgomery (2004) stated that nonword repetition task is considered a 'purer' test of working memory because the task requires the listener to invoke various cognitive processes that are independent of lexical knowledge.

Gathercole and Baddeley (1990) demonstrated that children with LI have working memory deficits when compared to typical age-matched peers. They developed the nonword repetition task with nonwords ranging from one to four syllables in length.

Children with LI had greater difficulty repeating longer nonwords than shorter nonwords. Gathercole and Baddeley argued that there is a link between working memory and LI. They stated that poorer nonword repetition score in children with LI was not likely a result of poor perceptual processing, verbal rehearsal or speech motor abilities. They suggested that poor nonword repetition reflected a deficit in working memory capacity.

Montgomery (1995) examined working memory by comparing 14 children with LI to 13 typically developing age-matched peers. Each child was presented with two tasks to complete. The first task was to listen and repeat to 48 nonwords via headphones, ranging in length from one to four syllables. The second task was to listen to 40 comprehensive sentences which included 20 linguistically redundant (longer) and 20 linguistically nonredundant (shorter) sentences presented in random order. Subjects were shown an array of four pictures. After listening to the sentence, the child was asked to point to the picture that best corresponded with the sentence. When comparing the two groups, children with LI performed significantly poorer on the three and four syllable nonwords. Comparison of the children with LI showed that they comprehended fewer redundant (longer) than nonredundant (shorter) sentences. A positive correlation was found when comparing results on the nonword repetition task and sentence comprehension task.

In a later study, Montgomery (2000) further examined the influence of working memory on sentence comprehension. Twelve children with LI were matched with 12 typical developing age-matched peers and 12 typical developing children matched for receptive vocabulary. Each participant completed two tasks. The first task was a verbal memory task in which the child recalled as many real words as possible in 3 different

memory capacity tasks: no-load capacity (least difficult), single-load capacity, dual-load capacity (most difficult). The second task was identical to the sentence comprehension task described by Montgomery (1995), discussed above. Comparison between the three groups of children on the verbal working memory task showed similar results for the three groups of children, except for the dual-load capacity task (most difficult) in which the children with LI and children who were matched for receptive vocabulary showed significantly poorer recall scores. On the sentence comprehension task, children with LI comprehended significantly fewer sentences than the chronological age-matched peers and fewer redundant (longer) sentences than the children matched for receptive vocabulary. Montgomery (2000) suggested that children with LI: (a) had poorer working memory capacity (ability to store and process information) than age-matched peers, and (b) had greater difficulty managing both their working memory and general processing resources when completing complex sentence comprehension tasks than either age-matched or receptive vocabulary matched peers.

Kamhi et al. (1995) assessed working memory through eight tasks, which included: word repetition, nonword repetition, rapid naming, syllable segmentation, paper folding, and form completion. Each task was administered to 30 children with LI, 30 children with reading difficulties, and 30 typical developing children, ages ranging from 6:8-8:10. When comparing the three groups, children with LI and children with reading difficulties performed comparably on every task except one, namely, repeating nonwords. Therefore, the nonword repetition task was a good separator of children with LI from children with reading difficulties. Further analysis showed that children with LI had relatively more difficulty than their peers as stimuli increased in complexity.

Sahlin et al. (1999) studied the relationship between word repetition, nonword repetition, and expressive language skills in 27 children with LI, age 4:11-5:11. Results showed that these children had significantly greater difficulty repeating nonwords than words. When comparing nonword repetition to expressive language scores, there was a significant correlation between nonword repetition score and development of phonological and grammatical skills. The most important predictor of nonword repetition skills was phonological output. Therefore, Sahlin et al. concluded that nonword repetition may not be a single, reliable index of working memory for preschool children with LI, since many preschool children were still developing phonological and grammatical skills.

Edwards and Lahey (1998) examined possible explanations for the differences in accuracy of nonwords among children with LI and typical developing peers. Fifty-four children with LI and 54 age-matched peers, between the ages of 4:6 to 9:8, listened and repeated six nonwords. The groups were compared by number and type of errors, and latency and duration of responses. Edwards and Lahey found that motor planning and execution of nonwords did not account for the differences in accuracy of nonwords among the groups. There was no significant difference between the groups when compared for the ability to discriminate acoustical signals. The difference in receptive language among the groups was not a significant factor when considering ability to repeat nonwords. Therefore, Edwards and Lahey suggested that the difference in accuracy of repeating nonwords was related to the ability to form a phonological representation of the nonwords in working memory.

Botting and Conti-Ramsden (2001) completed a longitudinal study on 200 children, at ages 7 and 11, looking at nonword repetition and performance IQ tasks (block

design and picture completion). Children were randomly chosen and there were not specific criteria for placement in the group with LI. Rather, children were divided into groups at age 7 according to their score on the nonword repetition task. Children one *SD* below the mean were identified with LI, totaling 14 subjects. Fourteen other children with performance IQ-matched scores were chosen to establish the comparison group. Comparison of the children's language and linguistic abilities, at age 7, showed significant differences in all linguistic measures except vocabulary assessments. After comparing both groups at age 11 years, similar results were obtained. Botting and Conti-Ramsden concluded that the nonword repetition task could be used to predict test performance in a number of language domains for children between ages 7 and 11 years. The researchers also suggested that there is a strong working memory element underlying LI in school age children.

Based on the literature discussed above, it can be concluded that children with LI have poorer performance on working memory tasks than typically developing age-matched peers. However, there are only a few studies that have described the impact that these deficits in working memory may have for children with LI. One potential impact that has been previously suggested is that working memory may contribute to some of the difficulties these children have in social interactions. For example, a child with LI may have difficulty being able to hold and process all the information that is needed to appropriately interact socially.

#### *Relationship between Social Behaviors and Working Memory*

There are relatively few studies that have looked at the connection between social behaviors and working memory. Bishop (1997) explained that children with LI may have

difficulties in social interactions with peers as an outcome of not being able to process all the information that is needed to appropriately interact in social situations. Bishop stated that if a child with LI has deficits in working memory, they would have difficulty integrating meaning from multiple sentences and building a representation. This general deficit would then affect some forms of social interaction. For example, in order to be a skilled conversationalist, a child needs to keep track of multiple utterances over time, infer conversational cohesiveness, integrate important contributions from all participants, and appropriately respond. Therefore, this deficit in working memory may also be contributing to the overall difficulties children with LI have in social interactions.

In one of the few studies of its kind, Donlan and Masters (2000) looked at the correlation between social development and working memory in 32 children with communication disorders. Working memory was assessed by having the child point to familiar words in the specific order in which they were read to them (two to six words at a time). Sociability was determined by consulting with the caregiver, teacher, and speech-language pathologist. Each child's sociability was rated through 14 yes/no questions which identified whether the child pointed out objects of interest, had a best friend, looked at the speech partner's face when talking, used imaginative ideas, spoke in pretend voices, lacked expression in their speech, or imitated exact portions of talk from videos, advertisements, or books.

Donlan and Masters (2000) found that level of social skills was predicted by working memory for school-age children with communication disorders. There was a negative correlation between the score on word span task and social behaviors as rated by the teacher, caregiver, and speech-language pathologist. Further analysis showed that the

level of social skills was not influenced by language comprehension. Based on these findings, the authors suggested that working memory may be one factor affecting differences noted in social interactions for children with LI when compared to typical age-matched peers. However, they stated that cognitive abilities, linguistic development, and social skills were not well differentiated in the study.

In order to more fully explore the relationship between working memory and social skills, this study examined the correlation between performance on the nonword repetition task and reticent withdrawal and sociability as rated by teachers in school-age children with LI and typical age-matched peers.

## Method

The data for this study were gathered as part of a larger project which focused on identifying the relationship between language impairment and emotional competence in school-age children. Thirty-eight children ages 7 years to 10 years 10 months old ( $M = 8:9$  years,  $SD = 12.2$  months) were evaluated at the end of the 2003-2004 school year. The internal review board of Brigham Young University approved the application for protection of human subjects prior to beginning the study. Written parental or guardian permission was obtained for each participant.

### *Participants*

Participants consisted of 19 children with LI (9 males and 10 females;  $M = 8:9$  years,  $SD = 11.7$  months) and 19 children with typically developing language skills (9 males and 10 females;  $M = 8:9$  years,  $SD = 12.9$  months). Children with LI were identified and selected from seven different elementary schools in Alpine and Jordan School Districts. The socioeconomic status for the participants was measured from block group data from the 2000 census (U.S. Census Bureau, 2003). In the neighborhoods surrounding the seven elementary schools, the mean percentage of families with income levels below the poverty level was 3.2% ( $SD = 3.7$ ).

All participants were required to speak English as a first language. They were also required to pass a pure-tone audiometry hearing screening within the past year, administered by the school speech-language pathologist or audiologist. Participants were administered the *Comprehensive Assessment of Spoken Language* (CASL; Carrow-Woolfolk, 1999) to determine relative language ability. The CASL is a norm-referenced language test that can identify LI across a wide age range (3 to 21 years old). Thus, the

CASL was a viable measure of language level for all participants in the study. Each participant was also administered the *Universal Nonverbal Intelligence Test* (UNIT; Bracken & McCallum, 2003), which is an entirely nonverbal assessment designed to provide a fair, comprehensive and standardized measurement of general intelligence for children (5 to 18 years old). The UNIT is a language-free and culturally-nonbiased measure of intellectual functioning. The test did not require the administrator or participant to listen, speak, read, or write when giving the test or in responding to the test items. Therefore, it was appropriate for assessing the nonverbal intellectual level of children with LI.

*Participants with LI.* Participants with LI were enrolled in speech-language pathology services with a diagnosis of language impairment. These children were required to have a score at least one standard deviation below the mean on the CASL, with no concomitant problems requiring special services other than speech-language therapy and/or resource. They were also required to obtain an IQ score of 80 or above on the UNIT. However, if the child did not score below one standard deviation on the CASL, another global test score was accepted that was given within the previous year. One child was included on this basis with a qualifying score of 71 on the Test of Language Development-Primary, Third Edition (TOLD-P3).

*Participants with typically developing language skills.* Typical children were selected from the same mainstream classroom as the child with LI. All children of the same gender and age (within 6 months) of a child with LI in the same classroom were identified. Permission to participate in the study was requested of these children and a match was randomly selected from the children whose guardian gave permission. Each

typically developing age-matched peer was required to have academic performance within the normal range based on school records and teacher reports. They were not enrolled in any special services for academic, behavioral, intellectual, or communication problems. These children were scored within one standard deviation of the mean on both the CASL and UNIT, which were administered to provide a measure of language ability and intelligence.

*Teachers.* Classroom teachers completed the *Teacher Behavior Rating Scale* (TBRS; C. H. Hart & Robinson, 1996). A total of 15 teachers participated from 15 individual classrooms. The questionnaires were completed between March and June 2004 for children ages 7 to 10 years old. This allowed each teacher an ample amount of time to become familiar with each student. Although teachers were familiar that some of the children were receiving language intervention, they were not informed of the purpose of this study.

#### *Assessment Instruments*

*Behavioral Assessment.* The TBRS (C. H. Hart & Robinson, 1996) is an informal measure designed to assess various subtypes of social behaviors. It consists of two questionnaires containing a total of 161 items focusing on several behavioral subtypes (see Appendix A for a copy of the TBRS). Teachers rated each item on a three-point scale (0 = never, 1 = sometimes, 2 = often). Teachers were asked to rate each child's present behaviors in comparison to others in their own age group that they have observed.

Only items focusing on reticence and sociability (prosocial and likeability) behaviors were included in the current study. These items were scattered throughout the 161 items on the TBRS. Teachers were not aware of which items were being used by the

researchers. In the past, the TBRS has been administered to teachers of large groups of preschool and elementary age children from different cultures (C. H. Hart et al., 2000). It has also been used in various other studies comparing elementary school age children with LI to typically developing peers (Brinton et al., 2000; Fujiki, Brinton, Morgan, et al., 1999; K. Hart et al., 2004).

The psychometric properties of the TBRS for elementary school-age children were described in Fujiki, Brinton, Morgan, et al. (1999). In summary, teachers completed questionnaires on 382 elementary school-age children (ages ranging from 6:4 to 12:6,  $M = 8:10$ ,  $SD = 1:6$ ). Several withdrawn and sociability items with (a) relatively little variance, (b) substantial cross-loadings ( $> .40$ ), or (c) low item-total correlations for factors resulting from preliminary analyses were dropped from the questionnaire. A final principal-component analysis showed three reliable factors for withdrawal with eigenvalues greater than one accounting for 55% of variance in the items. A similar analysis was completed for sociability which yielded two reliable factors with eigenvalues greater than one accounting for 61% of variance in the items. Based on this evaluation, a total of six items were selected to define reticence, five items for solitary-passive, and five items for solitary-active. In terms of sociability behaviors, eight items were chosen to define likeability and five items were used to define prosocial.

The same items on the TBRS that comprised the reticence and sociability (likeability and prosocial) behaviors from the previously described study (Fujiki, Brinton, Morgan, et al., 1999) and others (Brinton et al., 2000; K. Hart et al., 2004) were used to assess social behaviors in this study. Teachers' ratings of these individual items were then combined, giving each participant a composite scores for each social behavior.

*Nonword Repetition Task.* Nine nonwords were created according to the procedures detailed by Edwards and Lahey (1998) to evaluate working memory. Edwards and Lahey created three 3-syllable and three 4-syllable nonwords for children between the ages of 4 to 9 years old. All nonwords had a strong-weak-strong-(weak) pattern and two-thirds of the nonwords began with a consonant cluster. The stimulus for this study consisted of three 3-syllable, three 4-syllable, and three 5-syllable nonwords. The 3-syllable and 4-syllable nonwords were borrowed from Edwards and Lahey; whereas, the 5-syllable nonwords had to be created, using the guidelines presented by Edwards and Lahey. Each nonword had a strong-weak-strong-(weak-strong) syllable stress pattern with three nonwords beginning with a consonant cluster. Refer to Appendix B for a list of nonwords used in this study.

Nonwords were produced by a female speaker and were recorded in a sound treated booth. The microphone was placed approximately 6 inches from the speaker's mouth. The nonwords were recorded with a digital audiotape recorder as digital audio files. The digital audio files were then converted into MP3 files and then copied onto a CD for administration purposes.

### *Procedures*

Teachers were provided with copies of the TBRS to fill out and return during the assessment period for each participant. The TBRS took teachers approximately 10 to 15 minutes to complete for each participant. If TBRS forms were not received within a couple of weeks, teachers were contacted and given a second copy to fill out and return. Responses of specific items used in this study were then recorded in an Excel file for analysis.

Administration of the nonword repetition task took approximately three minutes to complete. It was given during one of three sessions within the context of the larger project. Each of the sessions lasted from 30 to 60 minutes in length. The nonword repetition task was administered in the quiet room in the school by one of three graduate students in speech-language pathology. Each child completed the nonword repetition task during the same session that the UNIT was administered. The CASL and emotion tasks were administered individually during the other two assessment sessions. Participants completed the sessions in random order.

Directions were read to each participant before beginning the nonword repetition task (see Appendix C). Each participant was then asked if they understood the directions and if they had any questions before starting the task. Two one-syllable nonwords were presented by the administrator to verify that the participant understood the task.

The nine nonwords used to evaluate working memory were presented to each participant using a Sony D-EJ625 portable CD player at a comfortable loudness level. Both the administrator and participant listened to the nonwords through Sony MDR-85 headphones. A beep was presented after each word to signal to the participant to repeat the nonword. The administrator waited for a response before presenting the next nonword. Participants were not given a time limit, but were only allowed to listen to each word once. If no response was given, the administrator asked the child to state what they heard. If the child again did not answer, the administrator waited and then presented the next nonword. Every participant repeated all the nonwords at the 3-syllable level. At the 4-syllable level, one child did not repeat one nonword. At the 5-syllable level, three children did not repeat one nonword and one child did not repeat two nonwords.

Responses were recorded onto cassette tapes using either a General Electrics 3-5015C or a Sony TCM-5000EV cassette recorder. Finally, the responses were imported and digitized on a computer using *CD Spin Doctor*. These digitized recordings were used for transcription. Nonword repetitions were scored using the same procedure as outlined by Edwards and Lahey (1998). In order to assess accuracy of nonword repetition, each response was scored according to percentage of correct phones. Each individual phoneme was scored as correct or incorrect. Correct pronunciation and mild distortions were considered correct if the phone was included within the same word placement as the presented nonword. Deletions and substitutions were all scored as errors. However, if the child exhibited a consistent substitution or distortion, it was not scored as incorrect. For example, if a child always substituted a /w/ for /r/, it was not scored as incorrect. Additions were considered an error and subtracted from the number of correct phones.

### *Reliability*

Two children with LI and two children with typically developing language skills were randomly chosen and administered the nonword repetition task twice by different graduate students in random order to obtain tester reliability. A comparison of the students' performance administered by the two graduate students showed 98% agreement. In order to obtain interrater reliability, ten percent of the data base were randomly chosen and scored by two different graduate students. A comparison of the two results showed 92% accuracy between raters.

## Results

Data were first analyzed to determine if language group or gender differentiated performance for social skills (reticence, likeability, and prosocial) and nonword repetition (3-syllable, 4-syllable, and 5-syllable). Regression analyses were then performed to determine how much variance in social behaviors could be explained by working memory.

### *Group Differences*

Children were divided into groups according to language group (LI and typical) and gender (male and female). Analyses of variance (ANOVA) were performed in order to answer the first two research questions, “do children with LI exhibit more reticence and poorer sociability (likeability and prosocial) behaviors than their typical age-matched peers?” and “how do children with LI compare to typical age-matched peers in the ability to repeat nonwords?” Six different ANOVA tests were performed to determine whether differences among the groups were statistically significant. Language group (LI and typical) and gender (male and female) were independent variables. Social behaviors (reticence, likeability, and prosocial) and nonword repetition scores (3-syllable, 4-syllable, and 5-syllable) were the dependent variables for each test.

Means and standard deviations for social behaviors (reticence, likeability, and prosocial) are presented in Table 1 for each group. When comparing all three social behaviors, it can be seen that the group of children with LI received poorer reticence and sociability ratings than the typical group. Additionally, females received higher sociability ratings than males. In regards to reticence, there was a significant difference between the language groups,  $F(1, 34) = 22.238, p = .000$ ; however, there was no

Table 1

*Means and Standard Deviations for Social Behavior Ratings*

Participant Group	Reticence	Likeability	Prosocial
Language Impaired, Male			
<i>M</i>	4.33	8.22	4.44
<i>SD</i>	2.92	3.60	3.43
Language Impaired, Female			
<i>M</i>	3.70	11.80	6.20
<i>SD</i>	2.16	2.39	2.20
Typical, Male			
<i>M</i>	0.67	13.44	6.11
<i>SD</i>	0.50	2.30	1.90
Typical, Female			
<i>M</i>	1.20	14.10	9.00
<i>SD</i>	1.69	2.81	1.76

*Note.* Higher reticence scores indicate greater withdrawal behaviors. Higher likeability and prosocial skills indicate greater sociability behaviors.

significant difference between the gender group,  $F(1, 34) = .006, p = .939$ . The children with LI received significantly higher reticence scores than typical peers. For likeability, there was a significant difference for both language group,  $F(1, 34) = 16.984, p = .000$ , and for gender,  $F(1, 34) = 5.379, p = .027$ . Children with LI received poorer ratings of likeability when compared to typical peers. Also, females produced higher likeability scores than males. Although there was a significant difference in both language group and gender, the interaction was not significant,  $F(1, 34) = 2.563, p = .119$ . In regards to the prosocial subtype, a significant difference was reported for both language group  $F(1, 34) = 8.251, p = .007$ , and gender,  $F(1, 34) = 8.921, p = .005$ . When comparing language groups, the LI group received poorer prosocial ratings than typical peers. When considering gender groups, females were more prosocial than males. However, the interaction of language group and gender for prosocial behaviors was not significant,  $F(1, 34) = .531, p = .471$ . These results were consistent with previous research (Fujiki, Brinton, Morgan, et al., 1999; Fujiki, Spackman, et al., 2004; Hart, et al., 2004).

In Table 2, the means and standard deviations are summarized for the nonword repetition task divided by syllable length. Significant differences were found for nonwords at each syllable length (3-syllable, 4-syllable, and 5-syllable). Children in the LI group performed poorer on the nonword repetition task for all three syllable lengths. At the 3-syllable length, children with LI performed significantly poorer than the typical children,  $F(1, 34) = 19.769, p = .000$ , but no significant difference between genders,  $F(1, 34) = 2.702, p = .109$ . A significant difference was found for both language group,  $F(1, 34) = 34.042, p = .000$ , and gender,  $F(1, 34) = 12.532, p = .001$  at the 4-syllable nonword level. There was also a significant interaction between language group and

Table 2

*Means and Standard Deviations for Nonword Repetition Scores*

Participant Group	3-syllable	4-syllable	5-syllable
Language Impaired, Male			
<i>M</i>	15.78	19.44	20.44
<i>SD</i>	1.99	3.09	5.61
Language Impaired, Female			
<i>M</i>	17.90	24.00	25.80
<i>SD</i>	2.60	2.26	6.18
Typical, Male			
<i>M</i>	19.89	25.56	30.22
<i>SD</i>	1.69	1.13	2.33
Typical, Female			
<i>M</i>	20.10	25.80	28.90
<i>SD</i>	2.28	1.32	3.90

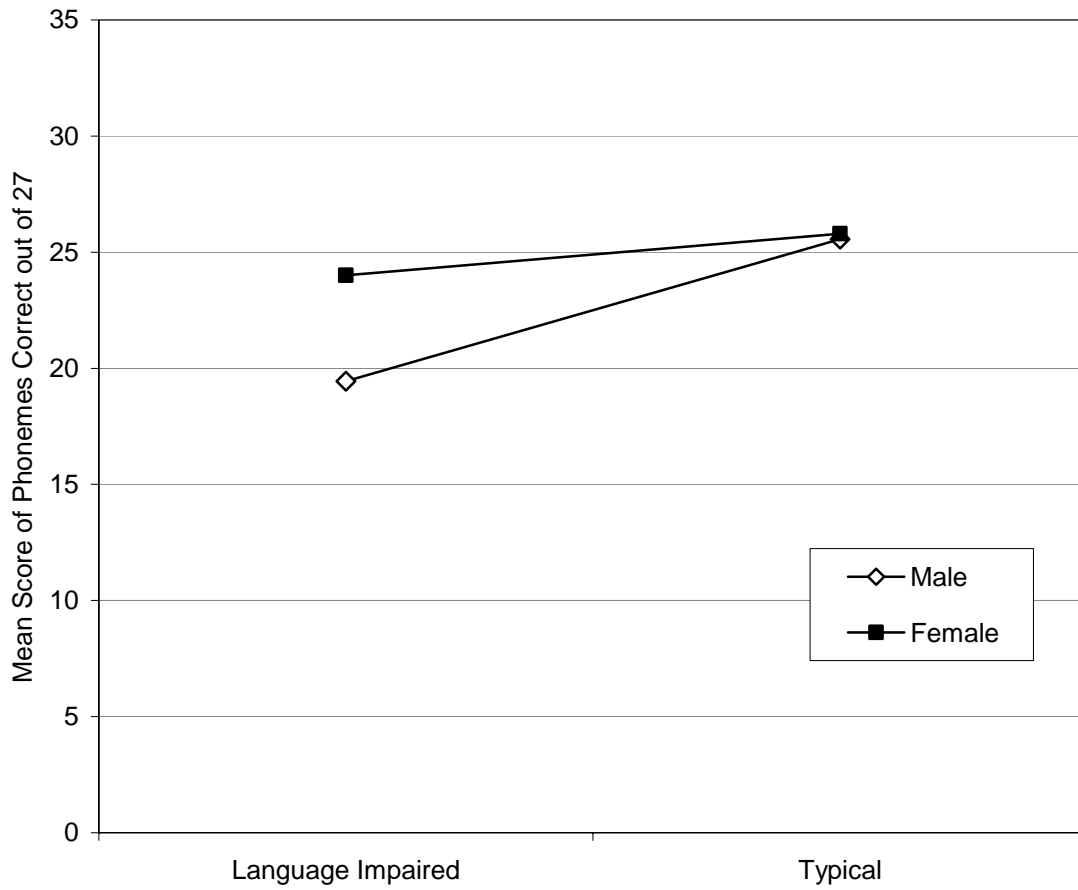
*Note.* Three syllable score out of a 22 total phonemes. Four syllable score out of a 27 total phonemes. Five syllable score out of 35 total phonemes.

gender,  $F(1, 34) = 10.019, p = .003$  (see Figure 1). Females in the group with LI performed better than the males with LI; however, both typical males and females performed better than either the males or females with LI. Similar results were found at the 5-syllable level. There was a significant difference between language groups,  $F(1, 34) = 17.203, p = .000$ ; but there was no significant difference between genders,  $F(1, 34) = 1.688, p = .203$ . However, there was a significant interaction between language group and gender,  $F(1, 34) = 4.626, p = .039$ . Figure 2 graphically shows that females with LI scored higher on the 5-syllable nonword than males with LI. The figure also shows that both genders in the typical group scored higher than either gender in the group with LI.

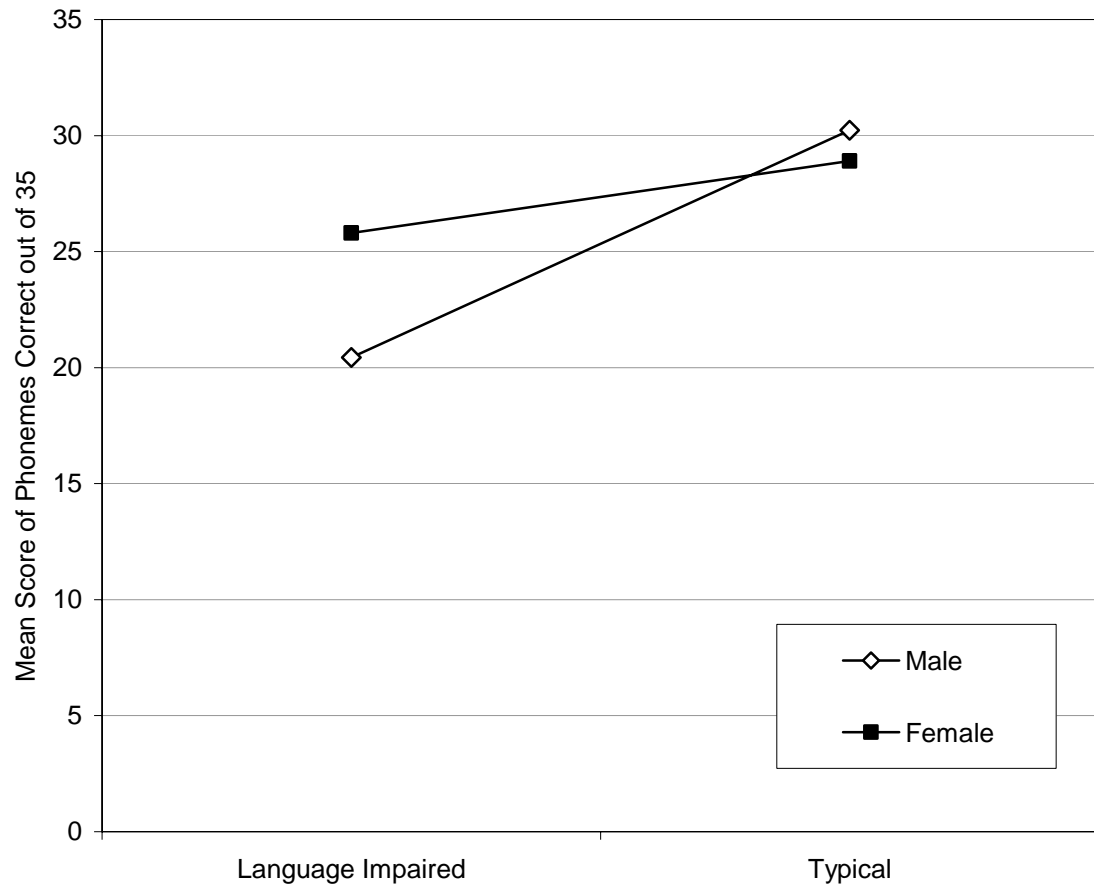
#### *Links between Social Behaviors and Working Memory*

Children with LI demonstrated more social difficulties and poorer working memory than typical peers. This finding provided the basis for addressing the third question “is there a relationship between performance in nonword repetition and level of social behaviors?” If so, “how does this relationship in children with LI compare to that in typical age-matched peers?”

In order to provide an indication of the relationship between working memory and social behaviors, three analyses of covariance (ANCOVA) were performed. Each ANCOVA measured whether there was a significant difference for language group and gender between social behaviors when controlling for working memory. Working memory as measured by the three nonword repetition scores (3-syllable, 4-syllable, and 5-syllable) served as covariates. Language group and gender group were the independent variables and the three social behaviors (reticence, likeability, and prosocial) were the



*Figure 1.* Means for 4-syllable nonwords differentiated by language group and gender.



*Figure 2.* Means for 5-syllable nonwords differentiated by language group and gender.

dependent variables for each ANCOVA. If the ANCOVA showed significant differences between nonword repetition scores and social behaviors, regression analyses were conducted to determine how much variance in social behaviors was predicted by nonword repetition.

When comparing all subjects, nonword repetition scores were significant predictors of reticence,  $F(7, 30) = 3.277, p = .010$ . In fact, the regression analysis showed that working memory accounted for 28% of the variance in reticence scores. The regression equation was  $\text{reticence} = -.008(3\text{-syllable}) - .474(4\text{-syllable}) - .092(5\text{-syllable})$ . There was a negative relationship between working memory and reticence. As working memory scores increased, reticence scores decreased. The nonword repetition scores were not significant predictors of reticence when controlling for language group,  $F(1, 30) = .896, p = .351$ , gender,  $F(1, 30) = .834, p = .368$ , or the interaction of language group and gender,  $F(1, 30) = .380, p = .542$ . In other words, when controlling for working memory, neither language group nor gender were significant predictors of reticence.

The second ANCOVA test showed that nonword repetition scores were also significant predictors for likeability,  $F(10, 27) = 4.626, p = .000$ , for all subjects. A regression analysis of all subjects showed that scores on the nonword repetition task accounted for 18% of the variance in participants' likeability scores. The regression equation was  $\text{likeability} = .155(3\text{-syllable}) + .135(4\text{-syllable}) + .229(5\text{-syllable})$ . Therefore, working memory had a positive on likeability.

When considering how individual factors influenced likeability, nonword repetition scores were also significant predictors for language groups,  $F(1, 27) = 16.385$ ,

$p = .000$ , and gender  $F(1, 27) = 13.797$ ,  $p = .001$ . Therefore, language group and gender group were important factors in predicting likeability from working memory. Results from the regression analyses showed that nonword repetition scores accounted for 1% of the variance in likeability for children with LI, and 18% for typical peers. Working memory was a significant predictor of likeability for typical developing children but not for children with LI. The regression equation for children with LI was likeability =  $-.113(3\text{-syllable}) + .142(4\text{-syllable}) - .003(5\text{-syllable})$ . In other words, working memory scores had only a very small positive effect on likeability. The equation for typical children was likeability =  $.085(3\text{-syllable}) - .148(4\text{-syllable}) + .367(5\text{-syllable})$ . Overall for typical developing children, likeability scores increased as working memory abilities increased. When conducting regression analyses for gender, working memory accounted for 20% of the variance in likeability for males and 16% for females. The regression equation for males was likeability =  $.341(3\text{-syllable}) + .034(4\text{-syllable}) + .139(5\text{-syllable})$ . For females, likeability =  $.006(3\text{-syllable}) - .202(4\text{-syllable}) + .422(5\text{-syllable})$ . Therefore, as working memory increased, likeability increased for both males and females, but likeability was more closely related to working memory for males than females.

A significant interaction between language group and gender was also observed,  $F(1, 27) = 5.580$ ,  $p = .026$ . Working memory accounted for 82% of the variance in likeability for males with LI, 34% for females with LI, 4% for typical developing males and 50% for typical developing females. Figure 3 graphically shows the  $R^2$  values for each language group by gender model. The regression equation for LI males was likeability =  $-.360(3\text{-syllable}) - .527(4\text{-syllable}) - .878(5\text{-syllable})$ . For females with LI,

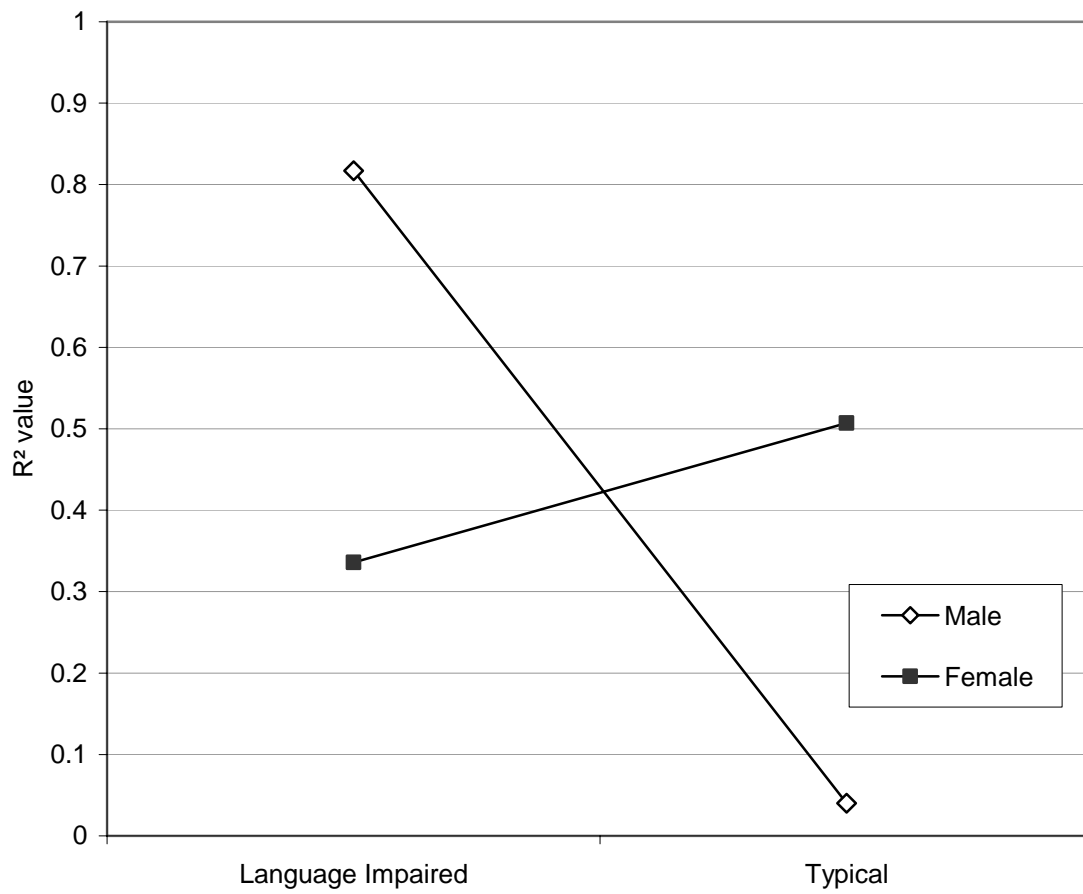


Figure 3.  $R^2$  for likeability differentiated by language group and gender.

the regression equation was likeability =  $-.428(3\text{-syllable}) - .319(4\text{-syllable}) + .239(5\text{-syllable})$ . The regression equation was likeability =  $.134(3\text{-syllable}) - .276(4\text{-syllable}) - .147(5\text{-syllable})$  for typically developing males. For typically developing females, likeability =  $-.114(3\text{-syllable}) - .443(4\text{-syllable}) + .760(5\text{-syllable})$ . Thus, the regression analyses showed that for males with LI, females with LI, and typical males, there was a negative relationship; but a positive relationship was found for typically developing females.

In regards to prosocial behaviors, nonword repetition scores were significant predictors,  $F(7, 30) = 2.831, p = .022$  when comparing all subjects. The regression analysis showed that working memory accounted for 11% of the variance in prosocial behaviors. The regression equation was prosocial ratings =  $-.144(3\text{-syllable}) + .289(4\text{-syllable}) + .181(5\text{-syllable})$ . Working memory ability had an overall positive relationship with prosocial behaviors. Therefore, as nonword repetition scores increased, there was an increase in prosocial ratings. Prosocial behaviors were predicted from working memory when comparing all subjects, but there were no significant differences when looking at the effect of language group,  $F(1, 30) = 1.068, p = .310$ , gender,  $F(1, 30) = .353, p = .557$ , or the interaction of group and gender,  $F(1, 30) = .018, p = .894$ . Therefore, language ability and gender were not important factors in the relationship between prosocial behaviors and working memory.

## Discussion

Children with LI have more difficulties in social interactions than age-matched peers with typically language developing (Brinton & Fujiki, 1999; Craig, 1993; Rice, 1993; Rice et al. 1991). Current research has shown that the LI alone does not fully explain the social deficits exhibited in children with LI (Fujiki, Brinton, Morgan, et al., 1999; Fujiki, Spackman, et al., 2004; K. Hart et al., 2004). In order to better understand social behaviors in children with LI, research has begun to investigate possible influential factors that may contribute to the overall social picture. Bishop (1997) suggested that children with LI may have difficulties in social interactions as a result of poor working memory and processing capacity.

The goal of this research project was to gain a clearer understanding of the relationship between social behaviors and working memory in children with LI. Specifically, this study examined the extent to which working memory predicted reticence, likeability, and prosocial behaviors in children with LI. Research has shown that children with LI tend to be more withdrawn than typical developing peers. Although withdrawal can be categorized into three main subtypes, only reticence was selected for scrutiny in this study because research consistently has shown that children with LI were significantly more reticence than typical developing peers (Fujiki, Brinton, Morgan, et al., 1999; Fujiki, Spackman, et al., 2004; K. Hart et al., 2004). In order to obtain a more balanced picture, sociability behaviors, consisting of likeability and prosocial behaviors, were also examined because withdrawn behaviors could be mediated by strong positive social skills.

*Withdrawal and Sociability*

The first research question addressed in this study asked, “do children with LI exhibit more reticence and poorer sociability (likeability and prosocial) behaviors than their typical age-matched peers?” As expected, based on teachers’ reports from the TBRS, children with LI were significantly more reticent than typical age-matched peers. Teachers reported higher reticence scores for many of the children with LI and reported little or no reticent behaviors in most of the typically developing children. This suggests that many of the children with LI were fearful and reserved in approaching and interacting with other children.

It is important to consider the impact of reticence observed in children with LI in context with sociable behaviors that may offset the consequence of withdrawal. In this study, teachers reported poorer likeability and prosocial behaviors in children with LI than typical age-matched peers. Typical developing peers were able to receive criticism well, control anger and emotional impulses, cooperate in rough and tumble play, and display assertive leadership skills better than children with LI. Typical children were also more likely to share items, comfort others, and offer help to peers than children with LI. These findings were expected and were consistent with previous research indicating that reticence observed in children with LI was not mediated by strong sociability behaviors.

Although there were no gender difference in regards to reticence, females demonstrated significantly more likeable and prosocial behaviors than males. This appears to be consistent with characteristics of specific gender roles. In general, females tend to be more person-oriented and more likely to participate in dyadic relationships that depend on sociability behaviors than males (Thorne, 2004).

*Working Memory*

On the basis of previous research, it was expected that measures of working memory would differentiate children with LI from their typically developing peers. For this study, working memory was measured through a nonword repetition task. Nonword repetition tasks have been used in many previous studies as a culturally-nonbiased measurement of working memory (Edwards & Lahey, 1998; Gathercole & Baddeley, 1993; Montgomery, 1995). Therefore, the second research question that was examined in this study was “how do children with LI compare to typical age-matched peers in the ability to repeat nonwords?” Each participant received a score for three nonword syllable lengths (3-syllable, 4-syllable, and 5-syllable).

Children with LI performed poorer on the nonword repetition task at all three syllable lengths. The most distinctive separator between groups was the 4-syllable length nonwords. Also, males were less accurate at repeating nonwords than females. Further analysis revealed a significant interaction between language and gender groups. As seen in Figure 1 (interaction of language group and gender at the 4-syllable level), there was a difference between males and females in the group with LI, but there did not appear to be a significant difference in the typical group. Thus, females with LI were more accurate at repeating 4-syllable nonwords than males with LI. However, both typical males and females performed in a similar manner on the task and they were more accurate than either males or females in the LI group.

At the 5-syllable level, there was still a difference found between language groups, however, typically developing children also began to make more errors. When looking only at gender, there were no differences between males and females; but when

looking at the interaction of language group and gender, outcomes were similar to the 4-syllable length nonwords. Figure 2 showed that females with LI performed better than males with LI. It also showed that typical males and females had the opposite results, with males scoring slightly higher than females.

From the results of this study, it was suggested that the most significant difference in nonword repetition was at the 4-syllable level for school-age children between ages 7 and 10 years. These results were consistent with previous research which showed that children with LI have poorer working memory, as targeted through nonword repetition. In other words, children with LI had difficulty temporally coding, storing, accessing, and retrieving new information.

#### *Links between Social Behaviors and Working Memory*

The fact that children with LI demonstrated more social difficulties and poorer working memory than typical peers provided the context to examine the third question “is there a relationship between performance in nonword repetition and level of social behaviors?” If so, “how does this relationship in children with LI compare to that in typical age-matched peers?”

Working memory, as targeted through the nonword repetition task, was a significant factor in predicting reticence, likeability, and prosocial behaviors in children with LI and typical developing peers. In fact, the regression analyses showed that working memory accounted for 28% of the variability in reticence scores, 18% in likeability scores, and 11% in prosocial scores. As expected, the regression analyses showed that as working memory increased, there was a decrease in reticence ratings and an increase in likeability and prosocial ratings.

Even though there was an overall positive connection between working memory and social behaviors, the influence language group or gender played in this relationship was still unclear. In order to determine whether language ability or gender impacted this relationship, subsequent analyses were completed. There were no significant differences in the prediction of reticence or prosocial behaviors between the groups. Language ability and gender were not influential factors in regards to how predictive working memory was for reticence or prosocial behaviors. Therefore, on the basis of these findings, working memory predicted reticence and prosocial behaviors similarly for all children. Thus, since children with LI had poorer working memory, they were more reticent and less prosocial than typical age-matched peers.

The relationship between nonword repetition scores and likeability was less clear. It was significantly differentiated by language group and gender. For children with LI, working memory accounted for only 1% of the variance for likeability, whereas it accounted for 18% of the variance for likeability for typically developing peers. Therefore, working memory was a significant predictor of likeability for typical peers but did not play a significant role for children with LI. As working memory increased, likeability scores increased for both children with LI and typical peers. It should be noted that this relationship for children with LI was very small. Thus, it is difficult to argue that children with LI were less likeable in social situations as a result of poorer working memory. In regards to gender, working memory was a stronger predictor of likeability for males than females. In fact, working memory accounted for 20% of the variance in males and 16% in females. A positive correlation was reported for both males and females, as working memory increased, likeability scores increased.

Further analyses were completed to understand the interaction of LI and gender. Due to the small sample size of the individual groups, these results should be interpreted with caution. It should be noted that there was one male with LI, one female with LI, and one typically developing male who had outlying scores compared to the rest of their individual group. The analyses showed that working memory had a negative effect on likeability for males with LI, females with LI, and typically developing males. Although the regression analyses showed that working memory had a significant negative correlation with likeability for three of the four subgroups, it should be clear that these results were significantly influenced by sample size. The only positive relationship between working memory and likeability at this level of analyses was for typically developing females.

In a general sense, there is a link between working memory and social behaviors. As nonword repetition scores increase, reticence scores decreased and likeability and prosocial scores increased. When determining if language group and gender were other influential factors, significant differences were only reported for likeability. Thus, the relationship between working memory and both reticence and prosocial behaviors was similar for all children; whereas, likeability was predicted by working memory for typical peers, but not for children with LI.

### *Limitations*

It must be cautioned that these findings and subsequent conclusions regarding the relationship between working memory and social behavior in children with LI can only be considered preliminary. Participants' working memory ability was based on a single informal measurement of nine nonwords. Although the nonword repetition task appears

to be a culturally nonbiased measure of working memory, there are no national normative samples. In previous studies where nonword repetition tasks were compared to other working memory tasks, the samples sizes were relatively small and each study had different criteria for their specific list of nonwords. For this study, the 3-syllable and 4-syllable nonwords were borrowed from Edwards and Lahey (1998), and the 5-syllable nonwords were made up according to the same guidelines, but these nonwords were never used in the studies which compared nonword repetition tasks to other working memory measures. Although all participants listened to the nonwords via recording at a comfortable loudness level, the ambient noise in the room varied between participants. The task was administered in quiet rooms in seven different elementary schools. Future assessment of working memory might include a variety of nonverbal and verbal measures, along with nonword repetition tasks, to provide a better indication of child's working memory.

A second reason this study should only be viewed as a preliminary measure was that the TBRS, despite its advantages and previous use, is an informal measure of social behaviors based on teacher ratings. The use of other methods of assessing social behaviors may have found differing results. Future methods may include direct observation from a variety of naturalistic contexts.

There may also be some limitations to the measures used to examine the relationship between working memory and social behaviors in this study. Even though nonword repetition tasks appear to be accurate measures of working memory, it is difficult to say that working memory level measured by the nonword task is comparable to the degree of working memory involved in social situations. It is hypothesized that

social interactions do not require the same degree of working memory in order for children to be successful. In other words, even though children with LI have poorer working memory than typical peers, this working memory deficit may not significantly impact their performance due to the limited memory demands involved in social situations. Further research should be done to better understand the degree of working memory involved in regularly occurring social situations.

This study only examined the relationship between working memory and social behaviors in children with LI and typical age-matched peers. CASL and UNIT scores were only used as qualifying measures and were not considered as factors in the analyses. More research should be conducted to measure the contribution language and intelligence scores have in the relationship between working memory and social behaviors. However, there are a number of potential factors that go beyond the scope of this study that may contribute to social outcomes. These variables may act together in a complex manner. It will be important for future work to illustrate how working memory and other potential contributing factors (e.g. emotional competence, cognitive abilities, linguistic skills, etc.) interact with language impairment to impact social outcomes.

### *Implications*

It is clear that many children with LI have greater difficulties in social interactions than typical peers. In this study, teachers rated children with LI as demonstrating significantly higher levels of reticence and lower levels of both types of sociability than typical children. Children with LI also performed poorer on the nonword repetition task at all syllable lengths (3-syllable, 4-syllable, and 5-syllable), indicating poorer working memory.

Bishop (1997) suggested that children with LI may have difficulties in social situations as a result of a deficit in working memory and processing capacity. When examining the relationship between specific social behaviors and working memory, the results showed that working memory was a significant predictor of specific social behaviors for children with LI and typical peers. Working memory, as targeted through nonword repetition, was a significant predictor of reticence, accounting for 28% of the variance, likeability, accounting for 18% of the variance, and prosocial behaviors, accounting for 11% of the variance. In general, as working memory ability increased, reticence decreased and both likeability and prosocial behaviors increased. Specifically for children with LI, the results indicated that working memory was linked to reticent behaviors and prosocial behaviors, but was not linked to likeability behaviors. Thus, since children with LI exhibited poorer working memory abilities, they were more reticent and less prosocial than typical peers.

These findings are similar to those found by Donlan and Masters (2002) implying that working memory may be one of many contributing factors in the development of social behaviors. Further research is needed to better understand the role working memory has in social situations. The present findings contribute to the growing work suggesting that many children with a diagnosis of LI have difficulties in other areas of development that may inhibit their ability to interact with peers.

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## APPENDIX A

## Teacher Behavior Rating Scale

**Social Skills Teacher Behavior Rating Scale, Part A**Directions

This questionnaire is designed to measure how often a child exhibits different types of social behaviors. Understanding the development of social skills is important for promoting the educational and psychological well-being of students. Therefore, your careful response to each item is requested.

Reflecting on your experience with children in this age group, read each item in this questionnaire and think about the child's present behavior relative to other you know or have known. Decide how often the child does the things described. If you are not sure about a particular, use your best judgment based on your knowledge of the child's personality,

If the child never does this behavior, fill in the line with a 0 in it.

If the child sometimes does this behavior, fill in the line with a 1 in it.

If the child very often does this behavior, fill in the line with a 2 in it.

HOW OFTEN?

0=Never, 1=Sometimes, 2=Very Often

- \_\_\_\_ 1. Other children like to be with this child.
- \_\_\_\_ 2. Offers to help other children who are having difficulty with a task in the classroom.
- \_\_\_\_ 3. Is slow to anger.
- \_\_\_\_ 4. Invites other to join in activities.
- \_\_\_\_ 5. Peers enjoy talking with him/her.
- \_\_\_\_ 6. Leads out in peer group activities.
- \_\_\_\_ 7. Offers to share materials (e.g. pencils, erasers) when used in a task.
- \_\_\_\_ 8. Controls temper in conflict situations with adults.
- \_\_\_\_ 9. Helps other children who are feeling sick.
- \_\_\_\_ 10. Has many friends.
- \_\_\_\_ 11. Is cooperative during rough and tumble play with peers.
- \_\_\_\_ 12. Children laugh together when engaged in rough and tumble play with him/her.
- \_\_\_\_ 13. Shows sympathy to someone who has made a mistake.
- \_\_\_\_ 14. Peers accept this child easily into ongoing peer group activities.
- \_\_\_\_ 15. Receive criticism well.
- \_\_\_\_ 16. Introduces himself or herself to new people without being told.
- \_\_\_\_ 17. Acknowledges compliments or praises from peers.
- \_\_\_\_ 18. Laughs and smiles easily.
- \_\_\_\_ 19. Peers enjoy rough housing with him/her.
- \_\_\_\_ 20. Controls temper in conflict situations with peers.

- \_\_\_ 21. Comforts a child who is crying or upset.
- \_\_\_ 22. Gets along even when rough housing with peers.
- \_\_\_ 23. Fights back when provoked by peers who are trying to be mean.
- \_\_\_ 24. Cries when picked on by peers.
- \_\_\_ 25. Reacts angrily when confronted aggressively by peer who is trying to be mean.
- \_\_\_ 26. Avoids children who tend to bully him/her.
- \_\_\_ 27. Is pushed around by other children.
- \_\_\_ 28. Ignores a child who is trying to be mean to him/her.
- \_\_\_ 29. Cowers or slinks away when confronted by a bully.
- \_\_\_ 30. Misinterprets the friendly intent of others' behavior and becomes defensive.
- \_\_\_ 31. Says assertively, but without hostility, something like "that's mine" or "give it back" in a firm voice when another child takes something of his/her.
- \_\_\_ 32. Pushes or hits others when perceived he/she is wrong.
- \_\_\_ 33. Tells child who tries to be mean to "stop it right now" or something to that effect.
- \_\_\_ 34. Is made fun of by mean kids.
- \_\_\_ 35. Behaves aggressively even when other children are making friendly overtures toward him/her.
- \_\_\_ 36. Cries when intimidated by a mean child.
- \_\_\_ 37. Pushes or hits when he/she wants to get something back another child has taken from him/her.
- \_\_\_ 38. Withdraws when provoked by peers.
- \_\_\_ 39. Is picked on by mean kids.
- \_\_\_ 40. Stands up assertively but not aggressively to bullies.
- \_\_\_ 41. Lashes out at peer even when peer has not intended to hurt him/her in any way.
- \_\_\_ 42. Tells child who tries to intimidate him/her that he/she "doesn't like it" or something to that effect.
- \_\_\_ 43. Inconsiderate of others.
- \_\_\_ 44. Does things to get the teacher's attention.
- \_\_\_ 45. Cries or screams when mad.
- \_\_\_ 46. Tells lies.
- \_\_\_ 47. Butts into games or activities.
- \_\_\_ 48. Has sudden mood changes.
- \_\_\_ 49. Disturbs ongoing activities.
- \_\_\_ 50. Dawdles when required to do something.
- \_\_\_ 51. Becomes aggressive when rough housing with peers.
- \_\_\_ 52. Tattles on other children to the teacher.
- \_\_\_ 53. Gets angry easily.
- \_\_\_ 54. Is obnoxious when rough housing with peers.
- \_\_\_ 55. Won't do chores/assignments (cleanup) unless threatened in some way.

- \_\_\_ 56. Has temper tantrums.
- \_\_\_ 57. Resists going along with ideas of other children.
- \_\_\_ 58. Excessive praise or reward is required to get child to do chores/assignment (cleanup).
- \_\_\_ 59. Is not sorry after misbehaves.
- \_\_\_ 60. Demands teacher's attention.
- \_\_\_ 61. Stamps feet when angry.
- \_\_\_ 62. Does not wait for opportune moments to enter ongoing peer group activities.
- \_\_\_ 63. Is overly boisterous in rough and tumble play.
- \_\_\_ 64. Interrupts conversations of others.
- \_\_\_ 65. Is louder than peers when engaged in rough and tumble play.
- \_\_\_ 66. Is secretive.
- \_\_\_ 67. Draws attention to self in disruptive ways when trying to enter ongoing play activities with peers.
  
- \_\_\_ 68. Blames others.
- \_\_\_ 69. Follows your instructions.
- \_\_\_ 70. Starts conversations rather than waiting on other to talk first.
- \_\_\_ 71. Is self-confident in social situations.
- \_\_\_ 72. Joins group activities without being told to.
- \_\_\_ 73. Makes friends easily.
  
- \_\_\_ 74. Finishes class assignments within time limits.
- \_\_\_ 75. Produces correct schoolwork.
- \_\_\_ 76. Puts work material or school property away.
- \_\_\_ 77. Attends to your instructions.
- \_\_\_ 78. Initiates conversations with peers.
- \_\_\_ 79. Accepts peers' ideas for group activities.
- \_\_\_ 80. Cooperates with peers without prompting.
- \_\_\_ 81. Compromises in conflict situations by changing own ideas to reach agreement.

## Social Skills Teacher Behavior Rating Scale, Part B

### Directions

This questionnaire is designed to measure how often a child exhibits different types of social behaviors. Understanding the development of social skills is important for promoting the educational and psychological well-being of students. Therefore, your careful response to each item is requested.

Reflecting on your experience with children in this age group, read each item in this questionnaire and think about the child's present behavior relative to other you know or have known. Decide how often the child does the things described. If you are not sure about a particular, use your best judgment based on your knowledge of the child's personality,

If the child never does this behavior, fill in the line with a 0 in it.

If the child sometimes does this behavior, fill in the line with a 1 in it.

If the child very often does this behavior, fill in the line with a 2 in it.

### HOW OFTEN?

0=Never, 1=Sometimes, 2=Very Often

- \_\_\_ 1. Bullies others just to be mean.
- \_\_\_ 2. Tries to embarrass peers by making fun of them in front of other children.
- \_\_\_ 3. Gives mean looks or frowns when upset at peers.
- \_\_\_ 4. Ruins other children's things (artwork, block structures) when upset.
- \_\_\_ 5. Laughs at other children in derogatory ways.
- \_\_\_ 6. Threatens to push a peer off a toy (e.g. tricycle, play house) or ruin what peer is working on unless he/she shares.
- \_\_\_ 7. Hits or kicks others for the sake of doing it.
- \_\_\_ 8. Tells a peer that he/she won't play with them if he/she doesn't do what is asked.
- \_\_\_ 9. Walks away or turns his/her back when he/she is made at another peer.
- \_\_\_ 10. Threatens or intimidates other children just to be mean.
- \_\_\_ 11. Tries to exclude other children who want to play.
- \_\_\_ 12. Says, "I won't be your friend" to peers "If you don't do things my way."
- \_\_\_ 13. Throws things at other children when he/she doesn't get his/her own way.
- \_\_\_ 14. Tells other children that they can't play with the group unless they do what the group wants them to do.
- \_\_\_ 15. Does not listen to other children when he/she is made (may cover ears).
- \_\_\_ 16. Makes fun of peer's possessions (e.g. clothes, art project).
- \_\_\_ 17. Picks on other children just to be mean.
- \_\_\_ 18. Tells other children not to play with or be a peer's friend.
- \_\_\_ 19. Hits, kicks, or pushes to get something he/she wants.
- \_\_\_ 20. Pouts or sulks when made at another child.
- \_\_\_ 21. Tells other children not to play with someone.
- \_\_\_ 22. Squirmy, fidgety child.
- \_\_\_ 23. Acts sad or depressed.

- \_\_\_ 24. Has poor concentration or short attention span.  
 \_\_\_ 25. Acts tearful.  
 \_\_\_ 26. Rather than asking for something he/she wants, does not ask and appears to wait for it to happen.  
 \_\_\_ 27. Talks very quietly.  
 \_\_\_ 28. Tends to be fearful or afraid of new things or new situations.  
 \_\_\_ 29. Is over-sensitive emotionally.  
 \_\_\_ 30. Inattentive.  
 \_\_\_ 31. Appears miserable, unhappy, tearful, or distressed.  
 \_\_\_ 32. Cries easily.  
 \_\_\_ 33. Can't sit still.  
 \_\_\_ 34. Rather than asking for something that he/she wants, chooses to do something else.  
 \_\_\_ 35. Shows anxiety about being with a group of children.  
 \_\_\_ 36. Has stutter or stammer.  
 \_\_\_ 37. Has other speech difficulty.  
 \_\_\_ 38. Gets mixed up when talking.  
 \_\_\_ 39. Restless. Runs about or jumps up & down. Doesn't keep still.
- \_\_\_ 40. Animates toys (e.g. pretends as inanimate object – doll or stick – is alive) by self, away from peers.  
 \_\_\_ 41. Reads books alone, away from others.  
 \_\_\_ 42. Feelings get hurt easily.  
 \_\_\_ 43. Can't get other to play with him/her.  
 \_\_\_ 44. Manipulates body parts (e.g. twists/wrings hands, hair mouth, ears).  
 \_\_\_ 45. Shies away when approached by other children.  
 \_\_\_ 46. Does constructive activities (e.g. build with blocks, legos) or does puzzles alone, away from others.  
 \_\_\_ 47. Is off task and preoccupied.  
 \_\_\_ 48. Other children tell him/her that he/she cannot play with them.  
 \_\_\_ 49. Talks aloud or sings dramatically around peers when they are doing similar things but does not interact with them while doing so.  
 \_\_\_ 50. Other children exclude him/her.  
 \_\_\_ 51. Is very shy.  
 \_\_\_ 52. Has twitches, mannerisms, or tics of the face and body.  
 \_\_\_ 53. Pretends to be something (e.g. fireman, doctor, airplane) in vicinity of peers doing similar things but does not interact with them while doing so.  
 \_\_\_ 54. Animates toys (e.g. pretends as inanimate object such as a doll or stick is alive) in vicinity of peers doing similar things but does not interact with them while doing so.  
 \_\_\_ 55. Builds things by self rather than with other children.  
 \_\_\_ 56. Pouts or sulks.  
 \_\_\_ 57. Likes to play alone.  
 \_\_\_ 58. Cries over seemingly little things.  
 \_\_\_ 59. Says nobody likes him or her.  
 \_\_\_ 60. Appears to be doing nothing.

- \_\_\_ 61. Does pretend/dramatic play with peers, but does not interact with them while doing so.
- \_\_\_ 62. Is reserved around other children.
- \_\_\_ 63. Is told to go away by other children.
- \_\_\_ 64. Is unoccupied even when there is plenty to do.
- \_\_\_ 65. Bites nails or fingers.
- \_\_\_ 66. Plays with toys by self rather than with other children.
- \_\_\_ 67. Is fearful in approaching other children.
- \_\_\_ 68. Twists/manipulates clothing.
- \_\_\_ 69. Stares at other children without interacting with them.
  
- \_\_\_ 70. Appears lonely.
- \_\_\_ 71. Is easily distracted.
- \_\_\_ 72. Is easily embarrassed.
- \_\_\_ 73. Doesn't listen to what others say.
- \_\_\_ 74. Argues with others.
- \_\_\_ 75. Talks back to adults when corrected.
- \_\_\_ 76. Acts impulsively.
- \_\_\_ 77. Is aggressive toward people or objects.
- \_\_\_ 78. Disobeys rules or requests.
- \_\_\_ 79. Fights with others.
- \_\_\_ 80. Has low self-esteem.

## APPENDIX B

## List of Nonwords

1. /kræŋkwɛd/
2. /ɔɛblɔd/
3. /ɔncɔwɔel/
4. /pæsɔubl/
5. /ɔwɔed/
6. /ɔblɔsɔm/
7. /ɔɔævl/
8. /ɔɔm/
9. /ɔɔw/

## APPENDIX C

## Nonword Repetition Task Directions

Listen. You will hear some made up words. I want you to say exactly what you hear. Let's try a practice word. Are you ready?

/tæs/

/pʌw/

(If child repeats the first word correctly, say "that was good," and go on to second word. If child does not repeat correctly, repeat instructions and present the word again.)

Now you will hear some longer made up words through these headphones. After each made up word you will hear a beep. After the beep, I want you to say the word you heard. Say exactly what you hear. Ready?