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A Comparison Of School-Aged Children Who Stutter And Do Not Stutter In Difficult Phonological Tasks

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A Comparison of School-Aged Children who Stutter and do not Stutter in Difficult Phonological Tasks

(TITLE)

BY

Christopher Lading

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Science

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

2007
YEAR

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DEPARTMENT/SCHOOL HEAD

A COMPARISON OF SCHOOL-AGED CHILDREN WHO STUTTER AND DO NOT STUTTER IN DIFFICULT PHONOLOGICAL TASKS

BY

CHRISTOPHER LADING

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A Comparison of School-Aged Children who Stutter and do not Stutter in Difficult Phonological Tasks

Chris Lading

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Abstract

The purpose of this study was to assess the phonology skills of school-aged children who stutter using tasks that task the speech system. Participants included 11 children who stuttered and 10 normally fluent children. The results suggested that no differences exist in the phonology of children who stutter and children who are normally fluent when presented with complex phonological tasks.

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Chapter I

Introduction

Several researchers have investigated the coexistence of stuttering and phonology disorders and have found that a higher incidence of people who stutter also having disordered phonology as compared to the general population. Blood and Seider (1981) found that 68% of school-aged children who stutter had a concomitant disorder as well, with 91% of that population receiving articulation therapy in addition to fluency treatment. Williams and Silverman (1968) found that 24% of 115 elementary school-aged children who stuttered also had a phonological disorder. Riley and Riley (1979) found that approximately 33% of 54 children who stuttered (ages 3-11 years) had moderate to severe phonological problems. Arndt and Healey's survey (2001) concluded that within a group of 205 children who stuttered (ages 3-20 years), 32% had a concomitant phonological disorder. St. Louis, Murray, and Ashworth (1991) analyzed the speech, language and hearing characteristics of 24 children who stuttered (mean age 12;6) and found that 42% also had an articulation disorder.

Several researchers have investigated the types of phonological errors in children who stutter and children who do not stutter to determine if there are differences. Wolk, Edwards, and Conture (1993) evaluated the stuttering/phonology relationship in 21 boys (7 children who stuttered with normal phonology; 7 children who stuttered with disordered phonology; 7 children with normal fluency with disordered phonology). The children who stuttered with disordered phonology and the fluent children with disordered phonology showed no significant difference in phonological behavior. Paden and Yairi (1999) investigated the phonological abilities of children whose stuttering persisted

compared with those who recovered from stuttering and found that both groups' phonology developed similar to fluent children, in that most of the errors occurred on late-acquired processes (e.g., liquids). However, the persistent stuttering group developed phonologically more slowly than the recovered group, as evidenced by poorer scores and less sophisticated strategies for dealing with deviant patterns (e.g., deleting vs. substituting).

Estimates of co-occurrence of stuttering and disordered phonology have been based primarily on data from surveys (Arndt & Healey, 2001; Blood & Seider, 1981; Nippold, 2004), screening tools (St. Louis & Hinzman, 1988), single word standardized articulation tests (Paden & Yairi, 1996; Paden & Yairi, 1999; Riley & Riley, 1979; Ryan, 1992), or studies with multiple measures of both conversational speech and single word production tasks (St. Louis, et al., 1991; Williams & Silverman, 1968; Wolk, et al., 1993; Yaruss & Conture, 1996). Research that has investigated the type of phonological errors produced by preschool or school-age children who stutter has used single word articulation tests or phonological analysis from conversational speech (Howell & Au-Yeung, 1995; Louko, et al., 1990; Melnick & Conture, 2000; Nippold, 2004; Throneburg, Yairi, & Paden, 1994; Wolk, et al., 1993; Wolk, Blomgren, & Smith, 2000). This suggests that primarily non-taxing speech tasks have been used in prior research.

Despite several studies demonstrating a strong relationship between phonology and stuttering (Arndt & Healey, 2001; Louko, Edwards, & Conture, 1990; Ryan, 1992; Williams & Silverman, 1968), other researchers have found no such connection (Howell & Au-Yeung, 1995; Melnick & Conture, 2000; Thronebug, et al., 1994; Wolk, et al., 2000). The negative findings may be a result of analyzing spontaneous conversational

speech, in which the child was able to avoid utterances that were phonologically difficult. Consequently, there is a need for researchers to stress the phonological ability of children by utilizing complex words and phrases that must be repeated so avoidance of complex words is minimal (Nippold, 2002).

Chapter II

Review of the Literature

Stuttering is a disorder in which interruptions or blockages impair the fluency of speech (Bloodstein, 1995). Phonology is the system of speech sounds of a language, and phonological errors occur when a child does not produce the correct sounds in words (Hodson & Paden, 1991). Numerous sources of evidence point to a possible stuttering-phonology connection. Research has suggested there is a higher incidence of phonology problems in people who stutter than the general population (Bernstein Ratner, 1995; Conture, Louko, & Edwards, 1993; Louko, 1995; Melnick & Conture, 2000; Wolk, 1998; Wolk, et al., 2000). School-aged children who stutter often have co-existing articulation/phonological problems (Ardnt & Healey, 2001; Bernstein Ratner, 1995; Blood & Seider, 1981; Conture, 2001; Conture, et al., 1993; Louko, 1995; Melnick & Conture, 2000; St. Louis, et al., 1991; Wolk, 1998; Wolk, et al., 2000; Wolk, et al., 1993). Edwards (as reported by Nippold, 2002), found that children sometimes become disfluent when treated for phonological disorders. Additionally, several researchers have investigated if the types and severity of phonological errors differ between children who stutter and children who do not stutter (Anderson & Conture, 2000; Louko, et al., 1990; Paden & Yairi, 1996; Paden & Yairi, 1999; Ryan, 1992; Wolk, et al., 1993; Yaruss, LaSalle, & Conture, 1998). Instances of disfluency may occur at points in utterances that are phonologically difficult; therefore, the coexistence of disfluency and phonological errors may be the result of motor planning and execution (Bloodstein, 1995; Howel & Au-Yeung, 1995; Johnson & Brown, 1935; Melnick & Conture, 2000; Throneburg, et al., 1994; Wolk, et al., 2000). Some authors (Daly, 1981; and Van Riper, 1982, as cited in

Wolk and Edwards, 1993) have speculated that children who have coexisting stuttering and articulation disorders may have a delay in neuromotor development. Additionally, there are several theories that explore the link between stuttering and phonology.

Stuttering-Phonology Theories

Sentence formulation can be broken down in three steps: 1) conceptualizing the ideas to be expressed; 2) mapping the ideas into linguistic form, which includes the selection of appropriate lexical items and the construction of a syntactic frame; and 3) phonological encoding, which involves specifying the prosody of the utterance in addition to its phonological structure. The phonetic plan is then forwarded for motor encoding and subsequent articulation. Often referred to as "frame-and-slot" models, standard models of sentence production include "frames" that represent syntax and phonology, and linguistic units which are inserted into them (Bernstein Ratner, 1997).

Some theories imply that disfluencies result from a glitch in the prearticulatory plan. The "fault-line" hypothesis (Wingate, 1988) suggests that deficits in phonological encoding cause stuttering. The speaker has trouble advancing past the syllable onset because the rime is not retrieved quickly enough (Bernstein Ratner).

The Covert Repair Hypothesis (Postma & Kolk, 1993) suggests that disfluencies may occur as a result of trying to fix phonetic errors before they are articulated. Phonological encoding may be impeded by a delay in activating and choosing correct speech targets, and this can cause errors in construction of the phonetic plan. As these errors are detected and the speaker attempts to correct them, disfluencies can occur in the form of postponement and restarting (Berstein Ratner, 1997).

Perkins, Kent, and Curlee (1991) advocated an alternative theory. Their Dyssynchronous Syllable Frames and Segment Content Model proposes that stuttering is a result of timing errors in combining the syllable frame and segment content. In other words, the syllable slot is not properly correlated in time with the sounds that go into the slot (Conture, 2001). Furthermore, perceived time pressure on the speaker can escalate a normal disfluency into an incident of stuttering (Bernstein Ratner, 1997).

The Demands Capacity Model suggests that there are several environmental demands on fluency which include demands on motor skills, language production, social/emotional skills, and cognitive skills. The capacities may not meet demands for a variety of reasons. Timing and coordination place demands on the motor system. Increases in linguistic knowledge place demands on language production. Emotional stress and excitement tax social skills. Attempting to answer questions or respond to prompts from parents with complex speech places demands on cognitive skill. Speech breaks down when the child does lacks the capacity to articulate the speech that he feels is demanded of him (Bernstein Ratner, 1997).

Loci of Stuttering and Phonological Complexity

Several studies have addressed a possible interaction between instances of disfluency and phonological complexity. Bloodstein (1995) noted that as early as the 1930's, researchers suggested that stuttering was influenced by certain sounds in words. Johnson and Brown (1935) discovered that the initial sound in a word increased the likelihood of adults blocking on that word, but the sounds that elicited blocking varied from person to person. The only similarity for adult stutterers as a group was that initial consonants were more likely to be stuttered than initial vowels. Bloodstein suggested

that different adult stutterers have trouble with different sounds because of their attitude towards certain sounds. People learn to fear and avoid certain sounds that have troubled them in the past, and these sounds are more likely to be disfluent because of this fear (Bloodstein).

Although there is a strong relationship between phonology and instances of disfluency for adults who stutter, that relationship does not appear to be present in children who stutter. Throneburg, et al. (1994) conducted a study focusing on the spontaneous conversational speech of 24 preschool children who stuttered. The subjects ranged in age from 25-59 months with a mean age of 40.5 months. Spontaneous speech samples consisting of 1,000 words were obtained and analyzed for disfluencies. The results indicated that the distribution of phonological complexity in disfluent words was very similar to the distribution of phonological complexity within the speech sample. Most of the disfluent words in the sample were phonologically simple. Howell and Au-Yeung (1995) conducted a similar study in which the conversational speech of 31 stutterers, ages 2;7-12;7, was analyzed for a potential link between stuttering and phonological complexity. The authors also found no link between the incidence of stuttering and phonologic complexity. However, both studies focused on spontaneous conversational speech, so it could not be guaranteed that the participants attempted words that were phonologically difficult (Nippold, 2002).

Wolk, et al. (2000) evaluated the conversational speech of 7 stutterers, ages 4;5-5;11, which contained at least 300 syllables and disfluencies on 5-30% of the words. This study sought to investigate the interaction of stuttering and phonological errors occurring in the same syllable. Wolk et al. found no difference between disfluencies on

syllables with and without phonemic errors. They did, however, notice that stuttering occurred more often on syllables with initial consonant clusters that were produced with phonological errors than initial clusters that were produced with no phonological errors.

Melnick and Conture (2000) investigated whether length and grammatical complexity of utterances influenced the likelihood of stuttering and phonological errors. Participants in the study included 10 males (ages 34-74 months) who exhibited both stuttering and disordered phonology. Conversational speech with a caregiver was recorded and analyzed. Results indicated that although the length and complexity of utterances were factors in the frequency of stuttering, they did not influence the occurrence of phonological processes, and phonological processes did not occur more frequently in stuttered versus nonstuttered utterances.

Incidence of Articulation/Phonology Difficulties in People Who Stutter

People who stutter tend to have more articulation/phonological difficulties than the general population (Bernstein Ratner, 1995; Conture, et al., 1993; Louko, 1995; Melnick & Conture, 2000; Wolk, 1998; Wolk, et al., 2000). Research has found that 30-40% of children who stutter have a coexisting phonological disorder, as compared with only 2-6% of fluent children.

The use of surveys is one method that has been implemented to gather data regarding the co-occurrence of stuttering and disordered phonology. Surveys have revealed a high incidence of disordered phonology within groups of children who stutter. Arndt and Healey's survey (2001) concluded that within a group of 205 children who stuttered (ages 3-20 years), 32% had a concomitant phonological disorder. Stipulations for specifying a disorder in the survey varied by states but included poor performance on

a standardized articulation test, verification by a multidisciplinary team, reduction of speech intelligibility as a result of the significance of the disorder, and poor academic or social performance due to articulation ability. Blood and Seider (1981) conducted a survey in which 351 speech-language pathologists provided information on the concomitant disorders of 1060 stutterers (ages 14 years and younger). Blood and Seider found that 68% of school-aged stutterers had a concomitant disorder, with 91% of that population receiving articulation therapy in addition to fluency treatment.

A higher incidence of disordered phonology in children who stutter was also reported in several studies using standardized tests or conversational speech samples. Ryan (1992) conducted a study in which 20 preschool children who stuttered (mean age 4;4) were given the Arizona Articulation Proficiency Scale and found no significant differences between their scores and the scores of their normally fluent peers. However, one fourth of the subjects who stuttered later required treatment for articulation errors. Louko, et al. (1990) analyzed 30-minute conversational speech recordings of 30 children who stuttered (mean age 4;6) and 30 children with no stuttering (mean age 4;6) interacting with their mothers and compared the phonological processes of the two groups. They found that 40% of the children who stuttered exhibited disordered phonology (as defined as atypical or age-inappropriate processes) compared to only 7% of the fluent children. Williams and Silverman (1968) analyzed conversational speech samples of school-aged children and discovered that 72% of children with stuttering and 24% of normally fluent children in kindergarten and first grade produced at least 1 consistent articulation error. Using standardized tests and language samples, St. Louis, et al. (1991) analyzed 24 children who stuttered (mean age 12;6) for speech, language, and

hearing variables. The results for second and third graders indicated 18% of children with stuttering and 6.2% of children with no stuttering produced at least 1 consistent articulation error. A mild disorder consisted of 2-4 errors and was present in 21% of the participants. Five to nine errors was considered a moderate articulation disorder, and this occurred in 13% of the participants. To be labeled as severe, a child had to produce more than 10 errors, which occurred in 8% of the participants.

There has been considerable variation between authors in how they define "disordered phonology." Some authors evaluated total scores on an articulation test (Ryan, 1992) and found no difference between preschool children who stutter and children with no stuttering. Studies that used criteria of at least one consistent articulation error (Williams and Silverman, 1988; St. Louis et al., 1991) found more differences in children who stutter than children with no stuttering.

There does not appear to be a relationship between the severity of stuttering and the degree of phonologic difficulties. Yaruss, et al. (as cited in Nippold, 2002) examined the speech of 99 children (mean age=4;7) and found that the presence of a phonological disorder did not indicate more severe stuttering. Louko, et al. (1990) evaluated speech samples of 30 stutterers (mean age=4;6) and found that severe stutterers were using no more phonological processes than mild stutterers. Anderson and Conture (2000) analyzed the speech of 20 stutterers (mean age=3;11) and found that the children's phonology was developing normally, despite having mild to severe levels of stuttering.

Although several studies have found no link between severity of stuttering and phonological difficulties (Howell & Au-Yeung, 1995; Melnick & Conture, 2000; Thronebug, et al., 1994; Wolk, et al., 2000), the research results of St. Louis and

Hinzman (1988) indicated that a link might exist. In this study, the speech of 24 moderate stutterers (mean age 12;7), 24 severe stutterers (mean age12;5), and 24 nonstutterers (mean age 12;5) was analyzed. Analysis showed that two thirds of the moderate stutterers were judged to have mild to moderate articulation deviations, and all of the severe stutterers were judged to have articulation errors, with one third rated as severe. Overall, 67% of the moderate stutterers had an articulation disorder, whereas 96% of the severe stutterers had an articulation disorder.

Types of Phonological Errors

Wolk, et al. (as cited in Nippold, 2002) evaluated the stuttering/phonology relationship in 21 boys (7 stutterers with normal phonology; 7 stutterers with disordered phonology; 7 nonstutterers with disordered phonology) ranging in age from 4-6 years. The children who stuttered with disordered phonology and the nonstutterers with disordered phonology showed no significant difference in phonological behavior. Both groups used vocalization, gliding, weak syllable deletion, syllable coalescence, and cluster reduction. Cluster reduction was the process used most frequently in both groups.

Paden and Yairi (1996) conducted a longitudinal study that investigated the phonological characteristics of children who persisted and children who recovered from stuttering. The study looked at 36 children (age range 27-65 months) and included 12 persistent stutterers, 12 early recoverers, and 12 late recoverers. The Assessment of Phonological Processes-Revised (APP-R) was administered to each participant at the beginning of the study and each succeeding year. The experimental groups scored poorer on all phonological patterns than the control groups. There were significant differences for consonant sequences, glides, velar obstruents, and stridents between the persistent

group and their controls. All groups, experimental and control, had a higher deficiency for liquids than any other process, followed by consonant sequences. Paden and Yairi cited developmental norms (Hodson 1994) suggesting that postvocalic consonants emerge by age 2; velars, stridents, and strident clusters by age 3; and liquids emerge last at age 5. In their study, 17 experimental subjects exhibited phonological processes that were age-inappropriate.

Paden and Yairi (1999) conducted another study that investigated the phonological abilities of children whose stuttering persisted, as compared with those who recovered from stuttering. The Assessment of Phonological Processes-Revised (APP-R) was administered to 22 children whose stuttering persisted and to 62 children who recovered from stuttering. Results indicated that the persistent group scored poorer on all ten basic phonological processes assessed on the APP-R. The study revealed that phonological development in both groups was similar to fluent children in that they did better on early developing patterns but evidenced more errors on late-acquired processes.

In the study by St. Louis, et al. (1991), substitutions were the most common type of phonological error produced (55.5%), followed by omissions (24.7%) and distortions (19.8%). Errors in the initial position occurred 53.1% of the time, which was twice as much as errors in the medial (22.2%) and final (24.7%) positions.

Summary and Purpose

Estimates of co-occurrence of stuttering and disordered phonology have been based primarily on data gathered from surveys (Arndt & Healey, 2001; Blood & Seider, 1981; Nippold, 2003), screening tools (St. Louis & Hinzman, 1988), single word standardized articulation tests (Paden & Yairi, 1996; Paden & Yairi, 1999; Riley & Riley,

1979; Ryan, 1992), or studies with multiple measures of both conversational speech and single word production tasks (St. Louis, et al., 1991; Williams & Silverman, 1968; Wolk, et al., 1993; Yaruss & Conture, 1996). Research studies investigating the type of phonological errors produced by preschool or school-age children who stutter have used single word articulation tests or phonological analysis from conversational speech (Howell & Au-Yeung, 1995; Conture, Louko, & Edwards, 1993; Louko, et al., 1990; Melnick & Conture, 2000; Nippold, 2003; Throneburg, et al., 1994; Wolk, et al., 2000; Wolk & Edwards, 1993). Therefore, it appears as though primarily non-taxing speech tasks have been analyzed in prior research. Despite several studies demonstrating a strong relationship between phonology and stuttering (Arndt & Healey, 2001; Louko, Edwards, & Conture, 1990; Ryan, 1992; Williams & Silverman, 1968), others have found no such correlation (Howell & Au-Yeung, 1995; Melnick & Conture, 2000; Thronebug, Yairi, & Paden, 1994; Wolk, Blomgren, & Smith, 2000). The negative findings may be a result of analyzing spontaneous conversational speech, in which children were able to avoid utterances that were phonologically difficult or using standardized articulation tests with school-age children which were not taxing to sensitive to minor residual difficulties. According to Nippold (2002), researchers need to use tasks that stress the phonological abilities of children by analyzing complex words and phrases that cannot be avoided within the designated task.

The purpose of the current study was to assess the phonology skills of school-aged children who stutter using tasks that tax the speech system. These tasks included a multisyllabic word list, speech error phrases, and tongue twisters. Three research questions were addressed in the study:

1. Do children who stutter and children who are fluent differ in their phonology when producing multisyllabic words, as measured by number of items correct or percentage of consonants correctly produced (PCC)?
2. Do children who stutter and children who are fluent differ in their phonology when producing speech error phrases, as measured by numbers of items correct or PCC?
3. Do children who stutter and children who are fluent differ in their phonology when producing tongue twisters, as measured by number of items correct?

Chapter III

Methods

Participants

Participants consisted of 11 school-aged children who stuttered (ages 8;7-12;6, M=10;2) and 10 school-aged children who were fluent (ages 8;6-12;3, M=10;4). The group who stuttered was comprised of 9 males and 2 females, while 9 males and 1 female made up the fluent group. Participants were recruited from central Illinois and the Milwaukee area of Wisconsin. The children who stuttered scored a group mean of 109 on the Peabody Picture Vocabulary Test (PPVT). The fluent children scored a group mean of 111 on the PPVT. A t-test revealed no significant difference between the groups for age or language/cognitive skills as measured by the PPVT. Subject information for the 24 participants is summarized in Table 1.

Procedures

Subjects were recruited and conversational speech samples and phonology tasks were recorded by researchers at the University of Illinois Champaign-Urbana and the University of Wisconsin at Milwaukee. The recording instrumentation at the University of Illinois consisted of a Crown PCC-Cardioid microphone connected to a Yamaha KM608 preamplifier (mixer). The audio signal was directed to a high quality Tascam 122 MKII stereo cassette recorder and a Sony SLV-353UC video recorder with frame-by-frame display capability. Video images were obtained via a Panasonic WV-BD400 camera (as described by Yairi et al., 1993). The speech sample ranged from 1,000 to 1,500 syllables and consisted of conversational speech between the child and a parent and between the child and an investigator. Samples lasted approximately 40 minutes and

consisted of the investigator asking the child several open-ended questions. The speech samples were used to analyze disfluencies in conversational speech.

Table 1

Subject Information

	Children Who Stutter					Normally Fluent Children			
	Gender	**Age**	**PPVT**	**SLD**		**Gender**	**Age**	**PPVT**	**SLD**
A509NP	M	8;7	117	4.35	A505JK	M	11;2	102	0.00
A507KP	M	9;4	135	3.19	A506AW	M	11	143	0.56
A508MT	M	10	103	3.30	A516JM	M	11;8	92	0.20
A511AT	M	11;7	119	4.44	A548DL	M	12;3	105	0.82
A515IN	M	9;4	91	6.12	A549LC	M	11;5	88	0.84
A531BB	M	12;6	90	1.20	A514JM	F	8;6	127	0.62
A533JJ	M	12;5	93	4.91	A520SH	M	9;3	121	0.42
A551RM	F	11;4	114	2.34	A518TR	M	9;8	125	0.83
S308	M	10	121	9.32	A519J1V	M	9;10	95	1.41
S300	F	9;1	105	2.33	A512TP	M	9;11	115	0.20
S301	M	8;9	103	2.62	**Group Mean**		**10;4**	**111**	**0.59**
Group Mean		**9;9**	**108**	**4.01**					

Note. PPVT = Peabody Picture Vocabulary Test; SLD= stuttering-like disfluencies.

Disfluency Analysis

The current investigator orthographically transcribed approximately 500 words of the speech samples. The Systematic Analysis of Language Transcripts (SALT, Miller & Chapman, 1993) program was used for transcript entry. A coding system compatible with SALT was used to code part word repetition, monosyllabic word repetition, and dysrthymic phonation. Different types of disfluencies in the same word were counted separately. Stuttering-like disfluencies (SLD) were determined by combining the three categories and calculating the mean number of stuttering-like disfluencies per 100 syllables (Yairi & Ambrose, 1999). Results are presented in Table 1. The children who stuttered had a mean SLD of 4.01 while the normally fluent children had a mean SLD of 0.59. Children who stuttered exhibited almost seven times as many as disfluencies as their fluent counterparts.

Procedures for Phonology Tasks

The participants produced the multisyllabic words (Catts, 1986), speech error phrases (Catts), and tongue twisters (Haber & Haber, 1982) after listening to them through headphones at the University of Illinois or University of Wisconsin at Milwaukee. The multisyllabic words consisted of 30 three-syllable words (e.g., emphasis), 16 four-syllable words (e.g., peculiar), three five-syllable words (e.g., enthusiasm), one two-syllable word (probably), and one six-syllable word combination (fire extinguisher). The Multisyllabic Word List evaluated sound sequencing difficulties in single words (Lewis & Freebairn, 1992). The multisyllabic words are included in Appendix A. The speech error phrases and the tongue twisters evaluated production of combinations of similar sounds in different syllable positions (Lewis & Freebairn). Each

participant was instructed to listen to a list of 36 phrases played on an audio tape and was allowed 4 seconds to repeat each phrase. An example of a speech error phrase was "She sells shorts." The 36 error phrases are included in Appendix B. The same directions were applied to the tongue twisters. There were ten tongue twisters (i.e., the Swiss wristwatch strap shuts soon) along with ten control sentences (Which pilot flew heavy bombers). The tongue twisters are included in Appendix C.

Scoring of Phonology Tasks

The current investigator analyzed the recorded productions of multisyllabic words, speech error phrases, and tongue twisters. Each item (multisyllabic word, speech error phrase, or tongue twister) was scored as correct or incorrect (Lewis & Freebairn, 1992). Items were scored as correct if all phonemes in all words were produced accurately. Items were scored as incorrect if any phoneme errors occurred. A percent accuracy for each task was calculated for each subject.

The Programs to Examine Phonetic and Phonologic Evaluation Records (PEPPER, Shriberg, 1986) was used to determine the percentage of consonants correctly produced (PCC) within the multisyllabic words and speech error phrases. This was a more detailed level of analysis than counting entire items as correct/incorrect. A description of the types of errors was used to denote substitutions, omissions, and distortions. Unfortunately, due to the nature of the errors made by both groups on the tongue twister tasks, data could not be inputted into PEPPER and thus, no PCCs were calculated for that task. Language omissions and substitutions (whole words) frequently occurred on this task, and many words were deleted entirely. This made it impossible to score with PCC.

Reliability of Scoring Phonology Tasks

Interjudge reliability was achieved by having a second researcher independently score the tasks. This researcher was a graduate student, trained in narrow phonetic transcription, who used PEPPER to transcribe the speech of preschoolers for 15 hours per week for 2 years. An agreement index was used in which the number of errors agreed upon was divided by the total number of task items. Interjudge reliability was 96%. Reliability of PCC was calculated by finding the difference between the PCCs reported by both researchers and then dividing that number by the total number of PCCs. The difference of errors between the two researchers for PCC was .70 for multisyllabic words and .77 for the speech error phrases.

Data Analysis

Individual participants' results were presented in tables showing the number of items correct for each task, as well as the PCC for each task. Means and standard deviations were presented for the children who stuttered and the normally fluent group. A MANOVA was conducted to determine if there is a significant difference between the groups on the number of items correctly produced for multisyllabic words, speech error phrases, and tongue twisters. If the MANOVA indicated a significant difference between the groups, univariate F-tests would have been used to determine which of the phonology tasks were significantly different for the groups of the children. A MANOVA was also conducted to determine if there is a significant difference between the groups in the percent of consonants correct (PCC) in multisyllabic words, speech error phrases, and tongue twisters. If the MANOVA had been significant, univariate F-tests would have been used for follow-up analyses.

Chapter IV

Results

This study addressed the question of whether children who stutter and children with no stuttering differ in their phonology when presented with difficult phonological tasks as measured by number of items correct or percentage of consonants correctly produced. Overall, results were similar for each task.

Table 2 illustrates the percent of items that were produced without any errors for each of the phonological tasks for the two groups of subjects. Data for the individual participants are included in Appendix D. Items were scored as incorrect if any phoneme errors occurred in any word. The means for the two groups were nearly identical for the multisyllabic word task (Ms=76.64 and 76.20). The children with stuttering produced a slightly higher accuracy (M=81.73) on the speech error phrases than the children with no stuttering (M=75.30). The tongue twister task resulted in much lower accuracies for both groups of children. The children with no stuttering, however, were slightly more accurate (M=36.51) than the children who stuttered (M=32.73). The results of a MANOVA (multivariate analysis of variance) indicated the percent accuracy of multisyllabic words, speech error phrases, and tongue twisters was not significantly different between the groups [$F(3, 17)=.930$; $p=.447$].

Table 2
Percent of Items Correct for Difficult Tasks

	n	Mean	SD
CWS			
Multisyllabic Words	11	76.64	9.95
Speech Error Phrases	11	81.73	7.38
Tongue Twisters	11	32.73	12.52
CWNS			
Multisyllabic Words	10	76.20	18
Speech Error Phrases	10	75.30	24.75
Tongue Twisters	10	36.51	23.33

Note. CWS=children with stuttering; CWNS=children with no stuttering; n=number; SD=standard deviation.

Table 3 illustrates a percentage of consonants correctly produced (PCC) for the multisyllabic and speech error phrase tasks. Again, the means for the two groups were similar on the multisyllabic word task with the children with stuttering scoring slightly higher (M=93.43) than the children with no stuttering (M=92.01). The means for both groups were also comparable on the speech error phrase tasks (Ms=95.47 and 95.01). A MANOVA revealed no significant differences between the groups [F (2, 18)=.060; p=.942.]

Table 3
Percent of Consonants Correctly Produced for Multisyllabic and Speech Error Phrases

	n	Mean	SD
CWS			
Multisyllabic Words	11	93.43	2.78
Speech Error Phrases	11	95.47	1.60
CWNS			
Multisyllabic Words	10	92.90	4.79
Speech Error Phrases	10	95.01	5.02

Note. CWS=children with stuttering; CWNS=children with no stuttering; n=number; SD=standard deviation.

Table 4 illustrates the proportion of relative error types in multisyllabic word and speech error phrase tasks for both groups. The error types included omitting, substituting, and distorting sounds. Both groups had similar scores for each error type in each task. Phoneme omission predominated in the multisyllabic word task for both groups (Ms=.43 and .47), while substitutions occurred more in speech error phrases (Ms=.45 and .45). Again, the results of a MANOVA suggested no significant difference between the groups [F (2, 18)= .060; p=.942].

Table 4
Relative Error Types

		Omissions		Substitutions		Distortions	
	n	Mean	SD	Mean	SD	Mean	SD
CWS							
Multisyllabic Words	11	.43	.22	.35	.13	.26	.25
Speech Error Phrases	11	.37	.23	.45	.25	.31	.27
CWNS							
Multisyllabic Words	10	.47	.24	.39	.21	.22	.27
Speech Error Phrases	10	.35	.16	.45	.16	.35	.18

Note. CWS=children with stuttering; CWNS=children with no stuttering; n=number; SD=standard deviation.

Chapter V

Discussion

Summary of Results

Nippold (2002) suggested that researchers need to use tasks that stress the phonological abilities of children by analyzing complex words and phrases that cannot be avoided within the designated task. The purpose of the current study was to assess the phonology skills of school-aged children who stutter compared to children who do not stutter using tasks that tax the speech system. These tasks included a multisyllabic word list, speech error phrases, and tongue twisters. Measures of phonology proficiency included the percent consonant correct and number of items correct. Results indicated the two groups of children performed very similarly on the challenging phonology tasks. Surprisingly, the children with stuttering had slightly higher mean accuracies on the number of items correct and percentage of consonants correctly produced within the multisyllabic word and speech error phrase tasks; however the differences between the groups were not significant on any of the tasks or measures.

When looking at the types of errors (omissions, substitutions, distortions), both groups omitted more sounds on the multisyllabic words and substituted more sounds on the speech error phrases. All of the speech error phrases were made up of only monosyllabic and bisyllabic words, which may explain why sound omissions occurred less frequently than on multisyallabic words which ranged from 2 to 6 syllables. The accuracies for the tongue twister task were dramatically lower than the other measures for both groups, but the means were similar between the groups.

Relation to past research

Estimates of co-occurrence of stuttering and disordered phonology have been based primarily on data gathered from surveys (Arndt & Healey, 2001; Blood & Seider, 1981; Nippold, 2003), screening tools (St. Louis & Hinzman, 1988), single word standardized articulation tests (Paden & Yairi, 1996; Paden & Yairi, 1999; Riley & Riley, 1979; Ryan, 1992), or studies with multiple measures of both conversational speech and single word production tasks (St. Louis, et al., 1991; Williams & Silverman, 1968; Wolk, et al., 1993; Yaruss & Conture, 1996).

The results of the current study conflicted with the findings of Louko, et al. (1990), Williams and Silverman (1968), and St. Louis, et al. (1991) which indicated that children who stutter tend to have more phonologic difficulties than their normally fluent peers. However, Louko, Edwards, and Conture (1990) analyzed the speech of preschool children rather than school-aged children, and Williams and Silverman (1968) and St. Louis, et al. (1991) evaluated school age children; however, their criteria was only at least one consistent articulation error as evidenced in conversational speech samples or on standardized articulation test.

Results of the current study supported past research that has not found a strong relationship between phonology and stuttering (Melnick & Conture, 2000; Ryan, 1992; Wolk, et al., 2000). These past studies found the negative findings from analyzing spontaneous conversational speech (in which the child was able to avoid utterances that were phonologically difficult) or using standardized articulation tests with school-age children which were not taxing to sensitive to minor residual difficulties. The current

study demonstrated that children who stuttered did not perform more poorly on challenging phonological tasks than children who did not stutter.

Research investigating the type of phonological errors produced by preschool or school-age children who stutter has used single word articulation tests or phonological analysis from conversational speech (Conture, et al., 1993; Louko, et al., 1990; Melnick & Conture, 2000; Nippold, 2004; Wolk, et al., 2000; Wolk & Edwards, 1993). While most of these authors looked at phonological processes, one (St. Louis, et al., 1991) looked at phonology errors in terms of omissions, substitutions, and distortions. The most common type of phonological error produced in the current study varied depending on which task was being presented. When repeating multisyllabic words, both groups committed omissions the most, followed by substitutions, and then distortions. However, substitutions were the most common errors by both groups on the speech error phrases, followed by omissions, and then distortions. The latter is consistent with St. Louis, et al.'s (1991) study in which the scores on articulation tests (Goldman-Fristoe Test of Articulation, Experimental Edition) of 24 stutterers were analyzed for different phonological error types. In that study, 55.5% of the errors were substitutions; 24.7% were omissions; and 19.8% were distortions.

The findings of Yaruss, et al. (as cited in Nippold, 2002) revealed that poorer phonology did not indicate more severe stuttering. Louko, et al. (1990) discovered that the severe stutterers in their study were not using more phonological processes than mild stutterers. The current study showed that the only hint of a relationship between stuttering severity and phonology is that the two participants with the highest SLD's also had the lowest PCCs as well as the lowest percents correct on the multisyllabic word task.

No other trends in any of the other measures were evident. These findings should be regarded with caution, however, due to the limited sample size.

Theoretical & Practical Implications

Indirectly, this study had hoped to reveal if complex phonology was a contributing factor in an overall larger motoric problem that included or even resulted in disfluencies. As stated before, no significant differences were found between the two groups on any of the measures. Had the children who stuttered exhibited more phonological errors than their fluent counterparts, then a link could have been substantiated between phonology and stuttering. If such a finding did exist, it would have treatment implications on how to best serve children who present with both disordered phonology and disfluencies. Indeed, if a relationship exists between both disorders, perhaps further research should focus on the cause and subsequent treatment of the motor problem that creates the conditions for both disorders to occur.

The majority of the children who stuttered committed several articulation and language errors during the complex tongue twister task. Perhaps a relationship between language and phonology exists that supersedes a phonology-stuttering relationship, but results in disfluencies that may be secondary to breakdowns within the connection. While there is a wealth of information on stuttering and phonology, much less is known about stuttering with a concomitant language disorder because such cases tend to be discarded during the research process (Bernstein Ratner, 1995). Nonetheless, some research that has looked at language abilities of children who stutter indicates that greater differences in language exist and that overall language proficiency is slightly reduced (Anderson & Conture, 2000; Ryan, 1992). Melnick and Conture (2000) also concluded

that although utterance length and grammatical complexity may result in increased disfluencies, they do not influence speech errors as once thought. Wolk (1998) discussed several perspectives of stuttering and disordered language including an underlying variable that contributes to deficiencies in both. If language is too complex for the speaker's capabilities, it can result in a motoric breakdown, with a negative impact on both phonology and fluency. In the current study, however, the children who stuttered and the normally fluent children produced similar amounts of language, articulation, and combined errors on the tongue twister tasks (means were 5.27 and 5.0 for articulation errors; 2.64 and 2.90 for language errors; and 5.36 and 4.60 for a combination of both types of errors). The Covert Repair Hypothesis suggested that if participants experienced difficulties with phonetic encoding, the participants may attempt to fix errors prior to production which may lead to disfluencies rather than phonological errors. The current study did not measure the amount of disfluencies produced during the difficult phonological tasks.

Limitations

A major weakness of the current study was the absence of any data regarding the phonological abilities of the participants prior to the study. Through watching conversational speech samples and the actual measures themselves, it was noted that four children exhibited consistent articulation errors. Since both groups of children had a mean age of approximately 10 years (10;2 for children who stuttered, 10;4 for normally fluent children), any children with articulation disorders may have received several years of speech therapy by the time they participated in the study. It is not known if any of the children had actually received speech therapy for articulation or phonological disorders.

Furthermore, no articulation tests were given in the current study, and no scores from any tests administered in the past were available to the author. Clearly, the presence of an articulation/phonological disorder would have been a factor in how that participant scored. In addition, research by Lewis and Freebairn (1992) has shown that when taxed with difficult phonological tasks such as the multisyllabic word list, speech error phrases, and tongue twisters, older children with a history of a phonological disorder can exhibit residual phonological errors. Perhaps a larger group of subjects would have negated any variables that could have influenced one group more than the other. Inclusion criteria that would have exempted children with articulation errors from participating in the study should also have been employed.

Another weakness of the study is the possibility of increased accuracy on the measures due to imitation. While it is clinically reported that stutterers can fluently imitate a model within the first few seconds of hearing it, little is known about whether the same holds true for those repeating difficult phonology. The complexity of the multisyllabic words, while required to make the task phonologically challenging, may also be a weakness in that the vocabulary may be too advance for the participants' age level. It was observed during the tasks that several of the participants reacted to some of the words in the model by looking confused, as though the words were novel to them.

Future Research

Future studies should consist of a larger number of participants to see if the results of the current study can be substantiated. More information needs to be gathered on the history of phonological disorders from each participant as well as socioeconomic

status. Perhaps studies should also include language as a measure in addition to phonology.

The current measure of challenging phonological tasks could be informative for future research and analyses. Future study into this topic should also include analysis of the position of words in which errors were made to see if any trend exists, as well as possible contributing factors to such a trend. Research should also examine how children who stutter perform under stress from both difficult linguistic and phonological tasks as well as time pressure. This would help evaluate the Dyssynchronous Syllable Frames and Segment Content Model proposed by Perkins, et al. (1991), which contends that time pressure is part of the phonology-stuttering relationship. Measuring the occurrence of disfluencies during the task would also be informative in relation to the Covert Repair Hypothesis.

Although no significant differences were found between the two groups in this study, the author hopes that this study will contribute to future research that may explore a relationship between phonology and stuttering.

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Appendix A

Multisyllabic Word List

(Catts, 1986).

1. peculiar
2. aluminum
3. emphasis
4. Colorado
5. bicyclist
6. cinnamon
7. associate
8. vacancy
9. establish
10. parallel
11. synthesis
12. calendar
13. susceptible
14. consciousness
15. orchestra
16. vulnerable
17. mobilize
18. symphony
19. regularly
20. exclamation
21. statistics
22. syllable
23. philosophy
24. animal
25. substantial
26. sympathize
27. specific
28. enemy
29. municipal
30. catalog
31. suspicious
32. terminal
33. governor
34. skeptical
35. fire extinguisher
36. hemisphere
37. fudgesicle
38. Nicaragua
39. permanent
40. consequence
41. pistachio
42. particularly
43. statistician
44. pneumonia
45. physicist
46. navigator
47. especially
48. Episcopal Church
49. chivalry
50. enthusiasm
51. specify

Appendix B

Speech Error Phrases

(H. Catts, 1986)

1. Tow boat
2. Toy boat
3. Three small crabs
4. Quiet crabs claws
5. Cheap car
6. Blue brush
7. He sews
8. Quite right
9. Snow slope
10. Weak smile
11. Black broom
12. Snow fence
13. Blue star
14. She sews
15. Just right
16. Sea shells
17. Tom wears shoes
18. Big black bread
19. Small wrist band
20. She sells shirts
21. Nine horse flies
22. Mixed biscuits
23. Bright blue beam
24. He makes shirts
25. Big farm house
26. Fine fruit flies
27. Blue plaid pants
28. Waste baskets
29. Sam shines shoes
30. Brand new pants
31. Swiss wrist watch
32. Dark blue hat
33. Cheap shot
34. Weak wrist
35. Small broom
36. Sea gulls

Appendix C

Tongue Twisters

(Haber & Haber, 1982)

Tongue Twisters

1. Barbara burned the brown bread badly.
2. The wild wind whipped Whit from the wharf
3. Nine nimble noblemen nibbled nuts.
4. She sells seashells by the seashore.
5. Francis Forbe's father fries five flounders.
6. Which witches wished wicked wishes?
7. The bootblack brought the black boot back.
8. Five French friars fanned the fainting flea.
9. The Swiss wristwatch strap shop shuts soon.
10. Naughty Nan's knitting knotted nighties

Control Forms

1. Samuel caught the high ball neatly.
2. The good boy took meat from the store.
3. The handsome fisherman baited hooks.
4. He finds stringbeans by the small barn.
5. Mary Wright's uncle cooks red lobsters.
6. Which pilot flew heavy bombers?
7. The salesman brought the new car in?
8. The old ladies saw the running man.

9. The brown bearskin rug man left town.

10. Little Tom's reading sixty novels.

APPENDIX D

Individual Results

Children Who Stuttered	PCC Multisyllabic Words	Percent Correct Multisyllabic Words	Percent Deletion Multisyllabic Words	Percent Substitution Multisyllabic Words	Percent Distortion Multisyllabic Words
A507KP	97.59	86.00	.80	.80	.80
A508MT	91.16	67.00	1.20	4.42	3.21
A509NP	92.91	76.00	3.94	2.76	.39
A511AT	95.18	82.00	.40	4.02	4.42
A515IN	88.76	61.00	5.22	.00	2.01
A531BB	96.85	88.00	1.57	.79	.79
A533JJ	93.28	84.00	5.22	.75	.75
A551RM	91.03	80.00	5.86	2.76	.34
S300	94.49	78.00	3.54	1.57	.39
S301	95.58	82.00	1.20	1.61	1.61
S308	90.88	59.00	2.55	5.11	1.46

Children Who Stuttered	PCC Speech Error Phrases	Percent Correct Speech Error Phrases	Percent Deletion Speech Error Phrases	Percent Substitution Speech Error Phrases	Percent Distortion Speech Error Phrases
A507KP	95.80	86.00	2.94	1.26	.00
A508MT	97.31	92.00	.45	1.79	.45
A509NP	97.84	86.00	.43	1.73	.00
A511AT	94.37	66.00	.43	1.30	3.90
A515IN	93.78	75.00	2.22	3.56	.00
A531BB	94.12	81.00	3.36	2.10	.42
A533JJ	96.94	89.00	.44	2.62	.00
A551RM	94.40	77.00	4.31	1.29	.00
S300	96.90	86.00	1.33	.88	.88
S301	96.90	83.00	2.55	3.83	.43
S308	95.52	78.00	1.35	.45	2.69

Normally Fluent Children	PCC Multisyllabic Words	Percent Correct Multisyllabic Words	Percent Deletion Multisyllabic Words	Percent Substitution Multisyllabic Words	Percent Distortion Multisyllabic Words
A505JK	91.63	86.00	4.18	3.42	.76
A506AW	96.48	92.00	3.13	.39	.00
A514JM	86.35	43.00	4.02	6.43	3.21
A512TP	99.21	96.00	.40	.00	.40
A516JM	84.06	66.00	4.78	8.37	2.79
A518TR	96.88	88.00	2.34	.39	.39
A519J1V	92.42	82.00	3.79	3.03	.76
A520SH	91.57	49.00	.00	2.01	4.42
A548DL	96.39	84.00	.40	2.81	.40
A549LC	93.98	76.00	2.41	2.81	.80

Normally Fluent Children	PCC Speech Error Phrases	Percent Correct Speech Error Phrases	Percent Deletion Speech Error Phrases	Percent Substitution Speech Error Phrases	Percent Distortion Speech Error Phrases
A505JK	96.55	89.00	1.29	1.72	.43
A506AW	99.11	94.00	.00	.45	.45
A514JM	86.52	33.00	3.04	3.48	6.96
A512TP	99.12	94.00	.44	.44	.00
A516JM	95.35	74.00	1.40	1.86	1.40
A518TR	95.67	83.00	.87	3.03	.43
A519J1V	96.68	75.00	1.24	.83	1.24
A520SH	85.15	28.00	2.18	5.24	7.42
A548DL	98.65	94.00	.90	.45	.00
A549LC	97.31	89.00	.90	1.79	.00

Children Who Stuttered	Percent Correct Tongue Twisters	Total Language Errors Tongue Twisters	Total Articulation Errors Tongue Twisters	Total Combination Errors Tongue Twisters
A507KP	50.00	2.00	4.00	4.00
A508MT	40.00	7.00	.00	5.00
A509NP	15.00	5.00	5.00	7.00
A511AT	20.00	3.00	6.00	7.00
A515IN	30.00	.00	5.00	9.00
A531BB	30.00	4.00	5.00	5.00
A533JJ	40.00	3.00	5.00	2.00
A551RM	55.00	.00	3.00	6.00
S300	30.00	3.00	4.00	7.00
S301	30.00	2.00	9.00	3.00
S308	20.00	.00	12.00	4.00

Normally Fluent Children	Percent Correct Tongue Twisters	Total Language Errors Tongue Twisters	Total Articulation Errors Tongue Twisters	Total Combination Errors Tongue Twisters
A505JK	30.00	4.00	5.00	5.00
A506AW	70.00	2.00	4.00	.00
A514JM	10.00	1.00	12.00	5.00
A512TP	70.00	3.00	3.00	.00
A516JM	30.00	7.00	1.00	6.00
A518TR	50.00	2.00	5.00	2.00
A519J1V	30.00	3.00	2.00	9.00
A520SH	.05	2.00	8.00	9.00
A548DL	50.00	3.00	5.00	2.00
A549LC	25.00	2.00	5.00	8.00