Follow-Up of College Students with a History of Developmental Speech Disorders

Christine Buchheit

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Follow-Up of College Students with a History of Developmental Speech Disorders

Christine L. Buchheit

A Thesis
Submitted to the John G. Rangos, Sr.
School of Health Sciences of Duquesne University
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Committee:

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Ravi Nigam, Ph.D.
ABSTRACT

The present study examined 16 college students with a childhood history of an articulation disorder involving isolated “residual” phoneme errors (RE) and 16 control subjects. Subjects were administered an experimental battery designed to tax the phonological system. Measures included conventional and pseudo-word spelling, syllabification, nonsense word repetition, and expository writing. Subjects also responded to questions assessing student adjustment and academic performance. Results revealed that the RE subjects performed comparably to controls on all of the experimental and academic/adjustment measures (p < .05). Two subjects in the RE group were still producing noticeable articulation distortions as adults. One of these subjects had highly favorable outcomes, whereas the other subject performed relatively poorly on several of the experimental and student adjustment measures. These findings suggest that some individuals who make persistent articulation distortion errors as adults may display subtle phonological and or social deficits that should be explored in future research.
ACKNOWLEDGMENTS

As I have reflected upon the past fifteen months, I have come to realize the amount of knowledge that I have gained throughout this experience. However, this thesis would not be possible without the support of those that have provided me with this knowledge. This opportunity has provided me the chance to develop a deeper understanding and fascination of research. Susan Felsenfeld, Ph.D., offered constant support, enthusiasm, and dedication. She is truly a wonderful mentor. I give her my unending gratitude for having the patience to teach the “professional writing” needed for research. I promise that one day I will, indeed, learn this style of writing! In addition, I appreciate the support and guidance that Ravi Nigam, Ph.D., provided when needed.

I have come to discover how very blessed I am to have such a loving family who supports my lofty aspirations. It is because of them, my dreams have become a reality. Much gratitude is given to Ben Butler. His persistent and optimistic nature was just what I needed at times. To all of my friends, I thank you for always listening and contributing to group projects when I could not.

Throughout this research project, I had the opportunity to become acquainted with thirty-four individuals who willingly sacrificed their time to help out a college student. I am very grateful to these individuals who provided me with the understanding and knowledge needed to write this document. I wish all of them the very best.
TABLE OF CONTENTS

Chapter I. Introduction ................................................................. 1
  Subgroups of Children with Speech Production Deficits ................. 1
  Review of Long-term Follow-Up Studies of Children with Developmental Speech Disorders .......................................................... 2
  Statement of the Purpose .......................................................... 6
Chapter II. Methods ................................................................. 8
  Sample .................................................................................. 8
  Methods ............................................................................ 9
  Screening Measures ............................................................ 10
  Test Instruments ................................................................. 10
Chapter III. Results ............................................................... 14
  Gender Differences ............................................................ 14
  Comparison of Residual Errors and Control Students on Experimental Measures .................................................. 14
  Summary ........................................................................... 18
  Comparison of Residual Errors and Control Students on Academic/Social Outcome Measures ............................................. 18
  Summary ........................................................................... 20
  Case Studies of Two Subjects Who Maintained Speech Errors into Adulthood .......................................................... 21
  Correlations Across Experimental Measures .................................. 24
Chapter IV. Discussion ............................................................ 26
  Long-term outcomes of individuals who received therapy for residual articulation errors as children ........................................ 26
  Residual errors versus multiple errors subjects ................................ 28
  Does it matter if residual distortion errors are maintained? ............ 29
  Limitations of Present Study ................................................... 31
References .................................................................................. 32
Appendix A ............................................................................. 34
Appendix B ............................................................................. 38
Appendix C ............................................................................. 42
Appendix D ............................................................................. 44
Appendix E ............................................................................. 46
Appendix F ............................................................................. 48
Appendix G ............................................................................. 51
Appendix H ............................................................................. 54
Appendix I ............................................................................. 57
Appendix J ............................................................................. 60
Appendix K ............................................................................. 63
Appendix L ............................................................................. 65
Appendix M ............................................................................. 67
Appendix N ............................................................................. 69
Appendix O ............................................................................. 73
Appendix P ............................................................................. 76
LIST OF TABLES AND FIGURES

Table
1  Mean Raw Scores and Standard Deviations for Experimental Measures……………17
2  Significance Levels of Each Subtest for Residual Errors and Control Subjects……..18
3  Significance Levels of Academic/Social Outcomes Measures for Residual Errors and Control Students……………………………………………………………………21
4  Pearson Correlations for the Four Phonologically Taxing Measures for all Subjects…..25

Figure
1  Scatter Plot of RE Subject Scores for the Conventional Spelling Test………………23
2  Scatter Plot of RE Subject Scores for the Pseudo-word Spelling Test…………….23
3  Scatter Plot of RE Subject Scores for the Nonsense Word Repetition Test……………24
Chapter I. Introduction

Subgroups of Children with Speech Production Deficits

Developmental speech delays (DSD) are common among children who present to speech clinics. The prevalence rate for phonological disorders among 3 to 11-year old children is estimated to be about 7.5%; of these affected cases, 5% are considered articulation impaired, with the remaining 2.5% diagnosed with a more severe phonological disorder (Shriberg & Kwiatkowski, 1994). These speech production problems are idiopathic; that is, they cannot be directly attributed to causal agents such as hearing loss, neurological impairment, mental retardation, structural anomalies, or severe emotional disorder.

At least two subgroups of DSD have been identified in the literature. One subgroup, the larger of the two, consists of children who appear to have a pure articulation disorder. These errors, typically known as “residual errors,” have either an organic, structural, or neurological origin, in which no identifiable pattern could be found (Shriberg, 1997; Pena-Brooks & Hedge, 2000). Children in the articulation subgroup maintain errors on a small set of commonly misarticulated speech sounds (e.g., /r/, /l/, or /s/) beyond the time when most of their peers have mastered these phonemes. The mild to moderate distortions of an articulation disorder will change the phonetic properties of a sound, but will not alter the meaning of the word (Pena-Brooks & Hedge, 2000). In contrast, children in the phonological disorder subgroup, otherwise known as “speech delay,” display speech that is characterized by multiple omission or substitution errors that can often be described using error pattern categories (e.g., substituting all fricative sounds with stop consonants). These phonological errors may result in a breakdown of phonemic contrasts which in turn, modifies the meaning of a word (Pena-Brooks & Hedge, 2000). These children ordinarily have cognitive-linguistic, learning and other special educational needs associated with their phonological disorder (Shriberg, 1997).
Interestingly, the prognosis for speech normalization (the elimination of surface misarticulations) is generally good for both disorder subgroups, although the *phonological disorder* subgroup may require more treatment time. What is becoming of increasing scientific interest, however, is the possibility that measurable residual effects of a childhood DSD may persist into adulthood, particularly for children who initially presented with a *phonological disorder*.

**Review of Long-term Follow-Up Studies of Children with Developmental Speech Disorders**

A small number of studies have been performed to identify the long-term outcomes of children with a history of moderate to severe phonological disorders (i.e., with *speech delay*) (Felsenfeld, Broen, & McGue, 1992; Felsenfeld, Broen, & McGue, 1994; Lewis & Freebairn, 1992). The results of these studies have provided consistent evidence that, in comparison to controls, children with a history of a moderate to severe *speech delay* tend to experience long-term and adverse consequences in speech, language, and academic performance. Specifically, in adolescence and early adulthood, subjects with *speech delay* were observed to perform more poorly than control subjects on complex speech production tasks (Lewis & Freebairn, 1992), and on various measures of expressive and receptive language (Felsenfeld et al., 1992). In addition, when compared to controls and gender-matched siblings, the children with *speech delay* were noted to have received significantly lower grades, to have required more remedial services, to have completed fewer years of post-secondary education, and to hold unskilled jobs with a higher frequency (Felsenfeld et al., 1994), all of which were interpreted as reflecting outcomes that were mildly to moderately unfavorable.
In contrast, the few studies that have examined children with a history of a residual articulation disorder seemed to have found better outcomes than have been found for subjects with a diagnosis of speech delay. Over the last three decades, there have been three studies in which articulation subjects were contacted in adolescence or adulthood to establish their current functioning. One of the first studies to address this topic was performed by Hall and Tomblin in 1978. In this study, 18 children who were diagnosed as language-impaired (LI) and 18 children who were diagnosed as articulation impaired (AI) were selected as study subjects at a University Clinic when they were approximately six years old. At the time of diagnosis, the AI children scored “below the mean for age” (pg. 230) on a standardized articulation test, with no evidence of language impairment. These subjects and their parents were re-contacted when subjects were between 22 and 23 years of age. A standardized achievement test (The Iowa Test of Educational Development) was administered to all subjects, and the subjects’ parents were asked to complete a questionnaire assessing their perception of their child’s present communication status. Results of this study found that the LI subjects performed more poorly than the AI subjects on the achievement test inventory, particularly in reading and quantitative performance. In addition, nine of the parents in the LI group (50%) reported that their child continued to have communication problems, in comparison to only one parent in the AI group (5%). These results were interpreted as suggesting that children with a history of language impairment are at greater risk for subsequent academic problems than are subjects with a history of pure articulation disorder. In addition, although all subjects were reported by parents to have completed high school, subjects with articulation impairment only were more likely to pursue post-secondary education than were subjects with language impairment.
Johnson et al. (1999) conducted a 14-year prospective, longitudinal study of 114 children with speech-language impairments (S/L) and 128 age-matched, typically developing peers, at ages 5, 12, and 19. Of the 114 S/L children, 39 (27.5%) had speech impairments only, 62 (43.6%) had language impairments only, and 41 (28.9%) had both speech and language impairments. Measures were used to test each subject’s communicative, cognitive, academic, behavioral, and psychiatric abilities. Results showed that the speech-impaired subgroup in adulthood demonstrated subtle, residual speech deficits, particularly minor phonetic distortions, “…but showed no long-term deficits in language, cognitive, and academic performance relative to peers without early communication impairments” (p. 755). However, subjects with childhood language impairments still exhibited insufficient language, cognitive, and academic achievements compared to controls. As has prior research comparing children with pure speech versus language impairments, results of this study found better long-term outcomes for those with pure speech impairments.

King, Jones, and Lasky (1982) performed the only study to date that has obtained follow-up information about children with articulation versus phonological impairments. In this retrospective study, the investigators contacted the parents of 50 subjects between 13 and 20 years of age who had been diagnosed as communicatively impaired when they were between the ages of 3 and 5 years. Subjects were placed into one of five diagnostic categories: 5 subjects with “no speech”, 18 subjects with “language disorder/delayed speech”, 18 subjects with “articulation problems”, 7 subjects with a “combination of language and articulation problems”, and 2 subjects with “articulation and fluency problems”. The two diagnostic categories of most relevance to the present study are the “language disorder/delayed speech
group” whose speech was described as “unintelligible,” and the “articulation” group, whose members were described as displaying “misarticulation of specific phonemes.”

Data were collected through telephone interviews with the subject’s mother that focused on their child’s educational and communicative achievement. Results from this interview showed that 67% of the subjects in the “language disorder/delayed speech” group still had some evidence of “communication problems,” left undefined. By comparison, only 16% of the subjects in the “articulation” group were reported by the parent as having a continuing “communication problem.” In addition, 39% of the subjects in the “language disorder/speech delay” group were reported to have had academic difficulties in two or more subjects (e.g. reading, math, and/or English), in comparison to 5% of the subjects (N=1) in the “articulation disorder” group. Results of this study are particularly important because they suggest that children with “residual errors” (their “articulation group”) display minimal problems in academics and overall communication at follow-up, whereas children with “speech delay” (their “language disorder/speech delay” group) continue to have communication difficulties at a fairly high rate (39%).

Although suggestive, these findings must be interpreted with some caution. The data that were collected were based solely on parental report of present communication functioning, which may not have accurately reflected the subjects’ true speech and language outcomes. In addition, the outcome measures were not sensitive, and would not reflect subtle deficits that may negatively impact educational or occupational performance. In addition, subjects in the “language disorder/speech delay” subgroup were heterogeneous, and included children who had not only expressive phonological disorders, but concomitant language disorders as well.
In summary, results of the follow-up studies performed to date have provided initial support for the hypothesis that adolescents and adults with a history of a speech delay manifest continuing performance deficits. Specifically, these studies have consistently found that, when compared to matched control subjects, individuals with speech delay perform more poorly in academic domains requiring phonological awareness and organization (e.g., reading and spelling), have more difficulty with global language processing and production tasks, and may experience educational and occupational outcomes that are judged to be less favorable. In contrast, there is some evidence in the literature that subjects who have a history of residual articulation disorder experience more favorable outcomes in speech, language, and academics. However, none of these prior studies have performed extensive testing of subjects in the residual errors subgroup when they reached adulthood. It is possible that, although these subjects may have appeared to have “recovered” from their early speech disorder, subtle but important deficits may remerge in contexts where phonological and language abilities are heavily taxed (e.g., in college).

Statement of the Purpose

The present investigation will examine college students with and without a history of a residual articulation disorder. Specifically, the following research questions will be addressed by this study:

1. Do college students with a history of residual articulation disorder perform more poorly than matched control subjects on experimental speech and academic tasks?

2. Do college students with a history of a residual articulation disorder respond differently than matched control subjects to measures assessing student adjustment, career aspirations, and current academic performance?
3. How highly correlated are the measures that we selected as being “phonologically taxing” for all subjects combined?
Chapter II. Methods

Sample

Thirty-two college students served as subjects for the present study: 16 students with a history of a residual articulation disorder and 16 gender and control students with no reported history of a speech or language disorder. Subjects were recruited from four college campuses in the Pittsburgh area. To identify speech-affected subjects, a flyer was created that sought college students who “had ever received therapy services for a speech impairment while in elementary school.” (See Appendix C) This flyer was posted in various campus locations and was given to selected campus organizations (e.g., fraternities, school newspapers, etc.). Any subject who responded to the solicitations was interviewed by phone. This phone interview asked subjects a series of questions that enabled the investigator to place them into one of three diagnostic categories: phonologically disordered, articulation disordered (“residual errors”), or control. Specifically, in order to be classified as a member of the residual errors subgroup, a potential subject had to indicate that they had received speech therapy in the past for misarticulations of a small number of speech sounds (typically, /s/ or /t/). When questioned about the nature of the misarticulations, subjects usually used terms such as “lisping” and/or responded affirmatively to models of distortion errors produced by the investigator. In addition, subjects who were placed into the residual errors group reported that they had not received therapy services for a co-occurring language disorder, although one subject did indicate that she believed she had had some difficulty acquiring verb tenses. All 16 subjects in the residual errors group had received articulation therapy for at least one year. None of the control subjects reported receiving speech therapy for any reason. (See Appendix E) All subjects were native English speakers. Prior to engaging in testing, potential subjects completed a hearing screening and a brief examination of oral structures and functioning. None of the individuals failed either of these screening tasks.
An attempt was made to verify the prior speech status of all subjects who identified themselves as either speech-affected or normally developing. (See Appendix D) To do this, the investigator obtained written permission from the subject to contact by phone his or her parents (or whomever was appropriate). Once permission was obtained, parents were called by the primary investigator (C.B.) and asked if they would complete a brief interview questionnaire that focused on their child’s prior speech problem. The data obtained from parental report agreed with the subjects’ own report for 100% of the cases. As part of this interview, parents were asked to provide copies of their child’s speech therapy records and reports from preschool or elementary school, if available. Only three parents had prior speech records of their child and in all cases, the records corroborated the parental and student report.

Every effort was made to identify subjects with a history of a phonological disorder in order to compare results to that of the residual error and control groups. Although there was extensive recruitment throughout four local universities, only two subjects were identified as having a history of a phonological disorder. Consequently, these two subjects were excluded from the study because the sample size was insufficient to enable any appropriate interpretations of results.

Methods

All subjects were tested individually by the primary investigator (C.B.). These sessions were performed in a treatment room located in the Duquesne University Speech-Language-Hearing Clinic. All testing was completed in a single session, lasting approximately one hour. Portions of the testing were audio recorded.
**Screening Measures**

A hearing screening was conducted at the frequencies of 1K, 2K, and 4K hertz at 25 dB. Any subject who failed this screening was either to be rescheduled for a follow-up screening or were to be excluded and referred for a complete audiological evaluation. However, all subjects passed this screening. In addition, subjects completed a standard oral-motor evaluation in which items are scored as either pass or fail. All subjects passed this screening. A brief voice screening and conversation sample were audio-recorded to ensure all subjects maintained a normal vocal quality with accurate utilization of suprasegmentals. (See Appendix P)

**Test Instruments**

Participants completed a battery of speech-related and academic tasks, as described below. These tasks were presented in the same order for each subject.

**Fisher-Logemann Sentence Test of Articulation:** Subjects were asked to read aloud 15 sentences. Each sentence contained multiple opportunities to produce two target phonemes (e.g., “Pete’s job was to keep the baby happy”). (See Appendix H) Responses were scored on-line as either correct (no errors on target phonemes) or incorrect (one or more errors on the target phoneme). To ensure accuracy, this test was audio-recorded and reviewed by the primary investigator if any responses were considered ambiguous during on-line scoring. An error was defined as any substitution, omission, or distortion of the target phoneme. Number of errors were totaled and entered into a spreadsheet.

**Conventional and Pseudo-Word Spelling Tests:** Subjects were asked to listen to a series of age-appropriate conventional (32) and nonsense (23) words found in the Woodcock-Johnson-
III Tests of Achievement (Woodcock, Johnson, & Mather, 2001). (See Appendix I and J) Following an auditory model, subjects were instructed to write each real or nonsense word maintaining correct spelling. Auditory models were provided by the examiner for the conventional spelling test and by a standardized pre-recorded audiotape for the pseudo-word-spelling test. Data were collected on-line and subsequently entered into a spreadsheet.

Syllabification Task A & B: For Syllabification Task A, the subjects were provided with a written list of 20 multi-syllabic true words and were asked to identify the number of syllables contained in each word. For Syllabification Task B, the subjects were presented with the same 20 multi-syllabic true words and were asked to identify the primary stress in each word by placing the number “1” directly over the vowel receiving primary stress. (See Appendix K and L) Responses were identified as either correct (accurately determined primary stress and number of syllables) or incorrect (wrongly identified primary stress and number of syllables). Number of errors were totaled and entered into a spreadsheet in tasks A and B separately.

Nonsense Word Repetition Task: Each participant was asked to listen to 16 single-syllable or multi-syllabic stimuli that were delivered via audio cassette, using stimuli prepared by Dollaghan and Campbell (1998). (See Appendix M) The investigator asked the subject to repeat the stimulus item exactly as it was produced by the speaker. A second audiocassette recorded the subject’s responses to ensure scoring accuracy and for purposes of obtaining inter-judge agreement. Each production was then scored as either correct (an exact repetition of the stimulus item) or incorrect. Number of errors were totaled and entered into a spreadsheet.

Expository Writing Task (Mechanics, Composition, Total): Subjects were asked to write an essay describing their particular career aspirations and goals or an extracurricular activity/sport/hobby in which they participated. (See Appendix N) Each participant was given
10 minutes to complete the task. Samples were evaluated with reference to the quality and mechanics of the written language. Specifically, the mechanics of language was divided into punctuation, capitalization, use of active voice, use of complete sentences, subject-verb agreement, spelling, coherence of tense/voice, parallel/awkward structures, and word choice. These nine test items were judged on a scale from 1 to 5, with 1 indicating multiple errors and 5 signifying no errors. Composition scores were based on use of a cohesive theme, a direct focus that was maintained throughout the essay, and appropriate length of output. These four test items were judged on a scale from 1 to 5, with 1 indicating very poor cohesion and 5 signifying excellence. Scores in each subtest were added and then combined to develop a composite score.

Samples were analyzed by a doctoral student from the Department of English who serves as director of the Duquesne Writing Center. This judge was blind to group membership.

**Subject Interview:** Subjects participated in a written interview that was developed for this study. (See Appendix F and G) The subjects were asked questions about their academic history (QPA, major, need for academic support services, academic satisfaction), career aspirations, participation in social or extra-curricular activities, and parental education and occupation. Responses were recorded on-line by the subject. Responses to the interviews were evaluated either descriptively (e.g., major, career aspirations) or quantitatively (QPA, academic satisfaction).

**Student Adjustment Survey:** Subjects completed an inventory assessing student adjustment to college life. (See Appendix O) This survey contained 78 declarative statements that were ranked as often a problem (2), sometimes a problem (1), and hardly ever a problem (0). Seven domains are included in the survey: self-esteem, group interaction and social processes, self-discipline, communication, energy/effort, learning/studying, and attitude towards the
learning environment. After completion of this task, the examiner added the number of points each subject marked for each statement. These scores were then used to compare the groups.
Chapter III. Results

In order to ensure that the underlying assumptions of parametric statistics were not violated, the distributional properties of the scores on the experimental measures from all subjects were examined. Specifically, the raw scores of subjects were displayed in a histogram to see if they formed an approximately normal distribution. Scores from six of the tests--the pseudo-word spelling, syllabification A and B, and the mechanics, composition, and total scores from the expository writing task--were noted to violate the assumption of normality. Therefore, these tests were subsequently analyzed using nonparametric procedures (Mann-Whitney U).

Gender Differences

The collected data were first analyzed by gender to determine if gender differences constituted an important main effect. These results were nonsignificant for all measures except for writing composition ($z = -2.428, p=0.015$), with males performing significantly poorer than females on this measure. Therefore, for subsequent analyses, data from males and females were collapsed within each group.

Comparison of Residual Errors and Control Students on Experimental Measures

Fisher-Logemann Sentence Test of Articulation: This task examined each subject’s ability to correctly produce all targeted phonemes in 15 sentences. All but two subjects (30/32) received a perfect score (109/109), with raw scores reflecting the number correct. The two subjects who did not receive a perfect score exhibited a mild lisp affecting phonemes /s/ and /z/.
The other subject exhibited a mild distortion of /sh/ across all targets and substitution of /f/ on /th/ on one occasion. Both of these subjects were members of the residual error group.

**Conventional Spelling:** This task examined each subject’s ability to correctly spell real words of increasing difficulty as read by the examiner. This subtest contained 32 test items, with raw scores reflecting the number correct. On this task, subjects in the residual errors group received a mean score of 23.63 (SD=2.90) and the control group received a mean score of 23.81 (SD=4.21). These differences were analyzed using a t-test, and results were found to be non-significant (t(30) = -.147, p= .884). This suggests that the two groups performed comparably on this measure of conventional spelling.

**Pseudo-Word Spelling:** This task examined each subject’s ability to correctly spell pseudo-words of increasing difficulty as presented by a standardized pre-recorded audiotape. This subtest contained 23 test items, with raw scores reflecting the number correct. On this task, subjects in the residual errors group received a mean score of 16.88 (SD=3.01) and the control group received a mean score of 17.75 (SD=2.32). These differences were analyzed using a Mann-Whitney U-test, and results were found to be non-significant (z= -.833, p= .405). This suggests that the two groups performed comparably on this measure of pseudo-word spelling.

**Syllabification Task A:** This task examined each subject’s ability to correctly identify the number of syllables contained in a multisyllabic true word. This subtest contained 20 test items, with raw scores reflecting the number correct. On this task, subjects in the residual errors group received a mean score of 19.69 (SD=.60) and the control group received a mean score of 19.31 (SD=1.74). These differences were analyzed using a Mann-Whitney U-test, and
results were found to be non-significant ($z = -.383$, $p = .701$). This suggests that the two groups performed comparably on this measure of syllable identification.

**Syllabification Task B:** This task examined each subject’s ability to correctly identify the primary stress in a multisyllabic true word. This subtest contained 20 test items, with raw scores reflecting the number correct. On this task, subjects in the residual errors group received a mean score of 14.69 (SD=4.47) and the control group received a mean score of 16.25 (SD=4.67). These differences were analyzed using a Mann-Whitney U-test, and results were found to be non-significant ($z = -1.43$, $p = .153$). This suggests that the two groups performed comparably on this measure of lexical stress.

**Nonsense Word Repetition:** This task examined each subject’s ability to repeat nonsense words of increasing syllabic difficulty presented via a standardized pre-recorded audiotape. This subtest contained 16 test items, with raw scores reflecting the number correct. On this task, subjects in the residual errors group received a mean score of 11.81 (SD=2.51) and the control group received a mean score of 13.19 (SD=1.28). These differences were analyzed using a $t$-test, and results were found to be non-significant, although significance was approached ($t(30) = -1.954$, $p = .063$).

**Expository Writing - Mechanics:** This task examined each subject’s ability to write using correct syntax, spelling, and word choice. This subtest contained nine test items judged on a scale from 1 to 5, with 1 indicating multiple errors and 5 signifying no errors (e.g. higher scale scores reflected better performance). Raw scores reflected the summed scale values. On this task, subjects in the residual errors group received a mean score of 41.63 (SD=1.89) and the control group received a mean score of 39.69 (SD=5.97). These differences were analyzed
using a Mann-Whitney U-test, and results were found to be non-significant ($z = -.796, p = .426$). This suggests that the two groups performed comparably on this measure of writing mechanics.

**Expository Writing - Composition:** This task examined each subject’s ability to write using appropriate cohesion throughout an essay. This subtest contained four test items judged on a scale from 1 to 5, with 1 indicating very poor cohesion and 5 signifying excellence. Raw scores reflected the summed scale values. On this task, subjects in the *residual errors group* received a mean score of 18.63 ($SD = 1.67$) and the *control group* received a mean score of 18.69 ($SD = 1.49$). These differences were analyzed using a Mann-Whitney U-test, and results were found to be non-significant ($z = - .197, p = .843$).

**Expository Writing - Total:** This task examined each subject’s total writing score which was derived by adding the mechanics and composition scores to develop a combined score. On this task, subjects in the *residual errors group* received a mean score of 60.31 ($SD = 2.57$) and the *control group* received a mean score of 59.69 ($SD = 4.19$). These differences were analyzed using a Mann-Whitney U-test, and results were found to be non-significant ($z = - .038, p = .970$).

The group means and standard deviations of each of the experimental measures are presented in Table 1.

**Table 1. Mean Raw Scores and Standard Deviations for Experimental Measures**

<table>
<thead>
<tr>
<th>Experimental Measures</th>
<th>Residual Errors</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Conventional Spelling</td>
<td>23.63</td>
<td>2.90</td>
</tr>
<tr>
<td>Pseudo-Word Spelling</td>
<td>16.88</td>
<td>3.01</td>
</tr>
<tr>
<td>Syllabification Task A</td>
<td>19.69</td>
<td>.60</td>
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<tr>
<td>Syllabification Task B</td>
<td>14.69</td>
<td>4.47</td>
</tr>
<tr>
<td>Nonsense Word Repetition</td>
<td>11.81</td>
<td>2.51</td>
</tr>
<tr>
<td>Expository Writing – Mechanics</td>
<td>41.63</td>
<td>1.89</td>
</tr>
<tr>
<td>Expository Writing – Composition</td>
<td>18.63</td>
<td>1.67</td>
</tr>
<tr>
<td>Expository Writing – Total</td>
<td>60.31</td>
<td>2.57</td>
</tr>
</tbody>
</table>
Summary

Results of the present investigation demonstrated that the residual errors and control subjects performed comparably on traditional and nontraditional measures that were selected to tax the expressive and representational phonologic system. With the exception of nonsense word repetition, which approached statistical significance, the two groups performed in a highly similar fashion across measures. This comparability is illustrated in Table 2, which displays the p-values for each measure. In all subtests, both groups were noted to generate a similar number of errors.

Table 2. Significance Levels of Each Subtest for Residual Errors and Control Subjects

<table>
<thead>
<tr>
<th>Experimental Measures</th>
<th>Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Spelling</td>
<td>t-test</td>
<td>.884</td>
</tr>
<tr>
<td>Pseudo-Word Spelling</td>
<td>Mann-Whitney U</td>
<td>.405</td>
</tr>
<tr>
<td>Syllabification Task A</td>
<td>Mann-Whitney U</td>
<td>.701</td>
</tr>
<tr>
<td>Syllabification Task B</td>
<td>Mann-Whitney U</td>
<td>.153</td>
</tr>
<tr>
<td>Nonsense Word Repetition</td>
<td>t-test</td>
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</tr>
<tr>
<td>Expository Writing – Mechanics</td>
<td>Mann-Whitney U</td>
<td>.426</td>
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<tr>
<td>Expository Writing – Composition</td>
<td>Mann-Whitney U</td>
<td>.843</td>
</tr>
<tr>
<td>Expository Writing – Total</td>
<td>Mann-Whitney U</td>
<td>.970</td>
</tr>
</tbody>
</table>

Comparison of Residual Errors and Control Students on Academic/Social Outcome Measures

Student Adjustment Survey: This task examined each subject’s adjustment to college life. This inventory contained 78 declarative statements that were ranked as often a problem (2), sometimes a problem (1), and hardly ever a problem (0). Raw scores were determined based on adding the number of points each subject marked for each statement. On this task, subjects in the residual errors group received a mean score of 20.00 (SD=13.90) and the control group received a mean score of 20.94 (SD=13.49). These differences were analyzed using a Mann-Whitney U, and results were found to be non-significant (z= -.226, p= .821).
Quality Point Average: As part of the written interview, subjects were asked to provide their current quality point average (QPA) performance in college. QPA is based on a 4.0 scale, with 4.0 equaling an “A.” Subjects in the residual errors group reported achieving a mean QPA of 3.52 (SD=.392) and the control group reported a mean QPA of 3.64 (SD=.301). These differences were analyzed using a t-test, and results were found to be non-significant (t\((30) = -1.037, p=.308\)).

Credit Hours Per Semester: Subjects were asked to indicate the average number of credit hours completed in a semester at college. The modal number of credit hours reported per semester was 15 hours (8 residual errors and 5 controls) with ranges from 10-18 credit hours. Responses were placed in one of eight categories, and results were analyzed using the Pearson chi-square statistic. Results were found to be non-significant (\(\chi^2(7)= 8.492, p=.291\)). This suggests that the two groups carried approximately the same credit load per semester, on average.

Special Services Received: Subjects were asked to indicate if they ever received special academic support services while attending college. Five subjects in the residual errors group reported that they did receive special services in comparison to six subjects in the control group. The most frequently reported special service was receiving help from The Writing Center (5/11), followed by receiving tutoring for a science or statistics class (4/11). Two subjects reported receiving services, but did not identify the specific service. Responses were placed in one of two categories (yes/no), and were analyzed using the Pearson chi-square statistic. Results were found to be non-significant (\(\chi^2(1) = .139, p=.710\)). This suggests that both groups received comparable number of support services, on average.
**Extracurricular Activities:** Subjects were asked to indicate the number of extracurricular activities they were involved in while attending college. Approximately 63% of the residual errors group and 69% of the control group participated in 2-4 activities. These activities included clubs, sports, social fraternities and sororities, student advisory committees, bands, choir, dance teams, and acting groups. Responses were placed in one of eight categories (number of activities involved in), and were analyzed using the Pearson chi-square statistic. Results were found to be non-significant ($\chi^2(7) = 4.543, p = .716$). This suggests that residual errors and control subjects tended to be involved in the same number of extracurricular activities.

**Volunteer Activities:** Subjects were asked to indicate the number of volunteer activities they have participated in while attending college. The majority of students reported no volunteer involvement, with 10 subjects from residual errors group and 11 subjects from the control group reporting. Subjects that did volunteer their time participated in organizations such as Special Olympics, Campus Ministry, and Duquesne University Volunteers (DUV). Responses were placed in one of three categories (number of volunteer activities reported), and were analyzed using the Pearson chi-square statistic. Results were found to be non-significant ($\chi^2(2) = 3.548, p = .170$).

**Summary**

Results of the present investigation suggest that individuals with a history of developmental residual (articulation) errors experienced similar educational and social outcomes to those students with normal developmental articulation abilities. Specifically, the residual errors group reported comparable grades, carried the same number of credit hours per
semester, and engaged in a comparable number of support services, extracurricular and volunteer activities to that of the control group. When asked to indicate their general satisfaction with their own academic outcomes, all subjects in both groups indicated that they were satisfied. Significance levels for academic and social outcome measures are summarized in Table 3.

Table 3. Significance Levels of Academic/Social Outcomes Measures for Residual Errors and Control Students

<table>
<thead>
<tr>
<th>Academic/Social Outcome</th>
<th>Statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Adjustment Survey</td>
<td>Mann-Whitney U</td>
<td>.821</td>
</tr>
<tr>
<td>QPA</td>
<td>t-test</td>
<td>.308</td>
</tr>
<tr>
<td>Credit Hours</td>
<td>chi-square</td>
<td>.291</td>
</tr>
<tr>
<td>Support Services</td>
<td>chi-square</td>
<td>.710</td>
</tr>
<tr>
<td>Extracurricular Activities</td>
<td>chi-square</td>
<td>.716</td>
</tr>
<tr>
<td>Volunteer Activities</td>
<td>chi-square</td>
<td>.170</td>
</tr>
</tbody>
</table>

Case Studies of Two Subjects Who Maintained Speech Errors into Adulthood

Two subjects in the residual errors subgroup obtained less than perfect scores on the Fisher-Logemann Sentence Test of Articulation measure. To determine if these two subjects performed differently than the remaining subjects in the residual errors subgroup, case studies highlighting the speech history and current performance of these two female subjects were constructed.

Subject #3. Subject #3 demonstrated a mild lisp affecting phonemes /s/ and /z/ in all positions within a word on our articulation test. In conversation, the distortion errors were judged to be noticeable, although the overall severity would be considered mild. She attended four years of speech therapy in elementary school. On all experimental measures, the subject presented within the average range when compared with subjects with a history of a residual articulation
disorder. In addition, the subject reported little difficulty adjusting to college life, as assessed by the Student Adjustment Survey (SAS). In fact, she received one of the lowest scores on the SAS, suggesting that she perceives herself as having excellent adjustment to college. The few problems that were identified on this measure included problems with liking to study, worrying about grades, knowing how to organize time, and not getting enough sleep.

Subject #14. Subject #14 demonstrated a mild to moderate distortion affecting phonemes /s/, /z/, and /sh/ in all positions within a word. On one occasion, the subject produced a substitution of /f/ for /th/ on the articulation test. In conversation, the distortion errors were judged to be noticeable, with the overall severity considered moderate. The subject attended speech therapy for approximately two years in elementary school. On two of the phonologically taxing experimental measures, S14 received the lowest score among the residual errors subjects (RE); on nonsense word repetition, she received a raw score of 8/16, and on pseudoword spelling, she received a score of 8/20. She also received one of the two lowest scores on the conventional spelling task (19/31). In addition, S14 tied for the highest SAS score among all 32 subjects, with high scores indicating poor adjustment to college life. Specific items that were rated as of concern for this subject included: asking to make up work that was not done, wanting others to like her, worrying about her appearance, concerns about being left out of things, not liking to do oral reports, and being afraid of losing her friends.

Figures 1-3 are scatter plots displaying the individual data points for three representative measures in this study- conventional spelling, pseudoword spelling, and nonsense word repetition. Individual subjects are displayed along the abscissa. The ordinate displays the raw score for each measure, and the dissecting line represents the mean score for that measure for the
RE group. The data points for S3 and S14 are highlighted, and clearly illustrate the significant performance difference noted for these two subjects.

Figure 1. Scatter plot of RE subject scores for the conventional spelling test.

Figure 2. Scatter plot of RE subject scores for the pseudoword spelling test.
Correlations Across Experimental Measures

To address our third research question, a correlation matrix was created to examine the relationship across experimental measures for all subjects combined (N=32). These analyses were undertaken to determine if the measures that we selected as being “phonologically taxing” correlated significantly with one another, thereby increasing our confidence that these tasks did assess one common underlying ability. For these analyses, the following measures were entered into the correlation matrix: conventional spelling, nonsense word repetition, syllabification B (assigning lexical stress) and pseudo-word spelling. Results of these analyses demonstrated that these subtests were positively correlated, with correlation values ranging from a low of .155 between conventional spelling and nonsense word repetition to a high of .459 between conventional spelling and pseudo-word spelling. Interestingly, the correlations tended to be higher for several of the comparisons within the control sample. For example, among the controls, the correlation between pseudo-word spelling and conventional spelling
for the *control group* was $r = .655$. For the RE group, the correlation between these two measures, though still positive, was significantly lower ($r = .293$). Similarly, for *controls*, pseudo-word spelling and nonsense word repetition were more strongly associated ($r = .601$) than was the case for the RE subjects ($r = .315$). Because the sample sizes for these analyses were so small ($n = 16$ each), these correlation differences may be unreliable. Alternatively, it is possible that these particular tasks are more “tightly connected” at a cognitive/performance level within the *control group* than is the case for the RE subjects. Additional studies with larger sample sizes would be needed to establish which of these hypotheses is correct. The correlation results for the groups combined are presented in Table 4.

**Table 4. Pearson Correlations for the Four Phonologically Taxing Measures for all Subjects**

<table>
<thead>
<tr>
<th></th>
<th>Conventional spelling</th>
<th>Pseudoword spelling</th>
<th>Assigning lexical stress</th>
<th>Nonsense word repetition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Spelling</td>
<td>1.0</td>
<td>.459**</td>
<td>.398*</td>
<td>.155</td>
</tr>
<tr>
<td>Pseudoword Spelling</td>
<td></td>
<td>1.0</td>
<td>.359*</td>
<td>.417*</td>
</tr>
<tr>
<td>Assigning lexical stress</td>
<td></td>
<td></td>
<td>1.0</td>
<td>.246</td>
</tr>
<tr>
<td>Nonsense word repetition</td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level
Chapter IV. Discussion

Long-term outcomes of individuals who received therapy for residual articulation errors as children

This is the first follow-up study of individuals with a history of a *residual articulation disorder* that has assessed subjects across a range of experimental, academic, and social outcomes measures in young adulthood. Many of our primary findings support and expand upon findings of previous research of articulation-impaired (AI) subjects (Hall & Tomblin, 1978; Johnson et al., 1999; King et al., 1982). These confirmatory results are important because they corroborate prior findings using alternative research methodology. Specifically, the present study directly assessed subjects using a range of performance variables, including measures that examined academic performance (e.g., spelling and essay writing) and those that were designed to tax the phonological system in a more experimental context (e.g., nonword repetition, pseudoword spelling). In addition, the present study was the first to obtain information about the social functioning of students with and without a history of residual articulation errors. Taken together, the results of this study paint a favorable prognostic portrait for this subgroup of previously speech-affected subjects. Unlike the findings for children who have appeared to have recovered from an early language disorder, only to display subtle difficulties when retested in late adolescence (a phenomenon which has been termed “illusory recovery,” see Scarborough & Dobrich, 1990), subjects in the present investigation appeared to function well in a college environment. These results are encouraging for parents and speech-language pathologists who work with this population, since the findings suggest that, once the misarticulations are resolved, affected individuals are not likely, as a group, to later display functionally important negative consequences in early adulthood.
The findings of the present study are in good agreement with those reported by Hall & Tomblin (1978). As in the present study, individuals who had been diagnosed with an articulation impairment (AI) in childhood were evaluated when they were between the ages of 22 and 23 years. That study focused primarily on the academic and educational outcomes of this group, although questions addressing current speech and language functioning were asked of the subjects’ parents. Results of the parent interview revealed that only 1 of the 18 AI subjects in this study was reported to still have a “speech deficit.” This value is similar to that found in the present study; in our investigation 2 of 16 speech-affected subjects continued to display noticeable distortion errors. In terms of their academic performance and achievement, the AI subjects in the Hall and Tomblin (1978) study were found to perform similarly to control subjects on a test of academic achievement, and 16 of them reported that they had completed at least some college.

The findings of the present study are also in general agreement with the 14-year prospective findings reported by Johnson et al. (1999). Their study included a subgroup of 39 subjects who had been identified as having an isolated articulation disorder at age 5. In comparison to a subgroup of affected children who had presented with a language impairment, these investigators found that the subjects with a history of an isolated articulation impairment displayed no long-term negative effects on tasks of language, cognitive, and academic performance. Some of the 39 RE subjects in the Johnson et al. (1999) investigation were reported to still be displaying residual distortion errors that were typically mild in severity, although the precise was unfortunately not specified. In their discussion, however, these researchers pointed out that, although the speech errors produced by their subjects were mild, the subjects still may have experienced negative listener reactions that were socially stigmatizing. This possibility was
not assessed in their study, but was raised as an important area of investigation for future research.

The findings of the present study agree somewhat less with the results reported by King, Jones, and Lasky (1982). Although this investigation did find that subjects aged 13-20 with a history of an isolated articulation impairment had more favorable social, emotional, and academic outcomes than subjects who had both a speech and language disorder, the outcomes of the AI subjects were less favorable than those found in our study. Specifically, King et al. (1982) reported that the parents of 44% (8/18) of the AI subjects reported that their child had experienced difficulties in reading, math, or English in high school. It is possible that the differing assessment methodologies--parent report versus direct subject interview and testing--may at least partially explain the different findings. Specifically, it is possible that parents may have tended to over-estimate the academic difficulties their child was experiencing, perhaps because that child was not as highly-achieving as the parent had hoped they would be (i.e., a B-student might have been perceived as “having difficulty”). Interestingly, the number of late adolescent subjects who were still reported to be displaying articulation distortions (3/18, or 16%) is close to the value reported in the present study (2/16, or 13%), and slightly lower than the persistence rate of 6% reported by Hall and Tomblin (1978).

**Residual errors versus multiple errors subjects**

Initially, one specific aim of the present study was to compare the outcomes of subjects in the *residual errors subgroup* to those who presented with *multiple errors (speech delay)* as children. However, despite, extensive recruitment efforts across four colleges and universities, only two subjects who met our criteria as *speech delayed* were identified. The difficulty
encountered in locating *speech delayed* subjects in our college sample has two possible interpretations: 1) these subjects, although represented in the college population, are less likely to volunteer for a research study involving speech; or 2) very few subjects with a history of *speech delay* are attending post-secondary school. Although the present study cannot provide evidence to distinguish between these possibilities, the latter interpretation is supported by the findings of Felsenfeld, Broen, & McGue (1994). In this study, 24 individuals with a history of a moderate to severe phonological disorder in childhood were re-examined in adulthood, and their outcomes were compared to 28 control subjects with a history of normal speech development. Among other outcome indicators, the investigators obtained information about years of formal education completed by both groups. Results revealed that 43% of the subjects in the control group reported that they had completed at least “some college,” in comparison to 8% of the subjects with a history of speech delay, and none of the speech-delayed subjects had earned a college degree.

**Does it matter if residual distortion errors are maintained?**

Across studies, it appears that between 6% and 16% of individuals who had a residual articulation disorder in childhood will still display noticeable distortion errors in late adolescence and adulthood. In the present study, 2 of 16 subjects in the residual errors group (13%) had persistent speech distortion errors as adults. One of these subjects (S3) performed well (at or above the mean) on all experimental measures, and obtained scores on the SAS that were well within the average range for all subjects. The other subject, however, (S14), although performing adequately in school, received among the lowest scores on several of the experimental measures, particularly those that taxed the phonological system (e.g., pseudo-word spelling, nonsense word
repetition, conventional spelling), and also tied for the highest score of all 32 subjects on the SAS (where high scores indicate less favorable adjustment). Of particular interest is an analysis of the individual SAS items that were endorsed by S14 as problematic. Several of these items involved oral participation or interaction in some form: answering the teacher or making an effort to answer, having problems with language, sharing with others, having others listen to me, saying the wrong things, giving reports before the class, being a member of the group, liking to do oral reports, and speaking up in class.

In the present study, we did not determine whether the areas that were identified by S14 as problematic were directly related to this subject’s recognition that her speech was articulated imperfectly. As noted by Johnson et al., (1999), it is reasonable to hypothesize that adults who continue to produce residual speech errors, even mild ones, will be perceived more negatively than controls in a number of socially impactful areas (e.g., attractiveness, intelligence, leadership abilities, etc.) For some individuals (perhaps for our S14, but not for our S3), measurably unfavorable reactions may develop, particularly among those who may also struggle to compensate for weaker underlying phonological systems. The present findings, though clearly preliminary, suggest that some but not all individuals who continue to produce phonemic distortion errors as adults may be experiencing negative feelings and struggles relating to their speech that they rarely share with others. One interesting area for future research would be to identify several adults who continue to display speech distortions. Using qualitative research methodology, these adults could be interviewed at length to determine if there are common themes that emerge with respect to their feelings about their speech, as well as their social outcomes and experiences. In addition, speech samples collected from these subjects could be presented to various listener groups to determine if the hypothesized social stigmatization for
speakers with residual distortions occurs in “modern-day” (and presumably highly diversity tolerant) audiences.

Limitations of Present Study

It should be emphasized that this study does have limitations, and therefore caution must be exercised in interpreting the findings. Most importantly, it should be emphasized that the subject sample was highly selective in several ways. All subjects were attending college, most of them Duquesne University, and thus we may not have obtained a random sample of RE and control individuals. For the RE group in particular, it is not known if the favorable results that were found in this study would replicate in a young adult sample comprised of individuals who did not attend college. In addition, the demographic composition of our sample was restricted: all subjects were Caucasian and came from home environments that were described as middle or upper-middle class. These factors will also limit the generalizability of the present findings.

Another limitation of this study is that we cannot definitively exclude the possibility that the subjects we selected as having only a residual articulation disorder may have had a more involved speech or language impairment in childhood. Although we attempted to exclude such subjects by questioning both the parent and the subject about the prior speech disorder, it is possible that some of our subjects may have had a co-occurring language or phonological deficit.

To properly control for this potential confound, a prospective study design in which subjects are directly tested and then followed longitudinally is suggested. Finally, although we attempted to make our test battery comprehensive, it is possible that we may have failed to include tasks that would have been more sensitive and would have uncovered “true differences” between our groups. In future studies of RE subjects, it would be useful if some of these subjects and task selection variables could be studied and controlled.
References


Appendix A

Consent Form for Residual Errors Subjects
CONSENT TO PARTICIPATE IN A RESEARCH PROJECT

Title: Follow-up of college students with a history of developmental speech delay

Investigator: Christine Buchheit, B.S., Principal Investigator
Graduate Student in Speech-Language Pathology
Duquesne University
112 Villa Road, St. Marys, PA 15857
(814) 594 – 4341

Advisor: Susan Felsenfeld, Ph.D., CCC-SLP, Co-Investigator
Assistant Professor
Department of Speech-Language Pathology
Duquesne University
Rangos School of Health Sciences
(412) 396 – 4205

SOURCE OF SUPPORT:
This study is being performed as partial fulfillment of the requirements for the Masters degree in Speech-Language Pathology at Duquesne University.

PURPOSE:
I understand that I have been asked to participate in a research project to assess the speech and academic performance of adults who did and did not have a history of pronunciation (articulation or phonological) problems as children. I understand that some of the participants in this study are people with a history of articulation or phonological disorders, and this is why I have been selected. If I choose to participate, I understand that I will be asked to complete a single two to three hour evaluation session at the Duquesne University Speech-Language-Hearing Clinic. During this session, I will be asked to complete an articulation test, a nonsense word repetition test, a syllabification test, and two spelling tests. In addition, I will be asked to generate a writing sample. My hearing and speech-motor systems will be screened to rule out deficits in these areas. I will be asked to respond to questions about my parent’s educational and occupational background, my academic achievement, academic support services I may have received, my career aspirations, and my extra-curricular activities. These responses will not be audio taped. Finally, I will be asked to complete a computer-based questionnaire that will assess my adjustment to college. Portions of the evaluation session will be audio taped. I also understand that the investigator will interview my parents (or other appropriate party) by phone to obtain information about my prior speech difficulties. At that time, my parents will be asked to provide copies of previous speech therapy records to document the occurrence and nature of my earlier speech problems, if such records are available. These are the only requests that will be made of me or my family.
RISKS AND BENEFITS:

The risks with participating in this study are minimal. By participating, I will have contributed to the understanding and knowledge of communication disorders and will be able to observe firsthand one communication research methodology.

COMPENSATION:

There will be no cost associated with participation in this study. Also, no monetary compensation will be provided.

CONFIDENTIALITY:

I understand that any information obtained about me from this research, including my completed data forms, audio tapes, and clinic records will be coded by subject number and will be kept confidential. This information will not be used to influence my current or future academic standing at Duquesne University, and will not be released to anyone without my written consent. Information and audio tapes will be kept in locked file cabinets that will be accessible only to the co-investigators. All written documents, audio tapes, and subject identifiers will be destroyed within five years of the testing date. I understand that my identity will not be revealed in any description or publication of this research. Therefore, I consent to such publication for scientific purposes.

RIGHT TO WITHDRAW:

I understand that I may refuse to participate in this study or withdraw my consent at any time.

SUMMARY OF RESULTS:

A summary of the results of this research will be supplied to me, at no cost, upon my request.

VOLUNTARY CONSENT:

I certify that I have read the above statements, or that Ms. Buchheit or Dr. Felsenfeld have explained all of the above to me and have answered my questions. I understand that any future questions I have about his research can be answered by Ms. Buchheit whom I may call at (814) 594-4341 or Dr. Felsenfeld whom I may call at (412) 396-4205. I understand that should I have any further questions about my participation in this study, I may call Dr. Paul Richer, Chair of the Duquesne University Institutional Review Board (412-396-6326). Also, I understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project.

_________________________  __________________
Subject’s signature        Date
INVESTIGATOR’S CERTIFICATION:

I certify that I have explained to the above individual the nature and purpose, the potential benefits and possible risks associated with participating in this research study, have answered any questions that have been raised, and have witnessed the above signature.

__________________________  ________________________
Investigator’s signature      Date
Appendix B

Consent Form for Control Subjects
CONSENT TO PARTICIPATE IN A RESEARCH PROJECT

Title: Follow-up of college students with a history of developmental speech delay

Investigator: Christine Buchheit, B.S., Principal Investigator
Graduate Student in Speech-Language Pathology
Duquesne University
112 Villa Road, St. Marys, PA 15857
(814) 594 – 4341

Advisor: Susan Felsenfeld, Ph.D., CCC-SLP, Co-Investigator
Assistant Professor
Department of Speech-Language Pathology
Duquesne University
Rangos School of Health Sciences
(412) 396 – 4205

SOURCE OF SUPPORT:

This study is being performed as partial fulfillment of the requirements for the Masters degree in Speech-Language Pathology at Duquesne University.

PURPOSE:

I understand that I have been asked to participate in a research project to assess the speech and academic performance of adults who did and did not have a history of pronunciation (articulation or phonological) problems as children. I understand that some of the participants in this study are control subjects and this is why I have been selected. If I choose to participate, I understand that I will be asked to complete a single two to three hour evaluation session at the Duquesne University Speech-Language-Hearing Clinic. During this session, I will be asked to complete an articulation test, a nonsense word repetition test, a syllabification test, and two spelling tests. In addition, I will be asked to generate a writing sample. My hearing and speech-motor systems will be screened to rule out deficits in these areas. I will be asked to respond to questions about my parent’s educational and occupational background, my academic achievement, academic support services I may have received, my career aspirations, and my extra-curricular activities. These responses will not be audio taped. Finally, I will be asked to complete a computer-based questionnaire that will assess my adjustment to college. Portions of the evaluation session will be audio taped. These are the only requests that will be made of me.
RISKS AND BENEFITS:

The risks with participating in this study are minimal. By participating, I will have contributed to the understanding and knowledge of communication disorders and will be able to observe firsthand one communication research methodology.

COMPENSATION:

There will be no cost associated with participation in this study. Also, no monetary compensation will be provided.

CONFIDENTIALITY:

I understand that any information obtained about me from this research, including my completed data forms, audio tapes, and clinic records will be coded by subject number and will be kept confidential. This information will not be used to influence my current or future academic standing at Duquesne University, and will not be released to anyone without my written consent. Information and audio tapes will be kept in locked file cabinets that will be accessible only to the co-investigators. All written documents, audio tapes, and subject identifiers will be destroyed within five years of the testing date. I understand that my identity will not be revealed in any description or publication of this research. Therefore, I consent to such publication for scientific purposes.

RIGHT TO WITHDRAW:

I understand that I may refuse to participate in this study or withdraw my consent at any time.

SUMMARY OF RESULTS:

A summary of the results of this research will be supplied to me, at no cost, upon my request.

VOLUNTARY CONSENT:

I certify that I have read the above statements, or that Ms. Buchheit or Dr. Felsenfeld have explained all of the above to me and have answered my questions. I understand that any future questions I have about his research can be answered by Ms. Buchheit whom I may call at (814) 594-4341 or Dr. Felsenfeld whom I may call at (412) 396-4205. I understand that should I have any further questions about my participation in this study, I may call Dr. Paul Richer, Chair of the Duquesne University Institutional Review Board (412-396-6326). Also, I understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project.

__________________________  _________________________
Subject’s signature                Date
INVESTIGATOR’S CERTIFICATION:

I certify that I have explained to the above individual the nature and purpose, the potential benefits and possible risks associated with participating in this research study, have answered any questions that have been raised, and have witnessed the above signature.

__________________________     ______________________
Investigator’s signature     Date
Appendix C

Recruitment Flyer
Have you ever received speech therapy?

Are you a college student who received therapy services for a speech impairment while in elementary school? If so, you are eligible to participate in a research study at Duquesne University. Your help is needed. Participation requires only a few hours of your time and refreshments will be provided. E-mail the address or call the number below and be a part of science.
Appendix D

Parent Interview to Verify Prior Speech Problems
Validation Interview for Parents

ID: ___________________
Date: ___________________
Informant: ________________

1. Do you recall if ________ received speech therapy during preschool or grade school?

2. If yes, can you tell me what kinds of speech problems ______ had?

3. How long did ________ attend speech therapy?

4. I am going to read you several statements about possible speech problems. Please indicate for each whether this was or was not a problem you believe ________ had when he/she was younger.
   
   • Trouble pronouncing a few speech sounds correctly (for example a lisp or trouble saying the /r/ or /th/ sounds) ______
   • Trouble pronouncing many speech sounds correctly, to the point where others had difficulty understanding ______
   • Trouble putting the endings onto words, or leaving out sounds within the word (example: “bee” for “beat”, or “moke” for “smoke” ______
   • Trouble putting words into grammatically correct sentences ______
   • Trouble with vocabulary development (could not learn or retrieve words like other children) ______
   • Trouble following directions or understanding basic concepts (e.g., like prepositions or colors or basic categories) ______
   • Stuttering ______

5. Do you have any existing records that would document your child’s therapy goals? These might include reports from speech clinics, old speech IEPs, or samples of speech homework. If these records are available, would you be willing to release copies of these to us for research purposes?
Appendix E

Subject Interview to Verify Prior Speech Problem
Speech History Interview

ID: __________________
Date: _______________
GROUP ASSIGNMENT: ________________

3. Did you receive speech therapy during preschool or grade school?

2. If yes, how long did you attend speech therapy?

3. Can you tell me what kinds of speech problems you had? Do you recall what specific speech goals you were working on?

6. I am going to read you several statements about possible speech problems. Please indicate for each whether this was or was not a problem you believe you had when you were younger.
   - Trouble pronouncing a few speech sounds correctly (for example, having a lisp or having trouble saying the /r/ or /th/ sounds) ____
   - Trouble pronouncing many speech sounds correctly, to the point where others had difficulty understanding you ____
   - Trouble putting the endings onto words, or leaving out sounds within the word (example: “bee” for “beat”, or “moke” for “smoke” ______
   - Trouble putting words into grammatically correct sentences ____
   - Trouble with vocabulary development (could not learn or retrieve words like other children) ______
   - Trouble following directions or understanding basic concepts (e.g., like prepositions or colors or basic categories) ______
   - Stuttering ______

7. Do you have any existing records that would document your therapy goals? These might include reports from speech clinics or old speech IEPs from school. If these records are available, would you be willing to release copies of these to us for research purposes?
Appendix F

Subject Questionnaire
Academic History & Career Goals

1. What is your major?

2. What year in college are you currently enrolled in?

3. How long have you attended college?

4. On average, how many credit hours are you enrolled in per semester?

5. What is your overall QPA?

6. While in college, have you ever sought learning support services? For example, attending The Writing Center, hiring a tutor?

7. Have you received any academic awards or scholarships? If so, what and when?

8. In general, are you satisfied with your college experience at an academic level?

9. What type of job do you hope to have when you graduate?
Social History

1. What extracurricular activities are you involved in? For example, sports, clubs.

2. Are there any volunteer organizations to which you belong? If yes, which organizations do you belong to?
Appendix G

Background Information Questionnaire
**Background Information**

Name: ____________________________________________

Address: __________________________________________

__________________________________________

__________________________________________

Home Phone: (____)____________________

E-mail Address: ___________________________________

Birth Date: ___________________________ Age: ______

Gender: Female_______ Male________

Marital Status: ______________________

Ethnicity: __________________________

In general, are there any medical or other relevant conditions that may affect your current speech?

Have you had a recent hearing screening completed? If so, what were the results?

What is your primary language?

What language(s) did you first learn as a child?

---

**Parent Information** (or other appropriate party)
Highest Level of Education Mother Received:
- Some High School
- High School
- Some College
- Associate’s Degree
- Bachelor’s Degree
- Master’s Degree
- Doctoral Degree
- Other – Please Specify: ___________________________

Highest Level of Education Father Received:
- Some High School
- High School
- Some College
- Associate’s Degree
- Bachelor’s Degree
- Master’s Degree
- Doctoral Degree
- Other – Please Specify: ___________________________

What is your mother’s current occupation?

What is your father’s current occupation?

The investigator may need to interview your parents for research purposes. If necessary, the investigator will inform you before contact is made.

Parents’ Names: __________________________________________________________

Address: ____________________________________________

__________________________________________

__________________________________________

Home Phone: (_____)____________________

Please enter additional information/comments below:

__________________________________________
Appendix H

Fisher-Logemann Test of Articulation
1. Pete’s job was to keep the baby happy.

2. Today Dick told Patty about it.

3. The girls were baking the biggest cake for Mr. Tag.

4. Their brother wouldn’t bathe because he thought a bath would make his toothache worse.

5. In a half day, he repaired five television sets, two telephones, and a very old stove.

6. Suzie sewed zippers on two new dresses at Bessie’s house.

7. She usually rushes to push the garage door closed.

8. George is at the church watching a magic show.
9. We rode with Lucy around the tall tower in her new yellow car.

10. Why haven’t you looked anywhere behind the house or beyond the hill yet?

11. Nancy found some fine hangers among the many things at the sale.

12. Let me keep a little of this wedding cake to eat later.

13. Father asked how much money Tom had saved to buy a bird cage.

14. Ruth caught a cold because she wouldn’t wear her new warm wool coat.

15. I found a huge toy music box outside Roy’s house.
Appendix I

Conventional Spelling Test
Instructions: You will hear a series of words. After each word is said aloud, please write the word using correct spelling.

<table>
<thead>
<tr>
<th>Number Correct (0–59)</th>
</tr>
</thead>
<tbody>
<tr>
<td>52 = unanimous</td>
</tr>
<tr>
<td>53 = bizarre</td>
</tr>
<tr>
<td>54 = acquaintance</td>
</tr>
<tr>
<td>55 = omniscient</td>
</tr>
<tr>
<td>56 = inflammation</td>
</tr>
<tr>
<td>57 = per se</td>
</tr>
<tr>
<td>58 = vacillate</td>
</tr>
<tr>
<td>59 = soliloquy</td>
</tr>
</tbody>
</table>

Score 1, 0
4. line around circle
5. Z
6. D
7. E
8. O, o
9. X, x
10. B, b
11. C, c
12. U, u
13. e
14. g
15. in
16. he
17. six
18. green
19. are
20. was
21. under
22. house
23. rain
24. table
25. when
26. cooked
27. sixteen
28. floor < Subjects Start here.
29. second
30. early
31. rewards
32. plain
33. adventure
34. garage
35. cough
36. beautiful
37. crystal
38. difference
39. saucer
40. scene
41. concrete
42. mansion
43. accept
44. congenial
45. coax
46. carriage
47. syllable
48. knead
49. arrogance
50. disappearance
51. apostrophe

Test 7 Spelling

*AE and GE are estimates of the precise values provided by the software scoring program.

Make a guess.
CONVENTIONAL SPELLING TEST

ID #: __________________  SCORE: ____________

Instructions: You will hear a series of words. After each word is said aloud, please write the word using correct spelling.

1.          18.
2.          19.
3.          20.
4.          21.
5.          22.
6.          23.
7.          24.
8.          25.
10.         27.
11.         28.
12.         29.
13.         30.
14.         31.
15.         
16.         
17.         

59
Appendix J

Pseudo-Word Spelling Test
Test 20  Spelling of Sounds

Instructions: you will hear a series of nonsense words. Please spell each word, as it sounds, after you hear it.

Score 3, 2, 1, 0

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>s</td>
</tr>
<tr>
<td>B</td>
<td>n</td>
</tr>
</tbody>
</table>

1. (1) p
2. (1) t
3. (1) z
4. (1) m
5. (1) r

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>ut</td>
</tr>
<tr>
<td>D</td>
<td>ab</td>
</tr>
</tbody>
</table>

6. (3) g-a-t
7. (3) i-t
8. (3) p-a-g
9. (3) g-l-a-y
10. (3) p-a-sh
11. (2) l-o
12. (3) j-o-n-g
13. (1) splun ted
14. (1) grun ches
15. (1) quib
16. (1) gloun der
17. (1) strie bles
18. (1) top ing
19. (1) scr itch
20. (1) glin ful
21. (1) lidge
22. (1) sten erous
23. (1) bri ff
24. (1) gaw
25. (1) tran ning
26. (1) au to mit ous
27. (1) ket
28. (1) slawn

Number of Points (0-41)

Test 20  Spelling of Sounds

<table>
<thead>
<tr>
<th>Number of Points</th>
<th>AE (Est)</th>
<th>GE (Est)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&lt;4-8</td>
<td>&lt;K,0</td>
</tr>
<tr>
<td>1</td>
<td>4-10</td>
<td>&lt;K,0</td>
</tr>
<tr>
<td>2</td>
<td>5-2</td>
<td>&lt;K,0</td>
</tr>
<tr>
<td>3</td>
<td>5-4</td>
<td>&lt;K,0</td>
</tr>
<tr>
<td>4</td>
<td>5-7</td>
<td>&lt;K,0</td>
</tr>
<tr>
<td>5</td>
<td>5-8</td>
<td>K,1</td>
</tr>
<tr>
<td>6</td>
<td>5-10</td>
<td>K,5</td>
</tr>
<tr>
<td>7</td>
<td>6-0</td>
<td>K,7</td>
</tr>
<tr>
<td>8</td>
<td>6-2</td>
<td>K,9</td>
</tr>
<tr>
<td>9</td>
<td>6-3</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>6-4</td>
<td>1.1</td>
</tr>
<tr>
<td>11</td>
<td>6-6</td>
<td>1.2</td>
</tr>
<tr>
<td>12</td>
<td>6-7</td>
<td>1.3</td>
</tr>
<tr>
<td>13</td>
<td>6-8</td>
<td>1.4</td>
</tr>
<tr>
<td>14</td>
<td>6-10</td>
<td>1.5</td>
</tr>
<tr>
<td>15</td>
<td>6-11</td>
<td>1.6</td>
</tr>
<tr>
<td>16</td>
<td>7-1</td>
<td>1.7</td>
</tr>
<tr>
<td>17</td>
<td>7-3</td>
<td>1.8</td>
</tr>
<tr>
<td>18</td>
<td>7-4</td>
<td>1.9</td>
</tr>
<tr>
<td>19</td>
<td>7-6</td>
<td>2.0</td>
</tr>
<tr>
<td>20</td>
<td>7-8</td>
<td>2.1</td>
</tr>
<tr>
<td>21</td>
<td>7-10</td>
<td>2.2</td>
</tr>
<tr>
<td>22</td>
<td>8-1</td>
<td>2.3</td>
</tr>
<tr>
<td>23</td>
<td>8-4</td>
<td>2.4</td>
</tr>
<tr>
<td>24</td>
<td>8-7</td>
<td>2.5</td>
</tr>
<tr>
<td>25</td>
<td>8-11</td>
<td>2.6</td>
</tr>
<tr>
<td>26</td>
<td>9-5</td>
<td>2.7</td>
</tr>
<tr>
<td>27</td>
<td>9-11</td>
<td>2.8</td>
</tr>
<tr>
<td>28 me r</td>
<td>10-7</td>
<td>2.9</td>
</tr>
<tr>
<td>29</td>
<td>11-4</td>
<td>3.0</td>
</tr>
<tr>
<td>30</td>
<td>12-2</td>
<td>3.1</td>
</tr>
<tr>
<td>31</td>
<td>13-0</td>
<td>3.2</td>
</tr>
<tr>
<td>32</td>
<td>14-0</td>
<td>3.3</td>
</tr>
<tr>
<td>33</td>
<td>15-0</td>
<td>3.4</td>
</tr>
<tr>
<td>34</td>
<td>16-4</td>
<td>3.5</td>
</tr>
<tr>
<td>35</td>
<td>18-1</td>
<td>3.6</td>
</tr>
<tr>
<td>36</td>
<td>21</td>
<td>3.7</td>
</tr>
<tr>
<td>&gt;36</td>
<td>&gt;24</td>
<td>&gt;18.0</td>
</tr>
</tbody>
</table>

*AE and GE are estimates of the precise values provided by the software scoring program.
PEUDO-WORD SPELLING TEST

ID #: __________________

SCORE: ____________

Instructions: You will hear a series of nonsense words. Please spell the words, as it sounds, after you hear each word.

1. 18.
2. 19.
3. 20.
4. 21.
5. 22.
6. 23.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
Appendix K

Syllabification Task A
SYLLABIFICATION TASK – Part A

ID #:____________________   Score:___________________

Instructions: For each of the following words, identify the number of syllables contained in each word. Write the number of syllables in the space next to each word.

Examples: Interpret ____________

Travel ____________

Document ________

Dinosaur ____________    Apostrophe ____________

Wyoming ____________    Argentina _____________

Satisfy ____________    Religion ____________

Legislature ________    Ratify ____________

Chicago ____________    Atmosphere __________

Establishment ________    Abound ____________

Furniture ____________

Absolutely ____________

Analytical ____________

Contaminants ________

Ordinary ____________

Recommended ________

Hypothesis ________

Elementary _________
Appendix L

Syllabification Task B
SYLLABIFICATION TASK – Part B

Instructions: For each of the following words, place the number “1” directly over the vowel in the syllable that receives primary stress.

Examples: In – ter - pret

Tra - vel

Doc- u - ment

Din – o - saur               A – pos – tro - phe
Wy – o - ming               Ar – gen – ti - na
Sa – tis - fy                Re – lig - ion
Leg – is- la - ture           Ra – ti - fy
Chi – ca - go               At – mos - phere
Es –tab- lish - ment          a - bound
Furn - i - ture
Ab – so – lute - ly
An – a – lyt – i - cal
Con – tam – in - ants
Or – din – ar - y
Rec – o – mmend - ed
Hy – poth – e - sis
El – e – men – ta - ry
Appendix M

Nonsense Word Repetition Task
NONSENSE WORD REPETITION TASK

ID #: ________________________

SCORE: ______________

Instructions: You will hear 16 nonsense words on a audio player. After each word is said, repeat the word back to the investigator.

1. /naib/
2. /vop/
3. /tارد3/
4. /di:f/
5. /tev αk/
6. /tʃ ovæg/
7. /vætʃaiəp/
8. /næ:tævʃf/
9. /tʃɪnʃtævʃb/
10. /nætʃoveb/
11. /dʒ i: dævæb/
12. /tevʃ i:tʃ ʌɪg/
13. /vetæ tʃ ʌidʒp/
14. /dʒ ʌvɒnʃ ɪgʃ/
15. /nætʃ i:tævʃub/
16. /tʃ ʌvʃ inaiɡ/
Appendix N

Expository Writing Task
EXPOSITORY WRITING TASK

ID #:______________________  SCORE:________________

Instructions: In the following space, write an essay about your career aspirations and goals. You will have 10 minutes to complete this essay.
EXPOSITORY WRITING TASK

ID #:______________________  SCORE:________________

Instructions: In the following space, write an essay describing an extracurricular activity/sport/hobby in which you participate in. You will have 10 minutes to complete this essay.
### Expository Writing – Data Sheet

#### Mechanics (45)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple Errors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Some Errors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>No Errors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Punctuation:**
  - 1 2 3 4 5

- **Capitalization:**
  - 1 2 3 4 5

- **Complete Sentences:**
  - 1 2 3 4 5

- **Use of Active Voice:**
  - 1 2 3 4 5

- **Subject-Verb Agreement:**
  - 1 2 3 4 5

- **Spelling:**
  - 1 2 3 4 5

- **Coherence – Tense/Voice:**
  - 1 2 3 4 5

- **Coherence – Parallel/Awkward Structures:**
  - 1 2 3 4 5

- **Word Choice:**
  - 1 2 3 4 5

#### Composition (20)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very Poor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Excellent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Use of Cohesive Theme:**
  - 1 2 3 4 5

- **Focus – Addressed Question Asked:**
  - 1 2 3 4 5

- **Maintained Focus Throughout Essay:**
  - 1 2 3 4 5

- **Length of Output (in terms of being appropriate):**
  - 1 2 3 4 5
  - _______too long _______too short

### Comments:

- **Comments:**
  - 

---

72
Appendix O

Student Adjustment Survey
Use the following key to mark your answers.

<table>
<thead>
<tr>
<th>(A) OFTEN A PROBLEM</th>
<th>(B) SOMETIMES A PROBLEM</th>
<th>(C) HARDLY EVER A PROBLEM</th>
</tr>
</thead>
</table>

1. Paying attention in class.
2. Answering the teacher or making an effort to answer.
3. Liking to study.
4. Asking to make up work that was not done.
5. Knowing what the teacher expects of me.
6. Being restless in class.
7. Obeying rules or teacher suggestions.
8. Respecting the ideas of others.
9. Wanting others to like me.
10. Having problems taking tests.

11. Having problems with reading.
12. Worrying about how I look.
13. Having problems with mathematics.
14. Getting along with my teacher.
15. Having problems with language.
16. Finding a part-time job.
17. Knowing how to study better.
18. Worrying about my grades.

21. Working well alone.
22. Being afraid of teachers.
23. Being teased.
24. Being afraid of other people.
25. Picking on other people.
26. Being afraid of losing my self control.
27. Taking turns with others.
28. Knowing what things I ought to do next.
29. Completing my work when bothered by others.
30. Being unable to do things as well as others.

31. Not playing games very well.
32. Knowing how to organize time.
33. Working by myself.
34. Being afraid of making mistakes.
35. Knowing how to make others like me.
36. Being afraid of groups.
37. Helping others who have problems.
38. Doing my homework.
39. Knowing how to finish an assignment.
40. Knowing where to go for answers to problems.
Use the following key to mark your answers.

<table>
<thead>
<tr>
<th>(A) OFTEN A PROBLEM</th>
<th>(B) SOMETIMES A PROBLEM</th>
<th>(C) HARDLY EVER A PROBLEM</th>
</tr>
</thead>
</table>

41. Taking turns in group activities.
42. Smiling at others.
43. Sharing with others.
44. Having others listen to me.
45. Being left out of things.
46. Following instructions.
47. Working on my own.
48. Spending enough time studying.
49. Thinking before I act.
50. Talking too much in class.

51. Disturbing others.
52. Saying the wrong things.
53. Doing the wrong things.
54. Giving reports before the class.
55. Being a member of the group.
56. Doing my share of work in a group.
57. Joining in group work.
58. Being chosen for an activity by others.
59. Being restless in school.
60. Feeling tired.

61. Being picked on by others.
62. Being able to complete my school work.
63. Being able to share with others.
64. Liking to do oral reports.
65. Speaking up in class.
66. Participating while in a group activity.
67. Being afraid of tests.
68. Getting by rather than doing well in school.
69. Not getting enough sleep.
70. Feeling weak.

71. Being unable to try harder.
72. Doing as well in school as I should.
73. Knowing what other people expect me to do.
74. Being afraid of losing my friends.
75. Listening to others.
76. Making suggestions to others.
77. Feeling I can't do things well.
78. Feeling unhappy about myself.
Appendix P
Elicitation of Spontaneous Conversation/Voice Screening
Elicitation of Spontaneous Conversation

Conversation Starters:
1. What did you think about this research and the various measures used?
2. Tell me about the classes you are taking this semester.

Voice Screening:

<table>
<thead>
<tr>
<th>Voice Parameters</th>
<th>-</th>
<th>N</th>
<th>+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>Too Low</td>
<td>Normal</td>
<td>Too High</td>
</tr>
<tr>
<td>Loudness</td>
<td>Inadequate</td>
<td>Normal</td>
<td>Too Loud</td>
</tr>
<tr>
<td>Quality</td>
<td>Hoarse/Breathy</td>
<td>Normal</td>
<td>Tight/Harsh</td>
</tr>
<tr>
<td>Nasal Resonance</td>
<td>Hyponasal</td>
<td>Normal</td>
<td>Hypernasal</td>
</tr>
<tr>
<td>Oral Resonance</td>
<td>Excessive posterior tongue carriage resulting in inadequate oral resonance</td>
<td>Normal</td>
<td>Excessive front-of-the-mouth tongue resulting in “thin” or “babyish” quality</td>
</tr>
</tbody>
</table>


Prosody:
- Normal
- Prolonged sound production
- Excessive Stressing
- Atypical Stressing
- Other: __________

Speaking Rate:
- Appropriate
- Excessively Fast
- Excessively Slow
- Other: __________

Fluency:
- Typical
- Atypical
- Other: __________

Comments: ______________________________________________________________
________________________________________________________________________