Speech and Motor Speech Measures and Reference Data

for the Speech Disorders Classification System (SDCS)

Technical Report No. 23

Heather L. Mabie

Lawrence D. Shriberg

November, 2017

Phonology Project, Waisman Center
University of Wisconsin-Madison

Preparation of this technical report was supported by research grant DC00496 from the National Institute on Deafness and Other Communication Disorders, National Institutes of Health (Lawrence D. Shriberg, Principal Investigator) and in part by a core grant to the Waisman Center from the National Institute of Child Health and Human Development (P30 HD03352).

TABLE OF CONTENTS

Part I. Background and Measures 5

The Phonology Project 5

Phonology Project Technical Reports 5

The Speech Disorders Classification System (SDCS) 6

Reference Databases 10

Standardization Criteria 15

Abbreviations 16

Part II. Speech Competence Measures and Summaries 18

Percentage Consonants Correct (PCC) 18

Sample PEPPER Output 18
Rationale and Description 18
Reference Data 21
Idiopathic Speech Delay 22

Intelligibility Index (II) and Ordinal Intelligibility Index (OII) 23

Sample PEPPER Output 23
Rationale and Description 23
Ordinal Intelligibility Index Findings 23
Reference Data 26
II: Idiopathic Speech Delay 27
OII: Typical Speakers 28
OII: Idiopathic Speech Delay 30

Prosody-Voice Screening Profile (PVSP) 31

Sample PEPPER Output 31
Rationale and Description 31
Reference Data 34

Speech Competence Index (SCI) 34

Sample PEPPER Output 34
Rationale and Description 34

Reference Data 39
Typical Speakers 40

Syllable Repetition Task (SRT) 70

Sample PEPPER Output 70
Rationale and Description 70
Reference Data 70
Typical Speakers 71
Idiopathic Speech Delay 78

Competence Measures Summary (CMS) 80

Sample PEPPER Output 80
Rationale and Description 80
Reference Data 83

Part III. Motor Speech Classification Measures and Summaries 159

Speech Motor Delay (SMD) Measure:
The Precision-Stability Index (PSI) 159

Sample PEPPER Output 159
Rationale and Description 159
Reference Data 166
Typical Speakers 167
Idiopathic Speech Delay 197

Childhood Dysarthria (CD) Measure:
The Dysarthria Index (DI) & Dysarthria Subtypes Indices (DSI) 203

Sample PEPPER Output 203
Rationale and Description 203
Reference Data 212
DI: Typical Speakers 213
DSI Ataxia: Typical Speakers 233
DSI Spastic: Typical Speakers 253
DSI Hyperkinetic: Typical Speakers 273
DSI Hypokinetic: Typical Speakers 293
DSI Flaccid: Typical Speakers 303
DI: Idiopathic Speech Delay 313

Childhood Apraxia of Speech (CAS) Measure:
The Pause Marker (PM) and Pause Marker Index (PMI) 317

Sample PEPPER Output 317

Rationale and Description....320
Reference Data....321
Typical Speakers....322

Speech Disorders Classification System Summary (SDCSS)....324

Sample PEPPER Output....324
Rationale and Description....324
Reference Data....327

References....328

PART I. BACKGROUND AND MEASURES

The Phonology Project

The Phonology Project is a research program in Speech Sound Disorders (SSD) of known and unknown origin. The primary goal of the Phonology Project is to identify risk factors and develop diagnostic measures and behavioral (speech-prosody-voice) classification markers for five types of speech disorders and four types of motor speech disorders. Each of the nine speech and motor speech disorders can occur in idiopathic contexts (Idiopathic Speech Sound Disorders; ISSD) or in the context of Complex Neurodevelopmental Disorders (CND). The primary conceptual framework for the Phonology Project is a four-level framework termed the Speech Disorders Classification System (SDCS). All data reduction and analyses of SDCS measures and analytics are completed in a software environment termed PEPPER: Programs to Examine Phonetic and Phonologic Evaluation Records (PEPPER, 2018). PEPPER is scheduled to be made freely available for download in 2018.

Phonology Project Technical Reports

Phonology Project Technical Reports provide technical information and reference data on measures and analyses available in the PEPPER software suite that are part of the Speech Disorders Classification System (SDCS) described in the next section. As is customary in these reports, information in the present report is presented without interpretive comment. Constraints on the internal and external validity of all information include the possibility of sampling errors due to limitations in the number and diversity of participants, and limitations in research design and statistical methods. We invite questions and correspondence on any aspect of the information in this report that may be helpful to researchers' research and clinical projects.

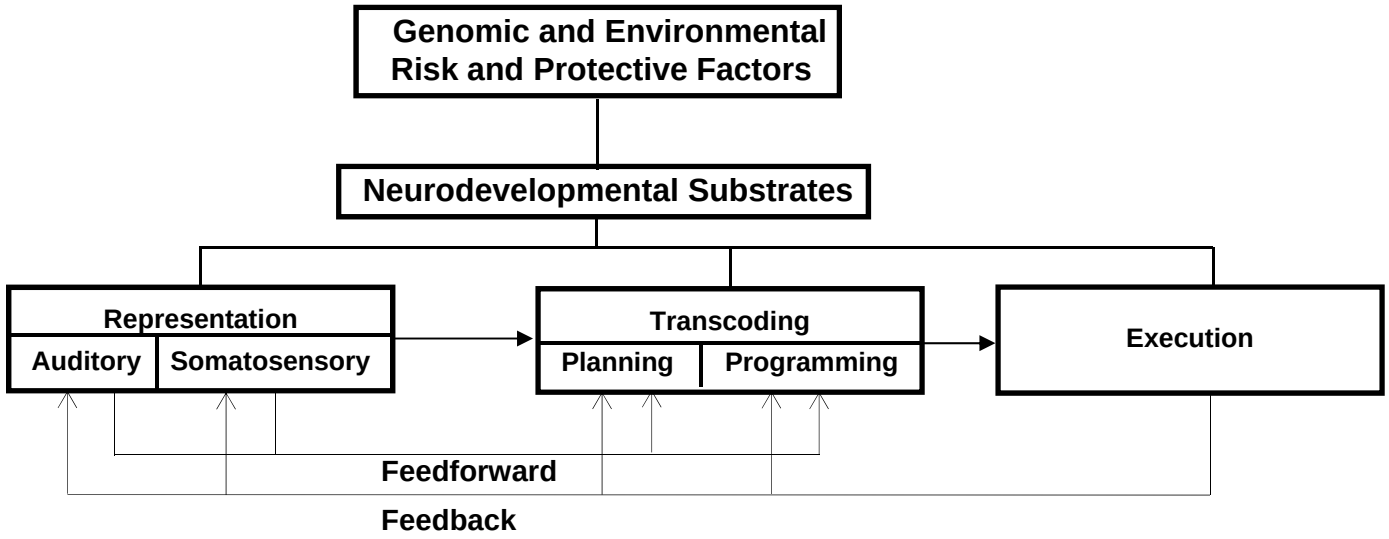
The Speech Disorders Classification System (SDCS)

Figure 1 is a graphic description of the finalized version of the SDCS, the conceptual framework for the research and clinical goals of the Phonology Project. In addition to preliminary versions of the SDCS in the 1980s, papers that include revisions and extensions of the SDCS and citations to other developmental SDCS research include Shriberg (1993, 1994, 2010); Shriberg, Austin, Lewis, McSweeny, and Wilson (1997); Shriberg et al. (2010); and Shriberg, Strand, and Mabie (2017). A number of Phonology Project technical reports include descriptions of methods and measures using the SDCS framework, and additional tabular and graphic reference data and findings. The following brief description of the SDCS in Figure 1 focuses only on terms and concepts relevant for the present technical report.

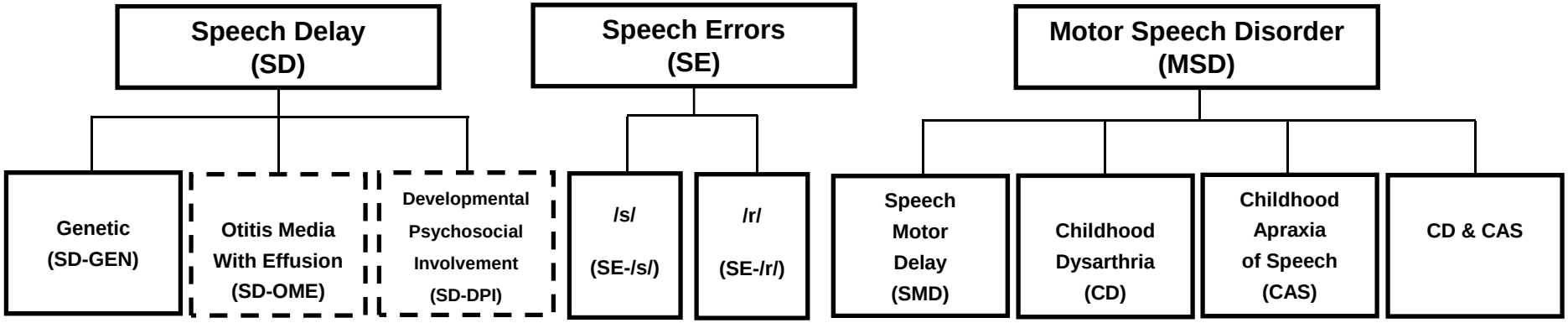
Level III within Figure 1, termed Clinical Typology, depicts the three classes of SSD, including the nine types of speech and motor speech disorders that may or may not be comorbid in a given speaker historically or at a given point in time. The first class of SSD, Speech Delay (SD), posits three risk factors for early and possibly persistent SD —genetic risks, early fluctuant conductive hearing loss, and psychosocial risk factors. The solid line around genetic risks indicates that research progress in speech genetics and other verbal trait disorders since the 1980's supports genomic risk factors for SSD. As indicated by the dashes for SD-GEN in Figure 1, Level IV, Phonology Project research has not developed diagnostic markers with sufficient sensitivity and specificity to identify children with SD-GEN (see Table 1-4 in Shriberg [2010] for promising speech-prosody-voice markers). The dashed borders for the other two risk factors indicate that although research findings in otitis media with effusion and developmental

I. Etiological Processes (Distal Causes)

II. Speech Processes (Proximal Causes)



III. Clinical Typology (Behavioral Phenotypes)



IV. Diagnostic Markers (Criterial Signs of Phenotype)[a]

–	–	–	M1	F_3-F_2	PSI	DI	PM	DI & PM

[a] M1: First Spectral Moment; F_3/F_2: Format 3/Formant 2; PSI: Precision-Stability Index; DI/DSI: Dysarthria Index/Dysarthria Subtype Indices; PM: Pause Marker

psychosocial involvement since the 1980s have provided statistical support for their association with early and persistent SD, research has not yielded sufficient, cross-validated support for SD-OME and SD-DPI as subtypes of SD.

The second class of SSD shown in Figure 1, Speech Errors (SE), includes two subtypes associated with phonetically challenging manner classes in languages of the world: a subtype limited to distortions of sibilants (SD-/s/) and a subtype limited to distortions of rhotic vowels and rhotic consonants (SD-/r/).

The third class of SSD, Motor Speech Disorders (MSD), includes the three remaining subtypes of SSD proposed in more recent research using a finalized version of the SDCS referenced previously: Speech Motor Delay (SMD), Childhood Dysarthria (CD), and Childhood Apraxia of Speech (CAS).

Table 1 includes descriptions of the 15 speech and motor speech classifications in the SDCS, including the five speech and five motor speech classifications above, and five subtype classifications for Childhood Dysarthria. The citations in Table 1 footnotes provide information in addition to the information in Part II and Part III of this technical report. The present technical report includes reference data only for those measures for which reference data has not been reported in prior Phonology Project Technical Reports. For example, reference data is not provided in the present report for the PCC and extensions of the PCC, for which reference data are included in Phonology Project Technical Report No. 3: Lifespan Reference Data for Ten Measures of Articulation Competence Using the Speech Disorders Classification System (SDCS).

Table 1. Speech classifications, Motor Speech classifications, and Dysarthria Subtype classifications in the Speech Disorders Classification System (SDCS). The five Speech classifications are mutually exclusive, as are the five Motor Speech classifications. The five subtypes of Childhood Dysarthria classifications are not mutually exclusive. That is, a speaker can meet percentile criteria for more than one of the five listed dysarthria subtype classifications (i.e., mixed dysarthria). See Appendix for the measures used to classify each motor speech disorder.

Speech Disorders Classification System (SDCS)		Age (yrs;mos) at Assessment	Description	Reference[a]
Classes, Types, and Subtypes	Abbreviation			
Five Speech Classification Types				
Normal(ized) Speech Acquisition	NSA	3-80	Does not meet criteria for any of the four Speech Disorder classifications. Includes children 3-8 years old with only distortion errors	2, 3, 4
Speech Errors	SE	6-8;11	Age-inappropriate speech sound distortions	3, 4
Persistent Speech Errors	PSE	9-80	Age-inappropriate speech sound distortions that persist past 9 years of age	4, 5
Speech Delay	SD	3-8;11	Age-inappropriate speech sound deletions and/or substitutions	3, 4
Persistent Speech Delay	PSD	9-80	Age-inappropriate speech sound deletions and/or substitutions that persist past 9 years of age	3, 4, 5
Five Motor Speech Classification Types				
No Motor Speech Disorder	No MSD	3-80	Does not meet criteria for any of the four Motor Speech Disorders classifications	2, 7
Speech Motor Delay	SMD	3-80	Meets Precision-Stability Index (PSI) criterion for SMD	2, 7
Childhood Dysarthria	CD	3-80	Meets Dysarthria Index (DI) and Dysarthria Subtype Indices (DSI) criteria for CD	2, 7
Childhood Apraxia of Speech	CAS	3-80	Meets Pause Marker (PM) criteria for CAS	6, 7, 8
Childhood Dysarthria & Childhood Apraxia of Speech	CD & CAS	3-80	Meets SDCS criteria for CD & CAS	2, 7
Five Dysarthria Subtypes				
Ataxic		3-80	Cerebellar disorder	1, 2
Spastic		3-80	Upper motor neuron disorder	1, 2
Hyperkinetic		3-80	Basal ganglia disorder; increased movement	1, 2
Hypokinetic		3-80	Basal ganglia disorder; decreased movement	1, 2
Flaccid		3-80	Lower motor neuron disorder	1, 2

[a] 1. Duffy (2013); 2. Mabie and Shriberg (2017); 3. Shriberg (1993); 4. Shriberg, Austin, Lewis, McSweeny, and Wilson (1997); 5. Shriberg et al. (2010); 6. Shriberg et al. (2017a); 7. Shriberg, Strand, and Mabie (2017); 8. Tilkens et al. (2017).

Reference Databases

Typical Speakers. Table 2 is a summary of the number and ages of 200 typically-speaking participants assessed on a two-hour speech-assessment protocol (Potter et al., 2012; Scheer-Cohen et al., 2013). These two Phonology Project Technical Reports include information on the sociodemographic composition of the sample and methods for speech sampling and data reduction using narrow phonetic transcription, prosody-voice coding, and acoustic analyses. They also include descriptive statistics for each age x sex group from 3-80 years. The reference data to follow provide means and standard deviations for each age and gender group for 3-18 year old participants and for each decade and gender group for the 20-80 year old participants. For comparison purposes, the descriptive statistics in Table 2 are provided for the participants from 3-80 years subgrouped into six age x sex groups.

Speakers with Idiopathic Speech Delay. Table 2 also includes a summary of the number and ages of 268 speakers with Idiopathic Speech Delay (ISD). These speakers were participants in a number of studies conducted using samples of participants from studies in Madison, Wisconsin; Pittsburgh, Pennsylvania; Dallas, Texas; Cincinnati, Ohio; Denver, Colorado; and Cleveland, Ohio. Each of the participants were classified as SD at the time of testing using the computer program described in Shriberg et al. (1997; Appendix A). The computer program is described in the following three pages. It is important to underscore that this program does not use z-score criteria, but rather, as described, uses a set of age-based classification rules. The present database of 268 children with Idiopathic Speech Delay includes some of the participants described in prior Phonology Project Technical Reports. More recent classification research suggested the utility of one large database of children who were positive for SD and negative for motor speech disorder as classified using the SDCS measures described

Table 2. Average age (in years) of 200 typically-speaking participants in six age cohorts (Potter et al., 2012; Scheer-Cohen et al., 2013) and 268 participants with Idiopathic Speech Delay in four age groups. The 268 children are 3-7 years of age and are classified as having No Motor Speech Disorder (No MSD).

Typical Speakers						Speakers with Idiopathic Speech Delay				
		Sex					Sex			
Age Group	*n*	Male (*n* = 100)	Female (*n* = 100)	Both (*n* = 200)		Age Group	*n*	Male (*n* = 181)	Female (*n* = 87)	Both (*n* = 268)
3;0-5;11	*n*	15	15	30		3;0-3;11	*n*	27	14	41
	M	4.5	4.5	4.5			*M*	3.2	3.2	3.2
	SD	1.0	0.7	0.9			*SD*	0.2	0.1	0.2
6;0-9;10	*n*	20	20	40		4;0-4;11	*n*	79	44	123
	M	7.8	7.9	7.9			*M*	4.0	4.0	4.0
	SD	1.2	1.4	1.3			*SD*	0.3	0.3	0.3
10;1-12;8	*n*	15	15	30		5;0-5;11	*n*	49	22	71
	M	11.3	11.3	11.3			*M*	4.9	4.9	4.9
	SD	0.9	0.9	0.9			*SD*	0.3	0.3	0.3
13;0-17;10	*n*	25	25	50		6;0-6;11	*n*	26	7	33
	M	15.4	15.4	15.4			*M*	5.9	5.9	5.9
	SD	1.6	1.4	1.5			*SD*	0.3	0.3	0.3
20;6-59;2	*n*	16	16	32						
	M	40.5	39.9	40.2						
	SD	12.8	12.0	12.2						
63;5-76;6	*n*	9	9	18						
	M	70.9	70.6	70.7						
	SD	4.9	4.3	4.5						

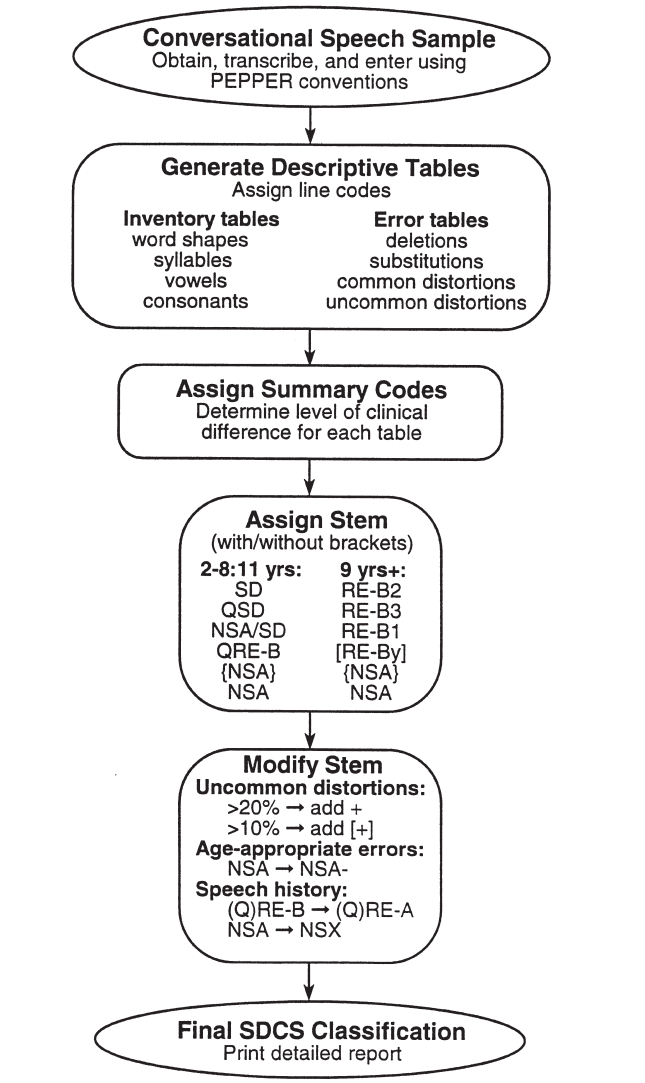
Appendix A: The Speech Disorders Classification System (SDCS).

Colleagues have inquired about technical details of the SDCS program, which will be ported from the VAX environment to a Windows95 PC program. For the interested reader, Figure A1 is a flow chart of the process the SDCS module of PEPPER uses to assign a classification to a conversational speech sample.

Conversational Speech Sample

The program begins with a narrowly transcribed conversational speech sample (see Shriberg, 1993, Appendix, for detailed discussion). The length of the conversational speech sample is important. To address validity and reliability concerns, the SDCS requires at least two tokens in two different words of any error or inventory item to be used in making a classification. As a result, a conversational speech sample rich in different word types yields more items for use in making an SDCS classification. Our lab has used 100 word types (i.e., first-occurrence words that are intelligible and not excluded for other reasons) as a goal for samples to be used for SDCS classification, although this criterion cannot always be met. For this reason, it is important to examine the descriptive tables produced by the SDCS, together with the final classification, to confirm results. The descriptive tables may also be helpful in describing the speech of children who, for reasons discussed in the companion paper (Shriberg, Austin, et al., 1997), cannot provide an adequate conversational speech sample for classification.

Figure A1. Flow chart of the Speech Disorders Classification System (SDCS).



The conversational speech sample is entered into PEPPER using the transcription rules established for other measures, including rules about which words/utterances to disregard, how to handle unintelligible words or parts of words, and other conventions originally described in Shriberg (1986). Whereas other PEPPER analyses (such as the PCC) examine all sounds in a sample, SDCS analysis is selective in the errors that it examines to make a classification, excluding casual word forms, errors that occur only once, word-medial errors, and (most importantly) age-appropriate errors from the classification process. To ensure that casual speech forms are not considered errors, the SDCS consults a table of common words and phrases to be ignored (e.g., variants of "I don't know," "yes," "no," etc.). Errors that occur only once are excluded for reliability concerns, and errors on medial consonants are excluded because there are few reliable developmental data on word-medial consonants.

The SDCS consults several tables in the analysis process to determine whether a sound or word-shape is expected at that age and whether an error is age-appropriate. A detailed discussion of the age-appropriate criteria for normal speech acquisition for ages 2 through 9+ is included in the Appendix of Shriberg, 1993. To maximize sensitivity to some speech problems, a few common and uncommon clinical distortions are considered errors by the SDCS, even when transcribed as nonerrors.

Generate Descriptive Tables

The next step in the SDCS analysis is to generate descriptive tables, including four *inventory tables* (Word Shape Inventory, Syllable Inventory, Vowel Inventory, Consonant Inventory) and four *error tables* (Consonant Deletions, Consonant Substitutions, Common Clinical Distortions, Uncommon Clinical Distortions), which provide item-by-item details about a speaker's inventory of sounds and word shapes and a listing of all errors by type in the sample. For each line in each table, the program provides a code for the speaker's current age (in years), for 1 and 2 years younger, and for 1 year older. To code an individual line in a table, the program consults the appropriate reference tables described above.

Inventory Tables

For the inventory tables, each incorrect and correct occurrence of a sound or word shape is counted for all words and for all different (first-occurrence) words. Only substitution and deletion errors are considered incorrect for the inventories. The Consonant Inventory provides a further breakdown of these counts by initial, medial, and final position, and by singletons and clusters. However, only different word occurrences (in any position, singleton or cluster) are used to determine if the item is *in the inventory* or if it meets *error* criteria. A sound or word shape is determined to be in the inventory if it is produced correctly twice in two different words or produced once correctly without other errors for that sound or word shape. An inventory item meets error criteria if it is produced incorrectly twice (in two different words) and correctly only one or fewer times. An item meets *questionable error* criteria if there is one incorrect production and one or fewer correct productions, or if the sound or word shape is expected to be present at the speaker's age and does not occur in the sample (and is not considered rare).

Error Tables

For the error tables, each deletion, substitution, and distortion (common and uncommon) is listed in the appropriate table. As in the Consonant Inventory, deletions and substitutions are reported by word position and by singleton versus cluster; however, only the initial and final positions are used to determine the line code (i.e., medial errors are disregarded). If more than one substitution type occurs for a consonant (e.g., f/θ and t/θ both occur) the counts for each substitution type appear as separate lines in the Consonant Substitutions table, and the sum of all substitutions for the target sound appear in a single summary line. Only the summary line is used when determining the Substitutions code at the table level.

For 6- to 8-year-old children, substitutions that are perceptually and productively similar to the common clinical distortions (i.e., w/r is similar to derhotacized /r/) are considered only for making a QRE classification and, therefore, are marked differently than other substitution errors. (QRE substitutions are: initial position: w/r, w/l; final position: vowel/r, vowel/l; any position: t/θ, θ/s, ð/z, vowel/ɚ, vowel/ɝ.) A deletion, substitution or distortion meets *error* criteria if it occurs at least twice in two different words and meets *questionable error* criteria if it occurs only once or in only one word. Distortion errors meet *multiple error* criteria if they occur four or more times in four or more different words.

Assign Summary Codes

Next, a summary code is assigned for each of the inventory and error tables. For the inventory tables, a summary code is assigned for the Vowel Inventory, Consonant Inventory, and the combined Word Shape Inventory and Syllable Inventory tables. For the error tables, summary codes are assigned for Deletions, Substitutions, and Common Clinical Distortions, with a separate code assigned for QRE Substitutions. Common clinical distortions are divided into six classes: labialized, dentalized, lateralized, velarized, derhotacized, and epenthetic stop /g/ added to /ŋ/ (i.e., [ŋᵍ]). Each class receives a summary code (as above), and the Common Clinical Distortions summary code is assigned the lowest code for any class. Uncommon Clinical Distortions are considered at a later point in the classification process. As with the line codes, summary codes are assigned for the speaker's current age, 1 and 2 years younger, and 1 year older. Whereas the line codes indicate whether a speaker's productions meet error criteria, the summary codes indicate whether the speaker has a *clinical difference* (CD) in one or more areas of speech production. Criteria for the four levels of clinical difference used to make SDCS classifications are defined in Table A1.

Assign a Stem

After all of the summary codes and the combined codes are assigned, the SDCS consults the classification table that lists the coding criteria for each of the stems and stem/bracket classification categories. Whereas NSA is appropriate for all ages, the remaining classifications are divided into two groups: those appropriate for speakers age 2 to 8 years (NSA, NSA/SD, QSD, SD, QRE) and those appropriate for speakers age 9 years and older (RE-1, RE-2, RE-3). Table A2 lists these classifications with their definitions and coding criteria.

Modify Classification Stems

The last step in the SDCS is to modify the assigned stem/brackets to reflect uncommon distortion errors, age-appropriate errors, and (for NSA and RE classifications) to reflect a speaker's speech history.

Uncommon Clinical Distortions

Because there are few normative data for uncommon clinical distortions, the SDCS does not make classification decisions based on these errors. However, their presence or absence may be important for clinical and/or research questions. To reflect the frequency of occurrence of these errors, a "+" is added to any stem if uncommon clinical distortions occur in more than 20% of words in the sample, and a "[+]" is added if 10–20% of the words have these errors.

Age-Appropriate Errors

For speakers classified as NSA, {NSA}, or NSA/SD, if age-appropriate errors occur a "-" is added to the NSA stem (i.e., NSA-, {NSA-}, NSA-/SD).

Speech History

Finally, the database is examined to determine if the speaker has a history of speech disorders. If the speaker has a previous sample in the database that meets criteria for any of the disorder classifications, or if a database variable indicates a documented history of speech disorder, NSA, QRE, and RE stems are modified to reflect that history. The NSA stem is changed to NSX, where X is the age at which speech normalized (e.g., a child classified as QSD at age 3 and {NSA-} at age 4 would receive a final classification of {NS4-}). The "B" in a QRE-B or RE-B stem is changed to an

Table A1. Criteria for levels of clinical difference (CD) used to make SDCS slassifications.

Level of clinical difference		Criteria	
No.	**Term**	**Inventory Tables**	**Error Tables**
1	Questionable clinical difference	Questionable errors occurred for one or more inventory items.	Questionable errors were found for one or more target consonants.
2	Marginal clinical difference	One sound or word shape meets error criteria.	One target consonant meets error criteria.
3	Clinical difference	Two or more sounds or word shapes meet error criteria.	*Substitutions and Deletions:* Two or three target consonants meet error criteria. *Distortions:* Two or more sounds in at least one class meet error criteria *or* one sound in at least one class meets multiple error criteria.
4	Multiple clinical differences	Not applicable	*Substitutions and Deletions:* Four or more target consonants meet error criteria.

Table A2. Description of and criteria for SDCS classifications.

Eligible ages	Classification	Description	Criteria
All ages	NSA	Normal Speech Acquisition	May include questionable CD.[a] Intelligibility Index (II) > 80%
	{NSA}	Marginal NSA	*All ages*: Marginal CD for Substitutions or Deletions *and/or* CD or marginal CD for any inventory table. *Ages 6–8*: As above *or* marginal CD for Distortions and/or QRE Substitutions
2:0–8:11	NSA/SD	Between NSA and Speech Delay	CD for Vowel Inventory, Deletions, or Substitutions *or* Marginal CD or CD for two of these three tables *or* II between 76% and 80%
2:0–8:11	SD	Speech Delay	Multiple CD for Deletions or Substitutions *or* CD for Vowel Inventory, Deletions, or Substitutions (2 of these 3)
2:0–5:11	QSD	Questionable Speech Delay	Meets criteria for Speech Delay at current age, but does not meet criteria for one year younger
6:0–8:11	QRE	Questionable Residual Errors	CD for QRE Substitutions and/or Distortions
9+	RE-1	Residual Errors 1 - Common Clinical Distortions	CD for Distortions
	RE-2	Residual Errors 2 - Common Clinical Distortions and Imprecise Speech	CD for Distortions *and* Multiple CD for Deletions or Substitutions *or* CD for Vowel Inventory, Deletions, or Substitutions (2 of these 3)
	RE-3	Residual Errors 3 - Imprecise Speech	Multiple CD for Deletions or Substitutions *or* CD for Vowel Inventory, Deletions, or Substitutions (2 of these 3)
	[RE-y], y = 1, 2, or 3	Residual Errors 1, 2, or 3 - with marginal Common Clinical Distortions and/or marginally Imprecise Speech	Marginal CD for Distortions *and/or* marginal CD for Vowel Inventory, Deletions, or Substitutions. Meets other criteria for RE-1, RE-2, or RE-3.

[a] CD: Clinical Difference (see Table A1)

"A" (e.g., QRE-A, RE-A1). If there is no history of speech disorder recorded in the database, the "B" assigned as a default remains in the RE classification (e.g., QRE-B, RE-B1).

The final output of the SDCS program is a multiple page report that includes the inventory tables, error tables, lists of all summary and combined codes, and the SDCS classification. To complete the description of the sample, a panel of all 10 of the measures described in the companion paper (including early, middle, and late subscales where appropriate; Shriberg, Austin, et al., 1997) are printed for the sample being classified and for any earlier or later samples available in the database from the same speaker.

in Part III. As indicated in the table caption, these 268 children are those from the total of 284 children described in Table 2 who were 3; 0 to 6;11 years of age and had No Motor Speech Disorder.

Standardization Criteria

Age and sex groups. Because the numbers of reference samples per age x sex group is limited for the two samples of typical speakers, standardized scores for all items in a measure for participants 3-18 years of age are obtained using the average of the speakers age and sex and the reference data for speakers of the same sex one age younger. For example, the *z*-score on an item in a measure from an 8-year-old female is standardized using reference means and standard deviations computed using the reference data from both the five 8-year-old and the five 7-year-old typically speaking females. For the typical speakers 20-80 years of age, standardized scores for all items in a measure are obtained using the mean and standard deviation of the same sex and age decade. As shown in Table 2, the decades from 20-60 years include four speakers of each sex and the 70-80 year old reference data include five participants of each sex. Last, for the multistate database of 268 participants with ISD (Table 2), the large numbers of participants at ages 3, 4, 5, and 6 years of age allows means and standard deviations to be used for each sex at each year.

Cut-off criteria. Cut-off criteria for SDCS motor speech classifications are described in Part III. Criterion used to code speakers as “0” (within typical range) or “1” (atypical, positive for disorder) are based on the speaker’s *z*-scores for each scoreable item in the measure, which yields total percentage scores for each measure. As described in Part III, low percentage scores on each SDCS measure indicate poorer performance.

Abbreviations

Units and Symbols. The following abbreviations for measurement units and characters are used in the sample measures and summaries and reference data in Parts II and III.

dB = decibel

Hz = Hertz

kHz = kiloHertz

ms = milliseconds

n = count

syll/sec = syllables/sec

u = unitless

% = percentage

* = no data

Measures and Classifications.

CAS = Childhood Apraxia of Speech

CD = Childhood Dysarthria

CD & CAS = Childhood Dysarthria and Childhood Dysarthria of Speech

CMS = Competence Measures Summary

DI = Dysarthria Index

DSI = Dysarthria Subtypes Indices

II = Intelligibility Index

ISD = Idiopathic Speech Delay

No MSD = No Motor Speech Disorder

NSA = Normal(ized) Speech Acquisition

OII = Ordinal Intelligibility Index

PCC = Percentage Consonants Correct

PM = Pause Marker

PMI = Pause Marker Index

PSD = Persistent Speech Delay

PSE = Persistent Speech Errors

PSI = Precision-Stability Index

PVSP = Prosody-Voice Screening Profile

SCI = Speech Competence Index

SD = Speech Delay

SDCS = Speech Disorders Classification System

SDCSS = Speech Disorders Classification System Summary

SE = Speech Errors

SMD = Speech Motor Delay

SRT = Syllable Repetition Task

SSD = Speech Sound Disorders

PART II. SPEECH COMPETENCE MEASURES AND SUMMARIES

Percentage Consonants Correct (PCC)

Sample PEPPER Output

Sample PEPPER Outputs 1 and 2, respectively, are sample outputs for group and individual findings for one of several PEPPER outputs for the Percentage Consonants Correct (PCC). The following section includes rationale and description of these outputs.

Rationale and Description

Shriberg and Kwiatkowski (1982) describes the development of the PCC, a quantitative index of speech competence. In the reference study, 52 clinicians from several states and over 100 naive listeners rated 30 speech-delayed children's "severity of involvement." Judgments about severity of involvement were based on one-minute, audio recorded samples of continuous speech. Analyses indicated that among several child characteristics (age, language, suprasegmentals), percentage of consonants correct was the largest statistically significant correlate of severity ratings.

The PCC is calculated from a continuous, preferably conversational speech sample. The number of consonants correct in the sample is divided by the number of correct plus incorrect consonants multiplied by 100 to yield the PCC. A four-category ordinal scale was suggested as the best fit to the distribution of PCC scores: Mild ($\geq$ 86%), Mild-Moderate (65-85%), Moderate-Severe (50-65%), and Severe (<50%). This approach was extended to an additional 9 measures, including PCC values computed for developmentally early-, middle-, and late-occurring consonants (Shriberg, 1993; Shriberg et al., 1997).

PERCENTAGE CONSONANTS CORRECT (PCC)

Sample PEPPER Output 1

Child __Group__DS_____
Study Identification _DSEW___
DOB _*_____
Age at Sampling Date ___0 mos
Sampling Date _*_____
Sampling Clinician _*_____
Pepfile Entry Date _*_____

Severity Adjective:

PCC	Adjective
≥86%	Mild
66%-85%	Mild-Moderate
50%-65%	Moderate-Severe
≤49%	Severe

Key:

+ Correct

- Incorrect

Consonant		Initial		Medial		Final		Consonants		Percentage Consonants	
Class	Sound	+	-	+	-	+	-	Correct	Total	Occurrence	Correct
Nasals	m	645	23	288	13	441	23	1374	1433	7.15	95.88
	n	413	9	228	86	1529	254	2170	2519	12.56	86.15
	ŋ	0	0	34	7	95	36	129	172	0.86	75.00
Glides	w	611	138	56	11	0	0	667	816	4.07	81.74
	j	374	44	31	17	0	0	405	466	2.32	86.91
Stops	p	375	20	96	8	137	3	608	639	3.19	95.15
	b	474	15	208	10	21	6	703	734	3.66	95.78
	t	616	54	304	119	765	372	1685	2230	11.12	75.56
	d	370	22	166	58	354	125	890	1095	5.46	81.28
	k	466	25	314	45	551	28	1331	1429	7.13	93.14
	g	458	23	74	8	45	9	577	617	3.08	93.52
Fricatives and Affricates	f	314	16	69	12	67	5	450	483	2.41	93.17
	v	22	11	111	14	133	25	266	316	1.58	84.18
	θ	38	19	20	23	82	56	140	238	1.19	58.82
	ð	262	225	19	23	0	0	281	529	2.64	53.12
	s	472	204	215	111	555	239	1242	1796	8.96	69.15
	z	2	2	52	23	509	302	563	890	4.44	63.26
	ʃ	103	40	38	22	20	12	161	235	1.17	68.51
	ʒ	0	0	4	0	0	1	4	5	0.02	80.00
	h	531	44	36	0	0	0	567	611	3.05	92.80
	tʃ	17	26	28	21	36	55	81	183	0.91	44.26
	ʤ	60	39	20	18	12	11	92	160	0.80	57.50
Liquids	l	436	192	148	64	271	236	855	1347	6.72	63.47
	r	262	222	115	125	200	184	577	1108	5.53	52.08
Percent Correct		83.82		76.14		74.61		15818	20051		
								Correct	Total		

Word Coding Summary	N	%
"Words" entered	17112	100.00
"Words" used	10846	63.38
Disregard	3037	17.75
Either/Or	6	0.04
Unsure	776	4.53
Unintelligible	2445	14.29
INTELLIGIBILITY INDEX		77.06

78.89

Percentage Consonants Correct (PCC)

Severity Adjective

MILD-MODERATE

PERCENTAGE CONSONANTS CORRECT (PCC)

Sample PEPPER Output 2

Child __DSEW01-c1 1CT$_____
Study Identification _DSEW___
DOB _*_____
Age at Sampling Date __204 mos
Sampling Date _*_____
Sampling Clinician _*_____
Pepfile Entry Date _04/13/2009

Severity Adjective:

PCC	Adjective
≥86%	Mild
66%-85%	Mild-Moderate
50%-65%	Moderate-Severe
≤49%	Severe

Key:

+ Correct

- Incorrect

Consonant		Initial		Medial		Final		Consonants		Percentage Consonants	
Class	Sound	+	-	+	-	+	-	Correct	Total	Occurrence	Correct
Nasals	m	8	0	2	0	7	0	17	17	4.83	100.00
	n	4	0	4	1	35	0	43	44	12.50	97.73
	ŋ	0	0	0	0	3	0	3	3	0.85	100.00
Glides	w	7	7	1	0	0	0	8	15	4.26	53.33
	j	10	0	2	0	0	0	12	12	3.41	100.00
Stops	p	11	0	2	1	3	0	16	17	4.83	94.12
	b	5	0	1	0	0	0	6	6	1.70	100.00
	t	10	0	12	0	27	3	49	52	14.77	94.23
	d	3	1	1	0	12	0	16	17	4.83	94.12
	k	10	0	8	0	8	0	26	26	7.39	100.00
	g	8	0	0	0	0	0	8	8	2.27	100.00
Fricatives and Affricates	f	4	0	3	0	0	0	7	7	1.99	100.00
	v	0	0	1	0	13	0	14	14	3.98	100.00
	θ	3	0	1	0	2	0	6	6	1.70	100.00
	ð	7	5	0	0	0	0	7	12	3.41	58.33
	s	7	1	3	0	9	2	19	22	6.25	86.36
	z	0	0	2	1	6	3	8	12	3.41	66.67
	ʃ	0	0	2	2	0	0	2	4	1.14	50.00
	ʒ	0	0	0	0	0	0	0	0	0.00	*
	h	15	0	1	0	0	0	16	16	4.55	100.00
	tʃ	2	0	0	0	3	1	5	6	1.70	83.33
	ʤ	0	0	0	0	0	0	0	0	0.00	*
Liquids	l	5	2	4	0	10	4	19	25	7.10	76.00
	r	6	1	0	1	1	2	7	11	3.13	63.64
Percent Correct		88.03		89.29		90.26		314	352		
								Correct	Total		

Word Coding Summary	N	%
"Words" entered	243	100.00
"Words" used	202	83.13
Disregard	39	16.05
Either/Or	0	0.00
Unsure	1	0.41
Unintelligible	1	0.41
INTELLIGIBILITY INDEX		99.02

89.20

Percentage Consonants Correct (PCC)

Severity Adjective

MILD

Reference Data

Phonology Project technical reports provide reference data for PCC and other PCC-based reference data for typical speakers from 3 to 17 years of age in Potter et al. (2012), for typical speakers from 20 to 80 years of age in Scheer-Cohen et al. (2013), for speakers with SD in McSweeny et al. (2012) and for a larger dataset of speakers with ISD in Mabie et al. (2015). Reference Data Table 1 provides additional PCC reference data for the 268 speakers in the ISD database who have been classified as having No Motor Speech Disorder (No MSD; see Table of Contents).

Percentage of Consonants Correct: Idiopathic Speech Delay
Reference Data 1

	Percentage of Consonants Correct (%)							
	3 Yrs		4 Yrs		5 Yrs		6 Yrs	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male	67.7	9.1	68.3	12.2	73.2	11.9	79.1	8.3
Female	70.7	6.6	68.0	10.1	76.4	5.5	80.8	5.5
Both	68.7	8.4	68.2	11.4	74.2	10.4	79.5	7.8

The Intelligibility Index (II) and the Ordinal Intelligibility Index (OII)

Sample PEPPER Output

There are no PEPPER outputs dedicated to only group and individual values for the II and OII. As described in a later section, II and OII scores are included in the first two sections of the Competence Measures Summary (CMS).

Rationale and Description

Intelligibility Index (II) scores are calculated by dividing the number of intelligible words in a conversational speech sample by the total number of words produced, multiplied by 100 (Shriberg, 1993). Because II distributions in typical speakers and speakers with speech and motor speech disorders are not normally distributed (see following Ordinal Intelligibility Index Findings), an ordinal intelligibility index was developed for research and clinical practice (Wilson, Abbeduto, Camarata, & Shriberg, 2017).

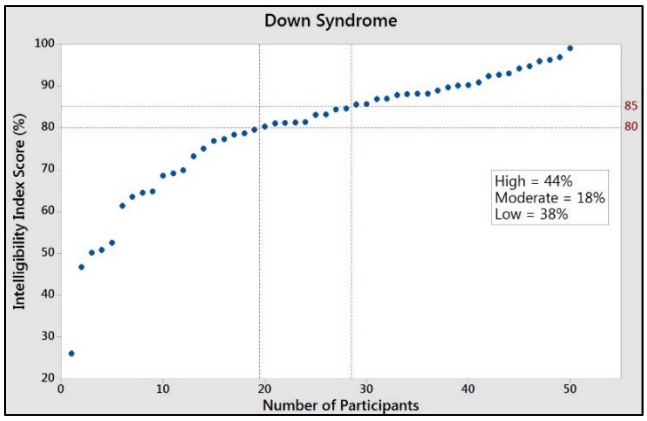
Ordinal Intelligibility Index Findings

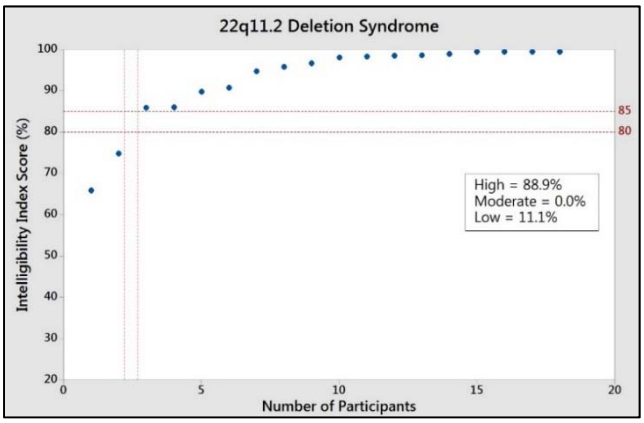
The Ordinal Intelligibility Index (OII) is a three-category scale to classify a speaker's intelligibility based on the speaker's II percentage scores. Low intelligibility includes II scores from 0% to 79.9%, Moderate intelligibility includes II scores from 80% to 84.9%, and High intelligibility includes II scores from 85% to 100%. The percentage ranges for the three severity adjectives were determined from inspection of the II distributions for 8 groups of speakers with complex neurodevelopmental disorders shown in the following Ordinal Intelligibility Index Findings. Additional information on the 8 groups of speakers with complex neurodevelopmental disorders is included in Phonology Project Technical Report No. 24 (Shriberg & Mabie, 2017).

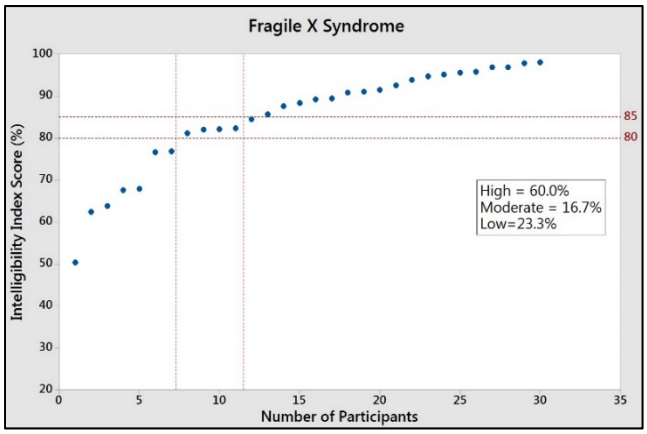
The Ordinal Intelligibility Index Findings which follow are sequenced in descending order of the mean Intelligibility Index score for each group, beginning with the lowest group

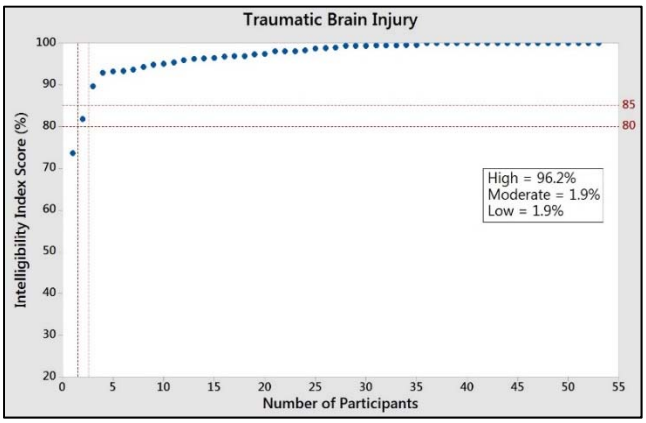
mean score (Down syndrome). The cut-off percentages at 79.9% and 84.9%% for Low and Moderate intelligibility, respectfully, appeared to be the best fit for the “knees” in the distribution of scores across groups, especially for the distribution of scores for the group of speakers with Down syndrome (Wilson et al., 2017).

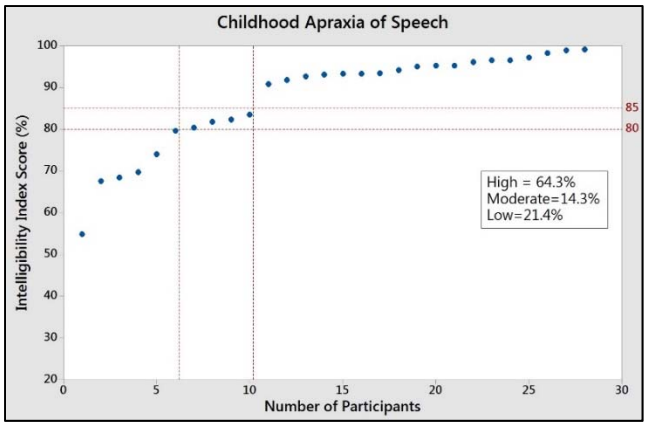
Ordinal Intelligibility Index Findings 1

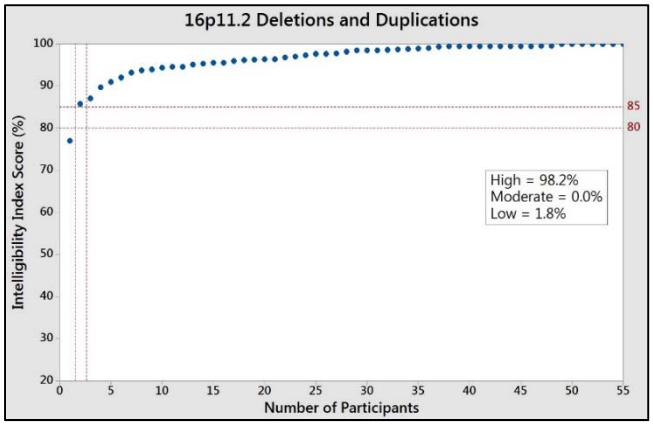


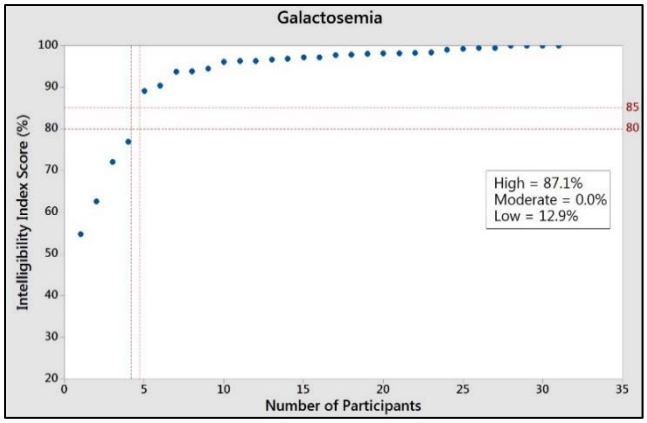


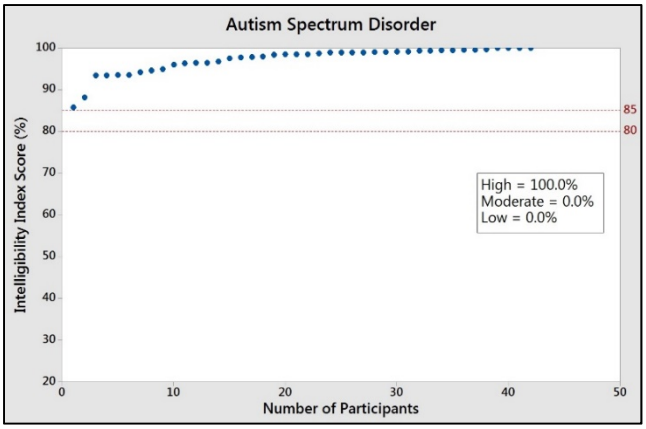












Reference Data

The following table includes additional reference data for the Intelligibility Index for 268 children, 3-7 years of age, with Idiopathic Speech Delay and No Motor Speech Disorder. The three succeeding tables include Ordinal Intelligibility Index reference data for typical speakers from 3 to 80 years of age in the Potter et al. (2012) and Scheer-Cohen et al. (2013) technical reports and for the 268 participants, ages 3 to 7 years, with Idiopathic Speech Delay and No Motor Speech Disorder (see Table of Contents).

Intelligibility Index: Idiopathic Speech Delay
Reference Data 1

	Intelligibility Index (%)							
	3 Yrs		4 Yrs		5 Yrs		6 Yrs	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male	87.0	9.4	90.8	8.0	93.3	6.9	90.3	8.6
Female	84.1	10.3	91.1	7.4	96.1	3.4	97.8	1.5
Both	86.0	9.7	90.9	7.8	94.1	6.1	91.9	8.3

Ordinal Intelligibility Index: Typical Speakers (3-17 Years)
Reference Data 2

Group	Ordinal Intelligibility Index														
	3 Yrs	4 Yrs	5 Yrs	6 Yrs	7 Yrs	8 Yrs	9 Yrs	10 Yrs	11 Yrs	12 Yrs	13 Yrs	14 Yrs	15 Yrs	16 Yrs	17 Yrs
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Male															
High	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Moderate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Female															
High	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Moderate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Both															
High	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Moderate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Ordinal Intelligibility Index: Typical Speakers (20-80 Years)
Reference Data 3

Group	Ordinal Intelligibility Index					
	20-29 Yrs	30-39 Yrs	40-49 Yrs	50-59 Yrs	60-69 Yrs	70-80 Yrs
	%	%	%	%	%	%
Both						
High	100.0	100.0	100.0	100.0	100.0	100.0
Moderate	0.0	0.0	0.0	0.0	0.0	0.0
Low	0.0	0.0	0.0	0.0	0.0	0.0

Ordinal Intelligibility Index: Idiopathic Speech Delay Reference Data 4

Group	Ordinal Intelligibility Index			
	3 Yrs (*n* = 41)	4 Yrs (*n* = 123)	5 Yrs (*n* = 71)	6 Yrs (*n* = 33)
	%	%	%	%
Male				
High	66.7	83.5	89.8	80.8
Moderate	11.1	7.6	6.1	0.0
Low	22.2	8.9	4.1	19.2
Female				
High	57.1	84.1	100.0	100.0
Moderate	7.1	6.8	0.0	0.0
Low	35.7	9.1	0.0	0.0
Both				
High	63.4	83.7	93.0	84.8
Moderate	9.8	7.3	4.2	0.0
Low	26.8	8.9	2.8	15.2

Prosody-Voice Screening Profile (PVSP)

Sample PEPPER Output

Sample PEPPER Outputs 1 and 2, respectively, are sample outputs of the Prosody-Voice Screening Profile (PVSP) group and individual findings from the Wilson et al. (2017) study cited previously. The following section includes rationale for and description of these outputs.

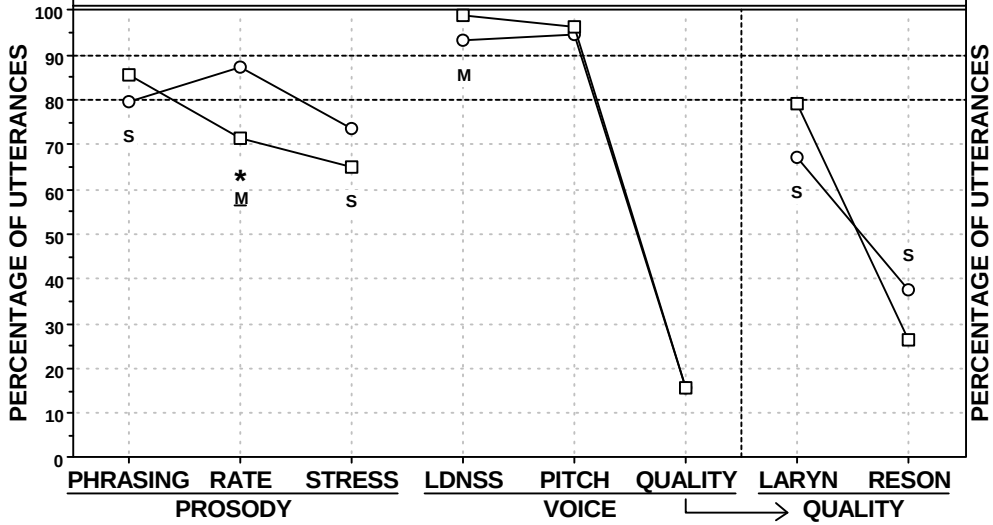
Rationale and Description

The Prosody-Voice Screening Profile (PVSP) is a perceptual procedure used to assess a speaker's prosody and voice in conversational speech. The PVSP provides summative and per-utterance data on the appropriateness of a speaker's phrasing, rate, stress, loudness, pitch, and quality. Quantitative information is obtained on 31 types of exclusion codes reflecting paralinguistic status and 31 subtypes of inappropriate prosody and voice. Rationale and an audio-tutorial to obtain prosody-voice data from a sample of conversational speech are described in Shriberg, Kwiatkowski, and Rasmussen (1990) As this document and audio materials are no longer in press they are included in the PEPPER software, freely available in 2018. Technical information on the PVSP, including reliability and validity studies and reference data for 352 3- to 19-year-old speech-normal and speech-delayed children, are provided in Shriberg, Kwiatkowski, Rasmussen, Lof, and Miller (1992).

Descriptions of PVSP findings using the same output as shown in Sample PEPPER Outputs 1 and 2 are available in several of the previous citations, including Shriberg et al. (1992).

PROSODY-VOICE SUMMARY Source: CS

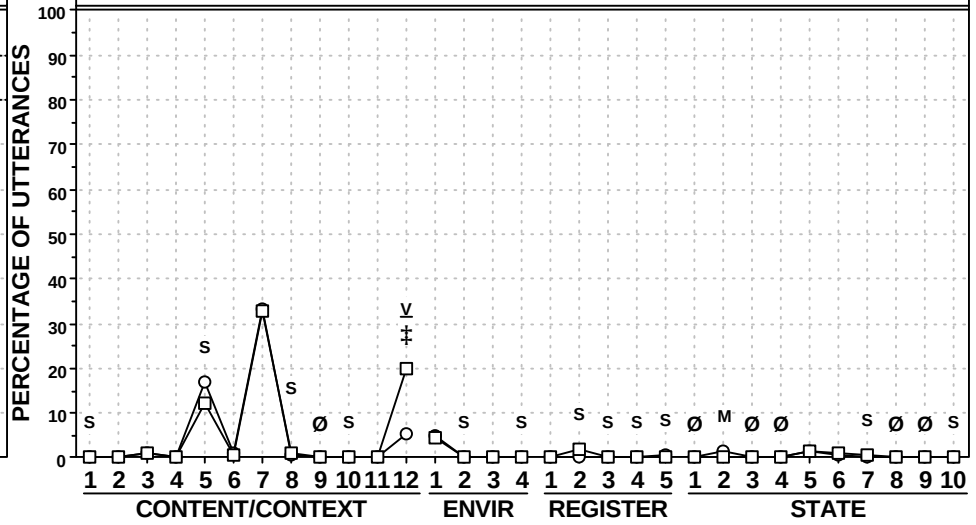
		APPROP PROSODY			APPROPRIATE VOICE					APPR
		SPHRAS	M*RATE	SSTRESS	MLDNSS	PITCH	QUAL	SLARYN	SRESON	UTTS
○ A	*M*	79.8	87.2	73.8	93.2	94.6	15.5	67.3	37.5	7.7
	SD	14.3	12.2	10.1	18.3	18.9	18.3	32.6	36.3	11.3
□ B	*M*	85.6	71.6	65.0	99.1	96.2	15.8	79.0	26.5	9.0
	SD	13.4	22.0	21.6	2.6	14.9	20.2	24.1	30.5	11.6



*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

SAMPLE INFORMATION AND EXCLUSION CODES Source: CS

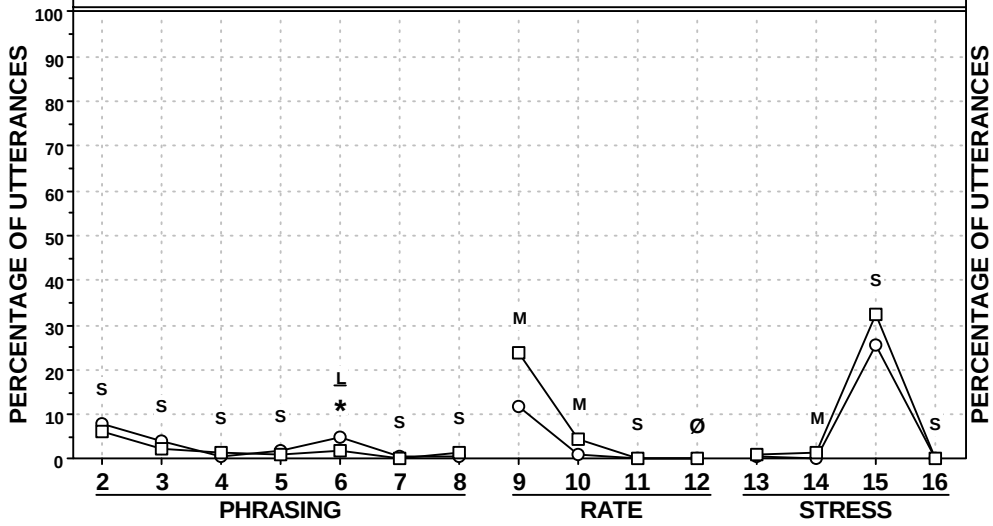
		NO. OF UTTS		%RESP	%DIFF	% EXCLUSION CODES				
		SEXCLD	SCODED	INVOLV	JUDGE	SCONT	ENVIR	SRGSTR	SSTATE	STOTAL
○ A	*M*	42.6	24.0	35.7	64.3	58.5	5.3	1.2	3.9	56.8
	SD	29.8	0.0	-	-	27.4	6.8	1.6	4.5	18.4
□ B	*M*	63.2	23.6	35.5	71.0	68.5	4.7	2.9	3.0	65.1
	SD	49.8	1.2	-	-	25.8	5.2	5.4	3.8	16.5



*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

INAPPROPRIATE PROSODY Source: CS

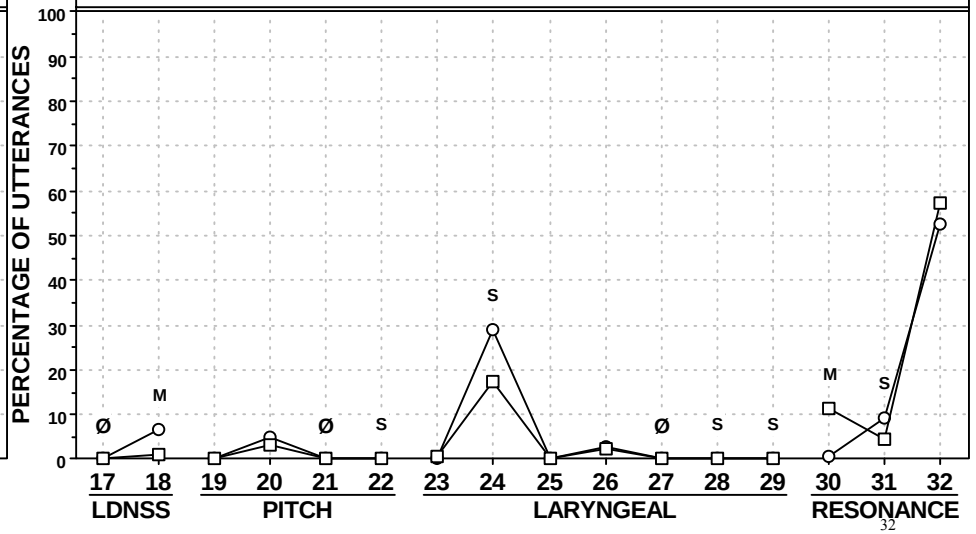
		PHRASING			RATE			STRESS			TOTAL		
		SQ	SN	ST	SQ	M*N	M*T	Q	SN	ST	Q	SN	ST
○ A	*M*	0.0	20.2	20.2	0.3	12.8	13.1	11.9	26.2	38.1	12.2	47.9	56.3
	SD	0.0	14.3	14.3	1.1	12.2	12.1	6.9	10.1	13.7	6.8	15.1	14.7
□ B	*M*	0.1	14.4	14.5	0.0	28.4	28.4	11.4	35.0	46.4	11.5	55.5	64.0
	SD	0.7	13.4	13.5	0.0	22.0	22.0	7.2	21.6	21.6	7.2	20.2	19.2



*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

INAPPROPRIATE VOICE Source: CS

		LDNSS			PITCH			LARYN			RESON			TOTAL		
		SQ	MN	MT	SQ	N	T	Q	SN	ST	Q	SN	ST	SQ	N	ST
○ A	*M*	2.7	6.8	9.5	1.5	5.4	6.8	5.7	32.7	38.4	10.4	62.5	72.9	19.3	86.0	94.3
	SD	3.9	18.3	21.3	3.5	18.9	22.1	4.5	32.6	35.8	15.9	36.3	35.8	17.6	18.4	8.9
□ B	*M*	1.7	0.9	2.6	0.8	3.8	4.6	5.3	21.0	26.3	9.0	73.5	82.4	15.9	84.6	91.5
	SD	2.6	2.6	4.0	2.1	14.9	15.3	5.4	24.1	26.1	16.2	30.5	24.0	16.4	19.9	12.3

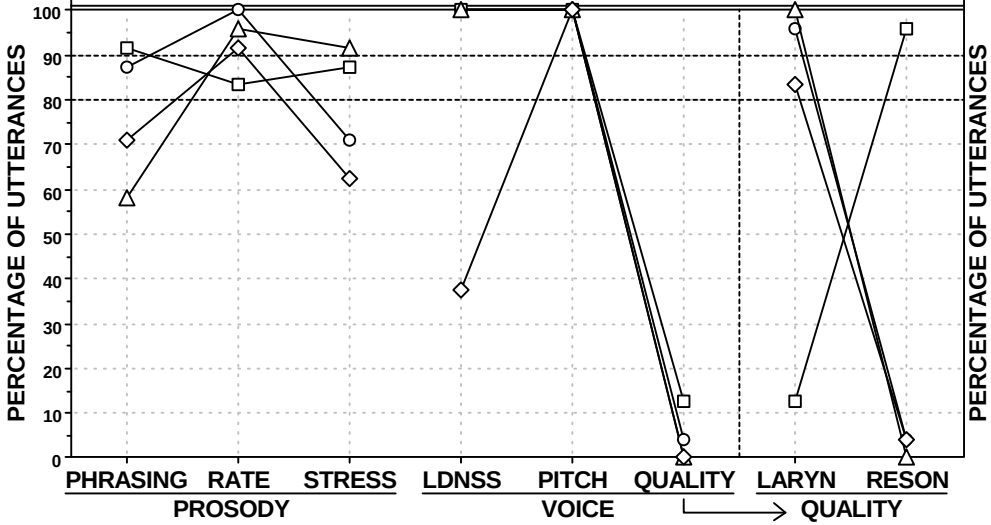


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A

PROSODY-VOICE SUMMARY Source: CS

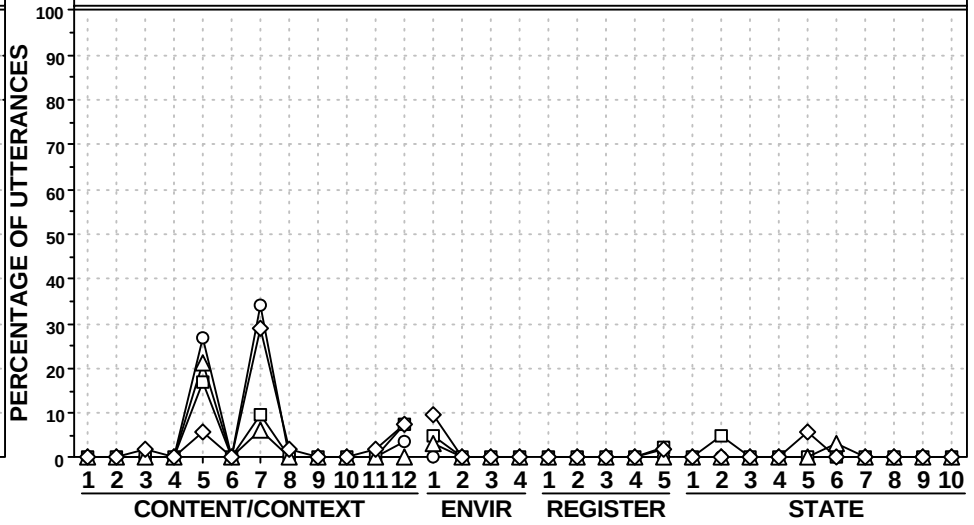
	APPROP PROSODY			APPROPRIATE VOICE					APPR
	PHRAS	RATE	STRESS	LDNSS	PITCH	QUAL	LARYN	RESON	UTTS
○ 1	87.5	100.0	70.8	100.0	100.0	4.2	95.8	4.2	0.0
□ 2	91.7	83.3	87.5	100.0	100.0	12.5	12.5	95.8	12.5
△ 3	58.3	95.8	91.7	100.0	100.0	0.0	100.0	0.0	0.0
◇ 4	70.8	91.7	62.5	37.5	100.0	0.0	83.3	4.2	0.0



B

SAMPLE INFORMATION AND EXCLUSION CODES Source: CS

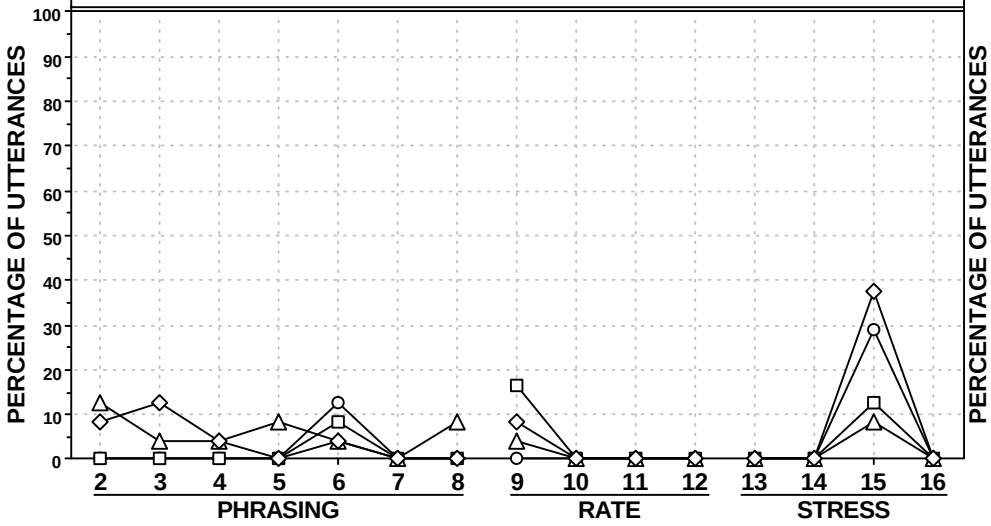
	NO. OF UTTS		%RESP	%DIFF	% EXCLUSION CODES				
	EXCLD	CODED	INVOLV	JUDGE	CONT	ENVIR	RGSTR	STATE	TOTAL
○ 1	32.0	24.0	0.0	0.0	64.3	0.0	0.0	0.0	57.1
□ 2	17.0	24.0	0.0	0.0	34.1	4.9	2.4	4.9	41.5
△ 3	9.0	24.0	0.0	0.0	27.3	3.0	0.0	3.0	27.3
◇ 4	28.0	24.0	0.0	0.0	48.1	9.6	1.9	5.8	53.8



C

INAPPROPRIATE PROSODY Source: CS

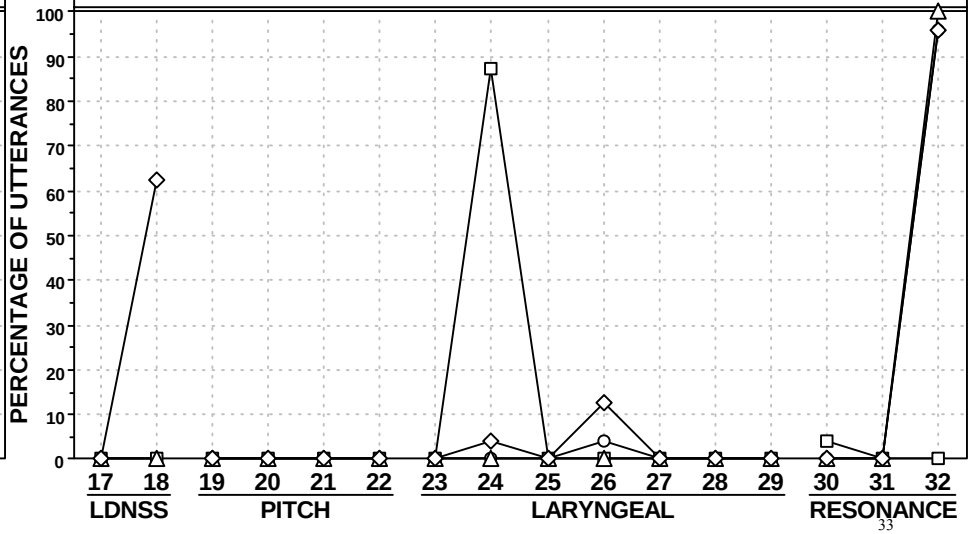
	PHRASING			RATE			STRESS			TOTAL		
	Q	N	T	Q	N	T	Q	N	T	Q	N	T
○ 1	0.0	12.5	12.5	0.0	0.0	0.0	29.2	29.2	58.3	29.2	37.5	62.5
□ 2	0.0	8.3	8.3	0.0	16.7	16.7	4.2	12.5	16.7	4.2	29.2	29.2
△ 3	0.0	41.7	41.7	0.0	4.2	4.2	8.3	8.3	16.7	8.3	50.0	54.2
◇ 4	0.0	29.2	29.2	4.2	8.3	12.5	8.3	37.5	45.8	12.5	62.5	66.7



D

INAPPROPRIATE VOICE Source: CS

	LDNSS			PITCH			LARYN			RESON			TOTAL		
	Q	N	T	Q	N	T	Q	N	T	Q	N	T	Q	N	T
○ 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.2	4.2	95.8	100	4.2	95.8	100
□ 2	0.0	0.0	0.0	0.0	0.0	0.0	4.2	87.5	91.7	0.0	4.2	4.2	4.2	87.5	91.7
△ 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	100	0.0	100	100
◇ 4	8.3	62.5	70.8	0.0	0.0	0.0	0.0	16.7	16.7	0.0	95.8	95.8	8.3	100	100



Reference Data

Prosody-Voice Screening Profile reference data are provided for typical speakers from 3 to 80 years of age in the Potter et al. (2012) and Scheer-Cohen et al. (2013) technical reports and reference data for Idiopathic Speech Delay groups can be found in McSweeny et al. (2012) and Mabie et al. (2015). As described in a following section, PVSP summary findings for individual or group data are also available in a PEPPER output to be described termed the Competence Measures Summary.

Speech Competence Index (SCI)

Sample PEPPER Output

Sample PEPPER Outputs 1 and 2, respectively, are sample group and individual Speech Competence Index (SCI) findings from the Wilson et al. (2017) study. The following section includes rationale for and description of these outputs.

Rationale and Description

The SCI was developed as a broad-based measure to quantify the speech, prosody, and voice competence of speakers across the lifespan (Shriberg, Strand, & Mabie, 2016). Using reference data from typical speakers ages 3 to 80 years (Potter et al., 2012; Scheer-Cohen et al., 2013), standardized scores from a conversational speech sample are obtained on the 38 perceptual signs in Sample PEPPER Outputs 1 and 2 using the standardization procedures and criteria described in Part I to code signs as positive or negative and to derive a total SCI percentage score and average *z*-score across the 38 items.

Speech Competence Index (SCI): Group

Sample PEPPER Output 1

	SCI Sign		Participants Positive on Sign		Ordinal Classification[b]
Linguistic Domain	No.	Description	No.	%[a]	
Vowels					
	1	Decreased Percent vowels correct	50	100.0	VF
	2	Decreased Percent vowels correct non-rhotic	50	100.0	VF
	3	Decreased Percent vowels correct revised	50	100.0	VF
Consonants					
	4	Decreased Percent consonants correct	50	100.0	VF
	5	Decreased Percent consonants correct - early	50	100.0	VF
	6	Decreased Percent consonants correct - middle	50	100.0	VF
	7	Decreased Percent consonants correct - late	49	98.0	VF
	8	Decreased Percent consonants correct adjusted	50	100.0	VF
	9	Decreased Percent consonants correct revised	50	100.0	VF
	10	Decreased Percent consonants correct revised - early	49	98.0	VF
	11	Decreased Percent consonants correct revised - middle	50	100.0	VF
	12	Decreased Percent consonants correct revised - late	50	100.0	VF
	13	Decreased Percent consonants in the inventory	42	84.0	VF
	14	Decreased Percent consonants in the inventory - early	0	0.0	I
	15	Decreased Percent consonants in the inventory - middle	33	66.0	F
	16	Decreased Percent consonants in the inventory - late	26	52.0	SF
	17	Increased Absolute omission index	50	100.0	VF
	18	Increased Absolute omission index - early	48	96.0	VF
	19	Increased Absolute omission index - middle	49	98.0	VF
	20	Increased Absolute omission index - late	46	92.0	VF
	21	Increased Absolute substitution index	50	100.0	VF
	22	Increased Absolute substitution index - early	44	88.0	VF
	23	Increased Absolute substitution index - middle	50	100.0	VF
	24	Increased Absolute substitution index - late	50	100.0	VF
	25	Increased Absolute distortion index	49	98.0	VF
	26	Increased Absolute distortion index - early	42	84.0	VF
	27	Increased Absolute distortion index - middle	27	54.0	SF
	28	Increased Absolute distortion index - late	49	98.0	VF
Vowels and Consonants					
	29	Decreased Intelligibility index	50	100.0	VF
	30	Decreased Percentage of phonemes correct	50	100.0	VF
	31	Decreased Percentage of phonemes correct revised	50	100.0	VF

Phrasing					
	32	**Decreased Percent Prosody Phrasing correct**	**15**	**30.0**	**SI**
Rate					
	33	**Decreased Percent Prosody Rate correct**	**41**	**82.0**	**VF**
Stress					
	34	**Decreased Percent Prosody Stress correct**	**42**	**84.0**	**VF**
Loudness					
	35	**Decreased Percent Prosody Loudness correct**	**6**	**12.0**	**I**
Pitch					
	36	**Decreased Percent Prosody Pitch correct**	**4**	**8.0**	**I**
Laryngeal Quality					
	37	**Decreased Percent Voice Quality Laryngeal correct**	**9**	**18.4**	**I**
Resonance Quality					
	38	**Decreased Percent Voice Quality Resonance correct**	**40**	**80.0**	**VF**

SCI Scores Summary			**SCI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**50**		**Very Frequent (VF): 80.0-100%**	**30**
Mean	**17.8**		**Frequent (F): 60.0-79.9%**	**1**
Standard Deviation	**4.8**		**Somewhat Frequent (SF): 40.0-59.9%**	**2**
Range	**7.9 - 31.6**		**Somewhat Infrequent (SI): 20.0-39.9%**	**1**
			Infrequent (I): 0.0-19.9%	**4**
			Not Used	**0**

[a] Increased/Decreased reference ≥ 1.25 standard deviation units from age-sex matched, typically developing speakers (Potter et al., 2012;Scheer-Cohen et al., 2013).

[b] Very Frequent (VF): 80.0-100%; Frequent (F): 60.0-79.9%; Somewhat Frequent (SF): 40.0-59.0%; Somewhat Infrequent (SI): 20.0-39.9%; Infrequent (I): 0.0-19.9%

Speech Competence Index (SCI): Individual

Sample PEPPER Output 2

	SCI Sign		SCI sign values	
Linguistic Domain	**No.**	**Description**	**Z-score[a]**	**Code[b]**
Vowels				
	1	**Decreased Percent vowels correct**	**-5.00**	**1**
	2	**Decreased Percent vowels correct non-rhotic**	**-5.00**	**1**
	3	**Decreased Percent vowels correct revised**	**-5.00**	**1**
Consonants				
	4	**Decreased Percent consonants correct**	**-4.77**	**1**
	5	**Decreased Percent consonants correct - early**	**-5.00**	**1**
	6	**Decreased Percent consonants correct - middle**	**-5.00**	**1**
	7	**Decreased Percent consonants correct - late**	**-3.78**	**1**
	8	**Decreased Percent consonants correct adjusted**	**-5.00**	**1**
	9	**Decreased Percent consonants correct revised**	**-5.00**	**1**
	10	**Decreased Percent consonants correct revised - early**	**-4.49**	**1**
	11	**Decreased Percent consonants correct revised - middle**	**-5.00**	**1**
	12	**Decreased Percent consonants correct revised - late**	**-5.00**	**1**
	13	**Decreased Percent consonants in the inventory**	**0.00**	**0**
	14	**Decreased Percent consonants in the inventory - early**	**0.00**	**0**
	15	**Decreased Percent consonants in the inventory - middle**	**0.00**	**0**
	16	**Decreased Percent consonants in the inventory - late**	**0.00**	**0**
	17	**Increased Absolute omission index**	**-3.21**	**1**
	18	**Increased Absolute omission index - early**	**0.47**	**0**
	19	**Increased Absolute omission index - middle**	**-3.90**	**1**
	20	**Increased Absolute omission index - late**	**-5.00**	**1**
	21	**Increased Absolute substitution index**	**-5.00**	**1**
	22	**Increased Absolute substitution index - early**	**-5.00**	**1**
	23	**Increased Absolute substitution index - middle**	**-3.53**	**1**
	24	**Increased Absolute substitution index - late**	**-5.00**	**1**
	25	**Increased Absolute distortion index**	**-2.46**	**1**
	26	**Increased Absolute distortion index - early**	**-5.00**	**1**
	27	**Increased Absolute distortion index - middle**	**-5.00**	**1**
	28	**Increased Absolute distortion index - late**	**-2.07**	**1**
Vowels and Consonants				
	29	**Decreased Intelligibility index**	**-2.12**	**1**
	30	**Decreased Percentage of phonemes correct**	**-5.00**	**1**
	31	**Decreased Percentage of phonemes correct revised**	**-5.00**	**1**

Phrasing				
	32	**Decreased Percent Prosody Phrasing correct**	**-0.91**	**0**
Rate				
	33	**Decreased Percent Prosody Rate correct**	**0.56**	**0**
Stress				
	34	**Decreased Percent Prosody Stress correct**	**-4.02**	**1**
Loudness				
	35	**Decreased Percent Prosody Loudness correct**	**0.38**	**0**
Pitch				
	36	**Decreased Percent Prosody Pitch correct**	**0.32**	**0**
Laryngeal Quality				
	37	**Decreased Percent Voice Quality Laryngeal correct**	**0.36**	**0**
Resonance Quality				
	38	**Decreased Percent Voice Quality Resonance correct**	**-3.96**	**1**

No. of positive signs	**28**
Average Sign Z-score	**-3.21**
SCI Score	**26.3**

[a] Z-scores referenced to age-sex matched typically developing speakers (Potter et al., 2012; Scheer-Cohen et al., 2013)

[b] Code: 0 = not positive on variable; 1 = postive on variable (Z-score $\leq$ -1.25)

Group SCI summaries include descriptive statistics for SCI scores (count, *M*, *SD*, range) and the counts of signs within 5 ordinal classifications based on the percentage of the group positive for a specific sign. The ordinal classifications include Very Frequent (VF; 80.0-100% of the group is positive on the sign), Frequent (F; 60.0-79.9% of the group is positive on the sign), Somewhat Frequent (SF; 40.0-59.9% of the group is positive on the sign), Somewhat Infrequent (SI; 20.0-99.9% of the group is positive on the sign), and Infrequent (I; 0.0-19.9% of the group is positive on the sign). An additional count of signs not used is included for signs for which no group data were available.

Individual SCI outputs include the number of positive signs (i.e., the count of "1" codes), an average sign *z*-score (the average of all 38 *z*-scores), and the SCI Score, calculated by taking the number of positive signs, dividing by the total number of SCI signs for which signs were obtained (i.e., 38 or fewer), and subtracting from 100 (so that higher percentage scores reflect higher competence).

Reference Data

The following tables provide SCI reference data for the two databases of 3-80 year old typical speakers (see Table of Contents).

Speech Competence Index Signs: Typical Speakers
Reference Data 1

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	97.9	1.9	97.4	1.5	99.0	1.0	96.6	2.7	99.3	0.8	99.3	0.7
Percent vowels correct non-rhotic	%	98.8	0.6	98.7	0.3	99.1	0.9	98.9	0.5	99.4	0.6	99.2	0.7
Percent vowels correct - revised	%	98.5	1.0	98.0	0.8	99.1	1.0	97.5	1.8	99.3	0.8	99.3	0.7
Consonants													
Percent consonants correct	%	81.7	6.4	85.9	8.0	88.6	6.9	89.0	4.7	94.5	6.1	97.7	0.8
Percent consonants correct - early	%	97.0	2.6	97.6	1.4	97.9	1.6	96.4	1.8	98.9	1.1	99.0	1.1
Percent consonants correct - middle	%	88.1	4.0	93.9	3.2	93.8	8.0	94.9	3.1	98.0	1.6	97.9	2.2
Percent consonants correct -late	%	56.4	17.6	59.9	28.2	68.9	23.0	71.3	12.6	85.0	19.2	95.6	3.1
Percent consonants correct - adjusted	%	90.8	3.1	93.5	1.9	93.6	5.7	93.4	4.2	97.1	2.3	98.0	1.0
Percent consonants correct - revised	%	91.0	3.0	93.8	1.3	93.7	5.8	93.9	3.8	97.2	2.2	98.0	1.0
Percent consonants correct revised - early	%	97.2	2.5	97.9	1.5	97.9	1.6	96.4	1.8	98.9	1.1	99.0	1.1
Percent consonants correct revised - middle	%	89.5	4.2	93.9	3.2	93.8	8.0	95.3	3.0	98.0	1.6	97.9	2.2
Percent consonants correct revised - late	%	85.0	8.0	87.1	6.8	86.8	12.1	87.9	11.0	94.1	5.5	96.6	3.4
Percent consonants in the inventory	%	93.4	5.2	93.9	4.8	95.3	3.8	97.0	3.0	99.1	1.3	100.0	0.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	98.7	3.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	91.0	10.5	94.9	4.7	98.6	3.2	95.4	4.3	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	88.1	12.1	85.6	13.9	85.7	11.3	96.6	4.6	96.9	4.3	100.0	0.0
Absolute omission index	%	2.7	0.8	2.3	0.8	1.4	0.9	1.7	0.7	0.9	0.5	0.7	0.5
Absolute omission index - early	%	1.0	1.0	1.6	1.7	1.5	1.5	1.9	1.0	0.6	0.6	0.7	0.6

Absolute omission index - middle	%	5.7	1.7	2.5	2.3	1.3	1.2	1.8	0.6	1.2	0.4	1.1	1.4
Absolute omission index - late	%	2.1	1.5	3.1	1.7	1.4	1.5	1.0	1.4	1.0	0.9	0.6	1.0
Absolute substitution index	%	6.4	3.1	3.9	1.4	5.0	5.0	4.5	3.2	1.9	1.8	1.2	1.1
Absolute substitution index - early	%	1.8	1.7	0.5	0.5	0.6	0.3	1.7	1.6	0.5	0.7	0.2	0.5
Absolute substitution index - middle	%	4.8	2.9	3.7	1.2	4.9	7.7	2.9	2.5	0.8	1.1	1.1	1.2
Absolute substitution index - late	%	13.0	8.1	9.8	5.6	11.9	10.8	11.1	10.8	4.9	4.8	2.8	3.8
Absolute distortion index	%	9.3	6.4	7.9	7.0	5.1	4.3	4.9	1.3	2.7	4.4	0.3	0.3
Absolute distortion index - early	%	0.2	0.4	0.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - middle	%	1.5	2.4	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.0	0.0	0.0
Absolute distortion index - late	%	28.6	20.7	27.2	22.1	17.9	16.2	16.7	3.2	9.1	15.4	1.1	1.0
Vowels & Consonants													
Intelligibility index	%	97.7	1.0	97.5	2.0	98.5	1.9	98.3	2.1	98.8	1.0	98.5	1.8
Percentage of phonemes correct	%	88.2	3.9	90.7	5.0	92.7	4.4	91.9	3.9	96.4	4.0	98.4	0.7
Percentage of phonemes correct - revised	%	94.0	1.5	95.6	1.1	95.9	3.7	95.3	3.0	98.1	1.6	98.5	0.8
Phrasing													
Percentage of Phrasing correct	%	79.2	15.0	86.7	8.0	92.5	5.4	86.0	12.4	81.7	14.3	89.2	8.1
Rate													
Percentage of Rate correct	%	95.8	5.1	100.0	0.0	100.0	0.0	92.9	15.8	100.0	0.0	97.5	5.6
Stress													
Percentage of Stress correct	%	88.6	10.4	89.2	8.1	85.8	6.3	92.3	7.8	80.0	11.6	86.7	7.5
Loudness													
Percentage of Loudness correct	%	80.6	22.3	87.5	8.3	96.7	5.4	84.2	17.8	80.8	25.5	85.0	14.0
Pitch													
Percentage of Pitch correct	%	94.2	9.1	88.3	9.5	86.6	12.3	98.3	2.3	94.0	9.0	94.1	6.3
Laryngeal Quality													

Percentage of Laryngeal Quality correct	%	80.6	16.5	89.1	4.8	81.7	19.2	79.8	25.9	74.0	37.6	61.6	20.9
Resonance Quality													
Percentage of Resonance Quality correct	%	86.7	19.2	73.3	29.1	100.0	0.0	71.7	43.9	91.7	11.4	95.0	6.9

Speech Competence Index Signs: Typical Speakers
Reference Data 2

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	98.1	2.8	98.0	2.7	99.5	0.5	99.3	0.5	99.4	0.7	99.8	0.2
Percent vowels correct non-rhotic	%	99.1	0.7	99.4	0.6	99.6	0.5	99.4	0.6	99.8	0.2	99.8	0.3
Percent vowels correct - revised	%	99.0	1.1	99.0	1.2	99.6	0.5	99.3	0.5	99.8	0.2	99.8	0.2
Consonants													
Percent consonants correct	%	95.8	4.7	96.3	2.9	98.8	0.8	97.9	1.6	96.9	2.9	98.5	2.3
Percent consonants correct - early	%	97.0	3.9	99.3	0.8	99.7	0.7	98.8	1.4	99.0	0.5	99.9	0.3
Percent consonants correct - middle	%	96.9	3.5	97.8	1.9	99.1	0.6	97.9	1.0	98.2	1.8	98.0	2.4
Percent consonants correct -late	%	93.1	9.3	91.0	9.0	97.6	1.8	96.8	4.1	93.5	6.9	96.8	5.9
Percent consonants correct - adjusted	%	96.8	4.3	97.6	1.3	99.2	0.5	98.8	1.0	97.9	1.4	99.2	0.7
Percent consonants correct - revised	%	97.0	4.3	97.8	1.2	99.2	0.5	98.8	1.0	98.1	1.1	99.3	0.8
Percent consonants correct revised - early	%	97.2	4.1	99.3	0.8	99.7	0.7	98.8	1.4	99.1	0.7	100.0	0.0
Percent consonants correct revised - middle	%	97.1	3.1	97.8	1.9	99.1	0.6	97.9	1.0	98.9	1.2	98.0	2.4
Percent consonants correct revised - late	%	96.6	5.7	95.6	2.7	98.6	1.2	99.3	0.8	96.3	2.8	99.5	0.5
Percent consonants in the inventory	%	98.1	4.2	99.1	2.0	99.1	1.3	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	97.3	6.0	97.3	6.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	96.7	7.5	100.0	0.0	97.1	3.9	100.0	0.0	100.0	0.0	100.0	0.0
Absolute omission index	%	1.2	1.6	0.7	0.7	0.4	0.2	0.6	0.3	0.4	0.4	0.4	0.4
Absolute omission index - early	%	1.6	2.0	0.3	0.6	0.2	0.4	0.6	0.6	0.5	0.3	0.0	0.0

Absolute omission index - middle	%	1.1	1.6	1.2	0.8	0.6	0.6	1.5	1.1	0.7	1.2	1.2	1.6
Absolute omission index - late	%	0.9	1.2	1.0	1.2	0.5	0.8	0.0	0.0	0.0	0.0	0.2	0.3
Absolute substitution index	%	1.8	2.8	1.5	0.6	0.4	0.3	0.6	0.8	1.5	1.1	0.3	0.4
Absolute substitution index - early	%	1.1	2.2	0.4	0.5	0.2	0.4	0.6	0.9	0.4	0.5	0.0	0.0
Absolute substitution index - middle	%	1.8	1.7	1.1	1.8	0.3	0.4	0.6	0.9	0.3	0.5	0.8	0.8
Absolute substitution index - late	%	2.6	4.7	3.4	2.5	0.9	0.6	0.7	0.8	3.7	2.8	0.4	0.5
Absolute distortion index	%	1.2	1.9	1.4	2.3	0.4	0.4	0.8	1.3	1.2	1.9	0.8	1.6
Absolute distortion index - early	%	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.1	0.3
Absolute distortion index - middle	%	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.5	0.0	0.0
Absolute distortion index - late	%	3.4	6.9	4.6	6.9	1.0	1.0	2.5	3.9	2.7	4.2	2.7	5.6
Vowels & Consonants													
Intelligibility index	%	99.2	1.4	99.7	0.4	99.3	0.5	99.4	0.7	99.8	0.4	99.9	0.2
Percentage of phonemes correct	%	96.7	3.6	97.0	2.8	99.1	0.6	98.5	1.2	97.9	2.0	99.0	1.5
Percentage of phonemes correct - revised	%	97.8	2.8	98.2	1.0	99.3	0.4	99.0	0.7	98.7	0.7	99.5	0.5
Phrasing													
Percentage of Phrasing correct	%	80.0	12.6	90.8	5.4	81.7	10.5	90.8	6.9	90.0	4.8	86.7	7.5
Rate													
Percentage of Rate correct	%	100.0	0.0	95.0	11.2	100.0	0.0	100.0	0.0	99.2	1.9	98.3	2.3
Stress													
Percentage of Stress correct	%	91.7	8.3	90.0	5.6	80.8	2.3	85.8	9.6	92.5	8.5	93.3	3.7
Loudness													
Percentage of Loudness correct	%	95.0	6.9	93.3	10.5	97.5	5.6	93.3	8.6	96.7	5.4	98.3	3.7
Pitch													
Percentage of Pitch correct	%	94.2	4.8	92.0	5.3	92.1	8.9	97.5	5.6	89.6	8.7	95.8	5.9
Laryngeal Quality													

Percentage of Laryngeal Quality correct	%	97.5	3.8	75.2	18.0	85.7	10.2	75.0	28.1	81.5	15.8	95.0	1.8
Resonance Quality													
Percentage of Resonance Quality correct	%	79.2	44.3	69.2	43.5	90.8	20.5	87.5	25.7	77.5	22.4	79.2	44.3

Speech Competence Index Signs: Typical Speakers
Reference Data 3

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	99.7	0.6	99.9	0.2	99.5	0.6	99.7	0.3	99.8	0.3	99.8	0.2
Percent vowels correct non-rhotic	%	99.6	0.6	99.9	0.2	99.5	0.4	99.7	0.3	99.8	0.4	99.8	0.2
Percent vowels correct - revised	%	99.7	0.6	99.9	0.2	99.5	0.6	99.9	0.2	99.8	0.3	99.8	0.2
Consonants													
Percent consonants correct	%	98.9	0.8	99.3	0.9	98.7	1.2	98.9	0.9	99.2	0.4	99.1	1.1
Percent consonants correct - early	%	99.4	0.7	99.7	0.5	99.9	0.3	99.0	1.4	99.4	0.7	99.8	0.4
Percent consonants correct - middle	%	99.8	0.4	99.3	1.0	99.0	1.4	98.6	1.6	98.7	1.5	99.8	0.6
Percent consonants correct -late	%	97.6	2.0	98.8	1.9	97.3	3.4	99.0	1.4	99.4	1.1	97.6	3.2
Percent consonants correct - adjusted	%	99.4	0.6	99.5	0.6	99.3	0.3	99.0	0.7	99.3	0.4	99.6	0.2
Percent consonants correct - revised	%	99.4	0.6	99.5	0.6	99.4	0.1	99.0	0.7	99.5	0.3	99.6	0.2
Percent consonants correct revised - early	%	99.4	0.7	99.7	0.5	99.9	0.3	99.0	1.4	99.6	0.4	99.8	0.4
Percent consonants correct revised - middle	%	99.8	0.4	99.3	1.0	99.0	1.4	98.6	1.6	99.1	1.2	99.8	0.6
Percent consonants correct revised - late	%	99.0	1.1	99.4	1.0	99.2	0.8	99.3	0.9	99.7	0.4	99.2	0.8
Percent consonants in the inventory	%	100.0	0.0	100.0	0.0	99.5	1.1	100.0	0.0	99.6	1.0	99.5	1.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	98.8	2.8	100.0	0.0
Percent consonants in the inventory - middle	%	100.0	0.0	100.0	0.0	98.5	3.4	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	98.5	3.4
Absolute omission index	%	0.4	0.4	0.3	0.4	0.3	0.2	0.3	0.2	0.5	0.4	0.2	0.1
Absolute omission index - early	%	0.5	0.5	0.2	0.3	0.2	0.3	0.1	0.3	0.5	0.4	0.3	0.4

Absolute omission index - middle	%	0.0	0.0	0.7	1.0	0.6	0.9	0.9	1.0	0.7	1.2	0.3	0.6
Absolute omission index - late	%	0.7	0.8	0.0	0.0	0.2	0.3	0.2	0.4	0.3	0.4	0.2	0.4
Absolute substitution index	%	0.2	0.2	0.2	0.3	0.3	0.1	0.7	0.6	0.1	0.1	0.2	0.3
Absolute substitution index - early	%	0.1	0.3	0.1	0.2	0.0	0.0	0.9	1.3	0.0	0.0	0.0	0.0
Absolute substitution index - middle	%	0.2	0.4	0.0	0.0	0.4	0.6	0.5	0.7	0.2	0.4	0.0	0.0
Absolute substitution index - late	%	0.4	0.4	0.6	1.0	0.6	0.7	0.5	0.7	0.0	0.0	0.7	0.9
Absolute distortion index	%	0.5	0.4	0.2	0.3	0.7	1.2	0.1	0.2	0.3	0.2	0.5	1.2
Absolute distortion index - early	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0
Absolute distortion index - middle	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.0	0.0
Absolute distortion index - late	%	1.3	1.2	0.6	1.0	1.9	3.4	0.3	0.7	0.3	0.8	1.6	3.6
Vowels & Consonants													
Intelligibility index	%	99.5	1.1	99.7	0.3	99.8	0.5	99.8	0.3	99.3	1.1	99.8	0.5
Percentage of phonemes correct	%	99.2	0.7	99.5	0.5	99.0	0.7	99.2	0.4	99.4	0.3	99.4	0.7
Percentage of phonemes correct - revised	%	99.5	0.6	99.7	0.4	99.4	0.3	99.4	0.4	99.6	0.2	99.7	0.1
Phrasing													
Percentage of Phrasing correct	%	79.2	12.2	94.2	2.3	90.0	11.6	87.5	8.8	84.2	10.8	94.2	7.0
Rate													
Percentage of Rate correct	%	98.3	3.7	98.3	2.3	98.8	2.6	98.3	3.7	96.7	4.6	99.2	1.9
Stress													
Percentage of Stress correct	%	90.8	7.5	91.7	6.6	97.5	3.7	95.0	4.6	90.8	6.2	88.3	6.2
Loudness													
Percentage of Loudness correct	%	95.0	6.9	100.0	0.0	90.8	12.0	100.0	0.0	98.3	2.3	98.3	2.3
Pitch													
Percentage of Pitch correct	%	94.0	8.4	98.3	3.9	91.3	10.5	99.2	1.9	92.5	10.4	93.0	8.1
Laryngeal Quality													

Percentage of Laryngeal Quality correct	%	71.3	33.9	98.3	2.3	85.4	13.1	52.5	37.9	81.5	23.6	83.6	15.9
Resonance Quality													
Percentage of Resonance Quality correct	%	83.3	37.3	99.2	1.9	100.0	0.0	100.0	0.0	82.5	25.1	99.2	1.9

Speech Competence Index Signs: Typical Speakers
Reference Data 4

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	99.9	0.2	100.0	0.0	99.9	0.2	100.0	0.0	99.9	0.2	99.9	0.2
Percent vowels correct non-rhotic	%	99.8	0.2	100.0	0.0	99.9	0.2	100.0	0.0	99.9	0.2	100.0	0.0
Percent vowels correct - revised	%	99.9	0.2	100.0	0.0	99.9	0.2	100.0	0.0	100.0	0.0	100.0	0.0
Consonants													
Percent consonants correct	%	99.5	0.6	99.2	0.9	98.6	0.7	99.6	0.3	99.1	0.5	99.6	0.6
Percent consonants correct - early	%	99.3	1.1	99.7	0.4	99.1	1.0	100.0	0.0	98.8	1.2	99.6	1.0
Percent consonants correct - middle	%	99.6	0.5	99.5	0.8	99.5	0.8	99.8	0.4	99.0	1.1	99.6	0.9
Percent consonants correct -late	%	99.7	0.4	98.0	3.4	97.3	1.1	98.9	1.2	99.8	0.5	99.7	0.7
Percent consonants correct - adjusted	%	99.5	0.6	99.7	0.5	98.6	0.7	99.6	0.3	99.1	0.5	99.7	0.7
Percent consonants correct - revised	%	99.5	0.6	99.7	0.5	98.8	0.7	99.7	0.4	99.1	0.5	99.7	0.7
Percent consonants correct revised - early	%	99.3	1.1	99.7	0.4	99.1	1.0	100.0	0.0	98.8	1.2	99.6	1.0
Percent consonants correct revised - middle	%	99.6	0.5	99.5	0.8	99.5	0.8	100.0	0.0	99.0	1.1	99.6	0.9
Percent consonants correct revised - late	%	99.7	0.4	99.8	0.5	97.7	1.1	98.9	1.2	99.8	0.5	100.0	0.0
Percent consonants in the inventory	%	100.0	0.0	100.0	0.0	99.1	1.2	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	100.0	0.0	100.0	0.0	97.2	3.8	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Absolute omission index	%	0.4	0.6	0.3	0.4	0.2	0.2	0.1	0.1	0.9	0.5	0.3	0.7
Absolute omission index - early	%	0.6	1.1	0.3	0.4	0.3	0.7	0.0	0.0	1.2	1.2	0.4	1.0

Absolute omission index - middle	%	0.4	0.5	0.6	0.8	0.2	0.4	0.0	0.0	1.0	1.1	0.4	0.9
Absolute omission index - late	%	0.3	0.4	0.0	0.0	0.0	0.0	0.2	0.5	0.2	0.5	0.0	0.0
Absolute substitution index	%	0.1	0.1	0.1	0.1	1.1	0.6	0.3	0.3	0.0	0.0	0.0	0.0
Absolute substitution index - early	%	0.1	0.3	0.0	0.0	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Absolute substitution index - middle	%	0.0	0.0	0.0	0.0	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Absolute substitution index - late	%	0.0	0.0	0.2	0.5	2.3	1.1	0.9	1.1	0.0	0.0	0.0	0.0
Absolute distortion index	%	0.0	0.0	0.5	0.9	0.2	0.2	0.1	0.1	0.0	0.0	0.1	0.2
Absolute distortion index - early	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - middle	%	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0
Absolute distortion index - late	%	0.0	0.0	1.8	3.5	0.5	0.4	0.0	0.0	0.0	0.0	0.3	0.7
Vowels & Consonants													
Intelligibility index	%	99.6	0.6	100.0	0.0	99.6	0.6	99.9	0.2	100.0	0.0	100.0	0.0
Percentage of phonemes correct	%	99.6	0.4	99.5	0.5	99.1	0.5	99.8	0.2	99.4	0.4	99.7	0.5
Percentage of phonemes correct - revised	%	99.6	0.4	99.8	0.3	99.2	0.4	99.8	0.2	99.5	0.3	99.8	0.4
Phrasing													
Percentage of Phrasing correct	%	89.2	3.7	93.3	4.8	80.0	3.5	92.5	10.4	83.3	12.2	96.7	3.5
Rate													
Percentage of Rate correct	%	99.2	1.9	99.2	1.9	99.2	1.9	100.0	0.0	99.2	1.9	99.2	1.9
Stress													
Percentage of Stress correct	%	97.5	2.3	97.5	2.3	95.8	7.2	98.3	3.7	90.8	9.0	98.3	3.7
Loudness													
Percentage of Loudness correct	%	95.0	5.4	98.3	2.3	100.0	0.0	99.2	1.9	98.3	3.7	95.8	5.1
Pitch													
Percentage of Pitch correct	%	95.5	3.9	98.3	3.7	100.0	0.0	100.0	0.0	94.1	5.8	93.3	8.6
Laryngeal Quality													

Percentage of Laryngeal Quality correct	%	50.8	42.4	87.0	13.1	85.0	29.0	97.5	3.7	76.7	32.2	29.9	37.4
Resonance Quality													
Percentage of Resonance Quality correct	%	82.5	39.1	80.8	42.9	100.0	0.0	100.0	0.0	64.2	49.6	100.0	0.0

Speech Competence Index Signs: Typical Speakers
Reference Data 5

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	99.9	0.2	100.0	0.0	100.0	0.0	99.8	0.2	100.0	0.0	100.0	0.0
Percent vowels correct non-rhotic	%	99.9	0.2	100.0	0.0	100.0	0.0	99.8	0.2	100.0	0.0	100.0	0.0
Percent vowels correct - revised	%	99.9	0.2	100.0	0.0	100.0	0.0	99.9	0.2	100.0	0.0	100.0	0.0
Consonants													
Percent consonants correct	%	99.4	0.4	99.8	0.3	99.3	0.8	98.2	2.8	99.6	0.6	99.8	0.2
Percent consonants correct - early	%	99.7	0.3	100.0	0.0	98.8	1.7	99.5	0.7	100.0	0.0	100.0	0.0
Percent consonants correct - middle	%	99.7	0.5	99.6	0.6	99.3	0.4	99.6	0.5	99.6	0.5	99.9	0.3
Percent consonants correct -late	%	98.9	1.2	99.6	0.8	99.8	0.4	95.6	8.9	98.9	1.8	99.6	0.6
Percent consonants correct - adjusted	%	99.5	0.4	99.8	0.2	99.3	0.8	99.6	0.3	99.6	0.6	99.8	0.2
Percent consonants correct - revised	%	99.5	0.4	99.8	0.2	99.3	0.8	99.6	0.3	99.6	0.6	99.8	0.2
Percent consonants correct revised - early	%	99.7	0.3	100.0	0.0	98.8	1.7	99.5	0.7	100.0	0.0	100.0	0.0
Percent consonants correct revised - middle	%	99.9	0.3	99.6	0.6	99.3	0.4	99.6	0.5	99.6	0.5	99.9	0.3
Percent consonants correct revised - late	%	99.0	0.9	99.8	0.4	99.8	0.4	99.7	0.5	99.0	1.8	99.6	0.6
Percent consonants in the inventory	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Absolute omission index	%	0.3	0.3	0.0	0.0	0.5	0.5	0.4	0.4	0.1	0.1	0.0	0.0
Absolute omission index - early	%	0.3	0.3	0.0	0.0	1.0	1.6	0.5	0.7	0.0	0.0	0.0	0.0

Absolute omission index - middle	%	0.0	0.0	0.0	0.0	0.6	0.5	0.4	0.5	0.2	0.3	0.0	0.0
Absolute omission index - late	%	0.4	0.6	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0
Absolute substitution index	%	0.2	0.3	0.2	0.2	0.2	0.3	0.1	0.1	0.3	0.6	0.2	0.2
Absolute substitution index - early	%	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Absolute substitution index - middle	%	0.1	0.3	0.4	0.6	0.2	0.5	0.0	0.0	0.2	0.5	0.1	0.3
Absolute substitution index - late	%	0.5	0.8	0.2	0.4	0.2	0.4	0.2	0.4	1.0	1.8	0.4	0.6
Absolute distortion index	%	0.1	0.2	0.1	0.1	0.0	0.0	1.4	3.0	0.1	0.1	0.0	0.0
Absolute distortion index - early	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - middle	%	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - late	%	0.2	0.4	0.2	0.4	0.0	0.0	4.0	9.0	0.2	0.3	0.0	0.0
Vowels & Consonants													
Intelligibility index	%	100.0	0.0	99.8	0.3	99.9	0.3	100.0	0.0	99.7	0.5	99.8	0.6
Percentage of phonemes correct	%	99.6	0.3	99.9	0.2	99.6	0.5	98.8	1.8	99.7	0.4	99.9	0.1
Percentage of phonemes correct - revised	%	99.7	0.3	99.9	0.1	99.6	0.5	99.7	0.2	99.8	0.4	99.9	0.1
Phrasing													
Percentage of Phrasing correct	%	90.0	8.1	91.7	8.8	93.3	4.8	92.5	8.5	89.2	12.7	95.0	5.4
Rate													
Percentage of Rate correct	%	100.0	0.0	100.0	0.0	100.0	0.0	99.2	1.9	99.2	1.9	95.0	6.9
Stress													
Percentage of Stress correct	%	87.5	14.7	95.8	4.2	98.3	2.3	99.2	1.9	95.0	7.5	95.0	9.0
Loudness													
Percentage of Loudness correct	%	100.0	0.0	97.5	3.7	98.3	2.3	95.0	9.0	100.0	0.0	100.0	0.0
Pitch													
Percentage of Pitch correct	%	100.0	0.0	100.0	0.0	95.7	7.5	97.5	5.6	100.0	0.0	100.0	0.0
Laryngeal Quality													

Percentage of Laryngeal Quality correct	%	100.0	0.0	99.2	1.9	90.7	5.5	85.0	16.0	100.0	0.0	97.5	2.3
Resonance Quality													
Percentage of Resonance Quality correct	%	100.0	0.0	100.0	0.0	80.0	44.7	85.8	31.7	100.0	0.0	100.0	0.0

Speech Competence Index Signs: Typical Speakers
Reference Data 6

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	99.9	0.2	99.8	0.2	99.8	0.2	100.0	0.0	99.9	0.1	99.9	0.2
Percent vowels correct non-rhotic	%	99.9	0.2	99.8	0.2	99.8	0.3	100.0	0.0	99.9	0.2	99.9	0.2
Percent vowels correct - revised	%	99.9	0.1	99.8	0.2	99.9	0.2	100.0	0.0	99.9	0.1	99.9	0.2
Consonants													
Percent consonants correct	%	99.8	0.3	99.3	0.7	99.7	0.5	99.4	0.3	99.8	0.2	99.8	0.3
Percent consonants correct - early	%	100.0	0.0	99.7	0.4	100.0	0.0	99.9	0.3	100.0	0.0	99.9	0.2
Percent consonants correct - middle	%	99.8	0.3	100.0	0.0	99.8	0.4	99.6	0.5	100.0	0.0	100.0	0.0
Percent consonants correct -late	%	99.5	0.7	98.3	1.7	99.2	1.6	98.4	1.1	99.2	0.6	99.6	0.5
Percent consonants correct - adjusted	%	99.8	0.3	99.3	0.7	99.7	0.4	99.4	0.2	99.8	0.2	99.8	0.3
Percent consonants correct - revised	%	99.8	0.3	99.4	0.6	99.7	0.4	99.4	0.1	99.8	0.1	99.8	0.3
Percent consonants correct revised - early	%	100.0	0.0	99.7	0.4	100.0	0.0	100.0	0.0	100.0	0.0	99.9	0.2
Percent consonants correct revised - middle	%	99.8	0.3	100.0	0.0	99.8	0.4	99.6	0.5	100.0	0.0	100.0	0.0
Percent consonants correct revised - late	%	99.5	0.7	98.5	1.4	99.4	1.2	98.6	0.8	99.4	0.4	99.6	0.5
Percent consonants in the inventory	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Absolute omission index	%	0.0	0.0	0.2	0.3	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Absolute omission index - early	%	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Absolute omission index - middle	%	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.5	0.0	0.0	0.0	0.0
Absolute omission index - late	%	0.0	0.0	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute substitution index	%	0.3	0.3	0.4	0.3	0.2	0.4	0.4	0.2	0.2	0.1	0.2	0.3
Absolute substitution index - early	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
Absolute substitution index - middle	%	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute substitution index - late	%	0.6	0.7	1.2	1.0	0.6	1.2	1.4	0.8	0.6	0.4	0.4	0.5
Absolute distortion index	%	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.0	0.0
Absolute distortion index - early	%	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
Absolute distortion index - middle	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - late	%	0.0	0.0	0.2	0.5	0.2	0.4	0.2	0.3	0.3	0.5	0.0	0.0
Vowels & Consonants													
Intelligibility index	%	100.0	0.0	99.8	0.3	99.9	0.3	100.0	0.0	99.8	0.3	99.9	0.3
Percentage of phonemes correct	%	99.8	0.2	99.5	0.5	99.7	0.4	99.6	0.2	99.8	0.1	99.8	0.2
Percentage of phonemes correct - revised	%	99.8	0.2	99.6	0.4	99.8	0.2	99.7	0.1	99.9	0.1	99.8	0.2
Phrasing													
Percentage of Phrasing correct	%	82.3	13.8	90.6	16.1	77.1	10.5	82.3	6.3	81.3	8.0	89.6	5.4
Rate													
Percentage of Rate correct	%	99.0	2.1	99.0	2.1	100.0	0.0	100.0	0.0	100.0	0.0	96.9	6.3
Stress													
Percentage of Stress correct	%	97.9	4.2	96.9	4.0	95.8	3.4	96.9	2.1	96.9	4.0	99.0	2.1
Loudness													
Percentage of Loudness correct	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Pitch													
Percentage of Pitch correct	%	92.7	9.9	97.9	4.2	97.9	4.2	100.0	0.0	100.0	0.0	100.0	0.0
Laryngeal Quality													

Percentage of Laryngeal Quality correct	%	100.0	0.0	96.9	6.3	91.7	16.7	100.0	0.0	99.0	2.1	100.0	0.0
Resonance Quality													
Percentage of Resonance Quality correct	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0

Speech Competence Index Signs: Typical Speakers
Reference Data 7

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	99.9	0.1	100.0	0.0	99.8	0.4	99.9	0.2	99.8	0.2	99.9	0.2
Percent vowels correct non-rhotic	%	99.9	0.1	100.0	0.0	100.0	0.0	99.9	0.2	99.9	0.2	99.9	0.2
Percent vowels correct - revised	%	99.9	0.1	100.0	0.0	100.0	0.0	99.9	0.2	99.8	0.2	99.9	0.2
Consonants													
Percent consonants correct	%	99.9	0.1	99.3	0.8	99.5	0.2	99.6	0.1	99.6	0.3	99.7	0.2
Percent consonants correct - early	%	99.9	0.2	99.8	0.4	100.0	0.0	99.8	0.4	99.8	0.3	99.9	0.2
Percent consonants correct - middle	%	99.9	0.3	99.6	0.8	100.0	0.0	100.0	0.0	99.8	0.4	99.7	0.4
Percent consonants correct -late	%	100.0	0.0	98.6	1.2	98.5	0.5	99.1	0.3	99.0	0.6	99.4	0.6
Percent consonants correct - adjusted	%	99.9	0.1	99.6	0.3	99.6	0.3	99.6	0.1	99.6	0.3	99.7	0.2
Percent consonants correct - revised	%	100.0	0.1	99.6	0.3	99.6	0.3	99.6	0.1	99.6	0.3	99.7	0.2
Percent consonants correct revised - early	%	100.0	0.0	99.8	0.4	100.0	0.0	99.8	0.4	99.8	0.3	99.9	0.2
Percent consonants correct revised - middle	%	99.9	0.3	99.6	0.8	100.0	0.0	100.0	0.0	99.8	0.4	99.7	0.4
Percent consonants correct revised - late	%	100.0	0.0	99.3	0.6	98.7	0.9	99.1	0.3	99.1	0.6	99.4	0.6
Percent consonants in the inventory	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Absolute omission index	%	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1
Absolute omission index - early	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0

Absolute omission index - middle	%	0.0	0.0	0.4	0.8	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.3
Absolute omission index - late	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0
Absolute substitution index	%	0.0	0.1	0.3	0.1	0.4	0.3	0.4	0.1	0.2	0.2	0.3	0.2
Absolute substitution index - early	%	0.0	0.0	0.2	0.4	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.2
Absolute substitution index - middle	%	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
Absolute substitution index - late	%	0.0	0.0	0.7	0.6	1.3	0.9	0.9	0.3	0.7	0.5	0.6	0.6
Absolute distortion index	%	0.0	0.1	0.3	0.5	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Absolute distortion index - early	%	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - middle	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - late	%	0.0	0.0	0.8	1.6	0.2	0.5	0.0	0.0	0.1	0.3	0.0	0.0
Vowels & Consonants													
Intelligibility index	%	100.0	0.0	100.0	0.0	100.0	0.0	99.9	0.2	99.7	0.5	99.7	0.5
Percentage of phonemes correct	%	99.9	0.1	99.6	0.5	99.6	0.2	99.8	0.1	99.7	0.2	99.8	0.2
Percentage of phonemes correct - revised	%	99.9	0.0	99.8	0.2	99.7	0.2	99.8	0.1	99.7	0.1	99.8	0.1
Phrasing													
Percentage of Phrasing correct	%	78.1	5.2	86.5	8.6	75.0	24.5	77.1	8.0	76.7	12.7	87.5	7.8
Rate													
Percentage of Rate correct	%	100.0	0.0	100.0	0.0	99.0	2.1	99.0	2.1	100.0	0.0	100.0	0.0
Stress													
Percentage of Stress correct	%	99.0	2.1	94.8	4.0	90.6	7.1	97.9	2.4	87.5	9.8	95.8	5.9
Loudness													
Percentage of Loudness correct	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Pitch													
Percentage of Pitch correct	%	100.0	0.0	99.0	2.1	100.0	0.0	100.0	0.0	100.0	0.0	91.7	18.6
Laryngeal Quality													

Percentage of Laryngeal Quality correct	%	100.0	0.0	90.6	12.0	90.6	16.1	100.0	0.0	76.7	41.5	100.0	0.0
Resonance Quality													
Percentage of Resonance Quality correct	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0

Speech Competence Index Signs: Typical Speakers
Reference Data 8

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	98.7	1.4	97.8	2.1	99.2	1.5	99.3	1.5	99.7	0.4	99.9	0.2
Percent vowels correct non-rhotic	%	99.1	0.7	98.9	0.5	99.5	0.6	99.6	0.5	99.7	0.3	99.9	0.2
Percent vowels correct - revised	%	99.0	0.9	98.3	1.4	99.5	0.7	99.5	0.7	99.7	0.4	99.9	0.2
Consonants													
Percent consonants correct	%	88.3	8.1	90.9	7.2	97.6	2.9	98.0	2.2	99.2	0.8	99.1	0.9
Percent consonants correct - early	%	97.9	1.9	97.7	1.8	98.8	2.2	99.4	0.9	99.5	0.8	99.5	0.9
Percent consonants correct - middle	%	93.3	6.4	95.5	3.2	98.5	2.1	98.2	1.7	99.1	1.2	99.3	1.1
Percent consonants correct -late	%	93.3	6.4	95.5	3.2	98.5	2.1	98.2	1.7	99.1	1.2	99.3	1.1
Percent consonants correct - adjusted	%	93.9	4.6	95.0	3.4	98.3	2.4	98.8	1.1	99.4	0.4	99.4	0.6
Percent consonants correct - revised	%	94.0	4.5	95.2	3.0	98.4	2.3	98.8	1.1	99.5	0.4	99.4	0.6
Percent consonants correct revised - early	%	98.0	1.9	97.8	1.8	98.9	2.2	99.4	0.9	99.6	0.7	99.5	0.9
Percent consonants correct revised - middle	%	93.8	6.1	95.7	3.1	98.7	1.9	98.2	1.7	99.2	1.0	99.3	1.1
Percent consonants correct revised - late	%	88.6	9.2	90.6	8.4	97.6	3.3	98.5	2.2	99.5	0.6	99.4	0.8
Percent consonants in the inventory	%	96.0	4.3	97.0	4.0	99.3	2.2	99.8	1.0	99.7	0.8	99.8	0.6
Percent consonants in the inventory - early	%	100.0	0.0	99.6	1.7	100.0	0.0	100.0	0.0	99.6	1.6	100.0	0.0
Percent consonants in the inventory - middle	%	96.5	7.2	96.8	4.2	99.3	3.0	99.3	3.0	99.5	2.0	100.0	0.0
Percent consonants in the inventory - late	%	90.3	10.4	94.1	10.1	98.5	4.2	100.0	0.0	100.0	0.0	99.5	2.0
Absolute omission index	%	1.7	1.1	1.6	0.9	0.6	0.9	0.5	0.5	0.4	0.4	0.3	0.3
Absolute omission index - early	%	1.1	1.1	1.4	1.2	0.7	1.1	0.3	0.5	0.4	0.7	0.2	0.3

Absolute omission index - middle	%	2.7	2.4	1.8	1.6	0.6	1.0	1.1	1.1	0.6	0.9	0.6	0.8
Absolute omission index - late	%	1.5	1.3	1.6	1.7	0.5	0.8	0.3	0.7	0.3	0.4	0.1	0.3
Absolute substitution index	%	4.4	3.8	3.2	2.4	1.0	1.5	0.7	0.7	0.1	0.2	0.3	0.5
Absolute substitution index - early	%	1.0	1.2	0.8	1.1	0.5	1.1	0.3	0.5	0.0	0.2	0.3	0.8
Absolute substitution index - middle	%	3.5	4.9	2.5	2.0	0.7	1.1	0.6	1.1	0.2	0.4	0.2	0.4
Absolute substitution index - late	%	9.9	8.5	7.9	7.8	1.9	2.9	1.3	1.8	0.2	0.5	0.5	0.7
Absolute distortion index	%	5.7	5.5	4.4	5.0	0.8	1.3	0.8	1.5	0.3	0.7	0.4	0.8
Absolute distortion index - early	%	0.1	0.2	0.1	0.4	0.1	0.3	0.0	0.2	0.1	0.2	0.0	0.0
Absolute distortion index - middle	%	0.5	1.5	0.2	0.6	0.2	0.8	0.0	0.0	0.1	0.3	0.0	0.0
Absolute distortion index - late	%	18.5	18.2	15.0	16.3	2.1	3.9	2.6	4.7	0.8	2.1	1.2	2.8
Vowels & Consonants													
Intelligibility index	%	98.3	1.4	98.1	1.9	99.5	0.9	99.7	0.5	99.6	0.8	99.9	0.3
Percentage of phonemes correct	%	92.4	5.2	93.7	4.9	98.2	2.2	98.5	1.8	99.4	0.5	99.4	0.5
Percentage of phonemes correct - revised	%	96.0	2.9	96.5	2.3	98.8	1.5	99.1	0.9	99.6	0.3	99.6	0.3
Phrasing													
Percentage of Phrasing correct	%	84.4	12.9	87.3	9.1	82.7	10.6	90.6	6.0	87.8	9.1	91.7	7.2
Rate													
Percentage of Rate correct	%	98.6	3.4	96.8	9.5	99.4	2.0	97.9	5.7	98.2	3.2	98.9	2.5
Stress													
Percentage of Stress correct	%	84.8	9.7	89.4	7.6	89.0	8.1	90.2	6.8	95.3	5.2	93.6	5.9
Loudness													
Percentage of Loudness correct	%	86.0	19.9	85.6	13.0	96.0	5.8	96.3	7.1	94.7	7.8	98.9	1.9
Pitch													
Percentage of Pitch correct	%	91.6	10.2	93.6	7.5	92.5	7.5	95.9	5.4	93.0	8.6	96.8	5.6
Laryngeal Quality													
Percentage of Laryngeal Quality correct	%	78.7	24.5	76.8	21.5	84.0	20.3	85.9	19.0	72.6	31.3	74.4	28.1

Resonance Quality													
Percentage of Resonance Quality correct	%	92.8	13.2	80.0	30.5	82.7	30.5	83.8	32.8	88.3	26.3	93.3	24.7

Speech Competence Index Signs: Typical Speakers
Reference Data 9

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	99.9	0.1	100.0	0.1	99.9	0.2	99.9	0.2	99.8	0.3	99.9	0.2
Percent vowels correct non-rhotic	%	99.9	0.2	100.0	0.1	99.9	0.2	99.9	0.2	99.9	0.1	99.9	0.2
Percent vowels correct - revised	%	100.0	0.1	100.0	0.1	99.9	0.1	99.9	0.2	99.9	0.2	99.9	0.2
Consonants													
Percent consonants correct	%	99.2	0.7	99.4	1.3	99.8	0.3	99.5	0.5	99.5	0.2	99.7	0.2
Percent consonants correct - early	%	99.3	1.1	99.8	0.6	100.0	0.1	99.8	0.3	99.9	0.2	99.9	0.3
Percent consonants correct - middle	%	99.4	0.7	99.7	0.6	99.9	0.3	99.8	0.4	99.9	0.3	99.8	0.3
Percent consonants correct -late	%	98.9	1.4	98.7	4.0	99.5	0.9	98.7	1.2	98.8	0.6	99.3	0.5
Percent consonants correct - adjusted	%	99.2	0.7	99.7	0.4	99.8	0.3	99.5	0.4	99.6	0.3	99.7	0.2
Percent consonants correct - revised	%	99.3	0.6	99.7	0.4	99.8	0.3	99.6	0.4	99.6	0.3	99.7	0.2
Percent consonants correct revised - early	%	99.3	1.1	99.8	0.6	100.0	0.0	99.8	0.3	99.9	0.2	99.9	0.3
Percent consonants correct revised - middle	%	99.4	0.7	99.7	0.5	99.9	0.3	99.8	0.4	99.9	0.3	99.8	0.3
Percent consonants correct revised - late	%	99.1	1.2	99.6	0.7	99.6	0.7	99.0	0.9	98.9	0.7	99.3	0.5
Percent consonants in the inventory	%	99.8	0.6	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - early	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	99.5	1.9	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Absolute omission index	%	0.4	0.5	0.1	0.3	0.0	0.1	0.1	0.2	0.1	0.2	0.0	0.1
Absolute omission index - early	%	0.6	1.0	0.2	0.6	0.0	0.0	0.1	0.2	0.1	0.2	0.0	0.0

Absolute omission index - middle	%	0.4	0.7	0.2	0.5	0.1	0.2	0.2	0.4	0.1	0.3	0.1	0.2
Absolute omission index - late	%	0.1	0.4	0.1	0.3	0.0	0.0	0.1	0.3	0.1	0.2	0.0	0.0
Absolute substitution index	%	0.4	0.6	0.1	0.2	0.2	0.3	0.3	0.2	0.3	0.2	0.3	0.2
Absolute substitution index - early	%	0.1	0.3	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.3
Absolute substitution index - middle	%	0.2	0.4	0.1	0.3	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.3
Absolute substitution index - late	%	0.8	1.3	0.3	0.6	0.4	0.7	0.9	0.8	1.0	0.7	0.7	0.5
Absolute distortion index	%	0.1	0.1	0.3	1.4	0.1	0.1	0.1	0.3	0.1	0.1	0.0	0.0
Absolute distortion index - early	%	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
Absolute distortion index - middle	%	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Absolute distortion index - late	%	0.2	0.3	0.9	4.0	0.1	0.3	0.3	0.8	0.2	0.4	0.0	0.0
Vowels & Consonants													
Intelligibility index	%	99.8	0.4	99.9	0.3	99.9	0.2	99.9	0.2	99.8	0.4	99.8	0.4
Percentage of phonemes correct	%	99.5	0.4	99.6	0.9	99.8	0.2	99.7	0.3	99.6	0.2	99.8	0.1
Percentage of phonemes correct - revised	%	99.5	0.4	99.8	0.2	99.9	0.2	99.7	0.2	99.7	0.1	99.8	0.1
Phrasing													
Percentage of Phrasing correct	%	87.2	9.6	93.7	7.3	79.7	9.1	87.2	9.6	75.9	17.5	83.3	8.8
Rate													
Percentage of Rate correct	%	99.5	1.4	98.7	3.6	99.7	1.0	99.0	3.2	99.5	1.4	99.6	1.3
Stress													
Percentage of Stress correct	%	93.5	9.2	97.3	4.9	97.4	3.4	96.9	3.2	88.9	8.3	97.1	4.4
Loudness													
Percentage of Loudness correct	%	99.3	2.0	97.5	5.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Pitch													
Percentage of Pitch correct	%	98.0	4.7	98.2	5.0	97.7	5.7	99.2	2.3	100.0	0.0	91.7	17.6
Laryngeal Quality													
Percentage of Laryngeal Quality correct	%	90.5	20.0	81.8	31.8	97.7	8.3	96.9	7.2	82.9	31.8	100.0	0.0

Resonance Quality													
Percentage of Resonance Quality correct	%	88.8	31.1	97.2	14.2	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0

Speech Competence Index Signs: Typical Speakers
Reference Data 10

		Age (yrs)											
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Percent vowels correct	%	98.2	1.8	99.2	1.5	99.8	0.3	100.0	0.1	99.9	0.2	99.8	0.2
Percent vowels correct non-rhotic	%	99.0	0.6	99.6	0.5	99.8	0.3	100.0	0.1	99.9	0.2	99.9	0.2
Percent vowels correct - revised	%	98.6	1.2	99.5	0.7	99.8	0.3	100.0	0.1	99.9	0.1	99.9	0.2
Consonants													
Percent consonants correct	%	89.6	7.6	97.8	2.6	99.1	0.8	99.3	1.1	99.6	0.5	99.6	0.2
Percent consonants correct - early	%	97.8	1.8	99.1	1.7	99.5	0.8	99.5	0.9	99.9	0.2	99.9	0.2
Percent consonants correct - middle	%	94.4	5.1	98.4	1.9	99.2	1.1	99.6	0.6	99.8	0.4	99.9	0.3
Percent consonants correct -late	%	72.8	22.2	95.7	5.9	98.5	2.4	98.8	3.0	99.1	1.1	99.0	0.6
Percent consonants correct - adjusted	%	94.4	4.0	98.5	1.8	99.4	0.5	99.5	0.6	99.7	0.4	99.6	0.2
Percent consonants correct - revised	%	94.6	3.8	98.6	1.8	99.5	0.5	99.5	0.6	99.7	0.3	99.6	0.2
Percent consonants correct revised - early	%	97.9	1.8	99.2	1.7	99.5	0.8	99.5	0.9	99.9	0.2	99.9	0.2
Percent consonants correct revised - middle	%	94.7	4.8	98.5	1.8	99.3	1.1	99.6	0.6	99.8	0.4	99.9	0.3
Percent consonants correct revised - late	%	89.6	8.7	98.0	2.8	99.5	0.7	99.3	1.0	99.3	0.9	99.1	0.6
Percent consonants in the inventory	%	96.5	4.1	99.5	1.7	99.8	0.7	99.9	0.5	100.0	0.0	100.0	0.0
Percent consonants in the inventory - early	%	99.8	1.2	100.0	0.0	99.8	1.1	100.0	0.0	100.0	0.0	100.0	0.0
Percent consonants in the inventory - middle	%	96.6	5.8	99.3	2.9	99.7	1.4	99.7	1.4	100.0	0.0	100.0	0.0
Percent consonants in the inventory - late	%	92.2	10.3	99.2	3.0	99.7	1.4	100.0	0.0	100.0	0.0	100.0	0.0
Absolute omission index	%	1.6	1.0	0.6	0.7	0.3	0.3	0.3	0.4	0.1	0.2	0.1	0.1
Absolute omission index - early	%	1.2	1.2	0.5	0.9	0.3	0.5	0.4	0.8	0.0	0.2	0.1	0.2

Absolute omission index - middle	%	2.3	2.1	0.9	1.1	0.6	0.8	0.3	0.6	0.1	0.4	0.1	0.2
Absolute omission index - late	%	1.5	1.5	0.4	0.8	0.2	0.3	0.1	0.3	0.0	0.2	0.0	0.2
Absolute substitution index	%	3.8	3.2	0.8	1.2	0.2	0.3	0.3	0.4	0.2	0.3	0.3	0.2
Absolute substitution index - early	%	0.9	1.1	0.4	0.9	0.2	0.6	0.1	0.3	0.0	0.2	0.1	0.2
Absolute substitution index - middle	%	3.0	3.7	0.7	1.1	0.2	0.4	0.1	0.3	0.0	0.1	0.1	0.2
Absolute substitution index - late	%	8.9	8.1	1.6	2.4	0.3	0.6	0.6	1.0	0.7	0.8	0.9	0.6
Absolute distortion index	%	5.0	5.2	0.8	1.4	0.3	0.8	0.2	1.0	0.1	0.2	0.0	0.1
Absolute distortion index - early	%	0.1	0.3	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
Absolute distortion index - middle	%	0.3	1.1	0.1	0.6	0.1	0.2	0.0	0.2	0.0	0.0	0.0	0.0
Absolute distortion index - late	%	16.8	17.1	2.4	4.3	1.0	2.4	0.5	2.9	0.2	0.6	0.1	0.3
Vowels & Consonants													
Intelligibility index	%	98.2	1.6	99.6	0.7	99.7	0.6	99.9	0.3	99.9	0.2	99.8	0.4
Percentage of phonemes correct	%	93.1	5.0	98.4	2.0	99.4	0.5	99.6	0.7	99.7	0.3	99.7	0.2
Percentage of phonemes correct - revised	%	96.2	2.6	99.0	1.2	99.6	0.3	99.7	0.4	99.8	0.2	99.7	0.1
Phrasing													
Percentage of Phrasing correct	%	85.9	11.1	86.7	9.4	89.7	8.3	90.4	9.1	83.5	10.0	79.4	14.0
Rate													
Percentage of Rate correct	%	97.7	7.0	98.7	4.3	98.6	2.8	99.1	2.7	99.4	2.4	99.5	1.4
Stress													
Percentage of Stress correct	%	87.1	8.9	89.6	7.4	94.4	5.5	95.4	7.5	97.1	3.3	92.8	7.7
Loudness													
Percentage of Loudness correct	%	85.8	16.5	96.2	6.4	96.8	6.0	98.4	3.9	100.0	0.0	100.0	0.0
Pitch													
Percentage of Pitch correct	%	92.6	8.9	94.2	6.7	95.0	7.3	98.1	4.8	98.4	4.3	97.7	9.8
Laryngeal Quality													
Percentage of Laryngeal Quality correct	%	77.8	22.7	84.9	19.4	73.5	29.2	86.2	26.6	97.3	7.7	90.9	24.2

Resonance Quality													
Percentage of Resonance Quality correct	%	86.4	24.0	83.2	31.3	90.8	25.2	93.0	24.3	100.0	0.0	100.0	0.0

Syllable Repetition Task (SRT)

Sample PEPPER Output

There are no sample Syllable Repetition Task (SRT) computer outputs because the SRT subscale information is included in the Competence Measures Summary (CMS) computer output to be described.

Rationale and Description

The Syllable Repetition Task (SRT) is an 18-item imitation task used to assess psycholinguistic processes that occur when a speaker is asked to repeat 2 to 4-syllable nonwords (Lohmeier & Shriberg, 2011; Shriberg & Lohmeier, 2008; Shriberg, Lohmeier, Strand, & Jakielski, 2012; Shriberg et al., 2009) This task was designed to be administered to speakers whose incomplete phonetic inventories invalidate use of other nonword repetition tasks and/or who have speech production patterns that are difficult to transcribe and/or score. The only speech sounds in the SRT nonwords are the four voiced consonants /b/, /d/, /m/, and /n/ and the vowel /a/. SRT items are scored as correct if they include the correct number of syllables and the correct consonant productions. Addition description of methods and audio materials for the SRT is provided in the previous citations, which include two Phonology Project technical reports.

Reference Data

The following tables include descriptive statistics on performance, encoding, memory, and transcoding subscales of the SRT for the two databases of 3-80 year old typical speakers and for the participants in the database of 268 children ages 3 to 7 years with Idiopathic Speech Delay and No Motor Speech Disorder (see Table of Contents).

Syllable Repetition Task – Typical Speakers
Reference Data 1

	Age (yrs)																	
	3 yrs						4 yrs						5 yrs					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	66.0	23.8	62.4	15.3	64.2	18.9	82.4	11.2	75.6	19.9	79.0	15.6	85.6	11.9	84.4	11.6	85.0	11.1
Encoding %	36.3	24.2	39.5	5.6	37.9	16.6	70.4	22.2	48.0	11.6	60.5	20.9	68.3	31.4	68.5	31.1	68.4	29.5
Memory %	50.3	44.5	59.0	42.9	54.7	41.4	74.3	26.5	68.2	25.5	71.3	24.7	87.2	13.8	93.8	8.9	90.5	11.5
Transcoding %	94.4	9.6	81.1	26.2	87.8	19.9	86.7	10.1	87.8	12.0	87.2	10.5	95.6	4.6	88.9	10.4	92.2	8.4

Syllable Repetition Task – Typical Speakers
Reference Data 2

	Age (yrs)																	
	6 yrs						7 yrs						8 yrs					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	90.8	5.4	86.4	4.8	88.6	5.3	86.0	8.8	87.6	8.3	86.8	8.1	89.5	6.6	93.2	3.9	91.2	5.5
Encoding %	68.3	20.7	77.3	22.0	72.8	20.7	67.9	22.6	49.8	38.6	58.8	31.3	64.2	38.6	82.5	23.6	72.3	32.4
Memory %	94.1	5.9	84.3	7.5	89.2	8.2	94.5	4.2	89.8	17.2	92.2	12.0	90.3	10.4	95.4	4.9	92.8	8.1
Transcoding %	93.3	7.2	92.2	9.3	92.8	7.9	91.1	6.3	94.4	6.8	92.8	6.4	94.4	5.6	93.3	6.1	93.9	5.5

Syllable Repetition Task – Typical Speakers
Reference Data 3

	Age (yrs)																	
	9 yrs						10 yrs						11 yrs					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	87.6	11.0	93.6	8.2	90.6	9.7	88.0	12.9	90.8	6.6	89.4	9.8	90.4	10.1	94.4	7.1	92.4	8.5
Encoding %	63.4	41.1	73.3	46.2	67.1	40.0	87.3	15.3	62.5	32.3	74.9	26.9	74.1	19.2	91.7	16.7	82.9	19.1
Memory %	77.3	28.8	88.4	16.9	82.8	23.0	87.6	16.1	81.8	15.6	84.7	15.3	88.5	13.3	95.2	7.9	91.9	10.9
Transcoding %	97.8	5.0	100.0	0.0	98.9	3.5	94.4	7.9	93.3	7.2	93.9	7.1	95.6	6.1	97.8	3.0	96.7	4.7

Syllable Repetition Task – Typical Speakers
Reference Data 4

	Age (yrs)																	
	12 yrs						13 yrs						14 yrs					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	97.6	3.3	94.8	4.1	96.2	3.8	93.2	5.2	95.5	4.7	94.3	4.8	98.0	2.4	97.2	5.2	97.6	3.9
Encoding %	91.7	14.4	81.7	21.3	86.0	18.0	60.0	30.3	75.0	43.3	66.4	33.9	88.9	19.2	100.0	*	91.7	16.7
Memory %	96.5	5.2	93.8	10.9	95.2	8.2	97.6	5.3	92.7	10.0	95.2	8.0	95.4	4.9	98.9	2.6	97.1	4.1
Transcoding %	98.9	2.5	100.0	0.0	99.4	1.8	95.6	4.6	97.8	5.0	96.7	4.7	100.0	0.0	97.8	5.0	98.9	3.5

Syllable Repetition Task – Typical Speakers
Reference Data 5

	Age (yrs)																	
	15 yrs						16 yrs						17 yrs					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	91.6	5.4	96.0	5.8	93.8	5.8	98.4	3.6	97.2	3.3	97.8	3.3	93.6	3.3	99.2	1.8	96.4	3.9
Encoding %	68.3	32.5	42.9	51.5	58.8	39.2	100.0	*	50.0	50.0	62.5	47.9	65.0	33.5	50.0	*	62.5	30.6
Memory %	100.0	0.0	96.5	5.2	98.3	4.0	100.0	0.0	97.7	3.1	98.9	2.4	94.3	*	100.0	0.0	97.1	3.0
Transcoding %	98.9	2.5	100.0	0.0	99.4	1.8	100.0	0.0	100.0	0.0	100.0	0.0	97.8	3.0	97.8	3.0	97.8	2.9

Syllable Repetition Task – Typical Speakers
Reference Data 6

	Age (yrs)																	
	20-29 yrs						30-39 yrs						40-49 yrs					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	96.5	4.1	95.5	5.3	96.0	4.4	97.5	3.0	97.5	5.0	97.5	3.8	99.0	2.0	100.0	0.0	99.5	1.4
Encoding %	58.3	11.8	55.0	7.1	56.7	8.2	33.3	47.1	60.0	*	42.2	36.7	100.0	*	*	*	100.0	*
Memory %	100.0	0.0	98.6	2.9	99.3	2.0	98.6	2.9	100.0	0.0	99.3	2.0	100.0	0.0	100.0	0.0	100.0	0.0
Transcoding %	100.0	0.0	98.6	2.8	99.3	2.0	100.0	0.0	98.6	5.0	99.3	2.0	100.0	0.0	100.0	0.0	100.0	0.0

Syllable Repetition Task – Typical Speakers
Reference Data 7

	Age (yrs)																	
	50-59 yrs						60-69 yrs						70-80 yrs					
	Male		Female		Both		Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	99.0	1.2	99.0	2.0	99.0	1.5	96.0	5.7	93.0	11.4	94.5	8.5	94.8	7.6	92.0	11.7	93.4	9.4
Encoding %	50.0	70.7	100.0	*	66.7	57.7	41.7	11.8	66.7	47.1	54.2	31.5	66.7	33.3	71.4	25.8	69.0	26.8
Memory %	98.6	2.9	100.0	0.0	99.3	2.0	90.8	12.0	92.3	11.9	91.5	11.1	90.7	17.7	92.3	14.1	91.5	15.1
Transcoding %	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	93.3	12.0	96.7	8.8

Syllable Repetition Task – Idiopathic Speech Delay
Reference Data 8

	Age (yrs)											
	3 yrs						4 yrs					
	Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	60.0	17.9	46.7	21.3	56.2	19.4	64.1	19.4	63.7	14.5	64.0	17.9
Encoding %	47.7	23.7	41.5	13.7	46.2	21.5	50.5	22.4	51.7	18.0	50.9	21.0
Memory %	61.5	34.2	54.7	31.2	59.6	32.8	69.8	28.3	66.8	26.2	68.9	27.5
Transcoding %	83.7	19.1	90.7	9.1	85.7	16.9	83.9	15.0	82.5	13.0	83.4	14.3

Syllable Repetition Task – Idiopathic Speech Delay
Reference Data 9

	Age (yrs)											
	5 yrs						6 yrs					
	Male		Female		Both		Male		Female		Both	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Performance %	70.0	12.6	74.7	15.1	71.8	13.6	70.2	11.1	69.2	26.2	69.9	15.8
Encoding %	53.0	16.2	48.1	20.8	51.2	17.9	52.8	14.3	48.3	9.1	51.6	12.9
Memory %	74.2	20.9	73.5	24.7	74.0	22.1	66.3	19.7	58.5	36.2	64.1	24.4
Transcoding %	82.6	14.2	86.5	13.0	84.1	13.7	79.9	17.4	86.7	7.5	81.8	15.3

Competence Measures Summary (CMS)

Sample PEPPER Output

Sample PEPPER Output 1 and 2, respectively, are sample outputs from the group and individual forms of the Competence Measures Summary (CMS). The following section includes rationale and description of these PEPPER outputs.

Rationale and Description

Rationale for the group and individual CMS was that it would be useful to provide in a one-page output, a summary of estimates of a speaker's speech, prosody, voice, and speech processes competence. In the SDCS framework, measures of competence are based on perceptual methods completed by well-trained speech-language pathologists, whereas measures of precision and stability use both perceptual and acoustic methods, the latter completed by well-trained acoustic analysts. A long term goal of assessment procedures in the health sciences is to automate all possible measures using emerging technologies.

The sample CMS group (Sample PEPPER Output 1) and individual (Sample PEPPER Output 2) outputs include competence estimates from six measurement domains. The first four sections in the CMS provide group and individual estimates speech competence, including estimates of intelligibility, consonants correct, and the 38 item Speech Competence Index that samples 10 linguistic domains. The fifth section provides summary estimates of prosody-voice variables and the sixth section (the Speech Repetition Task) described in the next section provides summary estimates of four domains of speech processing.

Competence Measures Summary (CMS): Group

Sample PEPPER Output 1

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		50	**79.4**	**-4.94**	**15.0**	**0.41**	**26.0**	**-5.00**	**99.0**	**-2.12**

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			22	**44.0**	**9**	**18.0**	**19**	**38.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		50	**78.5**	**-4.96**	**8.8**	**0.24**	**56.9**	**-5.00**	**93.3**	**-3.29**

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		50	**17.8**		**4.8**		**7.9**		**31.6**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**50**	**30.0**
Rate		**50**	**48.0**
Stress		**50**	**72.0**
Loudness		**50**	**6.0**
Pitch		**50**	**6.0**
Laryngeal Quality		**49**	**40.8**
Resonance Quality		**50**	**92.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**13**	**70.2**	**-3.72**	**11.2**	**1.23**	**52.0**	**-5.00**	**86.0**	**-1.24**
Encoding		**13**	**40.3**	**-1.26**	**12.0**	**0.90**	**23.1**	**-3.09**	**57.1**	**0.17**
Memory		**13**	**65.3**	**-2.80**	**23.5**	**1.97**	**27.6**	**-5.00**	**95.1**	**0.21**
Transcoding		**13**	**67.1**	**-4.22**	**17.6**	**1.51**	**38.9**	**-5.00**	**94.4**	**-0.19**

Competence Measures Summary (CMS): Individual

Sample PEPPER Output 2

Measure	Abbreviation	Score	
Intelligibility Index	**II**	**%**	**Z**
		99.0	**-2.12**
Ordinal Intelligibility Index	**OII**	**Competence**	
		High	

Percentage of Consonants Correct	PCC	Score	
		%	**Z**
		89.2	**-2.12**

Speech Competence Index	SCI	Score	
		%	
		26.3	

Prosody-Voice Screening Profile	PVSP	Score	
		%	**Z**
Phrasing		**87.5**	**-0.91**
Rate		**100.0**	**0.56**
Stress		**70.8**	**-4.02**
Loudness		**100.0**	**0.38**
Pitch		**100.0**	**0.32**
Laryngeal Quality		**95.8**	**0.36**
Resonance Quality		**4.2**	**-3.96**

Syllable Repetition Task	SRT	Score	
		%	**Z**
Performance		**86.0**	**-4.45**
Encoding		**57.1**	**0.17**
Memory		**67.5**	**-5.00**
Transcoding		**88.9**	**-4.27**

Reference Data

Reference data for each of the six tables in this summary output is included in other sections of this technical report or previous technical reports. The following CMS PEPPER outputs are provided for typical speakers and Idiopathic Speech Delay groups (see Table of Contents).

Age: 3 yrs Typical Speakers

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**97.7**		**1.0**		**96.6**		**99.1**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**81.7**		**6.4**		**74.8**		**90.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**85.3**		**3.0**		**81.6**		**89.5**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**40.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**20.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**40.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**66.0**		**23.8**		**34.0**		**94.0**	
Encoding		**5**	**36.3**		**24.2**		**0.0**		**62.5**	
Memory		**5**	**50.3**		**44.5**		**0.0**		**100.0**	
Transcoding		**5**	**94.4**		**9.6**		**77.8**		**100.0**	

Age: 3 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**97.5**		**2.0**		**94.0**		**99.1**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**85.9**		**8.0**		**73.3**		**94.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**88.9**		**9.7**		**73.7**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**20.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**60.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**62.4**		**15.3**		**40.0**		**78.0**	
Encoding		**5**	**39.5**		**5.6**		**30.0**		**44.4**	
Memory		**5**	**59.0**		**42.9**		**0.0**		**100.0**	
Transcoding		**5**	**81.1**		**26.2**		**38.9**		**100.0**	

Age: 3 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**97.6**		**1.5**		**94.0**		**99.1**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**83.8**		**7.2**		**73.3**		**94.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**87.1**		**7.1**		**73.7**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**30.0**
Rate		**10**	**0.0**
Stress		**10**	**20.0**
Loudness		**10**	**20.0**
Pitch		**10**	**20.0**
Laryngeal Quality		**10**	**20.0**
Resonance Quality		**10**	**50.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**64.2**		**18.9**		**34.0**		**94.0**	
Encoding		**10**	**37.9**		**16.6**		**0.0**		**62.5**	
Memory		**10**	**54.7**		**41.4**		**0.0**		**100.0**	
Transcoding		**10**	**87.8**		**19.9**		**38.9**		**100.0**	

Age: 4 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.5**		**1.9**		**95.9**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**88.6**	**0.47**	**6.9**	**0.95**	**82.4**	**-0.38**	**98.8**	**1.88**

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**91.6**		**14.8**		**65.8**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**82.4**	**0.42**	**11.2**	**0.57**	**72.0**	**-0.11**	**98.0**	**1.22**
Encoding		**5**	**70.4**	**0.60**	**22.2**	**0.78**	**40.0**	**-0.47**	**100.0**	**1.65**
Memory		**5**	**74.3**	**0.33**	**26.5**	**0.72**	**30.7**	**-0.86**	**100.0**	**1.02**
Transcoding		**5**	**86.7**	**-0.38**	**10.1**	**0.99**	**77.8**	**-1.26**	**100.0**	**0.93**

Age: 4 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		5	98.3	0.20	2.1	1.05	95.2	-1.36	100.0	1.08
Ordinal Intelligibility Index	OII		High		Moderate		Low			
			n	%	n	%	n	%		
			5	100.0	0	0.0	0	0.0		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		5	89.0	0.24	4.7	0.73	84.2	-0.52	94.6	1.12

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		5	88.4		14.0		65.8		100.0	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		5	20.0
Rate		5	20.0
Stress		5	0.0
Loudness		5	40.0
Pitch		5	0.0
Laryngeal Quality		5	40.0
Resonance Quality		5	40.0

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		5	75.6	0.36	19.9	1.10	44.0	-1.38	96.0	1.49
Encoding		4	48.0	0.51	11.6	1.24	37.5	-0.62	62.5	2.07
Memory		5	68.2	0.14	25.5	0.76	41.2	-0.67	100.0	1.08
Transcoding		5	87.8	0.17	12.0	0.62	66.7	-0.91	94.4	0.51

Age: 4 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		10	98.4	0.23	1.9	1.10	95.2	-1.47	100.0	1.28
Ordinal Intelligibility Index	OII		High		Moderate		Low			
			n	%	n	%	n	%		
			10	100.0	0	0.0	0	0.0		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		10	88.8	0.36	5.6	0.81	82.4	-0.52	98.8	1.88

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		10	90.0		13.7		65.8		100.0	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		10	10.0
Rate		10	10.0
Stress		10	10.0
Loudness		10	20.0
Pitch		10	10.0
Laryngeal Quality		10	40.0
Resonance Quality		10	20.0

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		10	79.0	0.39	15.6	0.83	44.0	-1.38	98.0	1.49
Encoding		9	60.5	0.56	20.9	0.94	37.5	-0.62	100.0	2.07
Memory		10	71.3	0.23	24.7	0.71	30.7	-0.86	100.0	1.08
Transcoding		10	87.2	-0.11	10.5	0.83	66.7	-1.26	100.0	0.93

Age: 5 yrs Typical Speakers

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.8**		**1.0**		**97.3**		**99.6**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**94.5**		**6.1**		**83.8**		**98.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**93.2**		**6.9**		**81.6**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**40.0**
Rate		**5**	**0.0**
Stress		**5**	**80.0**
Loudness		**5**	**40.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**40.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**85.6**		**11.9**		**70.0**		**98.0**	
Encoding		**5**	**68.3**		**31.4**		**33.3**		**100.0**	
Memory		**5**	**87.2**		**13.8**		**67.5**		**100.0**	
Transcoding		**5**	**95.6**		**4.6**		**88.9**		**100.0**	

Age: 5 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.5**		**1.8**		**95.6**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**97.7**		**0.8**		**96.9**		**98.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**95.8**		**3.0**		**92.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**40.0**
Loudness		**5**	**20.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**100.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**84.4**		**11.6**		**68.0**		**96.0**	
Encoding		**5**	**68.5**		**31.1**		**35.7**		**100.0**	
Memory		**5**	**93.8**		**8.9**		**80.8**		**100.0**	
Transcoding		**5**	**88.9**		**10.4**		**77.8**		**100.0**	

Age: 5 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**98.7**		**1.4**		**95.6**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			10	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**96.1**		**4.4**		**83.8**		**98.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**94.5**		**5.2**		**81.6**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**20.0**
Rate		**10**	**0.0**
Stress		**10**	**60.0**
Loudness		**10**	**30.0**
Pitch		**10**	**10.0**
Laryngeal Quality		**10**	**70.0**
Resonance Quality		**10**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**85.0**		**11.1**		**68.0**		**98.0**	
Encoding		**10**	**68.4**		**29.5**		**33.3**		**100.0**	
Memory		**10**	**90.5**		**11.5**		**67.5**		**100.0**	
Transcoding		**10**	**92.2**		**8.4**		**77.8**		**100.0**	

Age: 6 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.2**		**1.4**		**96.8**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**95.8**		**4.7**		**89.0**		**99.6**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**85.8**		**24.7**		**42.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**90.8**		**5.4**		**82.0**		**96.0**	
Encoding		**5**	**68.3**		**20.7**		**50.0**		**100.0**	
Memory		**5**	**94.1**		**5.9**		**88.2**		**100.0**	
Transcoding		**5**	**93.3**		**7.2**		**83.3**		**100.0**	

Age: 6 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.7**		**0.4**		**99.1**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**96.3**		**2.9**		**92.0**		**99.1**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**87.4**		**13.9**		**71.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**20.0**
Stress		**5**	**0.0**
Loudness		**5**	**20.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**60.0**
Resonance Quality		**5**	**40.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**86.4**		**4.8**		**78.0**		**90.0**	
Encoding		**5**	**77.3**		**22.0**		**50.0**		**100.0**	
Memory		**5**	**84.3**		**7.5**		**74.9**		**94.7**	
Transcoding		**5**	**92.2**		**9.3**		**77.8**		**100.0**	

Age: 6 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.4**		**1.0**		**96.8**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			10	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**96.1**		**3.7**		**89.0**		**99.6**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**86.6**		**18.9**		**42.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**10.0**
Rate		**10**	**10.0**
Stress		**10**	**10.0**
Loudness		**10**	**10.0**
Pitch		**10**	**0.0**
Laryngeal Quality		**10**	**30.0**
Resonance Quality		**10**	**30.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**88.6**		**5.3**		**78.0**		**96.0**	
Encoding		**10**	**72.8**		**20.7**		**50.0**		**100.0**	
Memory		**10**	**89.2**		**8.2**		**74.9**		**100.0**	
Transcoding		**10**	**92.8**		**7.9**		**77.8**		**100.0**	

Age: 7 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.3**		**0.5**		**98.9**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.8**		**0.8**		**97.8**		**99.8**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**97.9**		**2.2**		**94.7**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**40.0**
Rate		**5**	**0.0**
Stress		**5**	**60.0**
Loudness		**5**	**0.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**86.0**		**8.8**		**76.0**		**98.0**	
Encoding		**5**	**67.9**		**22.6**		**42.9**		**100.0**	
Memory		**5**	**94.5**		**4.2**		**88.2**		**100.0**	
Transcoding		**5**	**91.1**		**6.3**		**83.3**		**100.0**	

Age: 7 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.4**		**0.7**		**98.4**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**97.9**		**1.6**		**95.8**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**94.2**		**6.0**		**86.8**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**20.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**60.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**87.6**		**8.3**		**76.0**		**96.0**	
Encoding		**5**	**49.8**		**38.6**		**0.0**		**100.0**	
Memory		**5**	**89.8**		**17.2**		**59.5**		**100.0**	
Transcoding		**5**	**94.4**		**6.8**		**83.3**		**100.0**	

Age: 7 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.4**		**0.5**		**98.4**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**98.4**		**1.3**		**95.8**		**99.8**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**96.1**		**4.7**		**86.8**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**20.0**
Rate		**10**	**0.0**
Stress		**10**	**40.0**
Loudness		**10**	**10.0**
Pitch		**10**	**10.0**
Laryngeal Quality		**10**	**50.0**
Resonance Quality		**10**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**86.8**		**8.1**		**76.0**		**98.0**	
Encoding		**10**	**58.8**		**31.3**		**0.0**		**100.0**	
Memory		**10**	**92.2**		**12.0**		**59.5**		**100.0**	
Transcoding		**10**	**92.8**		**6.4**		**83.3**		**100.0**	

Age: 8 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.8**		**0.4**		**99.1**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**96.9**		**2.9**		**91.9**		**99.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**85.8**		**15.4**		**60.5**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**60.0**
Resonance Quality		**5**	**60.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**89.2**		**6.6**		**82.0**		**96.0**	
Encoding		**5**	**64.2**		**38.6**		**0.0**		**100.0**	
Memory		**5**	**90.3**		**10.4**		**74.9**		**100.0**	
Transcoding		**5**	**94.4**		**5.6**		**88.9**		**100.0**	

Age: 8 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.9**		**0.2**		**99.5**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.5**		**2.3**		**94.5**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**90.5**		**12.4**		**68.4**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**40.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**93.2**		**3.9**		**90.0**		**100.0**	
Encoding		**4**	**82.5**		**23.6**		**50.0**		**100.0**	
Memory		**5**	**95.4**		**4.9**		**88.2**		**100.0**	
Transcoding		**5**	**93.3**		**6.1**		**88.9**		**100.0**	

Age: 8 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.9**		**0.3**		**99.1**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**97.7**		**2.6**		**91.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**88.2**		**13.4**		**60.5**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**20.0**
Rate		**10**	**0.0**
Stress		**10**	**10.0**
Loudness		**10**	**0.0**
Pitch		**10**	**10.0**
Laryngeal Quality		**10**	**30.0**
Resonance Quality		**10**	**40.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**91.2**		**5.5**		**82.0**		**100.0**	
Encoding		**9**	**72.3**		**32.4**		**0.0**		**100.0**	
Memory		**10**	**92.8**		**8.1**		**74.9**		**100.0**	
Transcoding		**10**	**93.9**		**5.5**		**88.9**		**100.0**	

Age: 9 yrs Typical Speakers

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.5**		**1.1**		**97.6**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.9**		**0.8**		**97.5**		**99.8**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**91.1**		**7.1**		**78.9**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**60.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**60.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**87.6**		**11.0**		**72.0**		**96.0**	
Encoding		**5**	**63.4**		**41.1**		**0.0**		**100.0**	
Memory		**5**	**77.3**		**28.8**		**41.2**		**100.0**	
Transcoding		**5**	**97.8**		**5.0**		**88.9**		**100.0**	

Age: 9 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.7**		**0.3**		**99.3**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.3**		**0.9**		**97.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**94.2**		**8.4**		**81.6**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**93.6**		**8.2**		**82.0**		**100.0**	
Encoding		**3**	**73.3**		**46.2**		**20.0**		**100.0**	
Memory		**5**	**88.4**		**16.9**		**59.5**		**100.0**	
Transcoding		**5**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 9 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.6**		**0.7**		**97.6**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.1**		**0.8**		**97.5**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**92.6**		**7.5**		**78.9**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**30.0**
Rate		**10**	**0.0**
Stress		**10**	**10.0**
Loudness		**10**	**0.0**
Pitch		**10**	**0.0**
Laryngeal Quality		**10**	**30.0**
Resonance Quality		**10**	**10.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**90.6**		**9.7**		**72.0**		**100.0**	
Encoding		**8**	**67.1**		**40.0**		**0.0**		**100.0**	
Memory		**10**	**82.8**		**23.0**		**41.2**		**100.0**	
Transcoding		**10**	**98.9**		**3.5**		**88.9**		**100.0**	

Age: 10 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.8**		**0.5**		**98.9**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.7**		**1.2**		**96.7**		**99.5**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**87.9**		**8.0**		**78.9**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**20.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**20.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**88.0**		**12.9**		**68.0**		**100.0**	
Encoding		**4**	**87.3**		**15.3**		**69.2**		**100.0**	
Memory		**5**	**87.6**		**16.1**		**62.0**		**100.0**	
Transcoding		**5**	**94.4**		**7.9**		**83.3**		**100.0**	

Age: 10 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.8**		**0.3**		**99.5**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.9**		**0.9**		**97.8**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**82.6**		**12.3**		**65.8**		**94.7**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**60.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**90.8**		**6.6**		**82.0**		**100.0**	
Encoding		**4**	**62.5**		**32.3**		**25.0**		**100.0**	
Memory		**5**	**81.8**		**15.6**		**57.2**		**100.0**	
Transcoding		**5**	**93.3**		**7.2**		**83.3**		**100.0**	

Age: 10 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.8**		**0.4**		**98.9**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**98.8**		**1.0**		**96.7**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**85.3**		**10.2**		**65.8**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**20.0**
Rate		**10**	**0.0**
Stress		**10**	**0.0**
Loudness		**10**	**10.0**
Pitch		**10**	**10.0**
Laryngeal Quality		**10**	**40.0**
Resonance Quality		**10**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**89.4**		**9.8**		**68.0**		**100.0**	
Encoding		**8**	**74.9**		**26.9**		**25.0**		**100.0**	
Memory		**10**	**84.7**		**15.3**		**57.2**		**100.0**	
Transcoding		**10**	**93.9**		**7.1**		**83.3**		**100.0**	

Age: 11 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.3**		**1.1**		**97.4**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			5	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.2**		**0.4**		**98.7**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**87.4**		**9.2**		**76.3**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**60.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**20.0**
Resonance Quality		**5**	**40.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**90.4**		**10.1**		**76.0**		**100.0**	
Encoding		**4**	**74.1**		**19.2**		**54.5**		**100.0**	
Memory		**5**	**88.5**		**13.3**		**65.9**		**100.0**	
Transcoding		**5**	**95.6**		**6.1**		**88.9**		**100.0**	

Age: 11 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.8**		**0.5**		**98.8**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			5	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.1**		**1.1**		**97.1**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**89.5**		**4.2**		**84.2**		**94.7**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**94.4**		**7.1**		**82.0**		**100.0**	
Encoding		**4**	**91.7**		**16.7**		**66.7**		**100.0**	
Memory		**5**	**95.2**		**7.9**		**81.8**		**100.0**	
Transcoding		**5**	**97.8**		**3.0**		**94.4**		**100.0**	

Age: 11 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.5**		**0.8**		**97.4**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.2**		**0.8**		**97.1**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**88.4**		**6.8**		**76.3**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**30.0**
Rate		**10**	**0.0**
Stress		**10**	**10.0**
Loudness		**10**	**0.0**
Pitch		**10**	**10.0**
Laryngeal Quality		**10**	**30.0**
Resonance Quality		**10**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**92.4**		**8.5**		**76.0**		**100.0**	
Encoding		**8**	**82.9**		**19.1**		**54.5**		**100.0**	
Memory		**10**	**91.9**		**10.9**		**65.9**		**100.0**	
Transcoding		**10**	**96.7**		**4.7**		**88.9**		**100.0**	

Age: 12 yrs Typical Speakers

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.6**		**0.6**		**98.5**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			5	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.5**		**0.6**		**98.6**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**92.1**		**10.5**		**73.7**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**5**	**60.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**97.6**		**3.3**		**92.0**		**100.0**	
Encoding		**3**	**91.7**		**14.4**		**75.0**		**100.0**	
Memory		**5**	**96.5**		**5.2**		**88.2**		**100.0**	
Transcoding		**5**	**98.9**		**2.5**		**94.4**		**100.0**	

Age: 12 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**100.0**		**0.0**		**100.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			5	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.2**		**0.9**		**97.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**89.5**		**9.7**		**76.3**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**94.8**		**4.1**		**90.0**		**100.0**	
Encoding		**4**	**81.7**		**21.3**		**60.0**		**100.0**	
Memory		**5**	**93.8**		**10.9**		**74.9**		**100.0**	
Transcoding		**5**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 12 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.8**		**0.5**		**98.5**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			10	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.4**		**0.7**		**97.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**90.8**		**9.6**		**73.7**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**0.0**
Rate		**10**	**0.0**
Stress		**10**	**0.0**
Loudness		**10**	**0.0**
Pitch		**9**	**0.0**
Laryngeal Quality		**10**	**50.0**
Resonance Quality		**10**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**96.2**		**3.8**		**90.0**		**100.0**	
Encoding		**7**	**86.0**		**18.0**		**60.0**		**100.0**	
Memory		**10**	**95.2**		**8.2**		**74.9**		**100.0**	
Transcoding		**10**	**99.4**		**1.8**		**94.4**		**100.0**	

Age: 13 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.6**		**0.6**		**98.9**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.6**		**0.7**		**97.8**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**80.0**		**18.1**		**52.6**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**60.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**20.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**93.2**		**5.2**		**88.0**		**100.0**	
Encoding		**4**	**60.0**		**30.3**		**33.3**		**100.0**	
Memory		**5**	**97.6**		**5.3**		**88.2**		**100.0**	
Transcoding		**5**	**95.6**		**4.6**		**88.9**		**100.0**	

Age: 13 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.9**		**0.2**		**99.5**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.6**		**0.3**		**99.2**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**94.7**		**3.2**		**92.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**95.5**		**4.7**		**89.5**		**100.0**	
Encoding		**3**	**75.0**		**43.3**		**25.0**		**100.0**	
Memory		**5**	**92.7**		**10.0**		**81.8**		**100.0**	
Transcoding		**5**	**97.8**		**5.0**		**88.9**		**100.0**	

Age: 13 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.7**		**0.4**		**98.9**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.1**		**0.7**		**97.8**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**87.4**		**14.5**		**52.6**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**40.0**
Rate		**10**	**0.0**
Stress		**10**	**0.0**
Loudness		**10**	**0.0**
Pitch		**10**	**0.0**
Laryngeal Quality		**10**	**10.0**
Resonance Quality		**10**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**94.3**		**4.8**		**88.0**		**100.0**	
Encoding		**7**	**66.4**		**33.9**		**25.0**		**100.0**	
Memory		**10**	**95.2**		**8.0**		**81.8**		**100.0**	
Transcoding		**10**	**96.7**		**4.7**		**88.9**		**100.0**	

Age: 14 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**100.0**		**0.0**		**100.0**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.1**		**0.5**		**98.5**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**88.9**		**7.1**		**78.9**		**94.7**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**40.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**98.0**		**2.4**		**94.0**		**100.0**	
Encoding		**3**	**88.9**		**19.2**		**66.7**		**100.0**	
Memory		**5**	**95.4**		**4.9**		**88.2**		**100.0**	
Transcoding		**5**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 14 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**100.0**		**0.0**		**100.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			5	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.6**		**0.6**		**98.5**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**88.9**		**16.2**		**60.5**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**5**	**80.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**97.2**		**5.2**		**88.0**		**100.0**	
Encoding		**1**	**100.0**				**100.0**		**100.0**	
Memory		**5**	**98.9**		**2.6**		**94.3**		**100.0**	
Transcoding		**5**	**97.8**		**5.0**		**88.9**		**100.0**	

Age: 14 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**100.0**		**0.0**		**100.0**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.4**		**0.6**		**98.5**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**88.9**		**11.8**		**60.5**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**10.0**
Rate		**10**	**0.0**
Stress		**10**	**10.0**
Loudness		**10**	**0.0**
Pitch		**10**	**10.0**
Laryngeal Quality		**10**	**60.0**
Resonance Quality		**10**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**97.6**		**3.9**		**88.0**		**100.0**	
Encoding		**4**	**91.7**		**16.7**		**66.7**		**100.0**	
Memory		**10**	**97.1**		**4.1**		**88.2**		**100.0**	
Transcoding		**10**	**98.9**		**3.5**		**88.9**		**100.0**	

Age: 15 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**100.0**		**0.0**		**100.0**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.4**		**0.4**		**98.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**92.1**		**5.9**		**84.2**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**91.6**		**5.4**		**84.0**		**96.0**	
Encoding		**5**	**68.3**		**32.5**		**25.0**		**100.0**	
Memory		**5**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**5**	**98.9**		**2.5**		**94.4**		**100.0**	

Age: 15 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.8**		**0.3**		**99.5**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.8**		**0.2**		**99.4**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**93.2**		**3.5**		**86.8**		**94.7**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**96.0**		**5.8**		**86.0**		**100.0**	
Encoding		**3**	**42.9**		**51.5**		**0.0**		**100.0**	
Memory		**5**	**96.5**		**5.2**		**88.2**		**100.0**	
Transcoding		**5**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 15 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.9**		**0.2**		**99.5**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.6**		**0.4**		**98.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**92.6**		**4.6**		**84.2**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**20.0**
Rate		**10**	**0.0**
Stress		**10**	**10.0**
Loudness		**10**	**0.0**
Pitch		**10**	**0.0**
Laryngeal Quality		**10**	**0.0**
Resonance Quality		**10**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**93.8**		**5.8**		**84.0**		**100.0**	
Encoding		**8**	**58.8**		**39.2**		**0.0**		**100.0**	
Memory		**10**	**98.3**		**4.0**		**88.2**		**100.0**	
Transcoding		**10**	**99.4**		**1.8**		**94.4**		**100.0**	

Age: 16 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.9**		**0.3**		**99.4**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.3**		**0.8**		**98.1**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**86.3**		**15.0**		**60.5**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**98.4**		**3.6**		**92.0**		**100.0**	
Encoding		**1**	**100.0**				**100.0**		**100.0**	
Memory		**5**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**5**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 16 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**100.0**		**0.0**		**100.0**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**98.2**		**2.8**		**93.2**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**82.6**		**7.1**		**73.7**		**92.1**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**20.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**20.0**
Resonance Quality		**5**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**97.2**		**3.3**		**92.0**		**100.0**	
Encoding		**3**	**50.0**		**50.0**		**0.0**		**100.0**	
Memory		**5**	**97.7**		**3.1**		**94.3**		**100.0**	
Transcoding		**5**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 16 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.9**		**0.2**		**99.4**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**98.8**		**2.0**		**93.2**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**84.5**		**11.3**		**60.5**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**10.0**
Rate		**10**	**0.0**
Stress		**10**	**0.0**
Loudness		**10**	**10.0**
Pitch		**10**	**0.0**
Laryngeal Quality		**10**	**10.0**
Resonance Quality		**10**	**20.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**97.8**		**3.3**		**92.0**		**100.0**	
Encoding		**4**	**62.5**		**47.9**		**0.0**		**100.0**	
Memory		**10**	**98.9**		**2.4**		**94.3**		**100.0**	
Transcoding		**10**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 17 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.7**		**0.5**		**98.8**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.6**		**0.6**		**98.6**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**91.6**		**12.0**		**71.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**93.6**		**3.3**		**90.0**		**98.0**	
Encoding		**5**	**65.0**		**33.5**		**25.0**		**100.0**	
Memory		**5**	**94.3**		**-1.$**		**94.3**		**94.3**	
Transcoding		**5**	**97.8**		**3.0**		**94.4**		**100.0**	

Age: 17 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.7**		**0.6**		**98.7**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.8**		**0.2**		**99.5**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**96.3**		**4.0**		**92.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**0.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**0.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**99.2**		**1.8**		**96.0**		**100.0**	
Encoding		**1**	**50.0**				**50.0**		**50.0**	
Memory		**5**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**5**	**97.8**		**3.0**		**94.4**		**100.0**	

Age: 17 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.7**		**0.5**		**98.7**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			10	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.7**		**0.4**		**98.6**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**93.9**		**8.8**		**71.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**10.0**
Rate		**10**	**0.0**
Stress		**10**	**10.0**
Loudness		**10**	**0.0**
Pitch		**10**	**0.0**
Laryngeal Quality		**10**	**0.0**
Resonance Quality		**10**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**96.4**		**3.9**		**90.0**		**100.0**	
Encoding		**6**	**62.5**		**30.6**		**25.0**		**100.0**	
Memory		**10**	**97.1**		**3.0**		**94.3**		**100.0**	
Transcoding		**10**	**97.8**		**2.9**		**94.4**		**100.0**	

Age: 20-29 yrs
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		4	100.0		0.0		100.0		100.0	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	%	n	%	n	%	
			4	100.0	0	0.0	0	0.0	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		4	99.7		0.3		99.4		100.0	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		4	95.4		3.9		89.5		97.4	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		4	50.0
Rate		4	0.0
Stress		4	0.0
Loudness		4	0.0
Pitch		4	25.0
Laryngeal Quality		4	0.0
Resonance Quality		4	0.0

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		4	96.5		4.1		92.0		100.0	
Encoding		2	58.3		11.8		50.0		66.7	
Memory		4	100.0		0.0		100.0		100.0	
Transcoding		4	100.0		0.0		100.0		100.0	

Age: 20-29 yrs Typical Speakers
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.8**		**0.3**		**99.5**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			4	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.3**		**0.6**		**98.6**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**82.2**		**21.1**		**52.6**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**25.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**0.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**95.5**		**5.3**		**90.0**		**100.0**	
Encoding		**2**	**55.0**		**7.1**		**50.0**		**60.0**	
Memory		**4**	**98.6**		**2.9**		**94.3**		**100.0**	
Transcoding		**4**	**98.6**		**2.8**		**94.4**		**100.0**	

Age: 20-29 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.9**		**0.2**		**99.5**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			8	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.5**		**0.5**		**98.6**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		8	**88.8**		**15.7**		**52.6**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**8**	**37.5**
Rate		**8**	**0.0**
Stress		**8**	**0.0**
Loudness		**8**	**0.0**
Pitch		**8**	**12.5**
Laryngeal Quality		**8**	**0.0**
Resonance Quality		**8**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**8**	**96.0**		**4.4**		**90.0**		**100.0**	
Encoding		**4**	**56.7**		**8.2**		**50.0**		**66.7**	
Memory		**8**	**99.3**		**2.0**		**94.3**		**100.0**	
Transcoding		**8**	**99.3**		**2.0**		**94.4**		**100.0**	

Age: 30-39 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.8**		**0.3**		**99.4**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			4	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.7**		**0.5**		**98.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**84.9**		**17.4**		**60.5**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**75.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**25.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**97.5**		**3.0**		**94.0**		**100.0**	
Encoding		**2**	**33.3**		**47.1**		**0.0**		**66.7**	
Memory		**4**	**98.6**		**2.9**		**94.3**		**100.0**	
Transcoding		**4**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 30-39 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**100.0**		**0.0**		**100.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			4	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.4**		**0.3**		**98.9**		**99.5**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**91.4**		**12.4**		**73.7**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**50.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**0.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**97.5**		**5.0**		**90.0**		**100.0**	
Encoding		**1**	**60.0**				**60.0**		**60.0**	
Memory		**4**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**4**	**98.6**		**2.8**		**94.4**		**100.0**	

Age: 30-39 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.9**		**0.2**		**99.4**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			8	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.5**		**0.4**		**98.9**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		8	**88.2**		**14.4**		**60.5**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**8**	**62.5**
Rate		**8**	**0.0**
Stress		**8**	**0.0**
Loudness		**8**	**0.0**
Pitch		**8**	**0.0**
Laryngeal Quality		**8**	**12.5**
Resonance Quality		**8**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**8**	**97.5**		**3.8**		**90.0**		**100.0**	
Encoding		**3**	**42.2**		**36.7**		**0.0**		**66.7**	
Memory		**8**	**99.3**		**2.0**		**94.3**		**100.0**	
Transcoding		**8**	**99.3**		**2.0**		**94.4**		**100.0**	

Age: 40-49 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.8**		**0.3**		**99.5**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			4	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.7**		**0.2**		**99.5**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**94.1**		**8.4**		**81.6**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**50.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**0.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**99.0**		**2.0**		**96.0**		**100.0**	
Encoding		**1**	**100.0**				**100.0**		**100.0**	
Memory		**4**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**4**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 40-49 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.8**		**0.3**		**99.4**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			4	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.8**		**0.2**		**99.5**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**89.5**		**12.7**		**71.1**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**0.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**0.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**100.0**		**0.0**		**100.0**		**100.0**	
Encoding										
Memory		**4**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**4**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 40-49 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.8**		**0.3**		**99.4**		**100.0**	

Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**		
			n	**%**	**n**	**%**	**n**	**%**	
			8	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	**PCC**		**Mean**		**Standard Deviation**		**Minimum**		**Maximum**	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.8**		**0.2**		**99.5**		**100.0**	

Speech Competence Index	**SCI**		**Mean**		**Standard Deviation**		**Minimum**		**Maximum**	
			%		**%**		**%**		**%**	
		8	**91.8**		**10.3**		**71.1**		**100.0**	

Prosody-Voice Screening Profile	**PVSP**		**% of Participants with Inappropriate (<80%) Scores**
			%
Phrasing		**8**	**25.0**
Rate		**8**	**0.0**
Stress		**8**	**0.0**
Loudness		**8**	**0.0**
Pitch		**8**	**0.0**
Laryngeal Quality		**8**	**0.0**
Resonance Quality		**8**	**0.0**

Syllable Repetition Task	**SRT**		**Mean**		**Standard Deviation**		**Minimum**		**Maximum**	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**8**	**99.5**		**1.4**		**96.0**		**100.0**	
Encoding		**1**	**100.0**				**100.0**		**100.0**	
Memory		**8**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**8**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 50-59 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**100.0**		**0.0**		**100.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			4	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.9**		**0.1**		**99.7**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**95.4**		**2.5**		**92.1**		**97.4**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**75.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**0.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**99.0**		**1.2**		**98.0**		**100.0**	
Encoding		**2**	**50.0**		**70.7**		**0.0**		**100.0**	
Memory		**4**	**98.6**		**2.9**		**94.3**		**100.0**	
Transcoding		**4**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 50-59 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**100.0**		**0.0**		**100.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			4	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.3**		**0.8**		**98.2**		**99.9**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**85.5**		**22.5**		**52.6**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**25.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**25.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**99.0**		**2.0**		**96.0**		**100.0**	
Encoding		**1**	**100.0**				**100.0**		**100.0**	
Memory		**4**	**100.0**		**0.0**		**100.0**		**100.0**	
Transcoding		**4**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 50-59 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**100.0**		**0.0**		**100.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			8	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.6**		**0.6**		**98.2**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		8	**90.5**		**15.7**		**52.6**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**8**	**50.0**
Rate		**8**	**0.0**
Stress		**8**	**0.0**
Loudness		**8**	**0.0**
Pitch		**8**	**0.0**
Laryngeal Quality		**8**	**12.5**
Resonance Quality		**8**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**8**	**99.0**		**1.5**		**96.0**		**100.0**	
Encoding		**3**	**66.7**		**57.7**		**0.0**		**100.0**	
Memory		**8**	**99.3**		**2.0**		**94.3**		**100.0**	
Transcoding		**8**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 60-69 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**100.0**		**0.0**		**100.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			4	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.5**		**0.2**		**99.4**		**99.7**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**92.1**		**5.7**		**86.8**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**50.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**25.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**96.0**		**5.7**		**88.0**		**100.0**	
Encoding		**2**	**41.7**		**11.8**		**33.3**		**50.0**	
Memory		**4**	**90.8**		**12.0**		**74.9**		**100.0**	
Transcoding		**4**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 60-69 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.9**		**0.2**		**99.5**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			4	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		4	**99.6**		**0.1**		**99.5**		**99.8**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		4	**95.4**		**5.4**		**89.5**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**4**	**50.0**
Rate		**4**	**0.0**
Stress		**4**	**0.0**
Loudness		**4**	**0.0**
Pitch		**4**	**0.0**
Laryngeal Quality		**4**	**0.0**
Resonance Quality		**4**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**4**	**93.0**		**11.4**		**76.0**		**100.0**	
Encoding		**2**	**66.7**		**47.1**		**33.3**		**100.0**	
Memory		**4**	**92.3**		**11.9**		**74.9**		**100.0**	
Transcoding		**4**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 60-69 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.9**		**0.2**		**99.5**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			8	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		8	**99.6**		**0.2**		**99.4**		**99.8**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		8	**93.8**		**5.4**		**86.8**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**8**	**50.0**
Rate		**8**	**0.0**
Stress		**8**	**0.0**
Loudness		**8**	**0.0**
Pitch		**8**	**0.0**
Laryngeal Quality		**8**	**12.5**
Resonance Quality		**8**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**8**	**94.5**		**8.5**		**76.0**		**100.0**	
Encoding		**4**	**54.2**		**31.5**		**33.3**		**100.0**	
Memory		**8**	**91.5**		**11.1**		**74.9**		**100.0**	
Transcoding		**8**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 70-80 yrs Typical Speakers
Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.7**		**0.5**		**99.0**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.6**		**0.3**		**99.3**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**88.4**		**9.6**		**76.3**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**60.0**
Rate		**5**	**0.0**
Stress		**5**	**20.0**
Loudness		**5**	**0.0**
Pitch		**5**	**0.0**
Laryngeal Quality		**5**	**40.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**94.8**		**7.6**		**82.0**		**100.0**	
Encoding		**3**	**66.7**		**33.3**		**33.3**		**100.0**	
Memory		**5**	**90.7**		**17.7**		**59.5**		**100.0**	
Transcoding		**5**	**100.0**		**0.0**		**100.0**		**100.0**	

Age: 70-80 yrs
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.7**		**0.5**		**99.0**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			5	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		5	**99.7**		**0.2**		**99.4**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		5	**95.2**		**4.4**		**89.5**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**5**	**20.0**
Rate		**5**	**0.0**
Stress		**5**	**0.0**
Loudness		**5**	**0.0**
Pitch		**5**	**20.0**
Laryngeal Quality		**4**	**0.0**
Resonance Quality		**5**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**92.0**		**11.7**		**72.0**		**100.0**	
Encoding		**3**	**71.4**		**25.8**		**50.0**		**100.0**	
Memory		**5**	**92.3**		**14.1**		**67.5**		**100.0**	
Transcoding		**5**	**93.3**		**12.0**		**72.2**		**100.0**	

Age: 70-80 yrs
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.7**		**0.4**		**99.0**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			10	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		10	**99.6**		**0.3**		**99.3**		**100.0**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		10	**91.8**		**7.9**		**76.3**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**10**	**40.0**
Rate		**10**	**0.0**
Stress		**10**	**10.0**
Loudness		**10**	**0.0**
Pitch		**10**	**10.0**
Laryngeal Quality		**9**	**22.2**
Resonance Quality		**10**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**10**	**93.4**		**9.4**		**72.0**		**100.0**	
Encoding		**6**	**69.0**		**26.8**		**33.3**		**100.0**	
Memory		**10**	**91.5**		**15.1**		**59.5**		**100.0**	
Transcoding		**10**	**96.7**		**8.8**		**72.2**		**100.0**	

Age: 3 yrs Idiopathic Speech Delay

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		27	**87.0**		**9.4**		**65.1**		**98.9**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			18	**66.7**	**3**	**11.1**	**6**	**22.2**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		27	**67.7**		**9.1**		**45.5**		**82.8**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		27	**43.4**		**13.4**		**21.1**		**65.8**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**27**	**7.4**
Rate		**27**	**0.0**
Stress		**27**	**29.6**
Loudness		**27**	**18.5**
Pitch		**27**	**3.7**
Laryngeal Quality		**27**	**18.5**
Resonance Quality		**27**	**11.1**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**15**	**60.0**		**17.9**		**32.0**		**88.0**	
Encoding		**15**	**47.7**		**23.7**		**0.0**		**87.5**	
Memory		**15**	**61.5**		**34.2**		**0.0**		**100.0**	
Transcoding		**15**	**83.7**		**19.1**		**50.0**		**100.0**	

Age: 3 years Idiopathic Speech Delay
Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		14	84.1		10.3		65.8	-	97.7	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	%	n	%	n	%	
			8	57.1	1	7.1	5	35.7	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		14	70.7		6.6		60.4		81.1	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		14	39.1		12.3		23.7		68.4	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		14	21.4
Rate		14	0.0
Stress		14	28.6
Loudness		14	35.7
Pitch		14	0.0
Laryngeal Quality		14	21.4
Resonance Quality		14	0.0

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		6	46.7		21.3		12.0		66.0	
Encoding		5	41.5		13.7		27.3		60.0	
Memory		6	54.7		31.2		0.0		88.2	
Transcoding		6	90.7		9.1		77.8		100.0	

Age: 3 years Idiopathic Speech Delay
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		41	86.0		9.7		65.1		98.9	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	%	n	%	n	%	
			26	63.4	4	9.8	11	26.8	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		41	68.7		8.4		45.5		82.8	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		41	41.9		13.1		21.1		68.4	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		41	12.2
Rate		41	0.0
Stress		41	29.3
Loudness		41	24.4
Pitch		41	2.4
Laryngeal Quality		41	19.5
Resonance Quality		41	7.3

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		21	56.2		19.4		12.0		88.0	
Encoding		20	46.2		21.5		0.0		87.5	
Memory		21	59.6		32.8		0.0		100.0	
Transcoding		21	85.7		16.9		50.0		100.0	

Age: 4 years Idiopathic Speech Delay

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		79	**90.8**		**8.0**		**52.7**		**98.8**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			66	**83.5**	**6**	**7.6**	**7**	**8.9**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		79	**68.3**		**12.2**		**17.5**		**90.8**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		79	**47.6**		**16.7**		**23.7**		**94.7**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**79**	**16.5**
Rate		**79**	**0.0**
Stress		**79**	**15.2**
Loudness		**79**	**12.7**
Pitch		**79**	**2.5**
Laryngeal Quality		**79**	**31.6**
Resonance Quality		**79**	**8.9**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**42**	**64.1**		**19.4**		**22.0**		**98.0**	
Encoding		**41**	**50.5**		**22.4**		**0.0**		**100.0**	
Memory		**43**	**69.8**		**28.3**		**0.0**		**100.0**	
Transcoding		**42**	**83.9**		**15.0**		**44.4**		**100.0**	

Age: 4 years Idiopathic Speech Delay

Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		44	**91.1**		**7.4**		**67.5**		**99.2**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			37	**84.1**	**3**	**6.8**	**4**	**9.1**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		44	**68.0**		**10.1**		**38.8**		**87.6**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		44	**41.3**		**12.2**		**21.6**		**84.2**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**44**	**18.2**
Rate		**44**	**2.3**
Stress		**44**	**11.4**
Loudness		**44**	**6.8**
Pitch		**43**	**4.7**
Laryngeal Quality		**44**	**22.7**
Resonance Quality		**44**	**11.4**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**19**	**63.7**		**14.5**		**34.0**		**92.0**	
Encoding		**19**	**51.7**		**18.0**		**25.0**		**100.0**	
Memory		**19**	**66.8**		**26.2**		**25.4**		**100.0**	
Transcoding		**19**	**82.5**		**13.0**		**61.1**		**100.0**	

Age: 4 years Idiopathic Speech Delay
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		123	90.9		7.8		52.7		99.2	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	%	n	%	n	%	
			103	83.7	9	7.3	11	8.9	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		123	68.2		11.4		17.5		90.8	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		123	45.3		15.5		21.6		94.7	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		123	17.1
Rate		123	0.8
Stress		123	13.8
Loudness		123	10.6
Pitch		122	3.3
Laryngeal Quality		123	28.5
Resonance Quality		123	9.8

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		61	64.0		17.9		22.0		98.0	
Encoding		60	50.9		21.0		0.0		100.0	
Memory		62	68.9		27.5		0.0		100.0	
Transcoding		61	83.4		14.3		44.4		100.0	

Age: 5 years Idiopathic Speech Delay

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		49	**93.3**		**6.9**		**63.3**		**100.0**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			44	**89.8**	**3**	**6.1**	**2**	**4.1**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		49	**73.2**		**11.9**		**42.3**		**90.4**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		49	**45.9**		**18.3**		**18.4**		**89.5**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**49**	**14.3**
Rate		**49**	**0.0**
Stress		**49**	**8.2**
Loudness		**49**	**8.2**
Pitch		**48**	**4.2**
Laryngeal Quality		**49**	**24.5**
Resonance Quality		**49**	**16.3**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**22**	**70.0**		**12.6**		**46.0**		**90.0**	
Encoding		**23**	**53.0**		**16.2**		**33.3**		**92.9**	
Memory		**23**	**74.2**		**20.9**		**18.9**		**100.0**	
Transcoding		**22**	**82.6**		**14.2**		**61.1**		**100.0**	

Age: 5 years Idiopathic Speech Delay

Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		22	**96.1**		**3.4**		**87.5**		**99.5**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			22	**100.0**	**0**	**0.0**	**0**	**0.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		22	**76.4**		**5.5**		**66.7**		**88.9**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		22	**46.7**		**14.7**		**26.3**		**86.8**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**22**	**22.7**
Rate		**22**	**9.1**
Stress		**22**	**9.1**
Loudness		**22**	**4.5**
Pitch		**22**	**4.5**
Laryngeal Quality		**22**	**31.8**
Resonance Quality		**22**	**9.1**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**14**	**74.7**		**15.1**		**50.0**		**92.0**	
Encoding		**14**	**48.1**		**20.8**		**0.0**		**77.8**	
Memory		**14**	**73.5**		**24.7**		**10.9**		**100.0**	
Transcoding		**14**	**86.5**		**13.0**		**55.6**		**100.0**	

Age: 5 years Idiopathic Speech Delay
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		71	94.1		6.1		63.3		100.0	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	%	n	%	n	%	
			66	93.0	3	4.2	2	2.8	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		71	74.2		10.4		42.3		90.4	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		71	46.1		17.2		18.4		89.5	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		71	16.9
Rate		71	2.8
Stress		71	8.5
Loudness		71	7.0
Pitch		70	4.3
Laryngeal Quality		71	26.8
Resonance Quality		71	14.1

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		36	71.8		13.6		46.0		92.0	
Encoding		37	51.2		17.9		0.0		92.9	
Memory		37	74.0		22.1		10.9		100.0	
Transcoding		36	84.1		13.7		55.6		100.0	

Age: 6 years Idiopathic Speech Delay

Male

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		26	**90.3**		**8.6**		**71.3**		**100.0**	
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			21	**80.8**	**0**	**0.0**	**5**	**19.2**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		26	**79.1**		**8.3**		**58.3**		**91.3**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		26	**48.9**		**14.0**		**26.3**		**81.6**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**26**	**26.9**
Rate		**26**	**0.0**
Stress		**26**	**11.5**
Loudness		**26**	**0.0**
Pitch		**26**	**7.7**
Laryngeal Quality		**25**	**16.0**
Resonance Quality		**26**	**15.4**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**13**	**70.2**		**11.1**		**52.0**		**94.0**	
Encoding		**13**	**52.8**		**14.3**		**33.3**		**75.0**	
Memory		**13**	**66.3**		**19.7**		**26.3**		**94.7**	
Transcoding		**13**	**79.9**		**17.4**		**44.4**		**100.0**	

Age: 6 years Idiopathic Speech Delay

Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		7	**97.8**		**1.5**		**95.0**		**99.1**	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	**%**	**n**	**%**	**n**	**%**	
			7	**100.0**	**0**	**0.0**	**0**	**0.0**	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		7	**80.8**		**5.5**		**73.1**		**87.9**	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		7	**38.3**		**11.4**		**26.3**		**60.5**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**7**	**28.6**
Rate		**7**	**0.0**
Stress		**7**	**28.6**
Loudness		**7**	**0.0**
Pitch		**7**	**14.3**
Laryngeal Quality		**7**	**0.0**
Resonance Quality		**7**	**0.0**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**5**	**69.2**		**26.2**		**24.0**		**92.0**	
Encoding		**5**	**48.3**		**9.1**		**33.3**		**58.3**	
Memory		**5**	**58.5**		**36.2**		**0.0**		**94.3**	
Transcoding		**5**	**86.7**		**7.5**		**83.3**		**100.0**	

Age: 6 years Idiopathic Speech Delay
Male & Female

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	II		%	Z	%	Z	%	Z	%	Z
		33	91.9		8.3		71.3		100.0	

Ordinal Intelligibility Index	OII		High		Moderate		Low		
			n	%	n	%	n	%	
			28	84.8	0	0.0	5	15.2	

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		33		-3.38	7.8		58.3		91.3	

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		33	46.7		14.0		26.3		81.6	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		33	27.3
Rate		33	0.0
Stress		33	15.2
Loudness		33	0.0
Pitch		33	9.1
Laryngeal Quality		32	12.5
Resonance Quality		33	12.1

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		18	69.9		15.8		24.0		94.0	
Encoding		18	51.6		12.9		33.3		75.0	
Memory		18	64.1		24.4		0.0		94.7	
Transcoding		18	81.8		15.3		44.4		100.0	

PART III. MOTOR SPEECH CLASSIFICATION

MEASURES AND SUMMARIES

Speech Motor Delay (SMD): Precision-Stability Index (PSI)

Sample PEPPER Output

Sample PEPPER Outputs 1 and 2 are sample group and individual summaries of the Precision-Stability Index (PSI) findings from participants in the Wilson et al. (2017) study cited previously. Rationale for and description of the PSI are provided in the next section.

Rationale and Description

Shriberg et al. (2010) proposed that a nosological term was needed for an often discussed subset of children whose SSD was associated with a clinical or subclinical deficit in motor speech processes. The Precision-Stability Index (PSI) was developed to identify and quantify the SDCS Motor Speech Disorder classification initially given the place holder termed Motor Speech Disorder-Not Otherwise Specified, later changed to Speech Motor Delay (SMD; Figure 1).

The PSI uses the reference data from the 200 typical speakers, ages 3 to 80 years, to standardize item-level classification of 32 signs of precision and stability in 10 domains of speech, prosody, and voice in continuous speech. As shown in both Sample PEPPER Outputs 1 and 2, 13 of the 32 (41%) of the signs are classified using perceptual methods and 19 (59%) are classified using acoustic methods. As described in Part I and shown in the sample PSI findings in Sample PEPPER Outputs 1 and 2, standardized scores are obtained for each of 32 items (Shriberg et al., 2010). Also as described in Part I, for speakers 3-18 years of age, *z*-scores for each of the signs are calculated using the averaged reference data for a speaker's sex and chronological age and one age below the speaker's chronological age (totaling data from 10

typical speakers). For speakers 20-80 years of age, *z*-scores are obtained from 4 speakers of the same sex from 20-70 years of age and 5 speakers of each sex of from 70-79 years of age.

As indicated in PSI Sample PEPPER Output 1 and 2, a cut-off criterion of 1.25 standard deviation units is used to code a speaker's precision or stability on the item. The signs are assigned a code of "0" if the speaker's *z*-scores is less than 1.25 (i.e., within the typical range) or "1" if the *z*-score is equal to or beyond 1.25 standard deviation units, indicating atypically low precision or stability on the sign. An average *z*-score across all items provides a normative-based means to compare PSI scores controlled for age and sex. A criterion- referenced PSI percentage score is also derived from the item codes. Individual PSI scores include the percentage of positive signs (i.e., the percentage of the "1" codes subtracted from 100 so that lower percentage scores indicate more involvement).

Speakers who PSI total score is below 70% meet criterion for SMD. As described in the following subsection, speakers positive on only SMD are classified as SMD on the MSD axis shown in Sample PEPPER Outputs 1 and 2 for the Speech Disorders Classification System Summary (SDCSS). Speakers who also meet criteria for CD, CAS, or CD & CAS (see Figure 1) are classified with that classification, presumably a more severe subtype of MSD than SMD.

As with other SDCS measures and summaries, the PSI Sample PEPPER Outputs 1 and 2 illustrate group and individual PSI findings, respectively. Group PSI findings include descriptive statistics on PSI scores (count, *M*, *SD*, range) and the counts of signs within 5 ordinal classifications based on the percentage of the group positive for a specific sign. The ordinal classifications include Very Frequent (VF; 80.0-100% of the group is positive on the sign), Frequent (F; 60.0-79.9% of the group is positive on the sign), Somewhat Frequent (SF; 40.0-59.9% of the group is positive on the sign), Somewhat Infrequent (SI; 20.0-99.9% of the group is

positive on the sign), and Infrequent (I; 0.0-19.9% of the group is positive on the sign). An additional count of signs not used is also included for any signs for which data were unavailable for the group. The sample PSI data shown for an individual speaker in Sample PEPPER Output 2 includes information for each of the 32 signs.

Precision-Stability Index (PSI): Group

Sample PEPPER Output 1

	Sign				Participants Positive on Sign		Ordinal Classification[c]
Linguistic Domain	No.	Description	Assessment Mode[a]		Findings	%[b]	
			P	A			
Vowels							
	1	Reduced Dispersion of Corner Vowels from Center		X	11/45	24.4	SI
	2	Reduced Dispersion of Corner Vowels from ^		X	6/45	13.3	I
	3	Reduced Average Pairwise Distance of Corner Vowels		X	10/45	22.2	SI
	4	Increased Duration of Corner Vowels		X	42/45	93.3	VF
	5	Increased Duration for Middle Vowels and Diphthongs		X	44/45	97.8	VF
	6	Reduced % Vowel Phoneme Target Consistency	X		0/0		
	7	Reduced % Vowel Target Consistency	X		0/0		
Consonants							
	8	Reduced % Correct Glides	X		37/45	82.2	VF
	9	Increased Relative Distortion Index: Sibilants	X		0/45	0.0	I
	10	Reduced % Dentalized Sibilants of Distorted Sibilants	X		0/45	0.0	I
	11	Increased Relative Distortion Index for Early Consonants	X		28/38	73.7	F
	12	Decreased 1st Moment on /s/ Initial Singletons		X	16/40	40.0	SF
	13	Increased Sqrt 2nd Moment of the /s/ Initial Singletons		X	26/40	65.0	F
	14	Increased Sqrt 2nd Moment of the /s/ initial, and /s/ and /z/ final singletons		X	36/45	80.0	VF
	15	Increased All Consonant-Consonant Duration		X	28/44	63.6	F
Vowels and Consonants							
	16	Increased Diacritic Modificatiion Index (DMI) Class: Place %	X		45/45	100.0	VF
	17	Increased DMI Class: Duration %	X		44/45	97.8	VF
	18	Increased % of Epenthesis Errors	X		45/45	100.0	VF
Phrasing							
	19	Increased PM errors: % of Addition, Breath, Repeat, or Long	X		25/45	55.6	SF
Rate							
	20	Reduced Average Syllable Artic Rate (without pauses)		X	38/45	84.4	VF
	21	Increased Average Syllable ms (without pauses)		X	40/45	88.9	VF
Stress							
	22	Increased % of Prosody Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration. (uncircled & circled)	X		39/45	86.7	VF
	23	Increased % of PV15/16 EE codes of all PV15/16 codes. (uncircled & circled)	X		30/45	66.7	F
Loudness							
	24	Decreased Intensity Difference dB Fricative+Vowel		X	1/42	2.4	I
Pitch							
	25	Decreased F0 for all delimited Vowels & Diphthongs		X	3/45	6.7	I
	26	Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs		X	10/45	22.2	SI

Laryngeal Quality							
	27	**Increased % Jitter for Vowels**		**X**	**3/45**	**6.7**	**I**
	28	**Increased % Shimmer for Vowels**		**X**	**2/45**	**4.4**	**I**
	29	**Decreased HNR dB for Vowels**		**X**	**8/45**	**17.8**	**I**
Resonance Quality							
	30	**Increased % Inappropriate Resonance**	**X**		**39/45**	**86.7**	**VF**
	31	**Decreased F1 /ɑ/ (Nasal)**		**X**	**5/45**	**11.1**	**I**
	32	**Decreased F2 for High Vowels (Nasopharyngeal)**		**X**	**9/45**	**20.0**	**SI**

Signs Scores Summary			**Signs Summary**	
			Number of signs with each ordinal classification	
Count	**45**		**Very Frequent (VF): 80.0-100%**	**11**
Mean	**49.5**		**Frequent (F): 60.0-79.9%**	**4**
Standard Deviation	**8.3**		**Somewhat Frequent (SF): 40.0-59.9%**	**2**
Range	**33.3 - 70.0**		**Somewhat Infrequent (SI): 20.0-39.9%**	**4**
			Infrequent (I): 0.0-19.9%	**9**
			Not Used	**2**

[a] A: Acoustic; P: Perceptual

[b] Increased/Decreased reference $\geq$ 1.25 standard deviation units from age-sex matched, typically developing speakers (Potter et al., 2012;Scheer-Cohen et al., 2013).

[c] Very Frequent (VF): 80.0-100%; Frequent (F): 60.0-79.9%; Somewhat Frequent (SF): 40.0-59.0%; Somewhat Infrequent (SI): 20.0-39.9%; Infrequent (I): 0.0-19.9%

Precision-Stability Index (PSI): Individual

Sample PEPPER Output 2

		Sign			Signs sign values		
Linguistic Domain	No.	Description	Assessment Mode[a]		Value	Z-score[b]	Code[c]
Vowels			P	A			
	1	Reduced Dispersion of Corner Vowels from Center		X	499.6 Hz	0.72	0
	2	Reduced Dispersion of Corner Vowels from ^		X	507.2 Hz	0.59	0
	3	Reduced Average Pairwise Distance of Corner Vowels		X	802.3 Hz	0.94	0
	4	Increased Duration of Corner Vowels		X	140.8 ms	-2.39	1
	5	Increased Duration for Middle Vowels and Diphthongs		X	119.9 ms	-3.26	1
	6	Reduced % Vowel Phoneme Target Consistency	X				
	7	Reduced % Vowel Target Consistency	X				
Consonants							
	8	Reduced % Correct Glides	X		74.07 %	-5.00	1
	9	Increased Relative Distortion Index: Sibilants	X		73.33 %	-0.14	0
	10	Reduced % Dentalized Sibilants of Distorted Sibilants	X		18.18 %	-0.41	0
	11	Increased Relative Distortion Index for Early Consonants	X		60.00 %	-5.00	1
	12	Decreased 1st Moment on /s/ Initial Singletons		X	5.56 kHz	-3.00	1
	13	Increased Sqrt 2nd Moment of the /s/ Initial Singletons		X	1.22 kHz	-0.20	0
	14	Increased Sqrt 2nd Moment of the /s/ initial, and /s/ and /z/ final singletons		X	1.41 kHz	-0.96	0
	15	Increased All Consonant-Consonant Duration		X	180.0 ms	-0.72	0
Vowels and Consonants							
	16	Increased Diacritic Modificatiion Index (DMI) Class: Place %	X		6.30 %	-3.78	1
	17	Increased DMI Class: Duration %	X		1.35 %	-3.13	1
	18	Increased % of Epenthesis Errors	X		1.68 %	-5.00	1
Phrasing							
	19	Increased PM errors: % of Addition, Breath, Repeat, or Long	X		0.76 %	-1.01	0
Rate							
	20	Reduced Average Syllable Artic Rate (without pauses)		X	4.39 syl/s	-1.37	1
	21	Increased Average Syllable ms (without pauses)		X	241.1 ms	-1.54	1
Stress							
	22	Increased % of Prosody Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration. (uncircled & circled)	X		33.33 %	-5.00	1
	23	Increased % of PV15/16 EE codes of all PV15/16 codes. (uncircled & circled)	X		57.14 %	-5.00	1
Loudness							
	24	Decreased Intensity Difference dB Fricative+Vowel		X	11.20 dB	0.32	0
Pitch							
	25	Decreased F0 for all delimited Vowels & Diphthongs		X	199.6 Hz	0.79	0
	26	Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs		X	269.5 Hz	1.14	0

Laryngeal Quality							
	27	**Increased % Jitter for Vowels**		**X**	**1.40 %**	**0.43**	**0**
	28	**Increased % Shimmer for Vowels**		**X**	**9.39 %**	**0.70**	**0**
	29	**Decreased HNR dB for Vowels**		**X**	**17.19 dB**	**1.08**	**0**
Resonance Quality							
	30	**Increased % Inappropriate Resonance**	**X**		**100.0 %**	**-4.15**	**1**
	31	**Decreased F1 /ɑ/ (Nasal)**		**X**	**961.7 Hz**	**2.19**	**0**
	32	**Decreased F2 for High Vowels (Nasopharyngeal)**		**X**	**2053 Hz**	**-0.86**	**0**

No. of positive signs	**13**
No. of signs with data	**30**
Average Sign Z-score	**-1.43**
Signs Score	**56.7**

[a] A: Acoustic; P: Perceptual

[b] Z-scores referenced to age-sex matched typically developing speakers (Potter et al., 2012; Scheer-Cohen et al., 2013)

[c] Code: 0 = not positive on variable; 1 = postive on variable (Z-score ≤ -1.25). Z-scores reversed for Increased.

Reference Data

The following tables include, respectively, reference data (means, standard deviation) for each of the 32 PSI signs for the 200 typical speakers ages 3-80 years, followed by reference data for the 32 PSI signs for the 268 children, 3-7 years of age with Idiopathic Speech Delay.

Precision-Stability Index Signs: Typical Speakers
Reference Data 1

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	604.0	115.8	594.7	86.8	560.1	101.2	635.8	77.9	562.9	125.2	651.1	114.4
Reduced Dispersion of Corner Vowels from ^	Hz	643.8	213.2	557.5	103.8	579.8	173.7	741.0	172.1	618.2	163.5	613.1	62.0
Reduced Average Pairwise Distance of Corner Vowels	Hz	859.5	217.2	916.7	241.4	806.1	172.5	938.4	159.7	823.5	206.7	957.4	151.2
Increased Duration of Corner Vowels	ms	151.0	37.4	151.7	22.1	160.5	42.2	148.1	58.2	147.3	27.2	148.6	25.9
Increased Duration for Diphthongs and Middle Vowels	ms	134.0	8.4	131.7	7.7	149.1	38.9	131.4	43.4	133.6	12.4	126.0	14.7
Reduced % Vowel Phoneme Target Consistency	u	100.0	0.0	100.0	*	*	*	63.3	32.2	*	*	100.0	0.0
Reduced % Vowel Target Consistency	u	100.0	0.0	100.0	0.0	*	*	37.8	54.3	*	*	100.0	0.0
Consonants													
Reduced % Correct Glide	%	98.2	2.5	98.3	2.4	96.0	2.6	92.1	10.9	100.0	0.0	99.2	1.8
Increased Relative Distortion Index: Sibilants	%	80.4	23.9	69.2	44.0	88.5	21.0	97.8	5.0	98.5	2.9	75.0	50.0
Reduced % Dentalized Sibilants of Distorted Sibilants	%	56.9	45.7	66.9	46.7	68.2	45.5	58.2	50.2	56.3	42.7	30.6	4.8
Increased Relative Distortion Index for Early Consonants	%	5.6	11.1	16.7	23.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased 1st Moment on /s/ Initial Singletons	kHz	6.6	0.5	7.5	0.8	7.0	0.3	7.4	0.6	7.0	0.9	7.5	0.6

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	2.0	0.4	1.8	0.6	1.6	0.1	1.5	0.4	1.6	0.2	1.4	0.1
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	2.1	0.2	2.1	0.3	2.2	0.1	1.9	0.2	1.8	0.4	1.8	0.4
Increased All Consonant-Consonant Duration	ms	249.7	45.2	240.8	35.3	229.0	52.1	235.4	41.6	201.1	46.6	197.6	20.4
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	6.3	3.6	5.6	4.4	4.7	3.5	4.1	1.6	1.9	2.7	0.6	0.4
Increased DMI Class: Duration %	%	0.8	0.8	0.7	0.6	0.5	0.3	1.2	1.9	0.8	0.5	0.7	0.7
Increased % of Epenthesis Errors	%	1.4	0.7	1.1	0.8	2.2	1.6	3.1	2.4	1.7	1.5	0.9	0.5
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.5	0.7	0.4	0.8	0.2	0.4	1.2	1.6	0.2	0.4	0.0	0.0
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	3.7	0.6	3.6	0.5	3.3	0.8	3.6	0.9	3.9	0.4	4.1	0.4
Increased Average Syllable ms (without pauses)	ms	294.1	40.6	298.5	48.8	328.1	71.8	324.1	96.3	280.6	31.6	262.9	30.7
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	2.8	3.9	0.0	0.0	2.5	2.3	4.0	5.6	0.0	0.0	0.0	0.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	10.7	14.7	0.0	0.0	19.5	21.9	26.7	32.7	0.0	0.0	0.0	0.0
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	13.9	1.4	13.4	7.5	11.3	4.3	12.0	6.0	12.7	5.3	14.1	2.2

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	283.7	39.8	256.0	40.5	251.4	25.6	272.6	52.6	264.6	34.6	261.5	31.4
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	432.1	141.1	433.6	195.2	270.2	87.2	288.5	49.5	317.9	101.7	349.6	29.1
Laryngeal Quality													
Increased % Jitter for Vowels	%	1.6	0.6	2.2	1.0	1.3	0.4	1.5	1.0	1.7	1.0	1.6	0.7
Increased % Shimmer for Vowels	%	9.0	3.0	10.8	4.0	8.4	1.5	8.5	5.0	10.8	2.7	8.6	1.7
Decreased HNR dB for Vowels	dB	18.5	2.2	16.6	3.7	18.3	1.8	18.7	2.3	17.4	1.1	17.6	1.3
Resonance Quality													
Increased % Inappropriate Resonance	%	13.3	19.2	26.7	29.1	0.0	0.0	28.3	43.9	8.3	11.4	5.0	6.9
Decreased F1 /a/ (Nasal)	Hz	834.0	116.6	802.4	118.9	919.2	132.8	1124.1	163.0	964.8	225.0	1101.0	216.9
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2436.5	493.4	2563.7	229.2	2212.1	241.2	2540.4	279.3	2398.8	240.2	2532.9	291.7

Precision-Stability Index Signs: Typical Speakers
Reference Data 2

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	594.5	36.0	510.1	115.9	563.1	50.5	532.8	85.1	561.4	79.0	533.0	62.7
Reduced Dispersion of Corner Vowels from ^	Hz	731.1	40.3	458.0	105.7	648.6	85.9	627.6	168.4	580.8	34.0	653.2	116.6
Reduced Average Pairwise Distance of Corner Vowels	Hz	939.5	95.1	675.6	166.7	830.9	61.3	765.1	129.3	871.9	98.5	761.1	143.7
Increased Duration of Corner Vowels	ms	102.2	7.4	141.3	62.5	140.9	16.8	133.0	19.6	101.6	12.2	118.0	21.3
Increased Duration for Diphthongs and Middle Vowels	ms	107.0	19.2	117.6	26.5	131.6	9.4	123.6	4.3	102.9	21.1	94.7	18.8
Reduced % Vowel Phoneme Target Consistency	u	33.3	*	46.8	23.3	*	*	40.0	*	*	*	*	*
Reduced % Vowel Target Consistency	u	33.3	*	61.6	24.6	*	*	40.0	*	40.0	*	*	*
Consonants													
Reduced % Correct Glide	%	96.2	4.4	99.1	1.9	100.0	0.0	98.3	2.4	97.8	3.1	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	97.2	5.6	76.4	29.5	97.8	5.0	100.0	0.0	87.5	25.0	92.6	11.9
Reduced % Dentalized Sibilants of Distorted Sibilants	%	0.0	0.0	39.3	34.4	35.8	45.2	72.9	14.7	33.3	23.6	15.5	31.0
Increased Relative Distortion Index for Early Consonants	%	20.0	44.7	0.0	0.0	0.0	*	0.0	0.0	20.0	44.7	100.0	*
Decreased 1st Moment on /s/ Initial Singletons	kHz	7.3	0.5	6.9	1.4	6.7	0.5	7.6	0.8	6.9	0.4	7.6	0.5

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.6	0.1	1.7	0.7	1.4	0.2	1.4	0.3	1.5	0.3	1.4	0.3
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.8	0.1	1.8	0.2	1.6	0.2	1.7	0.3	1.9	0.1	1.7	0.3
Increased All Consonant-Consonant Duration	ms	205.3	37.7	200.8	69.9	222.9	42.1	198.1	36.1	194.6	66.1	195.3	38.9
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	2.8	2.3	1.9	2.3	0.7	0.4	0.8	1.0	1.5	1.4	1.1	1.6
Increased DMI Class: Duration %	%	0.6	0.7	0.9	1.6	0.9	0.3	0.3	0.3	0.5	0.7	0.4	0.2
Increased % of Epenthesis Errors	%	1.2	0.9	1.2	1.2	0.8	0.5	0.4	0.4	1.0	1.0	0.6	1.1
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.3	0.5	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.0
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	4.0	0.4	4.1	0.9	3.7	0.3	3.8	0.5	4.4	0.6	4.5	0.6
Increased Average Syllable ms (without pauses)	ms	262.7	23.4	276.5	86.3	295.5	30.6	278.2	38.1	245.9	44.9	240.5	40.6
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	2.5	2.3	2.5	3.7	1.7	3.7	1.7	2.3	1.7	2.3	0.0	0.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	38.3	43.3	30.0	44.7	10.0	22.4	10.0	13.7	33.3	28.9	0.0	0.0
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	10.1	2.6	10.9	2.7	10.9	1.5	9.0	1.2	10.1	3.1	7.8	2.8

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	237.1	31.3	227.7	39.0	249.2	24.4	231.1	24.9	213.5	21.1	222.2	15.5
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	281.0	133.8	293.3	67.2	262.5	99.8	300.8	82.5	217.5	20.0	254.2	84.4
Laryngeal Quality													
Increased % Jitter for Vowels	%	1.7	1.1	2.3	1.3	3.3	3.1	1.4	0.6	1.4	0.9	1.4	0.8
Increased % Shimmer for Vowels	%	9.2	4.2	10.8	6.8	13.1	5.1	11.4	4.6	9.2	3.8	8.5	4.2
Decreased HNR dB for Vowels	dB	18.9	3.3	17.8	4.7	18.7	2.4	17.5	2.3	19.0	3.4	17.8	2.2
Resonance Quality													
Increased % Inappropriate Resonance	%	20.8	44.3	30.8	43.5	12.5	28.0	12.5	25.7	22.5	22.4	20.8	44.3
Decreased F1 /a/ (Nasal)	Hz	964.8	123.9	967.5	198.6	809.5	156.5	933.1	58.4	905.0	126.1	851.8	121.7
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2421.8	123.6	2491.5	415.5	2431.2	108.8	2563.9	217.8	2552.1	141.4	2459.5	219.0

Precision-Stability Index Signs: Typical Speakers
Reference Data 3

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	582.5	41.2	548.7	71.9	507.7	78.1	567.9	118.4	431.8	75.3	544.4	156.5
Reduced Dispersion of Corner Vowels from ^	Hz	706.7	249.3	585.1	156.5	572.3	133.8	521.4	88.9	541.0	46.7	579.3	101.9
Reduced Average Pairwise Distance of Corner Vowels	Hz	855.8	68.7	819.5	99.0	731.5	185.6	794.9	154.2	679.2	144.7	824.8	304.1
Increased Duration of Corner Vowels	ms	122.2	18.3	114.3	11.9	103.7	16.1	104.0	17.2	128.2	33.6	105.0	16.4
Increased Duration for Diphthongs and Middle Vowels	ms	111.2	18.2	105.8	16.1	85.5	8.6	88.8	9.5	106.1	13.9	102.8	6.4
Reduced % Vowel Phoneme Target Consistency	u	39.3	*	*	*	*	*	*	*	*	*	*	*
Reduced % Vowel Target Consistency	u	39.3	*	*	*	*	*	*	*	*	*	*	*
Consonants													
Reduced % Correct Glide	%	99.3	1.5	99.4	1.2	100.0	0.0	100.0	0.0	96.7	7.5	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	100.0	0.0	71.4	*	98.3	3.7	55.6	50.9	100.0	0.0	83.3	28.9
Reduced % Dentalized Sibilants of Distorted Sibilants	%	25.0	50.0	40.0	*	10.5	14.3	0.0	0.0	12.5	25.0	33.3	57.7
Increased Relative Distortion Index for Early Consonants	%	0.0	0.0	0.0	0.0	0.0	*	0.0	0.0	16.7	28.9	0.0	0.0
Decreased 1st Moment on /s/ Initial Singletons	kHz	6.8	0.8	7.5	1.0	6.3	0.5	7.8	0.5	6.5	0.6	7.6	0.4

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.4	0.2	1.3	0.2	1.6	0.2	1.3	0.2	1.5	0.2	1.3	0.3
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.6	0.2	1.6	0.4	1.6	0.2	1.5	0.2	1.7	0.1	1.5	0.2
Increased All Consonant-Consonant Duration	ms	214.7	33.7	178.7	38.4	165.4	32.1	185.8	33.6	173.7	52.1	192.6	35.9
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	0.6	0.8	0.4	0.5	0.7	0.6	0.2	0.2	0.4	0.3	0.5	0.6
Increased DMI Class: Duration %	%	0.5	0.3	0.2	0.2	0.6	0.7	0.2	0.3	0.5	0.4	0.3	0.2
Increased % of Epenthesis Errors	%	0.2	0.2	0.5	0.5	0.3	0.5	0.4	0.4	0.3	0.3	0.1	0.2
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.1	0.3	0.0	0.0	0.0	0.0	0.6	1.2	0.2	0.3	0.0	0.0
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	4.0	0.4	4.7	0.7	4.5	0.9	4.8	0.3	4.5	0.6	4.8	0.4
Increased Average Syllable ms (without pauses)	ms	269.3	25.7	228.9	35.0	249.9	36.9	228.0	24.3	233.7	30.2	221.4	11.1
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	3.3	5.4	2.5	2.3	0.0	0.0	1.7	3.7	1.7	2.3	1.7	2.3
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	14.0	21.9	25.8	21.2	0.0	0.0	33.3	57.7	16.7	23.6	10.7	15.4
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	11.1	2.4	10.4	4.1	7.1	4.4	6.8	10.4	10.9	4.4	9.6	2.4

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	196.4	23.7	221.7	31.2	212.1	24.9	228.4	12.6	210.2	18.2	210.0	17.2
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	190.0	39.2	252.8	67.5	272.0	88.0	282.6	54.8	181.7	60.0	252.4	34.9
Laryngeal Quality													
Increased % Jitter for Vowels	%	2.0	1.4	1.0	0.4	1.3	0.4	2.1	0.8	1.1	0.5	1.9	1.6
Increased % Shimmer for Vowels	%	11.1	5.2	8.0	3.4	10.9	3.8	11.4	2.4	8.8	2.8	12.4	4.7
Decreased HNR dB for Vowels	dB	16.6	2.2	18.8	2.7	15.5	2.0	16.3	1.7	18.2	1.6	16.6	1.4
Resonance Quality													
Increased % Inappropriate Resonance	%	16.7	37.3	0.8	1.9	0.0	0.0	0.0	0.0	17.5	25.1	0.8	1.9
Decreased F1 /a/ (Nasal)	Hz	806.7	100.1	997.8	117.5	796.9	88.0	916.3	85.6	746.5	148.9	855.5	121.6
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2551.5	216.7	2329.9	83.5	2382.8	139.3	2368.4	240.8	2303.8	121.2	2290.9	350.5

Precision-Stability Index Signs: Typical Speakers
Reference Data 4

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	532.7	78.5	469.2	92.7	374.6	54.9	485.3	50.4	525.5	38.4	471.1	43.8
Reduced Dispersion of Corner Vowels from ^	Hz	552.6	130.2	471.5	87.9	400.4	84.8	525.2	162.1	644.3	254.0	508.3	52.9
Reduced Average Pairwise Distance of Corner Vowels	Hz	780.0	95.9	720.1	147.4	524.9	119.7	701.1	36.4	789.7	40.6	716.9	76.4
Increased Duration of Corner Vowels	ms	100.3	21.0	97.3	14.1	107.8	27.5	113.7	23.3	105.4	13.2	95.0	19.8
Increased Duration for Diphthongs and Middle Vowels	ms	86.6	16.5	80.9	15.6	96.2	22.3	98.4	10.2	97.1	11.4	76.4	10.5
Reduced % Vowel Phoneme Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Reduced % Vowel Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Consonants													
Reduced % Correct Glide	%	99.2	1.7	100.0	0.0	99.0	2.4	100.0	0.0	96.5	3.5	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	100.0	0.0	100.0	0.0	58.3	50.0	50.0	70.7	100.0	0.0	100.0	0.0
Reduced % Dentalized Sibilants of Distorted Sibilants	%	0.0	0.0	36.0	49.8	0.0	0.0	0.0	*	0.0	0.0	50.0	70.7
Increased Relative Distortion Index for Early Consonants	%	0.0	0.0	0.0	0.0	0.0	0.0	*	*	0.0	0.0	0.0	*
Decreased 1st Moment on /s/ Initial Singletons	kHz	5.8	0.8	7.0	0.6	6.5	1.1	7.7	0.7	6.2	0.5	7.3	0.7

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.4	0.2	1.5	0.2	1.4	0.2	1.3	0.2	1.7	0.3	1.5	0.2
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.4	0.2	1.6	0.2	1.6	0.1	1.3	0.2	1.6	0.2	1.5	0.2
Increased All Consonant-Consonant Duration	ms	183.9	67.7	180.7	21.8	134.8	19.2	164.6	17.8	173.9	29.9	167.0	24.5
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	0.4	0.5	0.9	0.8	0.3	0.2	0.2	0.2	0.6	0.4	0.4	0.2
Increased DMI Class: Duration %	%	0.2	0.2	0.1	0.2	0.5	0.6	0.4	0.5	0.7	0.4	0.1	0.1
Increased % of Epenthesis Errors	%	0.2	0.2	0.1	0.2	0.0	0.0	0.1	0.2	0.1	0.2	0.6	0.6
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.2	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.0
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	4.8	0.9	4.9	0.6	5.3	1.0	4.8	0.4	4.6	0.8	4.9	1.0
Increased Average Syllable ms (without pauses)	ms	230.0	51.4	221.2	34.3	204.4	40.3	218.4	20.9	237.3	36.7	219.0	47.9
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	2.5	3.7	0.0	0.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	0.0	0.0	33.3	57.7	0.0	0.0	0.0	0.0	25.7	43.3	0.0	*
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	10.5	3.4	10.3	2.0	9.1	3.2	8.8	2.7	11.4	3.6	11.0	3.2

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	183.9	46.7	191.9	14.6	180.3	43.1	197.7	22.1	123.3	35.1	164.9	29.2
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	202.8	71.4	268.0	66.7	233.6	52.4	214.8	35.0	134.8	35.6	242.2	37.9
Laryngeal Quality													
Increased % Jitter for Vowels	%	5.4	8.7	4.3	6.1	8.1	10.2	1.9	2.0	2.5	1.4	9.0	7.6
Increased % Shimmer for Vowels	%	13.8	11.0	12.9	9.1	17.4	13.8	10.5	5.8	12.6	5.5	20.8	12.6
Decreased HNR dB for Vowels	dB	19.7	3.4	18.3	3.2	21.7	7.7	16.9	3.0	15.8	2.0	20.3	4.6
Resonance Quality													
Increased % Inappropriate Resonance	%	17.5	39.1	19.2	42.9	0.0	0.0	0.0	0.0	35.8	49.6	0.0	0.0
Decreased F1 /a/ (Nasal)	Hz	805.8	85.3	806.4	42.6	689.0	94.5	789.6	115.9	708.0	31.9	815.4	87.3
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2294.2	211.1	2305.5	151.4	2030.0	163.1	2297.8	165.4	2150.4	109.7	2083.3	287.9

Precision-Stability Index Signs: Typical Speakers
Reference Data 5

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	365.9	49.6	467.2	129.0	392.5	23.1	442.1	39.2	410.4	28.8	470.1	78.2
Reduced Dispersion of Corner Vowels from ^	Hz	367.6	64.1	456.7	119.6	412.8	55.6	473.8	79.3	439.8	65.7	454.6	73.0
Reduced Average Pairwise Distance of Corner Vowels	Hz	529.4	169.4	641.2	181.8	597.8	55.1	692.4	99.6	592.6	63.8	690.2	146.8
Increased Duration of Corner Vowels	ms	107.5	9.2	96.7	11.3	82.5	4.5	89.1	20.1	111.7	12.3	103.0	16.2
Increased Duration for Diphthongs and Middle Vowels	ms	96.2	9.1	94.2	9.6	78.6	11.6	80.3	13.8	90.4	12.8	83.6	10.5
Reduced % Vowel Phoneme Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Reduced % Vowel Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Consonants													
Reduced % Correct Glide	%	100.0	0.0	100.0	0.0	95.5	6.7	100.0	0.0	100.0	0.0	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	100.0	*	100.0	0.0	100.0	0.0	100.0	*	50.0	70.7	33.3	*
Reduced % Dentalized Sibilants of Distorted Sibilants	%	0.0	*	33.3	57.7	0.0	0.0	85.2	*	0.0	*	0.0	*
Increased Relative Distortion Index for Early Consonants	%	0.0	0.0	*	*	0.0	0.0	0.0	0.0	*	*	*	*
Decreased 1st Moment on /s/ Initial Singletons	kHz	5.7	0.5	6.7	0.9	5.9	0.5	7.7	1.0	5.7	0.9	7.8	0.4

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.3	0.1	1.5	0.3	1.4	0.1	1.1	0.3	1.5	0.1	1.2	0.1
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.3	0.1	1.5	0.2	1.5	0.2	1.2	0.2	1.5	0.2	1.3	0.1
Increased All Consonant-Consonant Duration	ms	169.1	35.5	139.5	19.1	139.2	14.3	161.0	40.8	154.6	31.2	143.1	38.9
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	0.5	0.5	0.1	0.1	0.3	0.2	1.1	2.1	0.5	0.3	0.2	0.2
Increased DMI Class: Duration %	%	0.5	0.3	0.5	0.3	0.1	0.2	0.3	0.4	0.4	0.2	0.3	0.3
Increased % of Epenthesis Errors	%	0.2	0.3	0.1	0.3	0.1	0.2	0.2	0.3	0.0	0.0	0.1	0.2
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.2	0.5	0.0	0.0	0.0	0.0	0.4	0.8	0.0	0.0	0.0	0.0
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	5.2	0.3	5.0	0.6	5.8	0.8	5.1	0.7	5.5	0.6	5.5	0.7
Increased Average Syllable ms (without pauses)	ms	199.7	12.5	221.3	35.3	182.2	22.8	208.1	29.2	191.1	22.1	194.9	22.8
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9	0.8	1.9
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	16.7	7.1	10.1
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	8.9	3.5	8.8	2.9	8.1	2.3	9.6	3.0	8.3	1.5	11.1	2.4

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	103.4	8.5	181.7	21.8	104.5	15.1	190.1	24.1	104.6	12.9	181.5	8.2
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	160.0	80.0	249.6	91.8	129.6	29.8	182.3	36.7	159.9	59.5	230.2	64.2
Laryngeal Quality													
Increased % Jitter for Vowels	%	3.8	1.9	7.5	5.2	4.1	1.9	1.4	0.2	2.5	0.8	3.1	2.7
Increased % Shimmer for Vowels	%	22.2	2.2	18.2	4.6	15.3	5.5	12.3	3.4	14.8	3.3	15.4	8.4
Decreased HNR dB for Vowels	dB	11.8	1.1	18.8	7.3	13.7	1.0	14.8	2.9	13.3	1.9	14.4	2.1
Resonance Quality													
Increased % Inappropriate Resonance	%	0.0	0.0	0.0	0.0	20.0	44.7	14.2	31.7	0.0	0.0	0.0	0.0
Decreased F1 /a/ (Nasal)	Hz	677.5	63.4	777.9	51.8	673.3	63.4	766.3	102.5	585.8	88.0	732.0	99.3
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	1874.2	198.9	2117.8	186.1	1984.9	67.2	2271.9	187.9	2001.9	185.7	2143.4	165.8

Precision-Stability Index Signs: Typical Speakers
Reference Data 6

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	327.0	53.5	463.3	42.7	374.4	46.2	410.4	120.6	341.3	43.3	448.4	47.1
Reduced Dispersion of Corner Vowels from ^	Hz	319.4	57.8	504.0	118.6	479.5	73.5	450.8	93.4	378.6	102.5	588.4	128.5
Reduced Average Pairwise Distance of Corner Vowels	Hz	457.3	91.4	666.4	22.4	553.9	48.9	579.8	198.2	467.5	58.1	678.4	79.2
Increased Duration of Corner Vowels	ms	110.4	13.4	104.6	25.4	114.9	7.7	118.3	6.3	108.8	28.3	109.8	17.0
Increased Duration for Diphthongs and Middle Vowels	ms	90.4	13.5	100.9	25.7	91.9	13.8	102.6	9.7	92.2	14.9	103.2	10.9
Reduced % Vowel Phoneme Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Reduced % Vowel Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Consonants													
Reduced % Correct Glide	%	100.0	0.0	100.0	0.0	100.0	0.0	99.3	1.4	100.0	0.0	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	66.7	57.7	100.0	*	83.3	23.6	100.0	*	100.0	*	100.0	*
Reduced % Dentalized Sibilants of Distorted Sibilants	%	0.0	0.0	0.0	*	25.0	35.4	100.0	*	0.0	*	0.0	*
Increased Relative Distortion Index for Early Consonants	%	*	*	0.0	0.0	*	*	100.0	*	*	*	0.0	*
Decreased 1st Moment on /s/ Initial Singletons	kHz	6.3	0.7	8.1	0.7	5.4	0.4	7.2	0.2	5.4	0.6	7.8	0.7

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.6	0.1	1.2	0.1	1.4	0.1	1.3	0.2	1.5	0.3	1.2	0.2
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.6	0.1	1.4	0.2	1.4	0.2	1.4	0.2	1.5	0.3	1.3	0.3
Increased All Consonant-Consonant Duration	ms	165.6	32.6	177.6	42.7	178.4	15.4	130.8	11.4	143.8	21.6	183.3	72.0
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	0.4	0.3	0.3	0.4	0.5	0.2	0.2	0.3	0.2	0.2	0.1	0.1
Increased DMI Class: Duration %	%	0.0	0.1	0.4	0.3	0.5	0.3	0.5	0.3	0.2	0.1	0.2	0.2
Increased % of Epenthesis Errors	%	0.1	0.2	0.2	0.5	0.1	0.3	0.1	0.2	0.0	0.0	0.1	0.2
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	5.0	0.7	5.2	0.8	5.0	0.4	5.1	0.4	5.0	0.5	4.9	0.5
Increased Average Syllable ms (without pauses)	ms	212.0	32.1	210.8	33.2	216.9	24.6	210.1	20.9	205.9	23.6	215.7	19.5
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	0.0	0.0	0.0	0.0	1.0	2.1	2.1	4.2	0.0	0.0	0.0	0.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	0.0	*	0.0	0.0	33.3	57.7	33.3	57.7	0.0	0.0	0.0	*
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	10.7	4.2	5.4	1.4	8.3	2.0	8.5	2.0	6.6	2.2	11.6	1.6

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	102.8	11.1	177.8	6.6	108.6	16.5	171.4	19.1	109.4	16.8	162.1	14.3
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	185.0	126.5	231.3	12.7	139.2	66.9	243.2	45.3	213.5	89.5	217.8	24.1
Laryngeal Quality													
Increased % Jitter for Vowels	%	2.7	1.7	2.6	1.2	5.1	6.6	2.5	1.5	5.1	4.3	2.6	1.3
Increased % Shimmer for Vowels	%	16.4	7.1	18.0	3.7	14.0	5.2	16.6	3.0	19.0	7.2	15.8	5.4
Decreased HNR dB for Vowels	dB	13.9	3.4	14.2	1.9	15.8	2.3	13.4	1.6	12.1	2.0	15.0	3.5
Resonance Quality													
Increased % Inappropriate Resonance	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 /a/ (Nasal)	Hz	631.7	23.4	831.6	85.5	655.9	98.7	724.9	92.6	554.6	74.8	843.3	110.7
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	1836.1	78.0	2342.4	269.7	1842.8	252.5	2124.9	142.3	1794.2	178.7	2147.0	225.3

Precision-Stability Index Signs: Typical Speakers
Reference Data 7

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	367.2	68.4	493.3	63.6	402.4	75.6	388.8	111.4	334.6	63.1	409.7	44.7
Reduced Dispersion of Corner Vowels from ^	Hz	396.6	96.8	463.6	65.1	481.7	146.9	391.5	64.6	439.7	164.1	480.7	96.6
Reduced Average Pairwise Distance of Corner Vowels	Hz	560.6	92.9	761.6	137.5	575.4	65.5	559.0	138.4	477.0	90.8	641.8	75.7
Increased Duration of Corner Vowels	ms	129.2	15.6	105.9	30.3	113.3	17.9	110.8	5.0	132.5	29.1	102.4	13.4
Increased Duration for Diphthongs and Middle Vowels	ms	110.6	14.1	99.5	11.8	109.6	21.0	101.7	11.7	112.4	23.4	92.9	11.4
Reduced % Vowel Phoneme Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Reduced % Vowel Target Consistency	u	*	*	*	*	100.0	*	*	*	*	*	*	*
Consonants													
Reduced % Correct Glide	%	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	99.4	1.3	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	*	*	100.0	0.0	100.0	0.0	100.0	*	100.0	0.0	100.0	0.0
Reduced % Dentalized Sibilants of Distorted Sibilants	%	*	*	50.0	70.7	0.0	0.0	0.0	*	0.0	0.0	0.0	0.0
Increased Relative Distortion Index for Early Consonants	%	100.0	*	0.0	*	*	*	0.0	*	0.0	0.0	0.0	*
Decreased 1st Moment on /s/ Initial Singletons	kHz	5.9	0.6	7.1	0.4	5.7	0.8	6.9	0.3	5.8	0.8	6.5	1.2

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.4	0.1	1.4	0.3	1.6	0.3	1.4	0.1	1.6	0.1	1.4	0.2
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.4	0.1	1.5	0.2	1.6	0.3	1.4	0.1	1.7	0.1	1.5	0.2
Increased All Consonant-Consonant Duration	ms	144.7	29.9	165.7	24.5	160.9	31.7	155.6	27.4	162.4	29.5	155.2	22.4
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	0.2	0.3	0.3	0.4	0.3	0.3	0.1	0.2	0.3	0.4	0.1	0.1
Increased DMI Class: Duration %	%	0.3	0.2	0.6	0.3	0.4	0.3	0.4	0.3	0.4	0.3	0.2	0.2
Increased % of Epenthesis Errors	%	0.1	0.2	0.7	1.2	0.0	0.0	0.2	0.3	0.1	0.2	0.3	0.2
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.1	0.2	0.2	0.3	0.2	0.4	0.4	0.5	0.2	0.4	0.2	0.4
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	4.4	0.7	5.0	0.5	4.7	0.8	4.5	0.6	4.4	1.1	4.8	0.5
Increased Average Syllable ms (without pauses)	ms	240.8	41.0	211.5	23.7	230.7	38.1	235.4	37.5	247.9	72.6	216.0	21.4
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	0.0	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	7.9	2.7	11.7	2.2	10.3	3.4	9.7	2.8	8.9	3.4	8.3	2.5

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	109.7	20.7	174.5	10.0	108.0	18.0	160.8	25.6	113.7	14.1	152.3	29.3
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	223.4	119.2	231.4	75.9	145.2	33.3	232.5	76.9	214.2	65.1	202.6	44.0
Laryngeal Quality													
Increased % Jitter for Vowels	%	3.2	2.3	2.0	0.9	3.0	1.4	2.1	1.5	4.3	0.9	5.9	5.7
Increased % Shimmer for Vowels	%	15.5	5.3	10.0	3.2	14.0	5.5	11.8	6.9	20.6	5.4	14.5	6.3
Decreased HNR dB for Vowels	dB	13.6	2.5	16.5	1.1	16.2	3.3	16.3	1.9	12.3	2.2	19.4	6.3
Resonance Quality													
Increased % Inappropriate Resonance	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 /a/ (Nasal)	Hz	724.9	133.3	816.4	131.3	673.0	150.2	721.3	61.2	614.5	44.6	719.1	82.4
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	1843.5	174.6	1999.4	227.6	1807.4	238.2	1990.9	273.8	1711.8	107.2	1949.2	123.3

Precision-Stability Index Signs: Typical Speakers
Reference Data 8

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	416.0	71.1	467.2	70.7	352.4	52.0	453.2	75.7	364.7	73.5	400.4	76.0
Reduced Dispersion of Corner Vowels from ^	Hz	457.3	159.4	483.7	100.0	393.5	96.0	501.6	107.8	458.3	148.5	441.0	91.9
Reduced Average Pairwise Distance of Corner Vowels	Hz	610.9	134.8	688.4	112.3	509.8	83.5	671.9	136.5	520.7	91.7	605.0	109.3
Increased Duration of Corner Vowels	ms	103.0	17.6	99.5	19.0	115.8	18.0	109.7	20.2	124.0	25.4	106.1	10.9
Increased Duration for Diphthongs and Middle Vowels	ms	91.7	14.8	86.6	13.2	96.3	15.3	101.6	14.3	111.1	21.0	96.8	11.7
Reduced % Vowel Phoneme Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Reduced % Vowel Target Consistency	u	*	*	*	*	*	*	*	*	*	*	*	*
Consonants													
Reduced % Correct Glide	%	98.2	3.8	100.0	0.0	100.0	0.0	99.8	0.7	99.7	1.0	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	77.8	41.0	81.5	37.7	77.8	40.4	100.0	0.0	100.0	0.0	100.0	0.0
Reduced % Dentalized Sibilants of Distorted Sibilants	%	0.0	0.0	35.7	49.4	10.0	22.4	40.0	54.8	0.0	0.0	0.0	0.0
Increased Relative Distortion Index for Early Consonants	%	0.0	0.0	0.0	0.0	100.0	*	20.0	44.7	0.0	0.0	0.0	0.0
Decreased 1st Moment on /s/ Initial Singletons	kHz	6.0	0.8	7.4	0.8	5.7	0.7	7.5	0.7	5.8	0.8	6.7	0.9

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.4	0.2	1.3	0.2	1.5	0.2	1.3	0.2	1.6	0.2	1.4	0.2
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.5	0.2	1.4	0.2	1.5	0.2	1.4	0.2	1.6	0.2	1.4	0.2
Increased All Consonant-Consonant Duration	ms	154.3	29.5	155.0	29.6	158.1	27.5	164.4	44.6	161.8	28.5	155.4	23.1
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	0.5	0.3	0.4	1.0	0.3	0.3	0.2	0.3	0.3	0.3	0.1	0.1
Increased DMI Class: Duration %	%	0.4	0.4	0.3	0.4	0.3	0.2	0.4	0.3	0.4	0.3	0.3	0.2
Increased % of Epenthesis Errors	%	0.1	0.2	0.2	0.4	0.1	0.2	0.3	0.6	0.1	0.1	0.2	0.3
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.1	0.5	0.1	0.4	0.0	0.1	0.0	0.2	0.2	0.4	0.3	0.4
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	5.3	0.8	5.1	0.7	4.8	0.6	5.0	0.5	4.5	0.9	4.6	0.5
Increased Average Syllable ms (without pauses)	ms	202.9	32.5	212.3	31.5	218.9	31.0	212.0	22.4	240.2	57.1	224.6	29.4
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	0.7	2.0	0.2	0.8	0.3	1.0	0.5	2.1	0.0	0.0	0.0	0.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	9.0	24.8	1.3	4.3	14.3	37.8	10.0	31.6	0.0	0.0	0.0	0.0
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	9.2	2.9	9.9	2.8	8.4	3.0	9.3	3.1	9.5	3.3	8.9	2.6

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	123.2	38.7	183.2	23.1	107.6	15.1	171.4	13.4	111.2	15.1	156.1	26.4
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	163.6	62.6	223.8	57.9	190.2	98.4	230.9	42.4	183.6	62.1	215.9	58.6
Laryngeal Quality													
Increased % Jitter for Vowels	%	4.2	4.8	4.6	5.1	4.0	3.9	2.4	1.1	3.7	1.3	4.2	4.6
Increased % Shimmer for Vowels	%	16.4	7.5	15.4	8.0	16.3	5.9	15.1	4.7	17.7	6.2	13.3	6.3
Decreased HNR dB for Vowels	dB	15.3	4.9	17.1	4.6	13.9	2.7	14.8	2.3	14.0	3.3	18.0	4.9
Resonance Quality													
Increased % Inappropriate Resonance	%	11.2	31.1	2.8	14.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 /a/ (Nasal)	Hz	666.7	78.4	776.2	90.2	641.8	103.3	804.0	106.8	640.5	102.0	720.1	69.3
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2008.3	166.4	2182.8	205.7	1829.2	164.0	2153.4	234.9	1754.3	172.0	1967.8	190.3

Precision-Stability Index Signs: Typical Speakers
Reference Data 9

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	575.7	108.0	627.2	90.8	575.3	51.8	533.5	75.5	490.8	84.2	527.2	123.9
Reduced Dispersion of Corner Vowels from ^	Hz	613.9	173.1	629.8	131.3	666.8	137.0	591.2	147.9	555.3	103.7	524.1	97.5
Reduced Average Pairwise Distance of Corner Vowels	Hz	829.7	186.3	937.5	175.4	874.5	86.2	764.4	128.1	730.2	142.3	779.9	203.7
Increased Duration of Corner Vowels	ms	152.9	34.0	149.5	36.1	116.7	21.2	126.6	34.0	110.8	26.2	102.1	15.2
Increased Duration for Diphthongs and Middle Vowels	ms	138.9	23.5	129.7	25.0	113.2	19.7	110.4	20.2	92.8	15.8	90.8	13.9
Reduced % Vowel Phoneme Target Consistency	u	100.0	0.0	81.7	28.6	36.3	4.2	45.1	19.3	*	*	*	*
Reduced % Vowel Target Consistency	u	100.0	0.0	73.3	45.7	37.5	3.7	56.2	22.8	*	*	*	*
Consonants													
Reduced % Correct Glide	%	98.1	2.6	96.5	6.9	98.4	3.0	99.2	1.6	98.6	4.4	100.0	0.0
Increased Relative Distortion Index: Sibilants	%	88.5	19.0	81.1	36.8	95.8	12.4	86.1	20.5	99.2	2.5	83.3	32.5
Reduced % Dentalized Sibilants of Distorted Sibilants	%	60.2	41.3	54.2	41.6	24.3	36.0	36.8	33.3	9.3	17.1	28.0	45.4
Increased Relative Distortion Index for Early Consonants	%	1.9	6.4	6.0	15.5	14.3	36.3	11.1	33.3	8.3	20.4	0.0	0.0
Decreased 1st Moment on /s/ Initial Singletons	kHz	6.9	0.7	7.5	0.6	6.9	0.6	7.4	0.9	6.2	0.7	7.5	0.6

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.7	0.3	1.6	0.4	1.5	0.2	1.4	0.4	1.5	0.2	1.4	0.2
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	2.0	0.3	1.9	0.3	1.7	0.2	1.7	0.3	1.6	0.2	1.5	0.2
Increased All Consonant-Consonant Duration	ms	226.6	49.0	224.6	36.9	209.4	44.2	193.2	44.8	174.4	49.4	186.3	29.2
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	4.3	3.6	3.4	3.3	1.4	1.6	1.0	1.5	0.5	0.5	0.5	0.6
Increased DMI Class: Duration %	%	0.7	0.5	0.9	1.2	0.6	0.5	0.5	0.8	0.4	0.5	0.2	0.2
Increased % of Epenthesis Errors	%	1.8	1.3	1.7	1.7	0.8	0.8	0.7	0.8	0.3	0.3	0.2	0.3
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.3	0.5	0.5	1.1	0.1	0.3	0.1	0.3	0.2	0.3	0.2	0.7
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	3.6	0.6	3.8	0.7	4.0	0.5	4.3	0.7	4.6	0.8	4.8	0.4
Increased Average Syllable ms (without pauses)	ms	300.9	51.5	295.2	65.4	268.4	34.8	256.1	54.5	237.9	38.5	223.5	23.5
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	1.8	2.8	1.3	3.6	2.3	3.4	1.7	2.5	0.6	1.5	1.4	2.6
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	10.8	16.7	8.2	20.8	22.0	29.3	16.9	27.3	7.4	16.9	23.0	39.6
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	12.6	3.9	13.2	5.3	10.5	2.3	9.5	2.9	9.5	4.2	8.9	6.0

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	266.6	34.2	263.4	39.9	224.0	31.4	225.7	26.9	202.1	32.7	210.1	20.7
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	340.1	125.5	357.2	125.0	237.8	87.4	275.3	73.1	218.9	79.3	267.7	51.3
Laryngeal Quality													
Increased % Jitter for Vowels	%	1.5	0.7	1.8	0.9	2.1	1.9	1.5	0.9	2.6	5.1	2.8	3.6
Increased % Shimmer for Vowels	%	9.4	2.5	9.3	3.7	10.6	4.5	9.7	4.7	11.2	6.7	12.2	5.7
Decreased HNR dB for Vowels	dB	18.1	1.7	17.7	2.6	18.3	2.8	18.0	2.9	17.8	2.9	17.0	2.2
Resonance Quality													
Increased % Inappropriate Resonance	%	7.2	13.2	20.0	30.5	18.1	31.5	16.3	32.8	11.7	26.3	6.7	24.7
Decreased F1 /a/ (Nasal)	Hz	906.0	162.9	1009.2	219.2	871.5	136.2	937.5	134.8	783.1	106.6	859.4	94.9
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2349.1	336.1	2545.7	248.6	2489.1	154.7	2461.2	255.8	2326.9	155.4	2321.6	243.7

Precision-Stability Index Signs: Typical Speakers
Reference Data 10

		Age (yrs)											
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Reduced Dispersion of Corner Vowels from Center	Hz	601.4	101.5	556.1	66.3	509.0	105.8	442.6	74.8	401.2	81.5	382.6	74.8
Reduced Dispersion of Corner Vowels from ^	Hz	621.6	151.9	632.1	145.2	539.7	100.2	471.0	131.0	445.8	114.2	449.7	120.1
Reduced Average Pairwise Distance of Corner Vowels	Hz	883.6	186.0	823.9	119.7	755.1	174.5	651.2	128.4	588.2	137.7	562.8	107.1
Increased Duration of Corner Vowels	ms	151.2	34.5	121.7	28.4	106.4	21.5	101.2	18.2	112.7	19.1	115.1	21.1
Increased Duration for Diphthongs and Middle Vowels	ms	134.3	24.3	111.8	19.8	91.8	14.7	89.1	14.1	98.9	14.8	104.0	18.1
Reduced % Vowel Phoneme Target Consistency	u	86.3	25.6	42.2	15.7	*	*	*	*	*	*	*	*
Reduced % Vowel Target Consistency	u	79.3	41.3	48.2	19.1	*	*	*	*	*	*	100.0	*
Consonants													
Reduced % Correct Glide	%	97.3	5.2	98.8	2.4	99.3	3.1	99.1	2.8	99.9	0.5	99.8	0.7
Increased Relative Distortion Index: Sibilants	%	84.6	29.3	92.0	16.4	91.3	23.9	79.4	38.7	87.9	30.8	100.0	0.0
Reduced % Dentalized Sibilants of Distorted Sibilants	%	57.3	40.7	29.2	34.9	18.2	34.1	15.8	36.6	25.0	42.5	0.0	0.0
Increased Relative Distortion Index for Early Consonants	%	4.1	12.1	13.0	34.4	4.2	14.4	0.0	0.0	33.3	51.6	0.0	0.0
Decreased 1st Moment on /s/ Initial Singletons	kHz	7.2	0.7	7.2	0.8	6.8	0.9	6.7	1.1	6.6	1.1	6.2	1.0
Increased Sqrt of the 2nd		1.6	0.4	1.5	0.3	1.5	0.2	1.4	0.2	1.4	0.2	1.5	0.2

Moment for /s/ Initial Singletons	kHz												
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	2.0	0.3	1.7	0.2	1.6	0.2	1.4	0.2	1.4	0.2	1.5	0.2
Increased All Consonant-Consonant Duration	ms	225.6	42.7	201.3	44.7	180.4	40.3	154.7	29.3	161.2	36.6	158.6	25.4
Vowels & Consonants													
Increased Diacritic Modification Index (DMI) Class: Place %	%	3.9	3.4	1.2	1.5	0.5	0.5	0.4	0.7	0.3	0.3	0.2	0.3
Increased DMI Class: Duration %	%	0.8	0.9	0.5	0.7	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3
Increased % of Epenthesis Errors	%	1.7	1.5	0.7	0.8	0.2	0.3	0.2	0.3	0.2	0.5	0.1	0.2
Phrasing													
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.4	0.8	0.1	0.3	0.2	0.5	0.1	0.4	0.0	0.1	0.2	0.4
Rate													
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	3.7	0.6	4.2	0.6	4.7	0.6	5.2	0.7	4.9	0.6	4.6	0.7
Increased Average Syllable ms (without pauses)	ms	298.04	57.9	262.2	45.6	230.7	32.2	207.6	32.0	215.5	26.8	232.4	44.8
Stress													
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	1.6	3.2	2.0	3.0	1.0	2.1	0.4	1.5	0.4	1.6	0.0	0.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	9.6	18.4	19.3	28.0	16.0	31.8	6.1	19.9	11.8	33.2	0.0	0.0
Loudness													
Decreased Intensity Difference dB Fricative+Vowel	dB	12.9	4.6	10.0	2.7	9.2	5.1	9.5	2.9	8.8	3.1	9.2	2.9

Pitch													
Decreased F0 for all Vowels & Diphthongs	Hz	265.0	36.5	224.9	28.9	206.1	27.2	153.2	43.7	139.5	35.3	133.6	31.1
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	348.7	123.4	256.5	81.8	243.3	70.2	193.7	67.0	210.6	77.3	199.7	60.9
Laryngeal Quality													
Increased % Jitter for Vowels	%	1.6	0.8	1.8	1.5	2.7	4.3	4.4	4.9	3.2	2.9	4.0	3.3
Increased % Shimmer for Vowels	%	9.3	3.1	10.2	4.6	11.7	6.1	15.9	7.7	15.7	5.3	15.5	6.5
Decreased HNR dB for Vowels	dB	17.9	2.2	18.1	2.8	17.4	2.6	16.2	4.8	14.3	2.5	16.0	4.5
Resonance Quality													
Increased % Inappropriate Resonance	%	13.6	24.0	17.2	31.8	9.2	25.2	7.0	24.3	0.0	0.0	0.0	0.0
Decreased F1 /a/ (Nasal)	Hz	957.6	196.9	904.5	137.9	821.2	106.5	721.5	100.3	722.9	132.2	680.3	94.0
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2447.4	307.2	2475.2	209.2	2324.2	200.9	2095.6	205.1	1991.3	258.6	1861.0	207.4

Precision-Stability Index Signs: Idiopathic Speech Delay
Reference Data 11

		Age (yrs)							
		3 yrs				4 yrs			
		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD
Vowels									
Reduced Dispersion of Corner Vowels from Center	Hz	631.5	141.5	605.9	121.0	624.7	128.4	613.8	133.4
Reduced Dispersion of Corner Vowels from ^	Hz	685.3	183.2	673.1	170.3	683.8	148.0	642.7	172.4
Reduced Average Pairwise Distance of Corner Vowels	Hz	983.6	274.2	925.4	199.5	930.5	237.7	894.9	200.2
Increased Duration of Corner Vowels	ms	182.1	36.6	183.8	35.2	162.1	33.4	162.2	35.3
Increased Duration for Diphthongs and Middle Vowels	ms	172.5	33.6	189.5	29.0	155.2	28.3	153.4	30.7
Reduced % Vowel Phoneme Target Consistency	u	69.4	23.7	61.8	29.5	61.7	28.5	54.1	27.6
Reduced % Vowel Target Consistency	u	71.5	24.3	66.3	31.7	54.2	28.4	55.8	26.7
Consonants									
Reduced % Correct Glide	%	87.2	21.2	88.4	11.9	92.8	10.3	90.3	13.1
Increased Relative Distortion Index: Sibilants	%	39.9	33.9	39.2	26.8	43.8	31.4	42.7	28.9
Reduced % Dentalized Sibilants of Distorted Sibilants	%	55.6	36.6	45.0	40.2	39.8	36.6	45.3	37.0
Increased Relative Distortion Index for Early Consonants	%	8.0	13.6	8.4	13.1	10.8	14.6	10.2	14.3
Decreased 1st Moment on /s/ Initial Singletons	kHz	6.5	1.7	7.0	0.8	6.3	1.5	6.0	1.7

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.6	0.6	1.8	0.4	1.5	0.4	1.8	0.4
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	2.0	0.6	2.0	0.5	1.8	0.4	2.1	0.6
Increased All Consonant-Consonant Duration	ms	254.4	132.6	244.0	70.6	246.2	76.2	204.6	85.4
Vowels & Consonants									
Increased Diacritic Modification Index (DMI) Class: Place %	%	5.6	3.0	5.6	3.0	5.8	3.3	6.7	3.9
Increased DMI Class: Duration %	%	0.9	0.9	1.0	0.6	1.3	1.2	1.4	1.7
Increased % of Epenthesis Errors	%	2.7	2.0	3.8	3.0	3.6	2.5	4.0	2.9
Phrasing									
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.5	0.8	0.7	1.7	0.5	1.2	0.9	1.4
Rate									
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	3.4	0.5	3.2	0.4	3.5	0.5	3.6	0.5
Increased Average Syllable ms (without pauses)	ms	321.1	54.2	335.8	42.8	314.9	49.0	305.0	48.2
Stress									
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	2.2	3.3	3.0	4.3	1.0	2.3	2.1	4.5
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	15.5	24.3	21.8	31.3	9.5	21.6	15.1	24.2
Loudness									
Decreased Intensity Difference dB Fricative+Vowel	dB	16.7	5.6	17.6	6.1	14.3	6.3	17.0	5.7

Pitch									
Decreased F0 for all Vowels & Diphthongs	Hz	310.3	50.8	288.4	30.9	286.4	49.6	283.4	36.5
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	419.7	148.5	388.3	170.1	364.6	152.0	359.6	149.8
Laryngeal Quality									
Increased % Jitter for Vowels	%	1.2	0.5	1.5	0.9	1.2	0.7	1.2	0.7
Increased % Shimmer for Vowels	%	8.3	3.4	9.2	5.1	8.5	3.6	7.7	3.1
Decreased HNR dB for Vowels	dB	18.7	3.2	18.9	3.4	19.1	3.5	19.7	2.6
Resonance Quality									
Increased % Inappropriate Resonance	%	6.8	17.0	3.5	6.2	8.0	16.6	10.0	19.7
Decreased F1 /a/ (Nasal)	Hz	938.9	195.3	987.8	215.0	911.8	189.1	1017.9	180.9
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2511.8	324.0	2704.9	431.9	2487.2	361.9	2350.3	323.7

Precision-Stability Index Signs: Idiopathic Speech Delay
Reference Data 12

		Age (yrs)							
		5 yrs				6 yrs			
		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD
Vowels									
Reduced Dispersion of Corner Vowels from Center	Hz	592.5	101.1	627.2	136.7	606.4	72.2	626.7	123.7
Reduced Dispersion of Corner Vowels from ^	Hz	630.5	151.2	685.2	168.6	664.1	122.3	615.2	128.5
Reduced Average Pairwise Distance of Corner Vowels	Hz	882.1	183.9	892.5	271.8	891.4	163.4	898.0	208.7
Increased Duration of Corner Vowels	ms	158.2	28.7	145.7	31.2	132.7	26.2	132.4	19.7
Increased Duration for Diphthongs and Middle Vowels	ms	145.8	21.9	141.8	29.2	134.6	33.8	128.7	18.8
Reduced % Vowel Phoneme Target Consistency	u	68.7	31.1	66.8	24.6	62.0	34.9	100.0	0.0
Reduced % Vowel Target Consistency	u	62.9	31.4	67.0	31.5	55.5	33.3	92.9	14.3
Consonants									
Reduced % Correct Glide	%	94.4	10.8	95.9	6.1	95.5	6.3	90.7	8.3
Increased Relative Distortion Index: Sibilants	%	49.9	32.2	57.6	29.5	41.2	34.2	68.6	15.7
Reduced % Dentalized Sibilants of Distorted Sibilants	%	43.6	33.9	44.8	37.9	47.6	42.5	56.1	38.9
Increased Relative Distortion Index for Early Consonants	%	10.9	15.7	19.4	28.9	5.9	9.5	7.1	13.1
Decreased 1st Moment on /s/ Initial Singletons	kHz	5.9	1.3	7.0	1.3	5.8	1.4	6.4	1.3

Increased Sqrt of the 2nd Moment for /s/ Initial Singletons	kHz	1.8	0.5	1.6	0.5	1.7	0.4	1.6	0.3
Increased Sqrt of the 2nd moment for /s/ initial, and /s/ and /z/ final singletons	kHz	1.9	0.4	1.8	0.4	1.7	0.5	1.8	0.4
Increased All Consonant-Consonant Duration	ms	248.8	104.8	252.5	91.2	187.1	60.9	184.4	48.8
Vowels & Consonants									
Increased Diacritic Modification Index (DMI) Class: Place %	%	5.8	4.7	7.1	3.3	4.9	3.2	6.9	4.3
Increased DMI Class: Duration %	%	0.9	0.9	0.9	0.9	0.9	0.8	0.7	0.6
Increased % of Epenthesis Errors	%	2.9	3.1	3.2	2.6	1.5	1.6	3.1	1.9
Phrasing									
Increased PM errors: % of Addition, Breath, Repeat, or Long	%	0.4	0.7	0.7	1.4	0.3	0.9	1.0	1.1
Rate									
Reduced Average Syllable Artic Rate (without pauses)	syll/sec	3.5	0.5	3.7	0.6	4.1	0.6	3.8	0.2
Increased Average Syllable ms (without pauses)	ms	308.7	47.6	293.1	46.5	265.0	41.5	277.0	12.5
Stress									
Increased % of Prosody-Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration (uncircled & circled)	%	1.6	3.3	0.9	2.0	2.0	4.2	1.2	2.0
Increased % of PV15/16 EE codes of all PV15/16 codes (uncircled & circled)	%	14.6	24.0	6.8	14.1	23.1	30.1	8.3	11.8
Loudness									
Decreased Intensity Difference dB Fricative+Vowel	dB	16.2	5.8	14.3	8.0	14.2	5.0	13.3	5.6

Pitch									
Decreased F0 for all Vowels & Diphthongs	Hz	276.7	38.7	267.6	34.4	276.7	47.3	252.3	23.8
Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs	Hz	317.8	125.7	339.9	113.2	342.4	171.1	384.9	76.1
Laryngeal Quality									
Increased % Jitter for Vowels	%	1.3	1.0	1.3	0.7	1.2	0.8	1.3	0.5
Increased % Shimmer for Vowels	%	7.9	4.9	8.7	3.9	8.6	4.2	9.2	3.1
Decreased HNR dB for Vowels	dB	18.8	3.7	19.2	3.7	16.7	2.6	17.2	2.0
Resonance Quality									
Increased % Inappropriate Resonance	%	10.3	20.9	7.2	15.4	10.1	19.3	1.8	2.2
Decreased F1 /a/ (Nasal)	Hz	922.9	187.9	968.3	220.0	913.7	196.0	975.1	185.4
Decreased F2 for High Vowels (Nasopharyngeal)	Hz	2470.5	450.3	2560.0	314.9	2566.6	366.4	2356.5	236.3

Childhood Dysarthria (CD): The Dysarthria Index (DI)

and Dysarthria Subtypes Indices (DSI)

Sample PEPPER Output

Sample PEPPER Outputs 1 and 2, respectively, are outputs from the group and individual forms of the Dysarthria Index (DI) and the Dysarthria Subtype Indices (DSI).

Rationale and Description

The Dysarthria Index (DI) was developed as a measure to identify and quantify the SDCS Motor Speech classification termed Childhood Dysarthria (CD). For 3-18 year old speakers as described in Part I, standardized scores are obtained for each of the 34 signs using a speaker's sex and chronological age, plus the data from participants of the same sex one age below the speaker's chronological age. For speakers from 20-80 years of age, the reference database of 50 speakers is used to standardize signs using 4 speakers from each decade from 20-70 years of age, and 5 speakers of each sex from 70-80 years of age. A *z*-score cut-off of 1.50 is used for each sign. Codes of "0" are applied to *z*-scores equal to or less than 1.49 and are considered "not positive" for the sign, and codes of "1" are applied to scores equal to or greater than 1.50 and are considered "positive" for the sign. Individual Dysarthria Index (DI) scores include the number of positive signs (i.e., the count of "1" codes), an average sign *z*-score (the average of all 34 *z*-scores), and the DI Score, calculated by taking the number of positive signs, dividing by the total number of DI signs (i.e., 34), and then subtracting from 100 (so that lower percentage scores indicate more involvement).

A database of 442 speakers at risk for motor speech disorders was assembled using participants in studies of speakers with suspected and confirmed Childhood Apraxia of Speech and eight complex neurodevelopmental disorders (CND: Shriberg, Strand, & Mabie, 2017). A

computer program in PEPPER was used to convert scores on the five dysarthria subscales shown in Sample PEPPER Outputs 1 and 2 (Ataxic, Spastic, Hyperkinetic, Hypokinetic, Flaccid) to percentile. Phonology Project Technical Report No. 24 (Shriberg & Mabie, 2017) provides dysarthria subscale percentile information for the 11 cohorts of participants in the database of 442 speakers at risk for motor speech disorders.

A series of studies of children and adults with diagnosed or suspected dysarthria was completed to determine classification criteria for dysarthria and for subtypes of dysarthria. The available dataset did not include a sufficient number of children with dysarthria as diagnosed by qualified clinical-researchers using the Mayo Clinic perceptual signs incorporated in the DI and used in the DSI subscales (see Shriberg, Strand, & Mabie, 2017). The following classification rule produced optimum sensitivity and specificity values relative to typical speakers and speakers with the three other types of motor speech disorders:

To be classified as CD, a speaker must meet each of the following three criteria:

1) the DI Score must be less than 80.0%,
2) any 2 or more of the 5 DYS subtypes must have a DSI percentage scores < 70.0%, and,
3) at least one DYS subtype percentile needs to be $\leq 10^{th}$ percentile of the 442 speakers at risk for motor speech disorders.

At present, there are no quantitative criteria to classify the subtype of dysarthria. As discussed in publications, the computer output (Sample PEPPER Outputs 1 and 2) provides percentile data for each dysarthria subtype. These descriptive data can be used to suggest a pure or mixed subtype of dysarthria, but research is presently insufficient to support criterion-referenced classification.

The group Dysarthria Index summaries shown in Sample PEPPER Outputs 1 includes descriptive statistics for DI scores (count, Mean percentage score, *SD*, range). The Group Dysarthria Subtype Indices summary includes the Mean DSI Percentage Score, Mean DSI Percentile Score, and the Percentage of Participants scoring <10th %ile on the 5 DYS Subtypes.

Dysarthria Index (DI) and Dysarthria Subtype Indices (DSI): Group

Sample PEPPER Output 1

Linguistic Domain	Sign No.	Description	Assessment Mode[a]		Participants Positive on Sign		Ordinal Classification[b]	Five Dysarthria Subtype Indices (DSI)[c]				
								Ataxia	Spastic	Hyper-kinetic	Hypo-kinetic	Flaccid
			P	A	No.	%[d]						
Vowels												
	1	**Increased Percentage of Vowels/Diphthongs Distortions**	**X**		**42**	**93.3**	**VF**	**X(2)**		**X(2)**		
Consonants												
	2	**Number of Nasal Emissions**	**X**		**9**	**20.0**	**SI**					**X(2)**
	3	**Increased Percentage of Weak Consonants**	**X**		**45**	**100.0**	**VF**					X(1)
Vowels and Consonants												
	4	**Increased Diacritic Modification Index Class Duration**	**X**		**39**	**86.7**	**VF**	X(1)		X(1)		
Phrasing												
	5	**Increased Slow/Pause Time**	**X**		**18**	**40.0**	**SF**			X(1)	**X(2)**	
Rate												
	6	**Increased Slow Articulation/Pause Time**	**X**		**38**	**84.4**	**VF**	X(1)	**X(2)**	X(1)		
	7	**Decreased Average syllable speaking rate (with pauses)**		**X**	**28**	**62.2**	**F**	X(1)	**X(2)**	X(1)		
	8	**Decreased Average syllable articulation rate (without pauses)**		**X**	**35**	**77.8**	**F**	X(1)	**X(2)**	X(1)		
	9	**Increased Fast Rate**	**X**		**1**	**2.2**	**I**				**X(2)**	
	10	**Decreased Stability of syllable speaking rate**		**X**	**13**	**28.9**	**SI**			X(1)	**X(2)**	
Stress												
	11	**Increased Excessive/Equal/Misplaced Stress**	**X**		**38**	**84.4**	**VF**	**X(2)**	X(1)			
	12	**Increased Reduced/Equal Stress**	**X**		**8**	**17.8**	**I**				**X(2)**	
Loudness												
	13	**Decreased Stability of Speech Intensity Index**		**X**	**4**	**8.9**	**I**	**X(2)**		**X(2)**		
	14	**Increased Stability of Speech Intensity Index**		**X**	**6**	**13.3**	**I**		X(1)		**X(2)**	X(1)
	15	**Increased Soft**	**X**		**0**	**0.0**	**I**				**X(2)**	X(1)
	16	**Decreased Speech Intensity Index**		**X**	**1**	**2.2**	**I**				**X(2)**	X(1)

Pitch												
	17	**Increased Low Pitch/Glottal Fry**	**X**		**4**	**8.9**	**I**		**X(2)**	X(1)		
	18	**Increased Low Pitch**	**X**		**3**	**6.7**	**I**		**X(2)**	X(1)		
	19	**Decreased F0 for all vowels & diphthongs**		**X**	**3**	**6.7**	**I**		**X(2)**	X(1)		
	20	**Decreased Range of char. F0 among vowels & diphthongs**		**X**	**8**	**17.8**	**I**		X(1)	X(1)	**X(2)**	X(1)
	21	**Decreased Stability of F0 for all vowels & diphthongs**		**X**	**2**	**4.4**	**I**	X(1)				
Laryngeal Quality												
	22	**Increased Breathy**	**X**		**1**	**2.2**	**I**				X(1)	**X(2)**
	23	**Increased Rough**	**X**		**7**	**15.6**	**I**		X(1)	X(1)		
	24	**Increased Strained**	**X**		**0**	**0.0**	**I**		X(1)	X(1)		
	25	**Number of utterances with [TREM] (tremulous) comment**	**X**		**9**	**20.0**	**SI**			X(1)		
	26	**Increased Break/Shift/Tremulous**	**X**		**16**	**35.6**	**SI**		**X(2)**	X(1)		
	27	**Increased Multiple Features**	**X**		**2**	**4.4**	**I**		**X(2)**	**X(2)**		
	28	**Number of Diplophonia**	**X**		**0**	**0.0**	**I**					**X(2)**
	29	**Increased % jitter for vowels**		**X**	**2**	**4.4**	**I**	X(1)				
	30	**Decreased Stability of jitter for vowels**		**X**	**1**	**2.2**	**I**	X(1)				
	31	**Increased % shimmer for vowels**		**X**	**2**	**4.4**	**I**	X(1)				
	32	**Decreased Stability of shimmer for vowels**		**X**	**3**	**6.7**	**I**	X(1)				
Resonance Quality												
	33	**Increased Nasal**	**X**		**10**	**22.2**	**SI**		X(1)	X(1)	X(1)	**X(2)**
	34	**Decreased F1 for /ɑ/ (Nasal)**		**X**	**5**	**11.1**	**I**		X(1)	X(1)	X(1)	**X(2)**
		Unweighted Total Possible Points						**12**	**15**	**19**	**11**	**10**
		Weighted Total Possible Points						**15**	**23**	**22**	**19**	**15**

[a] A: Acoustic; P: Perceptual

[b] Very Frequent (VF): 80.0-100%; Frequent (F): 60.0-79.9%; Somewhat Frequent (SF): 40.0-59.0%; Somewhat Infrequent (SI): 20.0-39.9%; Infrequent (I): 0.0-19.9%

[c] The DI includes all 34 items, unweighted. The number in parentheses is the weighting of the item for each of the 5 DSI (1 or 2 points). The criteria for a classification of CD are a DI score below 80%, two weighted DSI indices below 70%, and at least one DSI $\leq$ 10th %ile.

[d] Increased/Decreased reference $\geq$ 1.5 standard deviation units from age-sex matched, typically developing speakers (Potter et al., 2012; Scheer-Cohen et al., 2013).

DI Summary	
n	**45**
Mean Percentage Score	**73.7**
Standard Deviation	**7.0**
Range	**58.8 - 85.3**

DSI Summary					
	Ataxia	**Spastic**	**Hyper-kinetic**	**Hypo-kinetic**	**Flaccid**
Mean DSI Percentage Score	**52.9**	**67.9**	**66.1**	**85.3**	**83.7**
Mean DSI Percentile Score	**18.5**	**23.1**	**20.9**	**41.2**	**34.7**
Percentage of Participants $\leq 10^{th}$ %ile	**46.7**	**17.8**	**26.7**	**15.6**	**17.8**

Dysarthria Index (DI) and Dysarthria Subtype Indices (DSI): Individual

Sample PEPPER Output 2

Linguistic Domain	Sign No.	Description	Assessment Mode[a]		DI Sign Values		Five Dysarthria Subtype Indices (DSI)[b]				
							Ataxia	Spastic	Hyper-kinetic	Hypo-kinetic	Flaccid
			P	A	Z-score[c]	Code[d]					
Vowels											
	1	**Increased Percentage of Vowels/Diphthongs Distortions**	**X**		**-5.00**	**1**	**1(2)**		**1(2)**		
Consonants											
	2	**Number of Nasal Emissions**	**X**		**0**	**0**					**0(2)**
	3	**Increased Percentage of Weak Consonants**	**X**		**-5.00**	**1**					1(1)
Vowels and Consonants											
	4	**Increased Diacritic Modification Index Class Duration**	**X**		**-4.07**	**1**	1(1)		1(1)		
Phrasing											
	5	**Increased Slow/Pause Time**	**X**		**-0.00**	**0**			0(1)	**0(2)**	
Rate											
	6	**Increased Slow Articulation/Pause Time**	**X**		**-0.00**	**0**	0(1)	**0(2)**	0(1)		
	7	**Decreased Average syllable speaking rate (with pauses)**		**X**	**-1.17**	**0**	0(1)	**0(2)**	0(1)		
	8	**Decreased Average syllable articulation rate (without pauses)**		**X**	**-1.37**	**0**	0(1)	**0(2)**	0(1)		
	9	**Increased Fast Rate**	**X**		**0.47**	**0**				**0(2)**	
	10	**Decreased Stability of syllable speaking rate**		**X**	**-0.29**	**0**			0(1)	**0(2)**	
Stress											
	11	**Increased Excessive/Equal/Misplaced Stress**	**X**		**-4.02**	**1**	**1(2)**	1(1)			
	12	**Increased Reduced/Equal Stress**	**X**		**-0.00**	**0**				**0(2)**	
Loudness											
	13	**Decreased Stability of Speech Intensity Index**		**X**	**-0.05**	**0**	**0(2)**		**0(2)**		
	14	**Increased Stability of Speech Intensity Index**		**X**	**0.05**	**0**		0(1)		**0(2)**	0(1)
	15	**Increased Soft**	**X**		**0.38**	**0**				**0(2)**	0(1)
	16	**Decreased Speech Intensity Index**		**X**	**1.45**	**0**				**0(2)**	0(1)

Pitch											
	17	**Increased Low Pitch/Glottal Fry**	**X**		**-0.00**	**0**		**0(2)**	0(1)		
	18	**Increased Low Pitch**	**X**		**0.32**	**0**		**0(2)**	0(1)		
	19	**Decreased F0 for all vowels & diphthongs**		**X**	**0.79**	**0**		**0(2)**	0(1)		
	20	**Decreased Range of char. F0 among vowels & diphthongs**		**X**	**1.14**	**0**		0(1)	0(1)	**0(2)**	0(1)
	21	**Decreased Stability of F0 for all vowels & diphthongs**		**X**	**-0.55**	**0**	0(1)				
Laryngeal Quality											
	22	**Increased Breathy**	**X**		**0.32**	**0**				0(1)	**0(2)**
	23	**Increased Rough**	**X**		**0.56**	**0**		0(1)	0(1)		
	24	**Increased Strained**	**X**		**-0.00**	**0**		0(1)	0(1)		
	25	**Number of utterances with [TREM] (tremulous) comment**	**X**		**0**	**0**			0(1)		
	26	**Increased Break/Shift/Tremulous**	**X**		**-5.00**	**1**		**1(2)**	1(1)		
	27	**Increased Multiple Features**	**X**		**-0.00**	**0**		**0(2)**	**0(2)**		
	28	**Number of Diplophonia**	**X**		**0**	**0**					**0(2)**
	29	**Increased % jitter for vowels**		**X**	**0.43**	**0**	0(1)				
	30	**Decreased Stability of jitter for vowels**		**X**	**0.98**	**0**	0(1)				
	31	**Increased % shimmer for vowels**		**X**	**0.70**	**0**	0(1)				
	32	**Decreased Stability of shimmer for vowels**		**X**	**0.79**	**0**	0(1)				
Resonance Quality											
	33	**Increased Nasal**	**X**		**-0.00**	**0**		0(1)	0(1)	0(1)	**0(2)**
	34	**Decreased F1 for /ɑ/ (Nasal)**		**X**	**2.19**	**0**		0(1)	0(1)	0(1)	**0(2)**
		Unweighted Total Possible Points					**12**	**15**	**19**	**11**	**10**
		Weighted Total Possible Points					**15**	**23**	**22**	**19**	**15**

[a] A: Acoustic; P: Perceptual

[b] Very Frequent (VF): 80.0-100%; Frequent (F): 60.0-79.9%; Somewhat Frequent (SF): 40.0-59.0%; Somewhat Infrequent (SI): 20.0-39.9%; Infrequent (I): 0.0-19.9%

[c] Z-scores referenced to age-sex matched, typically developing speakers (Potter et al., 2012; Scheer-Cohen et al., 2013). For the three "Number of" items (#2, #25 & #28), this column has a count rather than a Z-Score.

[d] Code: 0 = not positive on variable; 1 = positive on variable (Z-Score $\leq$ -1.50 or "Number of" $\geq$ 2); - = no data

DI Summary	
No. of positive signs	**5**
No. of signs with data	**34**
Average Sign Z-Score	**-0.54**
DI (% Non-Positive Signs)	**85.3**

DSI Summary					
	Ataxia	**Spastic**	**Hyper-kinetic**	**Hypo-kinetic**	**Flaccid**
Percentage of Positive Signs	**25.0**	**13.3**	**15.8**	**0.0**	**10.0**
DSI (% Non-Positive Weighted)	**66.7**	**87.0**	**81.8**	**100.0**	**93.3**
DSI Percentile Score	**35**	**51**	**46**	**85**	**60**

Reference Data

The following tables include, respectively, reference data (means, standard deviation) for each of the 34 DI and DSI signs for the 200 typical speakers ages 3-80 years, followed by reference data for the 34 DI signs for the 268 children, ages 3-7 years, with Idiopathic Speech Delay (see Table of Contents).

Dysarthria Index Signs: Typical Speakers
Reference Data 1

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.6	1.0	0.6	1.0	0.1	0.2	0.9	1.7	0.0	0.0	0.0	0.0
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.1	0.1	0.1	0.2	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.2
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.4	0.3	0.3	0.4	0.3	1.3	2.2	0.9	0.6	0.3	0.4
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/ Pause Time	ms	0.8	1.9	0.0	0.0	0.0	0.0	7.1	15.8	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.3	0.4	3.3	0.5	2.8	0.7	3.2	0.9	3.4	0.4	3.7	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.7	0.6	3.6	0.5	3.3	0.8	3.6	0.9	3.9	0.4	4.1	0.4
Increased Fast Rate	ms	3.3	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.6
Decreased Stability of syllable speaking rate	u	73.6	10.0	74.6	13.9	65.3	11.1	62.1	14.4	63.1	6.2	67.1	12.0
Stress													
Increased Excessive/Equal/Misplaced Stress	%	11.4	10.4	10.8	8.1	14.2	6.3	7.7	7.8	20.0	11.6	13.3	7.5
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	47.8	14.8	39.3	13.2	29.4	18.7	32.5	37.5	45.9	9.6	42.1	16.4
Increased Stability of Speech Intensity Index	u	47.8	14.8	39.3	13.2	29.4	18.7	32.5	37.5	45.9	9.6	42.1	16.4

Increased Soft	%	1.9	2.7	4.2	4.2	0.8	1.9	4.2	9.3	4.2	5.9	3.3	5.4
Decreased Speech Intensity Index	dB	11.9	2.0	10.8	3.3	11.7	2.2	11.5	4.7	12.0	2.6	12.3	1.7
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.8	1.9	0.8	1.9	0.8	1.9	0.9	1.9	3.3	3.5
Increased Low Pitch	%	3.3	4.6	8.3	10.2	10.9	13.0	0.0	0.0	0.9	1.9	2.6	3.8
Decreased F0 for all vowels & diphthongs	Hz	283.7	39.8	256.0	40.5	251.4	25.6	272.6	52.6	264.6	34.6	261.5	31.4
Decreased Range of char. F0 among vowels	Hz	432.1	141.1	433.6	195.2	270.2	87.2	288.5	49.5	317.9	101.7	349.6	29.1
Decreased Stability of F0 for all vowels & diphthongs	u	77.8	3.7	67.9	8.3	82.7	4.5	80.4	4.0	81.5	7.2	74.8	4.9
Laryngeal Quality													
Increased Breathy	%	1.7	2.3	1.7	2.3	0.8	1.9	7.5	14.6	4.2	5.1	1.7	3.7
Increased Rough	%	16.7	16.9	8.4	5.2	13.3	18.5	12.8	20.5	17.6	24.0	34.2	23.1
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	9.3	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	1.1	2.5	0.0	0.0	4.2	5.1	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	2.6	3.9
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	1.6	0.6	2.2	1.0	1.3	0.4	1.5	1.0	1.7	1.0	1.6	0.7
Decreased Stability of jitter for vowels	u	-8.3	23.4	-49.4	32.0	-6.2	44.6	-26.5	76.2	4.1	54.9	-34.5	28.3
Increased % shimmer for vowels	%	9.0	3.0	10.8	4.0	8.4	1.5	8.5	5.0	10.8	2.7	8.6	1.7
Decreased Stability of shimmer for vowels	u	17.1	18.5	21.5	29.9	30.9	29.8	31.2	39.8	3.7	19.2	-2.0	45.8
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	834.0	116.6	802.4	118.9	919.2	132.8	1124.1	163.0	964.8	225.0	1101.0	216.9

Dysarthria Index Signs: Typical Speakers
Reference Data 2

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.9	1.8	1.0	1.6	0.1	0.2	0.0	0.0	0.4	0.6	0.0	0.0
Consonants													
Number of Nasal Emissions	*n*	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.1	0.2	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.5	0.6	0.8	1.4	0.8	0.3	0.3	0.4	0.3	0.4	0.4	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	5.0	11.2	0.0	0.0	0.0	0.0	0.8	1.9	0.8	1.9
Decreased Average syllable speaking rate (with pauses)	syll/ sec	3.6	0.4	3.7	1.0	3.3	0.3	3.3	0.4	4.0	0.5	4.1	0.6
Decreased Average syllable articulation rate (without pauses)	syll/ sec	4.0	0.4	4.1	0.9	3.7	0.3	3.8	0.5	4.4	0.6	4.5	0.6
Increased Fast Rate	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Decreased Stability of syllable speaking rate	u	67.1	10.6	66.4	10.2	64.7	3.9	68.0	7.4	66.9	4.6	66.3	8.9
Stress													
Increased Excessive/Equal/Misplaced Stress	%	8.3	8.3	10.0	5.6	18.3	3.7	14.2	9.6	7.5	8.5	6.7	3.7
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	27.6	12.9	39.0	16.5	27.4	10.5	28.0	16.0	34.3	10.0	42.2	14.4

Increased Stability of Speech Intensity Index	u	27.6	12.9	39.0	16.5	27.4	10.5	28.0	16.0	34.3	10.0	42.2	14.4
Increased Soft	%	0.8	1.9	4.2	7.2	1.7	3.7	5.0	9.0	3.3	5.4	1.7	3.7
Decreased Speech Intensity Index	dB	11.0	2.5	9.8	2.2	10.2	1.5	9.6	1.9	12.5	3.1	10.9	1.9
Pitch													
Increased Low Pitch/Glottal Fry	%	0.8	1.9	4.3	4.2	0.9	1.9	0.0	0.0	3.5	4.8	0.8	1.9
Increased Low Pitch	%	4.2	3.0	2.7	3.8	5.2	5.6	0.8	1.9	5.2	5.8	3.3	4.6
Decreased F0 for all vowels & diphthongs	Hz	237.1	31.3	227.7	39.0	249.2	24.4	231.1	24.9	213.5	21.1	222.2	15.5
Decreased Range of char. F0 among vowels	Hz	281.0	133.8	293.3	67.2	262.5	99.8	300.8	82.5	217.5	20.0	254.2	84.4
Decreased Stability of F0 for all vowels & diphthongs	u	82.7	8.3	78.4	7.5	82.0	7.0	81.4	1.8	82.5	6.1	83.6	3.5
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	3.5	7.8	3.4	5.4	0.8	1.9	2.7	4.0	0.8	1.9
Increased Rough	%	0.9	1.9	19.6	14.0	10.1	9.6	21.7	21.5	8.6	9.7	2.5	2.3
Increased Strained	%	0.0	0.0	0.9	1.9	0.0	0.0	2.5	5.6	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	1.7	3.7	0.9	2.0	0.9	1.9	0.0	0.0	7.3	11.9	1.7	2.3
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	1.7	1.1	2.3	1.3	3.3	3.1	1.4	0.6	1.4	0.9	1.4	0.8
Decreased Stability of jitter for vowels	u	-74.0	57.3	-56.8	66.9	-71.5	93.1	14.5	49.9	-29.5	55.7	1.3	35.2
Increased % shimmer for vowels	%	9.2	4.2	10.8	6.8	13.1	5.1	11.4	4.6	9.2	3.8	8.5	4.2
Decreased Stability of shimmer for vowels	u	-14.0	29.0	0.5	42.5	-5.8	31.5	3.8	26.7	5.2	39.1	37.2	17.3
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	22.4	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	964.8	123.9	967.5	198.6	809.5	156.5	933.1	58.4	905.0	126.1	851.8	121.7

Dysarthria Index Signs: Typical Speakers
Reference Data 3

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.1	0.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.3	0.3	0.3	0.2	0.6	0.8	0.3	0.3	0.3	0.5	0.3	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	1.7	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/ sec	3.6	0.3	4.0	0.5	4.0	0.9	4.3	0.5	3.8	0.3	4.3	0.4
Decreased Average syllable articulation rate (without pauses)	syll/ sec	4.0	0.4	4.7	0.7	4.5	0.9	4.8	0.3	4.5	0.6	4.8	0.4
Increased Fast Rate	ms	1.7	3.7	0.0	0.0	1.2	2.6	1.7	3.7	2.5	3.7	0.0	0.0
Decreased Stability of syllable speaking rate	u	63.9	10.0	70.1	4.4	66.1	12.5	60.9	12.6	68.3	11.1	70.8	6.8
Stress													
Increased Excessive/Equal/Misplaced Stress	%	9.2	7.5	8.3	6.6	2.5	3.7	5.0	4.6	9.2	6.2	10.8	4.8
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	41.9	11.0	24.4	23.3	3.2	58.7	31.6	31.8	31.4	41.5	50.6	9.8

Increased Stability of Speech Intensity Index	u	41.9	11.0	24.4	23.3	3.2	58.7	31.6	31.8	31.4	41.5	50.6	9.8
Increased Soft	%	4.2	7.2	0.0	0.0	3.3	4.6	0.0	0.0	1.7	2.3	1.7	2.3
Decreased Speech Intensity Index	dB	12.2	1.0	10.8	3.1	8.4	3.5	11.0	2.4	9.9	3.5	10.0	1.5
Pitch													
Increased Low Pitch/Glottal Fry	%	2.5	5.6	0.9	1.9	0.0	0.0	0.0	0.0	1.7	3.7	1.7	2.4
Increased Low Pitch	%	3.5	7.8	0.0	0.0	7.5	11.2	0.8	1.9	5.8	7.0	4.4	6.3
Decreased F0 for all vowels & diphthongs	Hz	196.4	23.7	221.7	31.2	212.1	24.9	228.4	12.6	210.2	18.2	210.0	17.2
Decreased Range of char. F0 among vowels	Hz	190.0	39.2	252.8	67.5	272.0	88.0	282.6	54.8	181.7	60.0	252.4	34.9
Decreased Stability of F0 for all vowels & diphthongs	u	79.7	10.6	84.1	4.2	81.3	7.8	82.6	5.3	86.9	4.5	81.4	5.6
Laryngeal Quality													
Increased Breathy	%	0.8	1.9	0.9	1.9	1.7	3.7	6.7	10.9	0.0	0.0	2.6	3.9
Increased Rough	%	27.9	33.6	0.0	0.0	11.2	15.1	36.7	28.3	18.5	23.6	12.9	12.7
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.6	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.8	1.9	1.7	3.7	0.8	1.9	0.0	0.0	0.9	1.9
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	2.0	1.4	1.0	0.4	1.3	0.4	2.1	0.8	1.1	0.5	1.9	1.6
Decreased Stability of jitter for vowels	u	-14.7	43.4	21.4	41.7	-5.1	28.6	-47.8	44.6	12.0	48.7	-6.3	41.4
Increased % shimmer for vowels	%	11.1	5.2	8.0	3.4	10.9	3.8	11.4	2.4	8.8	2.8	12.4	4.7
Decreased Stability of shimmer for vowels	u	21.8	28.8	31.4	52.3	25.2	18.9	13.3	22.8	39.7	28.6	14.2	48.4
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Decreased F1 for /a/ (Nasal)	Hz	806.7	100.1	997.8	117.5	796.9	88.0	916.3	85.6	746.5	148.9	855.5	121.6

Dysarthria Index Signs: Typical Speakers
Reference Data 4

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.2
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.1	0.2	0.1	0.2	0.5	0.6	0.4	0.6	0.5	0.3	0.1	0.1
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/ sec	4.0	1.0	4.3	0.5	4.6	1.1	4.2	0.4	3.8	0.8	4.2	0.9
Decreased Average syllable articulation rate (without pauses)	syll/ sec	4.8	0.9	4.9	0.6	5.3	1.0	4.8	0.4	4.6	0.8	4.9	1.0
Increased Fast Rate	ms	0.8	1.9	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9
Decreased Stability of syllable speaking rate	u	64.2	7.2	64.4	9.6	71.2	3.7	74.4	5.2	61.7	4.9	72.8	6.0
Stress													
Increased Excessive/Equal/Misplaced Stress	%	2.5	2.3	2.5	2.3	4.2	7.2	1.7	3.7	9.2	9.0	1.7	3.7
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	29.8	15.1	47.7	10.9	21.8	21.5	43.0	14.1	38.5	17.5	49.4	7.4

Increased Stability of Speech Intensity Index	u	29.8	15.1	47.7	10.9	21.8	21.5	43.0	14.1	38.5	17.5	49.4	7.4
Increased Soft	%	5.0	5.4	1.7	2.3	0.0	0.0	0.8	1.9	1.7	3.7	4.2	5.1
Decreased Speech Intensity Index	dB	10.5	2.6	11.0	2.1	8.3	2.1	9.9	1.8	13.1	2.4	12.0	2.8
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	1.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.4
Increased Low Pitch	%	3.6	3.9	0.0	0.0	0.0	0.0	0.0	0.0	5.9	5.8	5.0	9.0
Decreased F0 for all vowels & diphthongs	Hz	183.9	46.7	191.9	14.6	180.3	43.1	197.7	22.1	123.3	35.1	164.9	29.2
Decreased Range of char. F0 among vowels	Hz	202.8	71.4	268.0	66.7	233.6	52.4	214.8	35.0	134.8	35.6	242.2	37.9
Decreased Stability of F0 for all vowels & diphthongs	u	81.9	5.7	77.4	5.7	78.2	9.8	82.8	6.9	84.8	3.5	68.7	9.5
Laryngeal Quality													
Increased Breathy	%	20.8	37.6	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9	1.7	3.9
Increased Rough	%	26.7	30.4	11.4	12.4	13.3	29.8	2.5	3.7	21.7	33.0	64.5	33.4
Increased Strained	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	3.9	6.5
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	1.7	2.3	0.0	0.0	0.8	1.9	0.0	0.0
Increased Multiple Features	%	1.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	5.4	8.7	4.3	6.1	8.1	10.2	1.9	2.0	2.5	1.4	9.0	7.6
Decreased Stability of jitter for vowels	u	-13.6	55.4	-51.2	62.5	-28.4	77.7	-3.9	40.2	-43.6	60.7	-79.7	83.3
Increased % shimmer for vowels	%	13.8	11.0	12.9	9.1	17.4	13.8	10.5	5.8	12.6	5.5	20.8	12.6
Decreased Stability of shimmer for vowels	u	14.6	40.3	4.6	29.6	20.8	30.0	38.2	15.5	-0.9	22.9	-0.3	31.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	805.8	85.3	806.4	42.6	689.0	94.5	789.6	115.9	708.0	31.9	815.4	87.3

Dysarthria Index Signs: Typical Speakers
Reference Data 5

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	0.4	0.4	0.3	0.1	0.2	0.3	0.5	0.3	0.1	0.2	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/ sec	4.5	0.3	4.3	0.6	5.0	0.8	4.5	0.7	4.9	0.8	5.1	0.7
Decreased Average syllable articulation rate (without pauses)	syll/ sec	5.2	0.3	5.0	0.6	5.8	0.8	5.1	0.7	5.5	0.6	5.5	0.7
Increased Fast Rate	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9	5.0	6.9
Decreased Stability of syllable speaking rate	u	65.4	7.1	62.4	8.1	67.7	4.7	67.5	9.8	69.7	7.4	72.0	8.7
Stress													
Increased Excessive/Equal/Misplaced Stress	%	12.5	14.7	4.2	4.2	1.7	2.3	0.8	1.9	5.0	7.5	5.0	9.0
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	47.9	19.1	42.5	21.4	26.3	18.5	43.2	22.0	42.9	6.9	51.6	10.6

Increased Stability of Speech Intensity Index	u	47.9	19.1	42.5	21.4	26.3	18.5	43.2	22.0	42.9	6.9	51.6	10.6
Increased Soft	%	0.0	0.0	2.5	3.7	1.7	2.3	5.0	9.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	9.7	3.1	9.2	3.2	8.4	1.9	9.0	3.1	8.5	1.5	10.3	1.6
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Low Pitch	%	0.0	0.0	0.0	0.0	4.3	7.5	2.5	5.6	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	103.4	8.5	181.7	21.8	104.5	15.1	190.1	24.1	104.6	12.9	181.5	8.2
Decreased Range of char. F0 among vowels	Hz	160.0	80.0	249.6	91.8	129.6	29.8	182.3	36.7	159.9	59.5	230.2	64.2
Decreased Stability of F0 for all vowels & diphthongs	u	78.4	4.6	71.7	6.0	85.3	2.2	82.4	7.3	78.1	7.6	75.8	7.6
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	3.3	7.5	0.0	0.0	0.0	0.0
Increased Rough	%	0.0	0.0	0.8	1.9	9.3	5.5	11.7	17.3	0.0	0.0	2.5	2.3
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	3.8	1.9	7.5	5.2	4.1	1.9	1.4	0.2	2.5	0.8	3.1	2.7
Decreased Stability of jitter for vowels	u	-8.4	24.6	-81.6	71.8	-61.5	9.6	-7.8	34.3	-42.0	42.8	16.1	44.9
Increased % shimmer for vowels	%	22.2	2.2	18.2	4.6	15.3	5.5	12.3	3.4	14.8	3.3	15.4	8.4
Decreased Stability of shimmer for vowels	u	16.1	16.7	-9.0	47.5	7.0	11.9	21.0	31.7	16.6	30.3	29.6	25.5
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	20.0	44.7	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	677.5	63.4	777.9	51.8	673.3	63.4	766.3	102.5	585.8	88.0	732.0	99.3

Dysarthria Index Signs: Typical Speakers
Reference Data 6

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.1	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.1
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.0	0.0	0.2	0.3	0.5	0.3	0.3	0.2	0.2	0.1	0.3	0.3
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/ sec	4.6	0.8	4.6	0.8	4.2	0.5	4.7	0.2	4.4	0.5	4.5	0.6
Decreased Average syllable articulation rate (without pauses)	syll/ sec	5.0	0.7	5.2	0.8	5.0	0.4	5.1	0.4	5.0	0.5	4.9	0.5
Increased Fast Rate	ms	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	3.1	6.3
Decreased Stability of syllable speaking rate	u	73.3	3.0	69.3	8.6	70.3	3.2	69.1	9.6	80.2	11.1	72.8	3.7
Stress													
Increased Excessive/Equal/Misplaced Stress	%	2.1	4.2	3.1	4.0	4.2	3.4	3.1	2.1	3.1	4.0	1.0	2.1
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	46.2	12.7	20.3	10.5	34.1	21.7	35.7	11.5	7.8	36.5	42.6	20.7

Increased Stability of Speech Intensity Index	u	46.2	12.7	20.3	10.5	34.1	21.7	35.7	11.5	7.8	36.5	42.6	20.7
Increased Soft	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	12.1	3.9	7.8	2.2	8.8	1.5	8.2	0.5	7.2	2.5	10.9	1.0
Pitch													
Increased Low Pitch/Glottal Fry	%	7.3	9.9	2.1	4.2	2.1	4.2	0.0	0.0	0.0	0.0	0.0	0.0
Increased Low Pitch	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	102.8	11.1	177.8	6.6	108.6	16.5	171.4	19.1	109.4	16.8	162.1	14.3
Decreased Range of char. F0 among vowels	Hz	185.0	126.5	231.3	12.7	139.2	66.9	243.2	45.3	213.5	89.5	217.8	24.1
Decreased Stability of F0 for all vowels & diphthongs	u	75.1	8.0	71.2	5.3	78.7	9.7	74.3	1.7	69.9	10.7	80.4	5.1
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Rough	%	0.0	0.0	3.1	6.3	5.2	10.4	0.0	0.0	0.0	0.0	0.0	0.0
Increased Strained	%	0.0	0.0	0.0	0.0	3.1	6.3	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	2.7	1.7	2.6	1.2	5.1	6.6	2.5	1.5	5.1	4.3	2.6	1.3
Decreased Stability of jitter for vowels	u	7.0	51.4	-7.9	27.7	25.6	34.5	3.1	50.0	-36.3	53.8	8.1	22.7
Increased % shimmer for vowels	%	16.4	7.1	18.0	3.7	14.0	5.2	16.6	3.0	19.0	7.2	15.8	5.4
Decreased Stability of shimmer for vowels	u	9.7	46.7	7.4	22.3	31.5	23.5	39.3	24.2	34.1	25.8	6.7	44.1
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	631.7	23.4	831.6	85.5	655.9	98.7	724.9	92.6	554.6	74.8	843.3	110.7

Dysarthria Index Signs: Typical Speakers
Reference Data 7

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.1
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.2	0.4	0.3	0.4	0.3	0.3	0.3	0.5	0.4	0.2	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/ sec	4.0	0.7	4.5	0.5	4.3	0.9	4.2	0.6	3.9	1.0	4.4	0.5
Decreased Average syllable articulation rate (without pauses)	syll/ sec	4.4	0.7	5.0	0.5	4.7	0.8	4.5	0.6	4.4	1.1	4.8	0.5
Increased Fast Rate	ms	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Stability of syllable speaking rate	u	76.7	7.2	75.9	8.2	69.5	10.9	79.8	9.3	75.7	8.2	77.9	2.5
Stress													
Increased Excessive/Equal/Misplaced Stress	%	1.0	2.1	5.2	4.0	9.4	7.1	2.1	2.4	12.5	9.8	4.2	5.9
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	44.6	11.0	44.3	12.8	15.6	11.9	31.0	21.3	35.7	17.2	46.3	16.9

Increased Stability of Speech Intensity Index	u	44.6	11.0	44.3	12.8	15.6	11.9	31.0	21.3	35.7	17.2	46.3	16.9
Increased Soft	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	8.8	2.6	12.2	2.0	9.0	1.9	10.2	2.6	10.0	3.0	10.7	1.1
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	18.6
Increased Low Pitch	%	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	109.7	20.7	174.5	10.0	108.0	18.0	160.8	25.6	113.7	14.1	152.3	29.3
Decreased Range of char. F0 among vowels	Hz	223.4	119.2	231.4	75.9	145.2	33.3	232.5	76.9	214.2	65.1	202.6	44.0
Decreased Stability of F0 for all vowels & diphthongs	u	77.2	6.5	79.7	6.6	80.3	8.1	81.4	1.1	71.8	10.8	80.9	5.6
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Rough	%	0.0	0.0	9.4	12.0	8.3	14.0	0.0	0.0	23.3	41.5	0.0	0.0
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	3.2	2.3	2.0	0.9	3.0	1.4	2.1	1.5	4.3	0.9	5.9	5.7
Decreased Stability of jitter for vowels	u	-28.8	79.7	5.0	29.2	-1.1	44.4	24.6	24.2	-18.3	38.5	-56.1	112.5
Increased % shimmer for vowels	%	15.5	5.3	10.0	3.2	14.0	5.5	11.8	6.9	20.6	5.4	14.5	6.3
Decreased Stability of shimmer for vowels	u	21.6	24.3	35.2	36.3	26.8	10.1	35.2	36.1	31.5	12.3	9.2	57.5
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	724.9	133.3	816.4	131.3	673.0	150.2	721.3	61.2	614.5	44.6	719.1	82.4

Dysarthria Index Signs: Typical Speakers
Reference Data 8

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.3	0.0	0.1
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.2	0.4	0.3	0.3	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.4
Rate													
Increased Slow Articulation/ Pause Time	ms	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/ sec	4.6	0.8	4.5	0.7	4.3	0.6	4.6	0.5	4.1	0.9	4.3	0.5
Decreased Average syllable articulation rate (without pauses)	syll/ sec	5.3	0.8	5.1	0.7	4.8	0.6	5.0	0.5	4.5	0.9	4.6	0.5
Increased Fast Rate	ms	0.3	1.2	1.2	3.5	0.0	0.0	1.0	3.2	0.5	1.4	0.0	0.0
Decreased Stability of syllable speaking rate	u	67.1	6.3	69.8	8.3	75.1	7.3	71.8	7.6	73.0	9.4	78.8	6.1
Stress													
Increased Excessive/Equal/Misplaced Stress	%	6.5	9.2	2.7	4.9	2.6	3.4	3.1	3.2	11.1	8.3	3.2	4.6
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	35.5	18.9	46.0	15.3	33.2	25.9	35.7	16.2	26.8	17.7	39.5	19.5

Increased Stability of Speech Intensity Index	u	35.5	18.9	46.0	15.3	33.2	25.9	35.7	16.2	26.8	17.7	39.5	19.5
Increased Soft	%	0.7	2.0	2.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	9.6	2.8	10.1	2.6	9.2	3.1	9.8	2.4	9.5	2.4	10.5	1.8
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.4	1.2	2.3	5.7	0.5	2.1	0.0	0.0	4.6	13.9
Increased Low Pitch	%	2.1	4.7	1.5	4.8	0.0	0.0	0.3	1.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	123.2	38.7	183.2	23.1	107.6	15.1	171.4	13.4	111.2	15.1	156.1	26.4
Decreased Range of char. F0 among vowels	Hz	163.6	62.6	223.8	57.9	190.2	98.4	230.9	42.4	183.6	62.1	215.9	58.6
Decreased Stability of F0 for all vowels & diphthongs	u	81.0	6.6	76.3	9.0	75.2	8.6	76.4	6.0	75.6	10.1	81.1	4.0
Laryngeal Quality													
Increased Breathy	%	0.2	0.8	1.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Rough	%	8.9	20.1	16.4	29.3	1.3	5.2	3.1	7.2	16.7	31.6	0.0	0.0
Increased Strained	%	0.0	0.0	0.8	3.1	0.8	3.1	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.5	1.4	0.0	0.0	0.3	1.0	0.0	0.0	0.5	1.4	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	4.2	4.8	4.6	5.1	4.0	3.9	2.4	1.1	3.7	1.3	4.2	4.6
Decreased Stability of jitter for vowels	u	-36.8	48.7	-31.4	67.6	-8.1	57.5	2.1	31.1	-10.6	39.5	-20.2	91.4
Increased % shimmer for vowels	%	16.4	7.5	15.4	8.0	16.3	5.9	15.1	4.7	17.7	6.2	13.3	6.3
Decreased Stability of shimmer for vowels	u	11.9	22.9	15.9	34.4	24.2	29.9	22.2	33.4	29.4	11.0	20.8	48.3
Resonance Quality													
Increased Nasal	%	4.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	666.7	78.4	776.2	90.2	641.8	103.3	804.0	106.8	640.5	102.0	720.1	69.3

Dysarthria Index Signs: Typical Speakers
Reference Data 9

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.2	0.6	0.5	1.1	0.3	0.9	0.3	0.9	0.0	0.0	0.1	0.2
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.1	0.1	0.2	0.1	0.3	0.1	0.2	0.0	0.1	0.0	0.1
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	0.5	0.7	1.3	0.5	0.4	0.5	0.7	0.4	0.5	0.2	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	0.0	0.0	0.3	1.1
Rate													
Increased Slow Articulation/ Pause Time	ms	0.3	1.1	2.4	9.1	0.2	0.9	1.5	5.6	0.0	0.0	0.3	1.1
Decreased Average syllable speaking rate (with pauses)	syll/ sec	3.2	0.6	3.4	0.7	3.6	0.4	3.8	0.7	3.9	0.7	4.3	0.4
Decreased Average syllable articulation rate (without pauses)	syll/ sec	3.6	0.6	3.8	0.7	4.0	0.5	4.3	0.7	4.6	0.8	4.8	0.4
Increased Fast Rate	ms	1.1	3.3	0.8	3.2	0.4	1.9	0.2	0.9	1.5	2.7	0.6	2.2
Decreased Stability of syllable speaking rate	u	67.3	9.8	67.9	13.6	65.7	7.4	67.7	7.5	66.2	9.9	65.4	10.1
Stress													
Increased Excessive/Equal/Misplaced Stress	%	15.2	9.7	10.6	7.6	10.8	8.0	9.8	6.8	4.7	5.2	6.1	5.2
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	41.0	16.2	37.9	23.4	32.8	11.9	33.4	18.1	21.4	41.5	43.3	20.6

Increased Stability of Speech Intensity Index	u	41.0	16.2	37.9	23.4	32.8	11.9	33.4	18.1	21.4	41.5	43.3	20.6
Increased Soft	%	2.3	3.9	3.9	6.2	2.5	4.8	2.7	5.9	3.3	4.2	1.1	1.9
Decreased Speech Intensity Index	dB	11.8	2.1	11.5	3.2	11.5	2.2	10.3	2.2	9.6	3.1	10.7	1.9
Pitch													
Increased Low Pitch/Glottal Fry	%	0.6	1.5	1.7	2.6	1.9	3.8	1.5	2.9	0.6	2.2	1.1	2.5
Increased Low Pitch	%	5.0	8.7	3.6	6.8	4.5	5.4	1.7	3.2	5.6	7.5	1.7	4.0
Decreased F0 for all vowels & diphthongs	Hz	266.6	34.2	263.4	39.9	224.0	31.4	225.7	26.9	202.1	32.7	210.1	20.7
Decreased Range of char. F0 among vowels	Hz	340.1	125.5	357.2	125.0	237.8	87.4	275.3	73.1	218.9	79.3	267.7	51.3
Decreased Stability of F0 for all vowels & diphthongs	u	80.7	5.4	74.4	7.7	81.7	7.6	81.9	4.9	83.4	6.3	80.5	5.6
Laryngeal Quality													
Increased Breathy	%	2.2	3.5	3.6	8.6	1.7	3.5	1.5	4.0	7.5	22.5	3.4	6.7
Increased Rough	%	15.9	18.7	18.5	20.4	11.9	19.5	10.9	15.5	18.8	23.1	20.3	21.5
Increased Strained	%	1.4	5.4	0.0	0.0	0.0	0.0	0.8	2.9	0.0	0.0	1.1	3.3
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	1.8	3.5	0.0	0.0	2.5	6.5	0.9	1.8	0.6	2.2	0.6	1.5
Increased Multiple Features	%	0.0	0.0	1.1	2.6	0.0	0.0	0.0	0.0	0.6	2.2	0.3	1.1
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	1.5	0.7	1.8	0.9	2.1	1.9	1.5	0.9	2.6	5.1	2.8	3.6
Decreased Stability of jitter for vowels	u	-3.5	40.2	-36.8	47.7	-47.4	65.4	-4.9	55.6	-2.3	43.7	-35.1	51.2
Increased % shimmer for vowels	%	9.4	2.5	9.3	3.7	10.6	4.5	9.7	4.7	11.2	6.7	12.2	5.7
Decreased Stability of shimmer for vowels	u	17.2	24.3	16.9	38.9	1.8	32.7	18.2	38.0	26.5	30.2	10.7	33.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	5.6	14.3	0.2	0.9	0.0	0.0	0.3	1.1
Decreased F1 for /a/ (Nasal)	Hz	906.0	162.9	1009.2	219.2	871.5	136.2	937.5	134.8	783.1	106.6	859.4	94.9

Dysarthria Index Signs: Typical Speakers
Reference Data 10

		Age (yrs)											
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.4	0.9	0.3	0.9	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.2
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Increased Percentage of Weak Consonants	%	0.1	0.2	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	1.0	0.5	0.6	0.3	0.4	0.3	0.4	0.3	0.2	0.3	0.3
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.2	0.9	0.1	0.8	0.0	0.0	0.0	0.0	0.2	1.0
Rate													
Increased Slow Articulation/ Pause Time	ms	1.3	6.5	0.8	4.0	0.1	0.8	0.1	0.6	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/ sec	3.3	0.6	3.7	0.6	4.1	0.6	4.5	0.8	4.4	0.6	4.2	0.7
Decreased Average syllable articulation rate (without pauses)	syll/ sec	3.7	0.6	4.2	0.6	4.7	0.6	5.2	0.7	4.9	0.6	4.6	0.7
Increased Fast Rate	ms	1.0	3.2	0.3	1.5	1.0	2.5	0.8	2.6	0.5	2.3	0.2	1.0
Decreased Stability of syllable speaking rate	u	67.6	11.7	66.7	7.4	65.8	9.9	68.5	7.4	73.5	7.5	75.9	8.2
Stress													
Increased Excessive/Equal/Misplaced Stress	%	12.9	8.9	10.3	7.4	5.4	5.2	4.6	7.5	2.9	3.3	7.2	7.7
Increased Reduced/Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Decreased Stability of Speech Intensity Index	u	39.5	19.8	33.1	15.1	32.4	34.1	40.7	17.8	34.5	21.3	33.1	19.2
Increased Stability of Speech Intensity Index	u	39.5	19.8	33.1	15.1	32.4	34.1	40.7	17.8	34.5	21.3	33.1	19.2

Increased Soft	%	3.1	5.1	2.6	5.3	2.2	3.4	1.6	3.9	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	11.7	2.7	10.9	2.3	10.1	2.6	9.8	2.7	9.5	2.7	10.0	2.1
Pitch													
Increased Low Pitch/Glottal Fry	%	1.1	2.2	1.7	3.3	0.9	2.3	0.2	0.9	1.4	4.3	2.3	9.8
Increased Low Pitch	%	4.3	7.7	3.1	4.6	3.7	6.3	1.8	4.7	0.1	0.7	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	265.0	36.5	224.9	28.9	206.1	27.2	153.2	43.7	139.5	35.3	133.6	31.1
Decreased Range of char. F0 among vowels	Hz	348.7	123.4	256.5	81.8	243.3	70.2	193.7	67.0	210.6	77.3	199.7	60.9
Decreased Stability of F0 for all vowels & diphthongs	u	77.5	7.3	81.8	6.3	81.9	6.0	78.6	8.2	75.8	7.3	78.4	8.0
Laryngeal Quality													
Increased Breathy	%	2.9	6.5	1.6	3.7	5.4	16.4	0.6	2.7	0.0	0.0	0.0	0.0
Increased Rough	%	17.2	19.3	11.4	17.4	19.6	21.9	12.6	25.2	2.2	6.3	8.3	23.3
Increased Strained	%	0.9	3.8	0.4	2.1	0.6	2.4	0.4	2.2	0.4	2.2	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.9	2.6	1.7	4.8	0.6	1.8	0.3	1.0	0.1	0.7	0.2	1.0
Increased Multiple Features	%	0.6	1.9	0.0	0.0	0.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	1.6	0.8	1.8	1.5	2.7	4.3	4.4	4.9	3.2	2.9	4.0	3.3
Decreased Stability of jitter for vowels	u	-20.1	46.6	-26.2	63.7	-18.7	49.7	-34.1	58.4	-3.0	45.8	-15.4	68.5
Increased % shimmer for vowels	%	9.3	3.1	10.2	4.6	11.7	6.1	15.9	7.7	15.7	5.3	15.5	6.5
Decreased Stability of shimmer for vowels	u	17.1	31.9	10.0	36.0	18.6	32.1	13.9	29.0	23.2	31.2	25.1	34.3
Resonance Quality													
Increased Nasal	%	0.0	0.0	2.9	10.4	0.1	0.8	2.0	14.1	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	957.6	196.9	904.5	137.9	821.2	106.5	721.5	100.3	722.9	132.2	680.3	94.0

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 11

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.6	1.0	0.6	1.0	0.1	0.2	0.9	1.7	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.4	0.3	0.3	0.4	0.3	1.3	2.2	0.9	0.6	0.3	0.4
Rate													
Increased Slow Articulation/ Pause Time	ms	0.8	1.9	0.0	0.0	0.0	0.0	7.1	15.8	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.3	0.4	3.3	0.5	2.8	0.7	3.2	0.9	3.4	0.4	3.7	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.7	0.6	3.6	0.5	3.3	0.8	3.6	0.9	3.9	0.4	4.1	0.4
Stress													
Increased Excessive/Equal/Misplaced Stress	%	11.4	10.4	10.8	8.1	14.2	6.3	7.7	7.8	20.0	11.6	13.3	7.5
Loudness													
Decreased Stability of Speech Intensity Index	u	47.8	14.8	39.3	13.2	29.4	18.7	32.5	37.5	45.9	9.6	42.1	16.4
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	77.8	3.7	67.9	8.3	82.7	4.5	80.4	4.0	81.5	7.2	74.8	4.9
Laryngeal Quality													
Increased % jitter for vowels	%	1.6	0.6	2.2	1.0	1.3	0.4	1.5	1.0	1.7	1.0	1.6	0.7

Decreased Stability of jitter for vowels	u	-8.3	23.4	-49.4	32.0	-6.2	44.6	-26.5	76.2	4.1	54.9	-34.5	28.3
Increased % shimmer for vowels	%	9.0	3.0	10.8	4.0	8.4	1.5	8.5	5.0	10.8	2.7	8.6	1.7
Decreased Stability of shimmer for vowels	u	17.1	18.5	21.5	29.9	30.9	29.8	31.2	39.8	3.7	19.2	-2.0	45.8

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 12

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.9	1.8	1.0	1.6	0.1	0.2	0.0	0.0	0.4	0.6	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.5	0.6	0.8	1.4	0.8	0.3	0.3	0.4	0.3	0.4	0.4	0.2
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	5.0	11.2	0.0	0.0	0.0	0.0	0.8	1.9	0.8	1.9
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.6	0.4	3.7	1.0	3.3	0.3	3.3	0.4	4.0	0.5	4.1	0.6
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.0	0.4	4.1	0.9	3.7	0.3	3.8	0.5	4.4	0.6	4.5	0.6
Stress													
Increased Excessive/Equal/Misplaced Stress	%	8.3	8.3	10.0	5.6	18.3	3.7	14.2	9.6	7.5	8.5	6.7	3.7
Loudness													
Decreased Stability of Speech Intensity Index	u	27.6	12.9	39.0	16.5	27.4	10.5	28.0	16.0	34.3	10.0	42.2	14.4
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	82.7	8.3	78.4	7.5	82.0	7.0	81.4	1.8	82.5	6.1	83.6	3.5
Laryngeal Quality													
Increased % jitter for vowels	%	1.7	1.1	2.3	1.3	3.3	3.1	1.4	0.6	1.4	0.9	1.4	0.8

Decreased Stability of jitter for vowels	u	-74.0	57.3	-56.8	66.9	-71.5	93.1	14.5	49.9	-29.5	55.7	1.3	35.2
Increased % shimmer for vowels	%	9.2	4.2	10.8	6.8	13.1	5.1	11.4	4.6	9.2	3.8	8.5	4.2
Decreased Stability of shimmer for vowels	u	-14.0	29.0	0.5	42.5	-5.8	31.5	3.8	26.7	5.2	39.1	37.2	17.3

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 13

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.0	0.0	0.1	0.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.3	0.3	0.3	0.2	0.6	0.8	0.3	0.3	0.3	0.5	0.3	0.2
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.6	0.3	4.0	0.5	4.0	0.9	4.3	0.5	3.8	0.3	4.3	0.4
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.0	0.4	4.7	0.7	4.5	0.9	4.8	0.3	4.5	0.6	4.8	0.4
Stress													
Increased Excessive/Equal/Misplaced Stress	%	9.2	7.5	8.3	6.6	2.5	3.7	5.0	4.6	9.2	6.2	10.8	4.8
Loudness													
Decreased Stability of Speech Intensity Index	u	41.9	11.0	24.4	23.3	3.2	58.7	31.6	31.8	31.4	41.5	50.6	9.8
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	79.7	10.6	84.1	4.2	81.3	7.8	82.6	5.3	86.9	4.5	81.4	5.6
Laryngeal Quality													
Increased % jitter for vowels	%	2.0	1.4	1.0	0.4	1.3	0.4	2.1	0.8	1.1	0.5	1.9	1.6

Decreased Stability of jitter for vowels	u	-14.7	43.4	21.4	41.7	-5.1	28.6	-47.8	44.6	12.0	48.7	-6.3	41.4
Increased % shimmer for vowels	%	11.1	5.2	8.0	3.4	10.9	3.8	11.4	2.4	8.8	2.8	12.4	4.7
Decreased Stability of shimmer for vowels	u	21.8	28.8	31.4	52.3	25.2	18.9	13.3	22.8	39.7	28.6	14.2	48.4

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 14

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.2
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.1	0.2	0.1	0.2	0.5	0.6	0.4	0.6	0.5	0.3	0.1	0.1
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.0	1.0	4.3	0.5	4.6	1.1	4.2	0.4	3.8	0.8	4.2	0.9
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.8	0.9	4.9	0.6	5.3	1.0	4.8	0.4	4.6	0.8	4.9	1.0
Stress													
Increased Excessive/Equal/Misplaced Stress	%	2.5	2.3	2.5	2.3	4.2	7.2	1.7	3.7	9.2	9.0	1.7	3.7
Loudness													
Decreased Stability of Speech Intensity Index	u	29.8	15.1	47.7	10.9	21.8	21.5	43.0	14.1	38.5	17.5	49.4	7.4
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	81.9	5.7	77.4	5.7	78.2	9.8	82.8	6.9	84.8	3.5	68.7	9.5
Laryngeal Quality													
Increased % jitter for vowels	%	5.4	8.7	4.3	6.1	8.1	10.2	1.9	2.0	2.5	1.4	9.0	7.6

Decreased Stability of jitter for vowels	u	-13.6	55.4	-51.2	62.5	-28.4	77.7	-3.9	40.2	-43.6	60.7	-79.7	83.3
Increased % shimmer for vowels	%	13.8	11.0	12.9	9.1	17.4	13.8	10.5	5.8	12.6	5.5	20.8	12.6
Decreased Stability of shimmer for vowels	u	14.6	40.3	4.6	29.6	20.8	30.0	38.2	15.5	-0.9	22.9	-0.3	31.0

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 15

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	0.4	0.4	0.3	0.1	0.2	0.3	0.5	0.3	0.1	0.2	0.2
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.5	0.3	4.3	0.6	5.0	0.8	4.5	0.7	4.9	0.8	5.1	0.7
Decreased Average syllable articulation rate (without pauses)	syll/sec	5.2	0.3	5.0	0.6	5.8	0.8	5.1	0.7	5.5	0.6	5.5	0.7
Stress													
Increased Excessive/Equal/Misplaced Stress	%	12.5	14.7	4.2	4.2	1.7	2.3	0.8	1.9	5.0	7.5	5.0	9.0
Loudness													
Decreased Stability of Speech Intensity Index	u	47.9	19.1	42.5	21.4	26.3	18.5	43.2	22.0	42.9	6.9	51.6	10.6
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	78.4	4.6	71.7	6.0	85.3	2.2	82.4	7.3	78.1	7.6	75.8	7.6
Laryngeal Quality													
Increased % jitter for vowels	%	3.8	1.9	7.5	5.2	4.1	1.9	1.4	0.2	2.5	0.8	3.1	2.7

Decreased Stability of jitter for vowels	u	-8.4	24.6	-81.6	71.8	-61.5	9.6	-7.8	34.3	-42.0	42.8	16.1	44.9
Increased % shimmer for vowels	%	22.2	2.2	18.2	4.6	15.3	5.5	12.3	3.4	14.8	3.3	15.4	8.4
Decreased Stability of shimmer for vowels	u	16.1	16.7	-9.0	47.5	7.0	11.9	21.0	31.7	16.6	30.3	29.6	25.5

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 16

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.1	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.0	0.0	0.2	0.3	0.5	0.3	0.3	0.2	0.2	0.1	0.3	0.3
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.6	0.8	4.6	0.8	4.2	0.5	4.7	0.2	4.4	0.5	4.5	0.6
Decreased Average syllable articulation rate (without pauses)	syll/sec	5.0	0.7	5.2	0.8	5.0	0.4	5.1	0.4	5.0	0.5	4.9	0.5
Stress													
Increased Excessive/Equal/Misplaced Stress	%	2.1	4.2	3.1	4.0	4.2	3.4	3.1	2.1	3.1	4.0	1.0	2.1
Loudness													
Decreased Stability of Speech Intensity Index	u	46.2	12.7	20.3	10.5	34.1	21.7	35.7	11.5	7.8	36.5	42.6	20.7
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	75.1	8.0	71.2	5.3	78.7	9.7	74.3	1.7	69.9	10.7	80.4	5.1
Laryngeal Quality													
Increased % jitter for vowels	%	2.7	1.7	2.6	1.2	5.1	6.6	2.5	1.5	5.1	4.3	2.6	1.3

Decreased Stability of jitter for vowels	u	7.0	51.4	-7.9	27.7	25.6	34.5	3.1	50.0	-36.3	53.8	8.1	22.7
Increased % shimmer for vowels	%	16.4	7.1	18.0	3.7	14.0	5.2	16.6	3.0	19.0	7.2	15.8	5.4
Decreased Stability of shimmer for vowels	u	9.7	46.7	7.4	22.3	31.5	23.5	39.3	24.2	34.1	25.8	6.7	44.1

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 17

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.1
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.2	0.4	0.3	0.4	0.3	0.3	0.3	0.5	0.4	0.2	0.2
Rate													
Increased Slow Articulation/ Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.0	0.7	4.5	0.5	4.3	0.9	4.2	0.6	3.9	1.0	4.4	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.4	0.7	5.0	0.5	4.7	0.8	4.5	0.6	4.4	1.1	4.8	0.5
Stress													
Increased Excessive/Equal/Misplaced Stress	%	1.0	2.1	5.2	4.0	9.4	7.1	2.1	2.4	12.5	9.8	4.2	5.9
Loudness													
Decreased Stability of Speech Intensity Index	u	44.6	11.0	44.3	12.8	15.6	11.9	31.0	21.3	35.7	17.2	46.3	16.9
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	77.2	6.5	79.7	6.6	80.3	8.1	81.4	1.1	71.8	10.8	80.9	5.6
Laryngeal Quality													
Increased % jitter for vowels	%	3.2	2.3	2.0	0.9	3.0	1.4	2.1	1.5	4.3	0.9	5.9	5.7

Decreased Stability of jitter for vowels	u	-28.8	79.7	5.0	29.2	-1.1	44.4	24.6	24.2	-18.3	38.5	-56.1	112.5
Increased % shimmer for vowels	%	15.5	5.3	10.0	3.2	14.0	5.5	11.8	6.9	20.6	5.4	14.5	6.3
Decreased Stability of shimmer for vowels	u	21.6	24.3	35.2	36.3	26.8	10.1	35.2	36.1	31.5	12.3	9.2	57.5

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 18

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.2	0.6	0.5	1.1	0.3	0.9	0.3	0.9	0.0	0.0	0.1	0.2
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	0.5	0.7	1.3	0.5	0.4	0.5	0.7	0.4	0.5	0.2	0.2
Rate													
Increased Slow Articulation/ Pause Time	ms	0.3	1.1	2.4	9.1	0.2	0.9	1.5	5.6	0.0	0.0	0.3	1.1
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.2	0.6	3.4	0.7	3.6	0.4	3.8	0.7	3.9	0.7	4.3	0.4
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.6	0.6	3.8	0.7	4.0	0.5	4.3	0.7	4.6	0.8	4.8	0.4
Stress													
Increased Excessive/Equal/Misplaced Stress	%	15.2	9.7	10.6	7.6	10.8	8.0	9.8	6.8	4.7	5.2	6.1	5.2
Loudness													
Decreased Stability of Speech Intensity Index	u	41.0	16.2	37.9	23.4	32.8	11.9	33.4	18.1	21.4	41.5	43.3	20.6
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	80.7	5.4	74.4	7.7	81.7	7.6	81.9	4.9	83.4	6.3	80.5	5.6
Laryngeal Quality													
Increased % jitter for vowels	%	1.5	0.7	1.8	0.9	2.1	1.9	1.5	0.9	2.6	5.1	2.8	3.6

Decreased Stability of jitter for vowels	u	-3.5	40.2	-36.8	47.7	-47.4	65.4	-4.9	55.6	-2.3	43.7	-35.1	51.2
Increased % shimmer for vowels	%	9.4	2.5	9.3	3.7	10.6	4.5	9.7	4.7	11.2	6.7	12.2	5.7
Decreased Stability of shimmer for vowels	u	17.2	24.3	16.9	38.9	1.8	32.7	18.2	38.0	26.5	30.2	10.7	33.0

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 19

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.3	0.0	0.1
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.2	0.4	0.3	0.3	0.2
Rate													
Increased Slow Articulation/ Pause Time	ms	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.6	0.8	4.5	0.7	4.3	0.6	4.6	0.5	4.1	0.9	4.3	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	5.3	0.8	5.1	0.7	4.8	0.6	5.0	0.5	4.5	0.9	4.6	0.5
Stress													
Increased Excessive/Equal/Misplaced Stress	%	6.5	9.2	2.7	4.9	2.6	3.4	3.1	3.2	11.1	8.3	3.2	4.6
Loudness													
Decreased Stability of Speech Intensity Index	u	35.5	18.9	46.0	15.3	33.2	25.9	35.7	16.2	26.8	17.7	39.5	19.5
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	81.0	6.6	76.3	9.0	75.2	8.6	76.4	6.0	75.6	10.1	81.1	4.0
Laryngeal Quality													
Increased % jitter for vowels	%	4.2	4.8	4.6	5.1	4.0	3.9	2.4	1.1	3.7	1.3	4.2	4.6

Decreased Stability of jitter for vowels	u	-36.8	48.7	-31.4	67.6	-8.1	57.5	2.1	31.1	-10.6	39.5	-20.2	91.4
Increased % shimmer for vowels	%	16.4	7.5	15.4	8.0	16.3	5.9	15.1	4.7	17.7	6.2	13.3	6.3
Decreased Stability of shimmer for vowels	u	11.9	22.9	15.9	34.4	24.2	29.9	22.2	33.4	29.4	11.0	20.8	48.3

Dysarthria Subtype Index: Ataxia
Typical Speakers
Reference Data 20

	Age (yrs)												
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage Vowels/Diphthongs Distorted	%	0.4	0.9	0.3	0.9	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.2
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	1.0	0.5	0.6	0.3	0.4	0.3	0.4	0.3	0.2	0.3	0.3
Rate													
Increased Slow Articulation/ Pause Time	ms	1.3	6.5	0.8	4.0	0.1	0.8	0.1	0.6	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.3	0.6	3.7	0.6	4.1	0.6	4.5	0.8	4.4	0.6	4.2	0.7
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.7	0.6	4.2	0.6	4.7	0.6	5.2	0.7	4.9	0.6	4.6	0.7
Stress													
Increased Excessive/Equal/Misplaced Stress	%	12.9	8.9	10.3	7.4	5.4	5.2	4.6	7.5	2.9	3.3	7.2	7.7
Loudness													
Decreased Stability of Speech Intensity Index	u	39.5	19.8	33.1	15.1	32.4	34.1	40.7	17.8	34.5	21.3	33.1	19.2
Pitch													
Decreased Stability of F0 for all vowels & diphthongs	u	77.5	7.3	81.8	6.3	81.9	6.0	78.6	8.2	75.8	7.3	78.4	8.0
Laryngeal Quality													
Increased % jitter for vowels	%	1.6	0.8	1.8	1.5	2.7	4.3	4.4	4.9	3.2	2.9	4.0	3.3

Decreased Stability of jitter for vowels	u	-20.1	46.6	-26.2	63.7	-18.7	49.7	-34.1	58.4	-3.0	45.8	-15.4	68.5
Increased % shimmer for vowels	%	9.3	3.1	10.2	4.6	11.7	6.1	15.9	7.7	15.7	5.3	15.5	6.5
Decreased Stability of shimmer for vowels	u	17.1	31.9	10.0	36.0	18.6	32.1	13.9	29.0	23.2	31.2	25.1	34.3

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 21

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.8	1.9	0.0	0.0	0.0	0.0	7.1	15.8	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.3	0.4	3.3	0.5	2.8	0.7	3.2	0.9	3.4	0.4	3.7	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.7	0.6	3.6	0.5	3.3	0.8	3.6	0.9	3.9	0.4	4.1	0.4
Stress													
Increased Excessive/Equal/Misplaced Stress	%	11.4	10.4	10.8	8.1	14.2	6.3	7.7	7.8	20.0	11.6	13.3	7.5
Loudness													
Increased Stability of Speech Intensity Index	u	47.8	14.8	39.3	13.2	29.4	18.7	32.5	37.5	45.9	9.6	42.1	16.4
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.8	1.9	0.8	1.9	0.8	1.9	0.9	1.9	3.3	3.5
Increased Low Pitch	%	3.3	4.6	8.3	10.2	10.9	13.0	0.0	0.0	0.9	1.9	2.6	3.8
Decreased F0 for all vowels & diphthongs	Hz	283.7	39.8	256.0	40.5	251.4	25.6	272.6	52.6	264.6	34.6	261.5	31.4
Decreased Range of char. F0 among vowels	Hz	432.1	141.1	433.6	195.2	270.2	87.2	288.5	49.5	317.9	101.7	349.6	29.1
Laryngeal Quality													
Increased Rough	%	16.7	16.9	8.4	5.2	13.3	18.5	12.8	20.5	17.6	24.0	34.2	23.1

Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	9.3	0.0	0.0
Increased Break/Shift/Tremulous	%	1.1	2.5	0.0	0.0	4.2	5.1	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	2.6	3.9
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	834.0	116.6	802.4	118.9	919.2	132.8	1124.1	163.0	964.8	225.0	1101.0	216.9

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 22

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	5.0	11.2	0.0	0.0	0.0	0.0	0.8	1.9	0.8	1.9
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.6	0.4	3.7	1.0	3.3	0.3	3.3	0.4	4.0	0.5	4.1	0.6
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.0	0.4	4.1	0.9	3.7	0.3	3.8	0.5	4.4	0.6	4.5	0.6
Stress													
Increased Excessive/Equal/Misplaced Stress	%	8.3	8.3	10.0	5.6	18.3	3.7	14.2	9.6	7.5	8.5	6.7	3.7
Loudness													
Increased Stability of Speech Intensity Index	u	27.6	12.9	39.0	16.5	27.4	10.5	28.0	16.0	34.3	10.0	42.2	14.4
Pitch													
Increased Low Pitch/Glottal Fry	%	0.8	1.9	4.3	4.2	0.9	1.9	0.0	0.0	3.5	4.8	0.8	1.9
Increased Low Pitch	%	4.2	3.0	2.7	3.8	5.2	5.6	0.8	1.9	5.2	5.8	3.3	4.6
Decreased F0 for all vowels & diphthongs	Hz	237.1	31.3	227.7	39.0	249.2	24.4	231.1	24.9	213.5	21.1	222.2	15.5
Decreased Range of char. F0 among vowels	Hz	281.0	133.8	293.3	67.2	262.5	99.8	300.8	82.5	217.5	20.0	254.2	84.4
Laryngeal Quality													
Increased Rough	%	0.9	1.9	19.6	14.0	10.1	9.6	21.7	21.5	8.6	9.7	2.5	2.3

Increased Strained	%	0.0	0.0	0.9	1.9	0.0	0.0	2.5	5.6	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	1.7	3.7	0.9	2.0	0.9	1.9	0.0	0.0	7.3	11.9	1.7	2.3
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	22.4	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	964.8	123.9	967.5	198.6	809.5	156.5	933.1	58.4	905.0	126.1	851.8	121.7

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 23

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.6	0.3	4.0	0.5	4.0	0.9	4.3	0.5	3.8	0.3	4.3	0.4
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.0	0.4	4.7	0.7	4.5	0.9	4.8	0.3	4.5	0.6	4.8	0.4
Stress													
Increased Excessive/Equal/Misplaced Stress	%	9.2	7.5	8.3	6.6	2.5	3.7	5.0	4.6	9.2	6.2	10.8	4.8
Loudness													
Increased Stability of Speech Intensity Index	u	41.9	11.0	24.4	23.3	3.2	58.7	31.6	31.8	31.4	41.5	50.6	9.8
Pitch													
Increased Low Pitch/Glottal Fry	%	2.5	5.6	0.9	1.9	0.0	0.0	0.0	0.0	1.7	3.7	1.7	2.4
Increased Low Pitch	%	3.5	7.8	0.0	0.0	7.5	11.2	0.8	1.9	5.8	7.0	4.4	6.3
Decreased F0 for all vowels & diphthongs	Hz	196.4	23.7	221.7	31.2	212.1	24.9	228.4	12.6	210.2	18.2	210.0	17.2
Decreased Range of char. F0 among vowels	Hz	190.0	39.2	252.8	67.5	272.0	88.0	282.6	54.8	181.7	60.0	252.4	34.9
Laryngeal Quality													
Increased Rough	%	27.9	33.6	0.0	0.0	11.2	15.1	36.7	28.3	18.5	23.6	12.9	12.7

Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.6	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.8	1.9	1.7	3.7	0.8	1.9	0.0	0.0	0.9	1.9
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Decreased F1 for /a/ (Nasal)	Hz	806.7	100.1	997.8	117.5	796.9	88.0	916.3	85.6	746.5	148.9	855.5	121.6

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 24

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.0	1.0	4.3	0.5	4.6	1.1	4.2	0.4	3.8	0.8	4.2	0.9
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.8	0.9	4.9	0.6	5.3	1.0	4.8	0.4	4.6	0.8	4.9	1.0
Stress													
Increased Excessive/Equal/Misplaced Stress	%	2.5	2.3	2.5	2.3	4.2	7.2	1.7	3.7	9.2	9.0	1.7	3.7
Loudness													
Increased Stability of Speech Intensity Index	u	29.8	15.1	47.7	10.9	21.8	21.5	43.0	14.1	38.5	17.5	49.4	7.4
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	1.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.4
Increased Low Pitch	%	3.6	3.9	0.0	0.0	0.0	0.0	0.0	0.0	5.9	5.8	5.0	9.0
Decreased F0 for all vowels & diphthongs	Hz	183.9	46.7	191.9	14.6	180.3	43.1	197.7	22.1	123.3	35.1	164.9	29.2
Decreased Range of char. F0 among vowels	Hz	202.8	71.4	268.0	66.7	233.6	52.4	214.8	35.0	134.8	35.6	242.2	37.9
Laryngeal Quality													
Increased Rough	%	26.7	30.4	11.4	12.4	13.3	29.8	2.5	3.7	21.7	33.0	64.5	33.4

Increased Strained	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	3.9	6.5
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	1.7	2.3	0.0	0.0	0.8	1.9	0.0	0.0
Increased Multiple Features	%	1.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	805.8	85.3	806.4	42.6	689.0	94.5	789.6	115.9	708.0	31.9	815.4	87.3

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 25

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.5	0.3	4.3	0.6	5.0	0.8	4.5	0.7	4.9	0.8	5.1	0.7
Decreased Average syllable articulation rate (without pauses)	syll/sec	5.2	0.3	5.0	0.6	5.8	0.8	5.1	0.7	5.5	0.6	5.5	0.7
Stress													
Increased Excessive/Equal/Misplaced Stress	%	12.5	14.7	4.2	4.2	1.7	2.3	0.8	1.9	5.0	7.5	5.0	9.0
Loudness													
Increased Stability of Speech Intensity Index	u	47.9	19.1	42.5	21.4	26.3	18.5	43.2	22.0	42.9	6.9	51.6	10.6
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Low Pitch	%	0.0	0.0	0.0	0.0	4.3	7.5	2.5	5.6	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	103.4	8.5	181.7	21.8	104.5	15.1	190.1	24.1	104.6	12.9	181.5	8.2
Decreased Range of char. F0 among vowels	Hz	160.0	80.0	249.6	91.8	129.6	29.8	182.3	36.7	159.9	59.5	230.2	64.2
Laryngeal Quality													
Increased Rough	%	0.0	0.0	0.8	1.9	9.3	5.5	11.7	17.3	0.0	0.0	2.5	2.3

Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	20.0	44.7	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	677.5	63.4	777.9	51.8	673.3	63.4	766.3	102.5	585.8	88.0	732.0	99.3

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 26

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.6	0.8	4.6	0.8	4.2	0.5	4.7	0.2	4.4	0.5	4.5	0.6
Decreased Average syllable articulation rate (without pauses)	syll/sec	5.0	0.7	5.2	0.8	5.0	0.4	5.1	0.4	5.0	0.5	4.9	0.5
Stress													
Increased Excessive/Equal/Misplaced Stress	%	2.1	4.2	3.1	4.0	4.2	3.4	3.1	2.1	3.1	4.0	1.0	2.1
Loudness													
Increased Stability of Speech Intensity Index	u	46.2	12.7	20.3	10.5	34.1	21.7	35.7	11.5	7.8	36.5	42.6	20.7
Pitch													
Increased Low Pitch/Glottal Fry	%	7.3	9.9	2.1	4.2	2.1	4.2	0.0	0.0	0.0	0.0	0.0	0.0
Increased Low Pitch	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	102.8	11.1	177.8	6.6	108.6	16.5	171.4	19.1	109.4	16.8	162.1	14.3
Decreased Range of char. F0 among vowels	Hz	185.0	126.5	231.3	12.7	139.2	66.9	243.2	45.3	213.5	89.5	217.8	24.1
Laryngeal Quality													
Increased Rough	%	0.0	0.0	3.1	6.3	5.2	10.4	0.0	0.0	0.0	0.0	0.0	0.0

Increased Strained	%	0.0	0.0	0.0	0.0	3.1	6.3	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	631.7	23.4	831.6	85.5	655.9	98.7	724.9	92.6	554.6	74.8	843.3	110.7

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 27

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.0	0.7	4.5	0.5	4.3	0.9	4.2	0.6	3.9	1.0	4.4	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	4.4	0.7	5.0	0.5	4.7	0.8	4.5	0.6	4.4	1.1	4.8	0.5
Stress													
Increased Excessive/Equal/Misplaced Stress	%	1.0	2.1	5.2	4.0	9.4	7.1	2.1	2.4	12.5	9.8	4.2	5.9
Loudness													
Increased Stability of Speech Intensity Index	u	44.6	11.0	44.3	12.8	15.6	11.9	31.0	21.3	35.7	17.2	46.3	16.9
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	18.6
Increased Low Pitch	%	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	109.7	20.7	174.5	10.0	108.0	18.0	160.8	25.6	113.7	14.1	152.3	29.3
Decreased Range of char. F0 among vowels	Hz	223.4	119.2	231.4	75.9	145.2	33.3	232.5	76.9	214.2	65.1	202.6	44.0
Laryngeal Quality													
Increased Rough	%	0.0	0.0	9.4	12.0	8.3	14.0	0.0	0.0	23.3	41.5	0.0	0.0

Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	724.9	133.3	816.4	131.3	673.0	150.2	721.3	61.2	614.5	44.6	719.1	82.4

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 28

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.3	1.1	2.4	9.1	0.2	0.9	1.5	5.6	0.0	0.0	0.3	1.1
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.2	0.6	3.4	0.7	3.6	0.4	3.8	0.7	3.9	0.7	4.3	0.4
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.6	0.6	3.8	0.7	4.0	0.5	4.3	0.7	4.6	0.8	4.8	0.4
Stress													
Increased Excessive/Equal/Misplaced Stress	%	15.2	9.7	10.6	7.6	10.8	8.0	9.8	6.8	4.7	5.2	6.1	5.2
Loudness													
Increased Stability of Speech Intensity Index	u	41.0	16.2	37.9	23.4	32.8	11.9	33.4	18.1	21.4	41.5	43.3	20.6
Pitch													
Increased Low Pitch/Glottal Fry	%	0.6	1.5	1.7	2.6	1.9	3.8	1.5	2.9	0.6	2.2	1.1	2.5
Increased Low Pitch	%	5.0	8.7	3.6	6.8	4.5	5.4	1.7	3.2	5.6	7.5	1.7	4.0
Decreased F0 for all vowels & diphthongs	Hz	266.6	34.2	263.4	39.9	224.0	31.4	225.7	26.9	202.1	32.7	210.1	20.7
Decreased Range of char. F0 among vowels	Hz	340.1	125.5	357.2	125.0	237.8	87.4	275.3	73.1	218.9	79.3	267.7	51.3
Laryngeal Quality													
Increased Rough	%	15.9	18.7	18.5	20.4	11.9	19.5	10.9	15.5	18.8	23.1	20.3	21.5

Increased Strained	%	1.4	5.4	0.0	0.0	0.0	0.0	0.8	2.9	0.0	0.0	1.1	3.3
Increased Break/Shift/Tremulous	%	1.8	3.5	0.0	0.0	2.5	6.5	0.9	1.8	0.6	2.2	0.6	1.5
Increased Multiple Features	%	0.0	0.0	1.1	2.6	0.0	0.0	0.0	0.0	0.6	2.2	0.3	1.1
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	5.6	14.3	0.2	0.9	0.0	0.0	0.3	1.1
Decreased F1 for /a/ (Nasal)	Hz	906.0	162.9	1009.2	219.2	871.5	136.2	937.5	134.8	783.1	106.6	859.4	94.9

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 29

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.6	0.8	4.5	0.7	4.3	0.6	4.6	0.5	4.1	0.9	4.3	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	5.3	0.8	5.1	0.7	4.8	0.6	5.0	0.5	4.5	0.9	4.6	0.5
Stress													
Increased Excessive/Equal/Misplaced Stress	%	6.5	9.2	2.7	4.9	2.6	3.4	3.1	3.2	11.1	8.3	3.2	4.6
Loudness													
Increased Stability of Speech Intensity Index	u	35.5	18.9	46.0	15.3	33.2	25.9	35.7	16.2	26.8	17.7	39.5	19.5
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.4	1.2	2.3	5.7	0.5	2.1	0.0	0.0	4.6	13.9
Increased Low Pitch	%	2.1	4.7	1.5	4.8	0.0	0.0	0.3	1.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	123.2	38.7	183.2	23.1	107.6	15.1	171.4	13.4	111.2	15.1	156.1	26.4
Decreased Range of char. F0 among vowels	Hz	163.6	62.6	223.8	57.9	190.2	98.4	230.9	42.4	183.6	62.1	215.9	58.6
Laryngeal Quality													
Increased Rough	%	8.9	20.1	16.4	29.3	1.3	5.2	3.1	7.2	16.7	31.6	0.0	0.0

Increased Strained	%	0.0	0.0	0.8	3.1	0.8	3.1	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.5	1.4	0.0	0.0	0.3	1.0	0.0	0.0	0.5	1.4	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	4.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	666.7	78.4	776.2	90.2	641.8	103.3	804.0	106.8	640.5	102.0	720.1	69.3

Dysarthria Subtype Index: Spastic
Typical Speakers
Reference Data 30

		Age (yrs)											
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Rate													
Increased Slow Articulation/Pause Time	ms	1.3	6.5	0.8	4.0	0.1	0.8	0.1	0.6	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.3	0.6	3.7	0.6	4.1	0.6	4.5	0.8	4.4	0.6	4.2	0.7
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.7	0.6	4.2	0.6	4.7	0.6	5.2	0.7	4.9	0.6	4.6	0.7
Stress													
Increased Excessive/Equal/Misplaced Stress	%	12.9	8.9	10.3	7.4	5.4	5.2	4.6	7.5	2.9	3.3	7.2	7.7
Loudness													
Increased Stability of Speech Intensity Index	u	39.5	19.8	33.1	15.1	32.4	34.1	40.7	17.8	34.5	21.3	33.1	19.2
Pitch													
Increased Low Pitch/Glottal Fry	%	1.1	2.2	1.7	3.3	0.9	2.3	0.2	0.9	1.4	4.3	2.3	9.8
Increased Low Pitch	%	4.3	7.7	3.1	4.6	3.7	6.3	1.8	4.7	0.1	0.7	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	265.0	36.5	224.9	28.9	206.1	27.2	153.2	43.7	139.5	35.3	133.6	31.1
Decreased Range of char. F0 among vowels	Hz	348.7	123.4	256.5	81.8	243.3	70.2	193.7	67.0	210.6	77.3	199.7	60.9
Laryngeal Quality													
Increased Rough	%	17.2	19.3	11.4	17.4	19.6	21.9	12.6	25.2	2.2	6.3	8.3	23.3

Increased Strained	%	0.9	3.8	0.4	2.1	0.6	2.4	0.4	2.2	0.4	2.2	0.0	0.0
Increased Break/Shift/Tremulous	%	0.9	2.6	1.7	4.8	0.6	1.8	0.3	1.0	0.1	0.7	0.2	1.0
Increased Multiple Features	%	0.6	1.9	0.0	0.0	0.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	2.9	10.4	0.1	0.8	2.0	14.1	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	957.6	196.9	904.5	137.9	821.2	106.5	721.5	100.3	722.9	132.2	680.3	94.0

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 31

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.6	1.0	0.6	1.0	0.1	0.2	0.9	1.7	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.4	0.3	0.3	0.4	0.3	1.3	2.2	0.9	0.6	0.3	0.4
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/Pause Time	ms	0.8	1.9	0.0	0.0	0.0	0.0	7.1	15.8	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.3	0.4	3.3	0.5	2.8	0.7	3.2	0.9	3.4	0.4	3.7	0.5
Decreased Average syllable artiulation rate (without pauses)	syll/sec	3.7	0.6	3.6	0.5	3.3	0.8	3.6	0.9	3.9	0.4	4.1	0.4
Decreased Stability of syllable speaking rate	u	73.6	10.0	74.6	13.9	65.3	11.1	62.1	14.4	63.1	6.2	67.1	12.0
Loudness													
Decreased Stability of Speech Intensity Index	u	47.8	14.8	39.3	13.2	29.4	18.7	32.5	37.5	45.9	9.6	42.1	16.4
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.8	1.9	0.8	1.9	0.8	1.9	0.9	1.9	3.3	3.5
Increased Low Pitch	%	3.3	4.6	8.3	10.2	10.9	13.0	0.0	0.0	0.9	1.9	2.6	3.8
Decreased F0 for all vowels & diphthongs	Hz	283.7	39.8	256.0	40.5	251.4	25.6	272.6	52.6	264.6	34.6	261.5	31.4
Decreased Range of char. F0 among	Hz	432.1	141.1	433.6	195.2	270.2	87.2	288.5	49.5	317.9	101.7	349.6	29.1

vowels													
Laryngeal Quality													
Increased Rough	%	16.7	16.9	8.4	5.2	13.3	18.5	12.8	20.5	17.6	24.0	34.2	23.1
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	9.3	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	1.1	2.5	0.0	0.0	4.2	5.1	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	2.6	3.9
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	834.0	116.6	802.4	118.9	919.2	132.8	1124.1	163.0	964.8	225.0	1101.0	216.9

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 32

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.9	1.8	1.0	1.6	0.1	0.2	0.0	0.0	0.4	0.6	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.5	0.6	0.8	1.4	0.8	0.3	0.3	0.4	0.3	0.4	0.4	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	5.0	11.2	0.0	0.0	0.0	0.0	0.8	1.9	0.8	1.9
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.6	0.4	3.7	1.0	3.3	0.3	3.3	0.4	4.0	0.5	4.1	0.6
Decreased Average syllable artiulation rate (without pauses)	syll/sec	4.0	0.4	4.1	0.9	3.7	0.3	3.8	0.5	4.4	0.6	4.5	0.6
Decreased Stability of syllable speaking rate	u	67.1	10.6	66.4	10.2	64.7	3.9	68.0	7.4	66.9	4.6	66.3	8.9
Loudness													
Decreased Stability of Speech Intensity Index	u	27.6	12.9	39.0	16.5	27.4	10.5	28.0	16.0	34.3	10.0	42.2	14.4
Pitch													
Increased Low Pitch/Glottal Fry	%	0.8	1.9	4.3	4.2	0.9	1.9	0.0	0.0	3.5	4.8	0.8	1.9
Increased Low Pitch	%	4.2	3.0	2.7	3.8	5.2	5.6	0.8	1.9	5.2	5.8	3.3	4.6
Decreased F0 for all vowels & diphthongs	Hz	237.1	31.3	227.7	39.0	249.2	24.4	231.1	24.9	213.5	21.1	222.2	15.5
Decreased Range of char. F0 among	Hz	281.0	133.8	293.3	67.2	262.5	99.8	300.8	82.5	217.5	20.0	254.2	84.4

vowels													
Laryngeal Quality													
Increased Rough	%	0.9	1.9	19.6	14.0	10.1	9.6	21.7	21.5	8.6	9.7	2.5	2.3
Increased Strained	%	0.0	0.0	0.9	1.9	0.0	0.0	2.5	5.6	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	1.7	3.7	0.9	2.0	0.9	1.9	0.0	0.0	7.3	11.9	1.7	2.3
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	22.4	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	964.8	123.9	967.5	198.6	809.5	156.5	933.1	58.4	905.0	126.1	851.8	121.7

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 33

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.1	0.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.3	0.3	0.3	0.2	0.6	0.8	0.3	0.3	0.3	0.5	0.3	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	1.7	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.6	0.3	4.0	0.5	4.0	0.9	4.3	0.5	3.8	0.3	4.3	0.4
Decreased Average syllable artiulation rate (without pauses)	syll/sec	4.0	0.4	4.7	0.7	4.5	0.9	4.8	0.3	4.5	0.6	4.8	0.4
Decreased Stability of syllable speaking rate	u	63.9	10.0	70.1	4.4	66.1	12.5	60.9	12.6	68.3	11.1	70.8	6.8
Loudness													
Decreased Stability of Speech Intensity Index	u	41.9	11.0	24.4	23.3	3.2	58.7	31.6	31.8	31.4	41.5	50.6	9.8
Pitch													
Increased Low Pitch/Glottal Fry	%	2.5	5.6	0.9	1.9	0.0	0.0	0.0	0.0	1.7	3.7	1.7	2.4
Increased Low Pitch	%	3.5	7.8	0.0	0.0	7.5	11.2	0.8	1.9	5.8	7.0	4.4	6.3
Decreased F0 for all vowels & diphthongs	Hz	196.4	23.7	221.7	31.2	212.1	24.9	228.4	12.6	210.2	18.2	210.0	17.2
Decreased Range of char. F0 among	Hz	190.0	39.2	252.8	67.5	272.0	88.0	282.6	54.8	181.7	60.0	252.4	34.9

vowels													
Laryngeal Quality													
Increased Rough	%	27.9	33.6	0.0	0.0	11.2	15.1	36.7	28.3	18.5	23.6	12.9	12.7
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.6	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.8	1.9	1.7	3.7	0.8	1.9	0.0	0.0	0.9	1.9
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Decreased F1 for /a/ (Nasal)	Hz	806.7	100.1	997.8	117.5	796.9	88.0	916.3	85.6	746.5	148.9	855.5	121.6

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 34

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.2
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.1	0.2	0.1	0.2	0.5	0.6	0.4	0.6	0.5	0.3	0.1	0.1
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.0	1.0	4.3	0.5	4.6	1.1	4.2	0.4	3.8	0.8	4.2	0.9
Decreased Average syllable artiulation rate (without pauses)	syll/sec	4.8	0.9	4.9	0.6	5.3	1.0	4.8	0.4	4.6	0.8	4.9	1.0
Decreased Stability of syllable speaking rate	u	64.2	7.2	64.4	9.6	71.2	3.7	74.4	5.2	61.7	4.9	72.8	6.0
Loudness													
Decreased Stability of Speech Intensity Index	u	29.8	15.1	47.7	10.9	21.8	21.5	43.0	14.1	38.5	17.5	49.4	7.4
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	1.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.4
Increased Low Pitch	%	3.6	3.9	0.0	0.0	0.0	0.0	0.0	0.0	5.9	5.8	5.0	9.0
Decreased F0 for all vowels & diphthongs	Hz	183.9	46.7	191.9	14.6	180.3	43.1	197.7	22.1	123.3	35.1	164.9	29.2
Decreased Range of char. F0 among	Hz	202.8	71.4	268.0	66.7	233.6	52.4	214.8	35.0	134.8	35.6	242.2	37.9

vowels													
Laryngeal Quality													
Increased Rough	%	26.7	30.4	11.4	12.4	13.3	29.8	2.5	3.7	21.7	33.0	64.5	33.4
Increased Strained	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	3.9	6.5
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	1.7	2.3	0.0	0.0	0.8	1.9	0.0	0.0
Increased Multiple Features	%	1.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	805.8	85.3	806.4	42.6	689.0	94.5	789.6	115.9	708.0	31.9	815.4	87.3

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 35

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	0.4	0.4	0.3	0.1	0.2	0.3	0.5	0.3	0.1	0.2	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.5	0.3	4.3	0.6	5.0	0.8	4.5	0.7	4.9	0.8	5.1	0.7
Decreased Average syllable artiulation rate (without pauses)	syll/sec	5.2	0.3	5.0	0.6	5.8	0.8	5.1	0.7	5.5	0.6	5.5	0.7
Decreased Stability of syllable speaking rate	u	65.4	7.1	62.4	8.1	67.7	4.7	67.5	9.8	69.7	7.4	72.0	8.7
Loudness													
Decreased Stability of Speech Intensity Index	u	47.9	19.1	42.5	21.4	26.3	18.5	43.2	22.0	42.9	6.9	51.6	10.6
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Low Pitch	%	0.0	0.0	0.0	0.0	4.3	7.5	2.5	5.6	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	103.4	8.5	181.7	21.8	104.5	15.1	190.1	24.1	104.6	12.9	181.5	8.2
Decreased Range of char. F0 among	Hz	160.0	80.0	249.6	91.8	129.6	29.8	182.3	36.7	159.9	59.5	230.2	64.2

vowels													
Laryngeal Quality													
Increased Rough	%	0.0	0.0	0.8	1.9	9.3	5.5	11.7	17.3	0.0	0.0	2.5	2.3
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	20.0	44.7	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	677.5	63.4	777.9	51.8	673.3	63.4	766.3	102.5	585.8	88.0	732.0	99.3

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 36

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.1	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.0	0.0	0.2	0.3	0.5	0.3	0.3	0.2	0.2	0.1	0.3	0.3
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.6	0.8	4.6	0.8	4.2	0.5	4.7	0.2	4.4	0.5	4.5	0.6
Decreased Average syllable artiulation rate (without pauses)	syll/sec	5.0	0.7	5.2	0.8	5.0	0.4	5.1	0.4	5.0	0.5	4.9	0.5
Decreased Stability of syllable speaking rate	u	73.3	3.0	69.3	8.6	70.3	3.2	69.1	9.6	80.2	11.1	72.8	3.7
Loudness													
Decreased Stability of Speech Intensity Index	u	46.2	12.7	20.3	10.5	34.1	21.7	35.7	11.5	7.8	36.5	42.6	20.7
Pitch													
Increased Low Pitch/Glottal Fry	%	7.3	9.9	2.1	4.2	2.1	4.2	0.0	0.0	0.0	0.0	0.0	0.0
Increased Low Pitch	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	102.8	11.1	177.8	6.6	108.6	16.5	171.4	19.1	109.4	16.8	162.1	14.3
Decreased Range of char. F0 among	Hz	185.0	126.5	231.3	12.7	139.2	66.9	243.2	45.3	213.5	89.5	217.8	24.1

vowels													
Laryngeal Quality													
Increased Rough	%	0.0	0.0	3.1	6.3	5.2	10.4	0.0	0.0	0.0	0.0	0.0	0.0
Increased Strained	%	0.0	0.0	0.0	0.0	3.1	6.3	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	631.7	23.4	831.6	85.5	655.9	98.7	724.9	92.6	554.6	74.8	843.3	110.7

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 37

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.1	0.1
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.2	0.4	0.3	0.4	0.3	0.3	0.3	0.5	0.4	0.2	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0
Rate													
Increased Slow Articulation/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.0	0.7	4.5	0.5	4.3	0.9	4.2	0.6	3.9	1.0	4.4	0.5
Decreased Average syllable artiulation rate (without pauses)	syll/sec	4.4	0.7	5.0	0.5	4.7	0.8	4.5	0.6	4.4	1.1	4.8	0.5
Decreased Stability of syllable speaking rate	u	76.7	7.2	75.9	8.2	69.5	10.9	79.8	9.3	75.7	8.2	77.9	2.5
Loudness													
Decreased Stability of Speech Intensity Index	u	44.6	11.0	44.3	12.8	15.6	11.9	31.0	21.3	35.7	17.2	46.3	16.9
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	18.6
Increased Low Pitch	%	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	109.7	20.7	174.5	10.0	108.0	18.0	160.8	25.6	113.7	14.1	152.3	29.3
Decreased Range of char. F0 among	Hz	223.4	119.2	231.4	75.9	145.2	33.3	232.5	76.9	214.2	65.1	202.6	44.0

vowels													
Laryngeal Quality													
Increased Rough	%	0.0	0.0	9.4	12.0	8.3	14.0	0.0	0.0	23.3	41.5	0.0	0.0
Increased Strained	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	724.9	133.3	816.4	131.3	673.0	150.2	721.3	61.2	614.5	44.6	719.1	82.4

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 38

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.2	0.6	0.5	1.1	0.3	0.9	0.3	0.9	0.0	0.0	0.1	0.2
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	0.5	0.7	1.3	0.5	0.4	0.5	0.7	0.4	0.5	0.2	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	0.0	0.0	0.3	1.1
Rate													
Increased Slow Articulation/Pause Time	ms	0.3	1.1	2.4	9.1	0.2	0.9	1.5	5.6	0.0	0.0	0.3	1.1
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.2	0.6	3.4	0.7	3.6	0.4	3.8	0.7	3.9	0.7	4.3	0.4
Decreased Average syllable artiulation rate (without pauses)	syll/sec	3.6	0.6	3.8	0.7	4.0	0.5	4.3	0.7	4.6	0.8	4.8	0.4
Decreased Stability of syllable speaking rate	u	67.3	9.8	67.9	13.6	65.7	7.4	67.7	7.5	66.2	9.9	65.4	10.1
Loudness													
Decreased Stability of Speech Intensity Index	u	41.0	16.2	37.9	23.4	32.8	11.9	33.4	18.1	21.4	41.5	43.3	20.6
Pitch													
Increased Low Pitch/Glottal Fry	%	0.6	1.5	1.7	2.6	1.9	3.8	1.5	2.9	0.6	2.2	1.1	2.5

Increased Low Pitch	%	5.0	8.7	3.6	6.8	4.5	5.4	1.7	3.2	5.6	7.5	1.7	4.0
Decreased F0 for all vowels & diphthongs	Hz	266.6	34.2	263.4	39.9	224.0	31.4	225.7	26.9	202.1	32.7	210.1	20.7
Decreased Range of char. F0 among vowels	Hz	340.1	125.5	357.2	125.0	237.8	87.4	275.3	73.1	218.9	79.3	267.7	51.3
Laryngeal Quality													
Increased Rough	%	15.9	18.7	18.5	20.4	11.9	19.5	10.9	15.5	18.8	23.1	20.3	21.5
Increased Strained	%	1.4	5.4	0.0	0.0	0.0	0.0	0.8	2.9	0.0	0.0	1.1	3.3
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	1.8	3.5	0.0	0.0	2.5	6.5	0.9	1.8	0.6	2.2	0.6	1.5
Increased Multiple Features	%	0.0	0.0	1.1	2.6	0.0	0.0	0.0	0.0	0.6	2.2	0.3	1.1
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	5.6	14.3	0.2	0.9	0.0	0.0	0.3	1.1
Decreased F1 for /a/ (Nasal)	Hz	906.0	162.9	1009.2	219.2	871.5	136.2	937.5	134.8	783.1	106.6	859.4	94.9

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 39

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.3	0.0	0.1
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.2	0.4	0.3	0.3	0.2
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.4
Rate													
Increased Slow Articulation/Pause Time	ms	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	4.6	0.8	4.5	0.7	4.3	0.6	4.6	0.5	4.1	0.9	4.3	0.5
Decreased Average syllable artiulation rate (without pauses)	syll/sec	5.3	0.8	5.1	0.7	4.8	0.6	5.0	0.5	4.5	0.9	4.6	0.5
Decreased Stability of syllable speaking rate	u	67.1	6.3	69.8	8.3	75.1	7.3	71.8	7.6	73.0	9.4	78.8	6.1
Loudness													
Decreased Stability of Speech Intensity Index	u	35.5	18.9	46.0	15.3	33.2	25.9	35.7	16.2	26.8	17.7	39.5	19.5
Pitch													
Increased Low Pitch/Glottal Fry	%	0.0	0.0	0.4	1.2	2.3	5.7	0.5	2.1	0.0	0.0	4.6	13.9

Increased Low Pitch	%	2.1	4.7	1.5	4.8	0.0	0.0	0.3	1.0	0.0	0.0	0.0	0.0
Decreased F0 for all vowels & diphthongs	Hz	123.2	38.7	183.2	23.1	107.6	15.1	171.4	13.4	111.2	15.1	156.1	26.4
Decreased Range of char. F0 among vowels	Hz	163.6	62.6	223.8	57.9	190.2	98.4	230.9	42.4	183.6	62.1	215.9	58.6
Laryngeal Quality													
Increased Rough	%	8.9	20.1	16.4	29.3	1.3	5.2	3.1	7.2	16.7	31.6	0.0	0.0
Increased Strained	%	0.0	0.0	0.8	3.1	0.8	3.1	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.5	1.4	0.0	0.0	0.3	1.0	0.0	0.0	0.5	1.4	0.0	0.0
Increased Multiple Features	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	4.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	666.7	78.4	776.2	90.2	641.8	103.3	804.0	106.8	640.5	102.0	720.1	69.3

Dysarthria Subtype Index: Hyperkinetic
Typical Speakers
Reference Data 40

		Age (yrs)											
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vowels													
Increased Percentage of Vowels/Diphthongs Distortions	%	0.4	0.9	0.3	0.9	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.2
Vowels & Consonants													
Increased Diacritic Modification Index Class Duration	ms	0.6	1.0	0.5	0.6	0.3	0.4	0.3	0.4	0.3	0.2	0.3	0.3
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.2	0.9	0.1	0.8	0.0	0.0	0.0	0.0	0.2	1.0
Rate													
Increased Slow Articulation/Pause Time	ms	1.3	6.5	0.8	4.0	0.1	0.8	0.1	0.6	0.0	0.0	0.0	0.0
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.3	0.6	3.7	0.6	4.1	0.6	4.5	0.8	4.4	0.6	4.2	0.7
Decreased Average syllable artiulation rate (without pauses)	syll/sec	3.7	0.6	4.2	0.6	4.7	0.6	5.2	0.7	4.9	0.6	4.6	0.7
Decreased Stability of syllable speaking rate	u	67.6	11.7	66.7	7.4	65.8	9.9	68.5	7.4	73.5	7.5	75.9	8.2
Loudness													
Decreased Stability of Speech Intensity Index	u	39.5	19.8	33.1	15.1	32.4	34.1	40.7	17.8	34.5	21.3	33.1	19.2
Pitch													
Increased Low Pitch/Glottal Fry	%	1.1	2.2	1.7	3.3	0.9	2.3	0.2	0.9	1.4	4.3	2.3	9.8
Increased Low Pitch	%	4.3	7.7	3.1	4.6	3.7	6.3	1.8	4.7	0.1	0.7	0.0	0.0

Decreased F0 for all vowels & diphthongs	Hz	265.0	36.5	224.9	28.9	206.1	27.2	153.2	43.7	139.5	35.3	133.6	31.1
Decreased Range of char. F0 among vowels	Hz	348.7	123.4	256.5	81.8	243.3	70.2	193.7	67.0	210.6	77.3	199.7	60.9
Laryngeal Quality													
Increased Rough	%	17.2	19.3	11.4	17.4	19.6	21.9	12.6	25.2	2.2	6.3	8.3	23.3
Increased Strained	%	0.9	3.8	0.4	2.1	0.6	2.4	0.4	2.2	0.4	2.2	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Break/Shift/Tremulous	%	0.9	2.6	1.7	4.8	0.6	1.8	0.3	1.0	0.1	0.7	0.2	1.0
Increased Multiple Features	%	0.6	1.9	0.0	0.0	0.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	2.9	10.4	0.1	0.8	2.0	14.1	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	957.6	196.9	904.5	137.9	821.2	106.5	721.5	100.3	722.9	132.2	680.3	94.0

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 41

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Fast Rate	ms	3.3	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.6
Decreased Stability of syllable speaking rate	u	73.6	10.0	74.6	13.9	65.3	11.1	62.1	14.4	63.1	6.2	67.1	12.0
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	47.8	14.8	39.3	13.2	29.4	18.7	32.5	37.5	45.9	9.6	42.1	16.4
Increased Soft	%	1.9	2.7	4.2	4.2	0.8	1.9	4.2	9.3	4.2	5.9	3.3	5.4
Decreased Speech Intensity Index	dB	11.9	2.0	10.8	3.3	11.7	2.2	11.5	4.7	12.0	2.6	12.3	1.7
Pitch													
Decreased Range of char. F0 among vowels	Hz	432.1	141.1	433.6	195.2	270.2	87.2	288.5	49.5	317.9	101.7	349.6	29.1
Laryngeal Quality													
Increased Breathy	%	1.7	2.3	1.7	2.3	0.8	1.9	7.5	14.6	4.2	5.1	1.7	3.7
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	834.0	116.6	802.4	118.9	919.2	132.8	1124.1	163.0	964.8	225.0	1101.0	216.9

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 42

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Fast Rate	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Decreased Stability of syllable speaking rate	u	67.1	10.6	66.4	10.2	64.7	3.9	68.0	7.4	66.9	4.6	66.3	8.9
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	27.6	12.9	39.0	16.5	27.4	10.5	28.0	16.0	34.3	10.0	42.2	14.4
Increased Soft	%	0.8	1.9	4.2	7.2	1.7	3.7	5.0	9.0	3.3	5.4	1.7	3.7
Decreased Speech Intensity Index	dB	11.0	2.5	9.8	2.2	10.2	1.5	9.6	1.9	12.5	3.1	10.9	1.9
Pitch													
Decreased Range of char. F0 among vowels	Hz	281.0	133.8	293.3	67.2	262.5	99.8	300.8	82.5	217.5	20.0	254.2	84.4
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	3.5	7.8	3.4	5.4	0.8	1.9	2.7	4.0	0.8	1.9
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	22.4	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	964.8	123.9	967.5	198.6	809.5	156.5	933.1	58.4	905.0	126.1	851.8	121.7

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 43

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	1.7	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Rate													
Increased Fast Rate	ms	1.7	3.7	0.0	0.0	1.2	2.6	1.7	3.7	2.5	3.7	0.0	0.0
Decreased Stability of syllable speaking rate	u	63.9	10.0	70.1	4.4	66.1	12.5	60.9	12.6	68.3	11.1	70.8	6.8
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	41.9	11.0	24.4	23.3	3.2	58.7	31.6	31.8	31.4	41.5	50.6	9.8
Increased Soft	%	4.2	7.2	0.0	0.0	3.3	4.6	0.0	0.0	1.7	2.3	1.7	2.3
Decreased Speech Intensity Index	dB	12.2	1.0	10.8	3.1	8.4	3.5	11.0	2.4	9.9	3.5	10.0	1.5
Pitch													
Decreased Range of char. F0 among vowels	Hz	190.0	39.2	252.8	67.5	272.0	88.0	282.6	54.8	181.7	60.0	252.4	34.9
Laryngeal Quality													
Increased Breathy	%	0.8	1.9	0.9	1.9	1.7	3.7	6.7	10.9	0.0	0.0	2.6	3.9
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Decreased F1 for /a/ (Nasal)	Hz	806.7	100.1	997.8	117.5	796.9	88.0	916.3	85.6	746.5	148.9	855.5	121.6

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 44

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Fast Rate	ms	0.8	1.9	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9
Decreased Stability of syllable speaking rate	u	64.2	7.2	64.4	9.6	71.2	3.7	74.4	5.2	61.7	4.9	72.8	6.0
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	29.8	15.1	47.7	10.9	21.8	21.5	43.0	14.1	38.5	17.5	49.4	7.4
Increased Soft	%	5.0	5.4	1.7	2.3	0.0	0.0	0.8	1.9	1.7	3.7	4.2	5.1
Decreased Speech Intensity Index	dB	10.5	2.6	11.0	2.1	8.3	2.1	9.9	1.8	13.1	2.4	12.0	2.8
Pitch													
Decreased Range of char. F0 among vowels	Hz	202.8	71.4	268.0	66.7	233.6	52.4	214.8	35.0	134.8	35.6	242.2	37.9
Laryngeal Quality													
Increased Breathy	%	20.8	37.6	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9	1.7	3.9
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	805.8	85.3	806.4	42.6	689.0	94.5	789.6	115.9	708.0	31.9	815.4	87.3

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 45

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Fast Rate	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9	5.0	6.9
Decreased Stability of syllable speaking rate	u	65.4	7.1	62.4	8.1	67.7	4.7	67.5	9.8	69.7	7.4	72.0	8.7
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	47.9	19.1	42.5	21.4	26.3	18.5	43.2	22.0	42.9	6.9	51.6	10.6
Increased Soft	%	0.0	0.0	2.5	3.7	1.7	2.3	5.0	9.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	9.7	3.1	9.2	3.2	8.4	1.9	9.0	3.1	8.5	1.5	10.3	1.6
Pitch													
Decreased Range of char. F0 among vowels	Hz	160.0	80.0	249.6	91.8	129.6	29.8	182.3	36.7	159.9	59.5	230.2	64.2
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	3.3	7.5	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	20.0	44.7	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	677.5	63.4	777.9	51.8	673.3	63.4	766.3	102.5	585.8	88.0	732.0	99.3

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 46

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rate													
Increased Fast Rate	ms	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	3.1	6.3
Decreased Stability of syllable speaking rate	u	73.3	3.0	69.3	8.6	70.3	3.2	69.1	9.6	80.2	11.1	72.8	3.7
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	46.2	12.7	20.3	10.5	34.1	21.7	35.7	11.5	7.8	36.5	42.6	20.7
Increased Soft	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	12.1	3.9	7.8	2.2	8.8	1.5	8.2	0.5	7.2	2.5	10.9	1.0
Pitch													
Decreased Range of char. F0 among vowels	Hz	185.0	126.5	231.3	12.7	139.2	66.9	243.2	45.3	213.5	89.5	217.8	24.1
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	631.7	23.4	831.6	85.5	655.9	98.7	724.9	92.6	554.6	74.8	843.3	110.7

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 47

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0
Rate													
Increased Fast Rate	ms	0.0	0.0	0.0	0.0	1.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Stability of syllable speaking rate	u	76.7	7.2	75.9	8.2	69.5	10.9	79.8	9.3	75.7	8.2	77.9	2.5
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	44.6	11.0	44.3	12.8	15.6	11.9	31.0	21.3	35.7	17.2	46.3	16.9
Increased Soft	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	8.8	2.6	12.2	2.0	9.0	1.9	10.2	2.6	10.0	3.0	10.7	1.1
Pitch													
Decreased Range of char. F0 among vowels	Hz	223.4	119.2	231.4	75.9	145.2	33.3	232.5	76.9	214.2	65.1	202.6	44.0
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	724.9	133.3	816.4	131.3	673.0	150.2	721.3	61.2	614.5	44.6	719.1	82.4

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 48

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	0.0	0.0	0.3	1.1
Rate													
Increased Fast Rate	ms	1.1	3.3	0.8	3.2	0.4	1.9	0.2	0.9	1.5	2.7	0.6	2.2
Decreased Stability of syllable speaking rate	u	67.3	9.8	67.9	13.6	65.7	7.4	67.7	7.5	66.2	9.9	65.4	10.1
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	41.0	16.2	37.9	23.4	32.8	11.9	33.4	18.1	21.4	41.5	43.3	20.6
Increased Soft	%	2.3	3.9	3.9	6.2	2.5	4.8	2.7	5.9	3.3	4.2	1.1	1.9
Decreased Speech Intensity Index	dB	11.8	2.1	11.5	3.2	11.5	2.2	10.3	2.2	9.6	3.1	10.7	1.9
Pitch													
Decreased Range of char. F0 among vowels	Hz	340.1	125.5	357.2	125.0	237.8	87.4	275.3	73.1	218.9	79.3	267.7	51.3
Laryngeal Quality													
Increased Breathy	%	2.2	3.5	3.6	8.6	1.7	3.5	1.5	4.0	7.5	22.5	3.4	6.7
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	5.6	14.3	0.2	0.9	0.0	0.0	0.3	1.1
Decreased F1 for /a/ (Nasal)	Hz	906.0	162.9	1009.2	219.2	871.5	136.2	937.5	134.8	783.1	106.6	859.4	94.9

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 49

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.4
Rate													
Increased Fast Rate	ms	0.3	1.2	1.2	3.5	0.0	0.0	1.0	3.2	0.5	1.4	0.0	0.0
Decreased Stability of syllable speaking rate	u	67.1	6.3	69.8	8.3	75.1	7.3	71.8	7.6	73.0	9.4	78.8	6.1
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	35.5	18.9	46.0	15.3	33.2	25.9	35.7	16.2	26.8	17.7	39.5	19.5
Increased Soft	%	0.7	2.0	2.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	9.6	2.8	10.1	2.6	9.2	3.1	9.8	2.4	9.5	2.4	10.5	1.8
Pitch													
Decreased Range of char. F0 among vowels	Hz	163.6	62.6	223.8	57.9	190.2	98.4	230.9	42.4	183.6	62.1	215.9	58.6
Laryngeal Quality													
Increased Breathy	%	0.2	0.8	1.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	4.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	666.7	78.4	776.2	90.2	641.8	103.3	804.0	106.8	640.5	102.0	720.1	69.3

Dysarthria Subtype Index: Hypokinetic
Typical Speakers
Reference Data 50

		Age (yrs)											
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Phrasing													
Increased Slow/Pause Time	ms	0.0	0.0	0.2	0.9	0.1	0.8	0.0	0.0	0.0	0.0	0.2	1.0
Rate													
Increased Fast Rate	ms	10.	3.2	0.3	1.5	1.0	2.5	0.8	2.6	0.5	2.3	0.2	1.0
Decreased Stability of syllable speaking rate	u	67.6	11.7	66.7	7.4	65.8	9.9	68.5	7.4	73.5	7.5	75.9	8.2
Stress													
Increased Reduced/ Equal Stress	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	39.5	19.8	33.1	15.1	32.4	34.1	40.7	17.8	34.5	21.3	33.1	19.2
Increased Soft	%	3.1	5.1	2.6	5.3	2.2	3.4	1.6	3.9	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	11.7	2.7	10.9	2.3	10.1	2.6	9.8	2.7	9.5	2.7	10.0	2.1
Pitch													
Decreased Range of char. F0 among vowels	Hz	348.7	123.4	256.5	81.8	243.3	70.2	193.7	67.0	210.6	77.3	199.7	60.9
Laryngeal Quality													
Increased Breathy	%	2.9	6.5	1.6	3.7	5.4	16.4	0.6	2.7	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	2.9	10.4	0.1	0.8	2.0	14.1	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	957.6	196.9	904.5	137.9	821.2	106.5	721.5	100.3	722.9	132.2	680.3	94.0

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 51

		Age (yrs)											
		3 yrs				4 yrs				5 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.1	0.1	0.1	0.2	0.0	0.0	0.1	0.2	0.0	0.0	0.1	0.2
Loudness													
Increased Stability of Speech Intensity Index	u	47.8	14.8	39.3	13.2	29.4	18.7	32.5	37.5	45.9	9.6	42.1	16.4
Increased Soft	%	1.9	2.7	4.2	4.2	0.8	1.9	4.2	9.3	4.2	5.9	3.3	5.4
Decreased Speech Intensity Index	dB	11.9	2.0	10.8	3.3	11.7	2.2	11.5	4.7	12.0	2.6	12.3	1.7
Pitch													
Decreased Range of char. F0 among vowels	Hz	432.1	141.1	433.6	195.2	270.2	87.2	288.5	49.5	317.9	101.7	349.6	29.1
Laryngeal Quality													
Increased Breathy	%	1.7	2.3	1.7	2.3	0.8	1.9	7.5	14.6	4.2	5.1	1.7	3.7
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	834.0	116.6	802.4	118.9	919.2	132.8	1124.1	163.0	964.8	225.0	1101.0	216.9

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 52

		Age (yrs)											
		6 yrs				7 yrs				8 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.1	0.2	0.3	0.5	0.1	0.3	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	27.6	12.9	39.0	16.5	27.4	10.5	28.0	16.0	34.3	10.0	42.2	14.4
Increased Soft	%	0.8	1.9	4.2	7.2	1.7	3.7	5.0	9.0	3.3	5.4	1.7	3.7
Decreased Speech Intensity Index	dB	11.0	2.5	9.8	2.2	10.2	1.5	9.6	1.9	12.5	3.1	10.9	1.9
Pitch													
Decreased Range of char. F0 among vowels	Hz	281.0	133.8	293.3	67.2	262.5	99.8	300.8	82.5	217.5	20.0	254.2	84.4
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	3.5	7.8	3.4	5.4	0.8	1.9	2.7	4.0	0.8	1.9
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	22.4	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	964.8	123.9	967.5	198.6	809.5	156.5	933.1	58.4	905.0	126.1	851.8	121.7

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 53

		Age (yrs)											
		9 yrs				10 yrs				11 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Loudness													
Increased Stability of Speech Intensity Index	u	41.9	11.0	24.4	23.3	3.2	58.7	31.6	31.8	31.4	41.5	50.6	9.8
Increased Soft	%	4.2	7.2	0.0	0.0	3.3	4.6	0.0	0.0	1.7	2.3	1.7	2.3
Decreased Speech Intensity Index	dB	12.2	1.0	10.8	3.1	8.4	3.5	11.0	2.4	9.9	3.5	10.0	1.5
Pitch													
Decreased Range of char. F0 among vowels	Hz	190.0	39.2	252.8	67.5	272.0	88.0	282.6	54.8	181.7	60.0	252.4	34.9
Laryngeal Quality													
Increased Breathy	%	0.8	1.9	0.9	1.9	1.7	3.7	6.7	10.9	0.0	0.0	2.6	3.9
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.9
Decreased F1 for /a/ (Nasal)	Hz	806.7	100.1	997.8	117.5	796.9	88.0	916.3	85.6	746.5	148.9	855.5	121.6

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 54

		Age (yrs)											
		12 yrs				13 yrs				14 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	29.8	15.1	47.7	10.9	21.8	21.5	43.0	14.1	38.5	17.5	49.4	7.4
Increased Soft	%	5.0	5.4	1.7	2.3	0.0	0.0	0.8	1.9	1.7	3.7	4.2	5.1
Decreased Speech Intensity Index	dB	10.5	2.6	11.0	2.1	8.3	2.1	9.9	1.8	13.1	2.4	12.0	2.8
Pitch													
Decreased Range of char. F0 among vowels	Hz	202.8	71.4	268.0	66.7	233.6	52.4	214.8	35.0	134.8	35.6	242.2	37.9
Laryngeal Quality													
Increased Breathy	%	20.8	37.6	0.8	1.9	0.0	0.0	0.0	0.0	0.8	1.9	1.7	3.9
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	805.8	85.3	806.4	42.6	689.0	94.5	789.6	115.9	708.0	31.9	815.4	87.3

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 55

		Age (yrs)											
		15 yrs				16 yrs				17 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	47.9	19.1	42.5	21.4	26.3	18.5	43.2	22.0	42.9	6.9	51.6	10.6
Increased Soft	%	0.0	0.0	2.5	3.7	1.7	2.3	5.0	9.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	9.7	3.1	9.2	3.2	8.4	1.9	9.0	3.1	8.5	1.5	10.3	1.6
Pitch													
Decreased Range of char. F0 among vowels	Hz	160.0	80.0	249.6	91.8	129.6	29.8	182.3	36.7	159.9	59.5	230.2	64.2
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	3.3	7.5	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	20.0	44.7	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	677.5	63.4	777.9	51.8	673.3	63.4	766.3	102.5	585.8	88.0	732.0	99.3

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 56

		Age (yrs)											
		20-29 yrs				30-39 yrs				40-49 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.1
Loudness													
Increased Stability of Speech Intensity Index	u	46.2	12.7	20.3	10.5	34.1	21.7	35.7	11.5	7.8	36.5	42.6	20.7
Increased Soft	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	12.1	3.9	7.8	2.2	8.8	1.5	8.2	0.5	7.2	2.5	10.9	1.0
Pitch													
Decreased Range of char. F0 among vowels	Hz	185.0	126.5	231.3	12.7	139.2	66.9	243.2	45.3	213.5	89.5	217.8	24.1
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	631.7	23.4	831.6	85.5	655.9	98.7	724.9	92.6	554.6	74.8	843.3	110.7

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 57

		Age (yrs)											
		50-59 yrs				60-69 yrs				70-80 yrs			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	44.6	11.0	44.3	12.8	15.6	11.9	31.0	21.3	35.7	17.2	46.3	16.9
Increased Soft	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	8.8	2.6	12.2	2.0	9.0	1.9	10.2	2.6	10.0	3.0	10.7	1.1
Pitch													
Decreased Range of char. F0 among vowels	Hz	223.4	119.2	231.4	75.9	145.2	33.3	232.5	76.9	214.2	65.1	202.6	44.0
Laryngeal Quality													
Increased Breathy	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	724.9	133.3	816.4	131.3	673.0	150.2	721.3	61.2	614.5	44.6	719.1	82.4

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 58

		Age (yrs)											
		3 to 5				6 to 9				10 to 12			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.1	0.1	0.2	0.1	0.3	0.1	0.2	0.0	0.1	0.0	0.1
Loudness													
Increased Stability of Speech Intensity Index	u	41.0	16.2	37.9	23.4	32.8	11.9	33.4	18.1	21.4	41.5	43.3	20.6
Increased Soft	%	2.3	3.9	3.9	6.2	2.5	4.8	2.7	5.9	3.3	4.2	1.1	1.9
Decreased Speech Intensity Index	dB	11.8	2.1	11.5	3.2	11.5	2.2	10.3	2.2	9.6	3.1	10.7	1.9
Pitch													
Decreased Range of char. F0 among vowels	Hz	340.1	125.5	357.2	125.0	237.8	87.4	275.3	73.1	218.9	79.3	267.7	51.3
Laryngeal Quality													
Increased Breathy	%	2.2	3.5	3.6	8.6	1.7	3.5	1.5	4.0	7.5	22.5	3.4	6.7
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	0.0	0.0	5.6	14.3	0.2	0.9	0.0	0.0	0.3	1.1
Decreased F1 for /a/ (Nasal)	Hz	906.0	162.9	1009.2	219.2	871.5	136.2	937.5	134.8	783.1	106.6	859.4	94.9

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 59

		Age (yrs)											
		13 to 18				20 to 59				60 to 80			
		Male		Female		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0
Increased Percentage of Weak Consonants	%	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	35.5	18.9	46.0	15.3	33.2	25.9	35.7	16.2	26.8	17.7	39.5	19.5
Increased Soft	%	0.7	2.0	2.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	9.6	2.8	10.1	2.6	9.2	3.1	9.8	2.4	9.5	2.4	10.5	1.8
Pitch													
Decreased Range of char. F0 among vowels	Hz	163.6	62.6	223.8	57.9	190.2	98.4	230.9	42.4	183.6	62.1	215.9	58.6
Laryngeal Quality													
Increased Breathy	%	0.2	0.8	1.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	4.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	666.7	78.4	776.2	90.2	641.8	103.3	804.0	106.8	640.5	102.0	720.1	69.3

Dysarthria Subtype Index: Flaccid
Typical Speakers
Reference Data 60

		Age (yrs)											
		3 to 5		6 to 9		10 to 12		13 to 18		20 to 59		60 to 80	
	Unit	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Consonants													
Number of Nasal Emissions	*n*	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Increased Percentage of Weak Consonants	%	0.1	0.2	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0
Loudness													
Increased Stability of Speech Intensity Index	u	39.5	19.8	33.1	15.1	32.4	34.1	40.7	17.8	34.5	21.3	33.1	19.2
Increased Soft	%	3.1	5.1	2.6	5.3	2.2	3.4	1.6	3.9	0.0	0.0	0.0	0.0
Decreased Speech Intensity Index	dB	11.7	2.7	10.9	2.3	10.1	2.6	9.8	2.7	9.5	2.7	10.0	2.1
Pitch													
Decreased Range of char. F0 among vowels	Hz	348.7	123.4	256.5	81.8	243.3	70.2	193.7	67.0	210.6	77.3	199.7	60.9
Laryngeal Quality													
Increased Breathy	%	2.9	6.5	1.6	3.7	5.4	16.4	0.6	2.7	0.0	0.0	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resonance Quality													
Increased Nasal	%	0.0	0.0	2.9	10.4	0.1	0.8	2.0	14.1	0.0	0.0	0.0	0.0
Decreased F1 for /a/ (Nasal)	Hz	957.6	196.9	904.5	137.9	821.2	106.5	721.5	100.3	722.9	132.2	680.3	94.0

Dysarthria Index Signs: Idiopathic Speech Delay
Reference Data 61

		Age (yrs)							
		3 yrs				4 yrs			
		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD
Vowels									
Increased Percentage of Vowels/Diphthongs Distortions	%	1.2	1.0	2.7	2.1	1.6	1.6	2.4	1.8
Consonants									
Number of Nasal Emissions	*n*	0.2	0.6	0.6	1.7	0.2	0.7	0.7	2.7
Increased Percentage of Weak Consonants	%	0.3	0.4	0.7	1.2	0.6	1.1	1.1	1.8
Vowels & Consonants									
Increased Diacritic Modification Index Class Duration	ms	0.6	0.6	0.6	0.6	1.0	1.0	1.3	1.7
Phrasing									
Increased Slow/Pause Time	ms	0.7	2.5	0.3	1.1	0.7	2.3	0.4	1.8
Rate									
Increased Slow Articulation/ Pause Time	ms	1.1	2.8	0.6	1.6	0.8	2.5	2.1	5.8
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.1	0.5	2.9	0.5	3.2	0.6	3.3	0.5
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.4	0.5	3.2	0.4	3.5	0.5	3.6	0.5
Increased Fast Rate	ms	0.5	1.8	0.0	0.0	0.3	1.3	0.4	1.5
Decreased Stability of syllable speaking rate	u	72.4	8.0	73.4	7.9	69.9	8.2	70.7	6.1
Stress									
Increased Excessive/Equal/Misplaced Stress	%	10.8	11.5	15.9	14.9	9.0	8.5	8.5	9.8
Increased Reduced/Equal Stress	%	0.2	0.9	0.3	1.1	0.1	0.7	0.2	0.9
Loudness									
Decreased Stability of Speech Intensity Index	u	47.8	19.9	43.9	20.3	43.6	20.7	44.4	23.1
Increased Stability of Speech Intensity Index	u	47.8	19.9	43.9	20.3	43.6	20.7	44.4	23.1

Increased Soft	%	2.2	4.5	3.5	9.6	3.1	6.6	3.2	6.4
Decreased Speech Intensity Index	dB	13.1	3.5	12.7	4.3	13.1	4.0	13.4	3.6
Pitch									
Increased Low Pitch/Glottal Fry	%	0.2	0.8	2.2	3.4	0.4	1.3	0.6	2.6
Increased Low Pitch	%	1.0	2.3	0.0	0.0	0.6	2.3	0.6	2.6
Decreased F0 for all vowels & diphthongs	Hz	310.3	50.8	288.4	30.9	286.4	49.6	283.4	36.5
Decreased Range of char. F0 among vowels	Hz	419.7	148.5	388.3	170.1	364.6	152.0	359.6	149.8
Decreased Stability of F0 for all vowels & diphthongs	u	74.6	7.6	74.1	9.9	77.5	7.7	77.7	7.8
Laryngeal Quality									
Increased Breathy	%	1.3	3.1	1.0	3.6	1.3	3.2	0.8	2.2
Increased Rough	%	7.8	9.5	6.6	9.1	12.8	22.9	8.7	14.7
Increased Strained	%	0.2	0.8	2.6	9.7	1.4	10.3	2.3	8.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.1	0.4	0.3	1.1	0.1	0.8	0.2	0.6
Increased Break/Shift/Tremulous	%	1.4	2.6	3.7	6.7	3.5	5.4	2.0	2.9
Increased Multiple Features	%	0.5	1.8	0.3	1.1	1.1	7.6	1.6	5.8
Number of Diplophonia	*n*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	1.2	0.5	1.5	0.9	1.2	0.7	1.2	0.7
Decreased Stability of jitter for vowels	u	7.3	44.1	-7.2	52.0	3.1	49.5	2.4	46.8
Increased % shimmer for vowels	%	8.3	3.4	9.2	5.1	8.5	3.6	7.7	3.1
Decreased Stability of shimmer for vowels	u	37.2	23.2	31.3	24.2	32.2	31.2	29.6	30.9
Resonance Quality									
Increased Nasal	%	0.3	1.1	0.0	0.0	1.3	4.1	2.8	15.2
Decreased F1 for /a/ (Nasal)	Hz	938.9	195.3	987.8	215.0	911.8	189.1	1017.9	180.9

Dysarthria Index Signs: Idiopathic Speech Delay
Reference Data 62

		Age (yrs)							
		5 yrs				6 yrs			
		Male		Female		Male		Female	
	Unit	M	SD	M	SD	M	SD	M	SD
Vowels									
Increased Percentage of Vowels/Diphthongs Distortions	%	1.6	1.6	2.1	1.6	1.9	1.3	2.0	2.3
Consonants									
Number of Nasal Emissions	*n*	0.3	0.9	0.5	1.3	0.1	0.3	0.7	1.9
Increased Percentage of Weak Consonants	%	0.7	1.3	1.0	1.6	0.4	0.8	0.3	0.4
Vowels & Consonants									
Increased Diacritic Modification Index Class Duration	ms	0.6	0.7	0.9	0.8	0.7	0.8	0.4	0.4
Phrasing									
Increased Slow/Pause Time	ms	0.3	1.4	0.8	2.1	0.2	0.8	0.6	1.6
Rate									
Increased Slow Articulation/ Pause Time	ms	1.2	3.2	1.1	4.5	0.0	0.0	1.8	3.3
Decreased Average syllable speaking rate (with pauses)	syll/sec	3.2	0.6	3.4	0.7	3.7	0.7	3.4	0.3
Decreased Average syllable articulation rate (without pauses)	syll/sec	3.5	0.5	3.7	0.6	4.1	0.6	3.8	0.2
Increased Fast Rate	ms	0.2	1.2	0.8	3.6	0.6	1.5	0.0	0.0
Decreased Stability of syllable speaking rate	u	69.5	6.7	71.3	5.2	71.0	9.1	70.2	7.1
Stress									
Increased Excessive/Equal/Misplaced Stress	%	7.6	8.0	7.3	7.4	6.8	10.7	7.7	8.8
Increased Reduced/Equal Stress	%	0.4	1.2	0.2	0.9	0.2	0.8	0.6	1.6
Loudness									
Decreased Stability of Speech Intensity Index	u	43.4	19.9	44.9	14.1	46.3	19.1	20.9	23.3
Increased Stability of Speech Intensity Index	u	43.4	19.9	44.9	14.1	46.3	19.1	20.9	23.3

Increased Soft	%	1.4	3.2	1.0	1.8	0.6	1.5	0.6	1.6
Decreased Speech Intensity Index	dB	13.6	3.7	11.7	4.9	11.9	3.2	10.4	2.4
Pitch									
Increased Low Pitch/Glottal Fry	%	0.1	0.6	2.1	6.4	4.3	18.8	4.2	9.3
Increased Low Pitch	%	0.4	1.5	0.2	0.9	0.3	1.1	1.2	3.2
Decreased F0 for all vowels & diphthongs	Hz	276.7	38.7	267.6	34.4	276.7	47.3	252.3	23.8
Decreased Range of char. F0 among vowels	Hz	317.8	125.7	339.9	113.2	342.4	171.1	384.9	76.1
Decreased Stability of F0 for all vowels & diphthongs	u	80.1	7.7	78.9	7.9	78.0	8.3	74.6	5.6
Laryngeal Quality									
Increased Breathy	%	0.6	2.0	0.2	0.9	0.3	1.1	0.6	1.6
Increased Rough	%	16.7	28.8	16.1	29.0	9.1	19.1	5.0	5.1
Increased Strained	%	1.6	9.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of utterances with [TREM] (tremulous) comment	*n*	0.0	0.1	0.2	0.9	0.2	0.8	0.0	0.0
Increased Break/Shift/Tremulous	%	1.7	3.2	1.9	4.6	0.8	3.3	2.6	3.4
Increased Multiple Features	%	0.4	1.3	0.6	1.5	0.2	0.9	0.0	0.0
Number of Diplophonia	*n*	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Increased % jitter for vowels	%	1.3	1.0	1.3	0.7	1.2	0.8	1.3	0.5
Decreased Stability of jitter for vowels	u	7.4	43.0	-7.1	38.8	7.3	55.4	6.0	28.1
Increased % shimmer for vowels	%	7.9	4.9	8.7	3.9	8.6	4.2	9.2	3.1
Decreased Stability of shimmer for vowels	u	34.4	27.6	18.0	27.2	39.3	31.4	26.0	35.7
Resonance Quality									
Increased Nasal	%	0.2	0.8	1.0	2.9	3.0	10.1	0.6	1.6
Decreased F1 for /a/ (Nasal)	Hz	922.9	187.9	968.3	220.0	913.7	196.0	975.1	185.4

Childhood Apraxia of Speech (CAS): The Pause Marker (PM) and Pause Marker Index (PMI)

Sample PEPPER Output

Sample PEPPER Outputs 1 and 2, respectively, are outputs from the group and individual forms of the Pause Marker Summary and Pause Marker Index. The group Pause Marker Summary (Sample PEPPER Output 1) provides percentages for PM classifications within the group (PM+, PM-, and Indeterminate), Supplemental Pause Marker Signs coding (on Rate, Stress, and Transcoding), Pause Marker Index classifications, and Type I and Type II inappropriate pause types. The individual Pause Marker Summary (Sample PEPPER Output 2) provides these Pause Marker and Supplementary Pause Marker Index findings for individual speakers.

Pause Marker Summary (PMS): Group

Sample PEPPER Output 1

Group: All *n*: 50

Pause Marker (PM)			Supplemental Pause Marker Signs (SPMS)							Pause Marker Index (PMI)[a]			Inappropriate Pauses					
	n	%		Rate		Stress		Transcoding			n	%	Type I	n	%	Type II	n	%
PM+	12	24.0		n	%	n	%	n	%	Mild	45	90.0	Abrupt	50	3.0	Long	50	0.8
PM- (before SPMS)	33	66.0	Code 1	5	83.3	4	66.7	2	33.3	Mild-Moderate	5	10.0	Alone	50	0.7	Repeat/Revise	50	0.7
Indeterminate	5	10.0	Code 0	1	16.7	2	33.3	0	0.0	Moderate-Severe	0	0.0	Change	50	0.7	Breath	50	0.1
										Severe	0	0.0	Grope	50	0.1	Addition	50	0.0

[a] **Mild = ≥90.0**
Mild-Moderate = 85.0-89.9
Moderate-Severe = 80.0-84.9
Severe = <80.0

Pause Marker Summary (PMS): Individual

Sample PEPPER Output 2

Individual: Age: Sex:

Pause Marker (PM)		Supplemental Pause Marker Signs (SPMS)				Pause Marker Index (PMI)[a]		Inappropriate Pauses			
No. Pause Opportunities	131		Rate	Stress	Transcoding			Type I		Type II	
PM%	93.9	%	-	70.8	88.9	Mild	X	% Abrupt	4.6	% Long	0.0
Code	1	Code	0	1	0	Mild-Moderate		% Alone	1.5	% Repeat/Revise	0.8
						Moderate-Severe		% Change	0.0	% Breath	0.0
Classification	CAS+	SPMS Classification			0	Severe		% Grope	0.0	% Addition	0.0

[a] Mild = ≥90.0
Mild-Moderate = 85.0-89.9
Moderate-Severe = 80.0-84.9
Severe = <80.0

Rationale and Description

As described in Shriberg et al. (2017a) and Tilkens et al. (2017), the Pause Marker (PM) is a behavioral diagnostic marker to discriminate Childhood Apraxia of Speech (CAS) from SD. Rationale for the PM was that among a series of candidate markers described in prior reports, the PM had near conclusive sensitivity and specificity in studies described in Shriberg et al. (2017b). The Pause Marker Index (PMI; Shriberg et al., 2017c), a four-category severity scale based on the PM percentage score, includes the following classifications: Mild (PM scores 90.0% and greater), Mild-Moderate (PM scores 85.0-89.9%), Moderate-Severe (PM scores 80.0-84.9%), and Severe (PM scores less than 80.0%).

A PM percentage score is determined from counts of four types of inappropriate between-word pauses (termed Type I pauses) in conversational speech. A minimum of 40 between-word pause opportunities must occur in the speech sample in order to obtain a valid PM score. PM classification (i.e., whether a speaker is classified as positive [PM+] or negative [PM-] for CAS) from a continuous speech sample with fewer than 40 between-words pause opportunities is classified as Indeterminate. The following five steps summarize the procedures to classify a speaker as positive (CAS+) or negative (CAS-) for CAS:

1. Obtain a conversational speech sample.
2. Complete transcription and prosody-voice coding to yield 24 useable utterances.
3. Complete acoustic analyses to identify in each utterance, occurrences of Type I between-words pauses (abrupt, alone, change, grope) and Type II between-words pauses (addition, repetition/revision, long, breath).
4. Calculate the Pause Marker (PM) percentage score

$$PM = 100 - \left[\frac{\text{No. Type I pauses}}{\text{No. pause opportunities (No. words – No. utterances)}} \right] \text{ x } 100$$

5. Classify CAS status: [a]

PM > 96% = CAS- (does not meet criterion for CAS)

PM < 94% = CAS+ (meets criterion for CAS)

[a] Classify marginal PM scores (94.0-95.9%) using the Supplementary Pause Marker Signs (SPMS) criterion, which requires positive findings on at least two of three standardized signs of CAS (Slow Articulatory Rate, Inappropriate Sentential Stress, Transcoding Errors; see Shriberg et al., 2017a).

Reference Data

The following tables include, respectively, reference data (mean, standard deviation) for the Pause Marker (PM%) for the 200 typical speakers ages 3-80 years (see Table of Contents).

Pause Marker: Typical Speakers
Reference Data 1

	Pause Marker (%)																													
	3 Yrs		4 Yrs		5 Yrs		6 Yrs		7 Yrs		8 Yrs		9 Yrs		10 Yrs		11 Yrs		12 Yrs		13 Yrs		14 Yrs		15 Yrs		16 Yrs		17 Yrs	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Male																														
	99.5	0.7	100.0	0.0	99.8	0.4	99.8	0.3	100.0	0.0	100.0	0.0	99.9	0.3	100.0	0.0	99.8	0.3	99.8	0.3	100.0	0.0	99.0	2.2	99.8	0.4	99.7	0.4	100.0	0.0
Female																														
	99.4	0.8	98.7	1.6	99.9	0.2	99.2	1.8	100.0	0.0	100.0	0.0	100.0	0.0	99.6	0.9	99.2	0.9	99.6	0.6	100.0	0.0	100.0	0.0	99.9	0.3	99.9	0.3	100.0	0.0
Both																														
	99.5	0.7	99.4	1.3	99.9	0.3	99.5	1.2	100.0	0.0	100.0	0.0	99.9	0.2	99.8	0.7	99.5	0.7	99.7	0.5	100.0	0.0	99.5	1.5	99.8	0.3	99.8	0.4	100.0	0.0

Pause Marker: Typical Speakers
Reference Data 2

	Pause Marker (%)											
	20-29 Yrs		30-39 Yrs		40-49 Yrs		50-59 Yrs		60-69 Yrs		70-80 Yrs	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Male												
	100.0	0.0	100.0	0.0	99.9	0.2	100.0	0.0	99.8	0.4	99.6	1.0
Female												
	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
Both												
	100.0	0.0	100.0	0.0	99.9	0.2	100.0	0.0	99.9	0.3	99.8	0.7

Speech Disorders Classification System Summary (SDCSS)

Sample PEPPER Output

Sample PEPPER Output 1 is an example of a Speech Disorders Classification System Summary (SDCSS) for a group of participants and Sample PEPPER Output 2 is an example of an SDCSS for an individual speaker. As with each of the examples of all measures and summaries in this report, the SDCSS Sample PEPPER outputs are from a study of 45 participants with Down syndrome (Wilson et al., 2017). The following section provides the rationale for the development of the SDCSS and describes each of the elements shown in Sample PEPPER Outputs 1 and 2.

Rationale and Description

The goal of the SDCSS was to cross-classify the speech and motor speech status of a group of speakers (Sample PEPPER Output 1) or an individual speaker (Sample PEPPER Output 2). As shown in the rows in both PSI Sample PEPPER Outputs 1 and 2, Speech Disorders is the cover term for typological classification of speakers into five mutually-exclusive speech classifications: normal or normalized speech acquisition (NSA), early (6-9 years of age) or persistent (after 9 years of age) Speech Errors (SE/PSE), or early (3-6 years of age) or persistent (after 9 years of age) Speech Delay (SD/PSD). The forward slash convention for SE and SD allows group data to be aggregated within each class (e.g., the total percentage of participants with SE in a group is the percentage of speakers with SE plus the percentage of speakers with PSE). Motor Speech Disorders is the cover term for five mutually-exclusive motor speech classifications: No Motor Speech Disorder (No MSD), Speech Motor Delay (SMD), Childhood Dysarthria (CD), Childhood Apraxia of Speech (CAS), and Childhood Dysarthria & Childhood Apraxia of Speech (CD & CAS).

Speech Disorders Classification System Summary (SDCSS)

Sample PEPPER Output 1

Speech Disorders Classification System Summary (SDCSS): Group									
Speech Classification		Motor Speech Classification						Totals	
		No Motor Speech Disorder (NO MSD)	Speech Motor Delay (SMD)	Childhood Dysarthria (CD)	Childhood Apraxia of Speech (CAS)	Childhood Dysarthria and Childhood Apraxia of Speech (CD & CAS)		n	%
Normal(ized) Speech Aquisition (NSA)[a]		0	0	1	0	0		1	2.2
Speech Errors (SE)		0	0	0	0	0		0	0.0
Persistent Speech Errors (PSE)		0	1	0	1	0		2	4.4
(SE/PSE)		0	1	0	1	0		2	4.4
Speech Delay (SD)		0	0	0	0	0		0	0.0
Persistent Speech Delay (PSD)		1	11	16	4	10		42	93.3
(SD/PSD)		1	11	16	4	10		42	93.3
Totals	n	1	12	17	5	10		45	
	%	2.2	26.7	37.8	11.1	22.2			100.0

[a] Includes children younger than 9 years old with age-appropriate distortions

Speech Disorders Classification System Summary (SDCSS)

Sample PEPPER Output 2

Speech Disorders Classification System Summary (SDCSS): Individual									
Speech Classification		Motor Speech Classification						Totals	
		No Motor Speech Disorder (NO MSD)	Speech Motor Delay (SMD)	Childhood Dysarthria (CD)	Childhood Apraxia of Speech (CAS)	Childhood Dysarthria and Childhood Apraxia of Speech (CD & CAS)		n	%
Normal(ized) Speech Aquisition (NSA)[a]									
Speech Errors (SE) Persistent Speech Errors (PSE) (SE/PSE)					X				
Speech Delay (SD) Persistent Speech Delay (PSD) (SD/PSD)									
Totals	n								
	%								

[a] Includes children younger than 9 years old with age-appropriate distortions

The subtype classifications within each axes of the SDCSS, speech disorders and motor speech disorders, are made mutually exclusive by a clinical severity rule. Specifically, for a speaker who meets criteria for both SE (or PSE) and for SD (or PSD), the speaker is classified as SD/PSD, nominally the more severe of the two subtypes of speech disorders. Similarly, for a speaker who meets criteria for both SMD and any of the other three motor speech disorder classifications shown in Sample PEPPER Outputs 1 and 2, the speaker is classified as having the other, more severe MSD subtype.

The "X" in Sample PEPPER Output 2 cross-classifies the speaker in this example as having Persistent Speech Errors (PSE) on the Speech Disorder axis and CAS on the Motor Speech Disorder axis. The percentages in the cells and marginals in Sample PEPPER Output 1 indicate that 93.3% of these speakers met criteria for Persistent Speech Delay (PSD) and that the most prevalent subtypes of motor speech disorders were CD (37.8%) and CD & CAS (22.2%).

Reference Data

There are no reference data for the SDCSS because, by definition, all of the participants in the reference database of typical speakers (Table 2) meet criteria for Normal(ized) Speech and all 268 participants in the Idiopathic Speech Delay reference group meet criteria for Speech Delay. Phonology Project Technical Report No. 24: Speech and Motor Speech Findings for Speakers with Complex Neurodevelopmental Disorders (CND; Shriberg & Mabie, 2017) includes SDCSS findings from 10 participant groups.

References

Duffy, J. R. (2013). *Motor speech disorders: Substrates, differential diagnosis, and management* (3rd ed.). St. Louis, MO: Mosby.

Lohmeier, H. L. & Shriberg, L. D. (2011). *Reference Data for the Syllable Repetition Task (SRT)* (Tech. Rep. No. 17). Phonology Project, Waisman Center, University of Wisconsin-Madison.

Mabie, H. L., Fourakis, M., Hall, S. D., Karlsson, H. B., McSweeny, J. L., Tilkens, C. M., Wilson, D. L., & Shriberg, L. D. (2015). *Conversational Speech Reference Data for Children with Speech Delay: A Database of 180 Participants, 3-to-5 years of age.* (Tech. Rep. No. 21). Phonology Project, Waisman Center, University of Wisconsin-Madison.

McSweeny, J. L., Fourakis, M., Hall, S. D., Karlsson, H. B., Lohmeier, H. L., Tilkens, C. M., Wilson, D. L., & Shriberg, L. D. (2012). *Reference Data for the Madison Speech Assessment Protocol (MSAP): A Database of 28 Participants, 3-to-6 years of age, with Speech Delay.* (Tech. Rep. No. 19). Phonology Project, Waisman Center, University of Wisconsin-Madison.

Potter, N. L., Hall, S., Karlsson, H. B., Fourakis, M., Lohmeier, H. L., McSweeny, J. L., . . . Shriberg, L. D. (2012). *Reference Data for the Madison Speech Assessment Protocol (MSAP): A Database of 150 Participants 3-to-18 Years of Age with Typical Speech.* (Tech. Rep. No. 18). Phonology Project, Waisman Center, University of Wisconsin28 Madison.

Programs to Examine Phonetic and Phonologic Evaluation Records [PEPPER: Computer software]. (2018). Madison, WI: Waisman Center, University of Wisconsin–Madison.

Scheer-Cohen, A. R., Holt, A. S., Karlsson, H. B., Mabie, H. L., McSweeny, J. L., Tilkens, C. M., & Shriberg, L. D. (2013). *Reference Data for the Madison Speech Assessment Protocol (MSAP): A Database of Fifty 20-to-80 year old Participants with Typical Speech.* (Tech. Rep. No. 20). Phonology Project, Waisman Center, University of Wisconsin-Madison.

Shriberg, L. D. (1993). Four new speech and prosody-voice measures for genetics research and other studies in developmental phonological disorders. *Journal of Speech and Hearing Research, 36,* 105–140.

Shriberg, L. D. (1994). Five subtypes of developmental phonological disorders. *Clinics in Communication Disorders, 4,* 38–53.

Shriberg, L. D. (2010). Childhood speech sound disorders: From post-behaviorism to the post-genomic era. In R. Paul & P. Flipsen (Eds), *Speech sound disorders in children* (pp. 1-34). San Diego, CA: Plural Publishing.

Shriberg, L. D., Austin, D., Lewis, B. A., McSweeny, J. L., & Wilson, D. L. (1997). The Percentage of Consonants Correct (PCC) Metric: Extensions and reliability data. *Journal of Speech, Language, and Hearing Research, 40,* 708-722.

Shriberg, L. D., Fourakis, M., Hall, S., Karlsson, H. B., Lohmeier, H. L, McSweeny, J., . . . Wilson, D. L. (2010). Extensions to the Speech Disorders Classification System (SDCS). *Clinical Linguistics & Phonetics, 24*, 795-824.

Shriberg, L. D., & Kwiatkowski, J. (1982). Phonological disorders III: A procedure for assessing severity of involvement. *Journal of Speech and Hearing Disorders, 47*, 256–270.

Shriberg, L. D., Kwiatkowski, J., & Rasmussen, C. (1990). *The Prosody-Voice Screening Profile*. Tucson, AZ: Communication Skill Builders.

Shriberg, L. D., Kwiatkowski, J., Rasmussen, C., Lof, G. L., & Miller, J. F. (1992). *The Prosody-Voice Screening Profile (PVSP): Psychometric data and reference information for children* (Tech. Rep. No. 1). Phonology Project, Waisman Center, University of Wisconsin-Madison.

Shriberg, L. D. & Lohmeier, H. L. (2008). *The Syllable Repetition Task* (Tech. Rep. No. 14). Phonology Project, Waisman Center, University of Wisconsin-Madison.

Shriberg, L. D., Lohmeier, H. L., Campbell, T. F., Dollaghan, C. A., Green, J. R., & Moore, C. A. (2009). A nonword repetition task for speakers with misarticulations: The Syllable Repetition Task (SRT). *Journal of Speech, Language, and Hearing Research, 52,* 1189-1212.

Shriberg, L. D., Lohmeier, H. L., Strand, E. A., & Jakielski, K. J. (2012). Encoding, memory, and transcoding deficits in Childhood Apraxia of Speech. *Clinical Linguistics & Phonetics, 26,* 445-482.

Shriberg, L. D., & Mabie, H. L. (2017). *Speech and motor speech classification findings for participants with complex neurodevelopmental disorders.* (Tech. Rep. No. 24). Technical Report in preparation.

Shriberg, L. D., Strand, E. A., Fourakis, M., Jakielski, K. J., Hall, S. D., Karlsson, H. B., . . . Wilson, D. L. (2017a). A diagnostic marker to discriminate childhood apraxia of speech from speech delay: I. Development and description of the Pause Marker. *Journal of Speech, Language, and Hearing Research, 60,* S1096-S1117. doi:10.1044/2016_JSLHR-S-15-0296

Shriberg, L. D., Strand, E. A., Fourakis, M., Jakielski, K. J., Hall, S. D., Karlsson, H. B., . . . Wilson, D. L. (2017b). A diagnostic marker to discriminate childhood apraxia of speech from speech delay: II. Validity studies of the Pause Marker. *Journal of Speech, Language, and Hearing Research, 60,* S1118-S1134. doi:10.1044/2016_JSLHR-S-15-0297

Shriberg, L. D., Strand, E. A., Fourakis, M., Jakielski, K. J., Hall, S. D., Karlsson, H. B., . . . Wilson, D. L. (2017c). A diagnostic marker to discriminate childhood apraxia of speech from speech delay: IV. The Pause Marker Index. *Journal of Speech, Language, and Hearing Research, 60,* S1153-S1169. doi:10.1044/2016_JSLHR-S-16-0149

Shriberg, L. D., Strand, E. A., & Mabie, H. L. (March, 2016). *Prevalence estimates for three types of Motor Speech Disorders in Complex Neurodevelopmental Disorders (CND).* Paper presented at the Eighteenth Biennial Conference on Motor Speech: Motor Speech Disorders & Speech Motor Control, Newport Beach, CA.

Shriberg, L. D., Strand, E. A., & Mabie, H. L. (2017). *Prevalence of Motor Speech Disorders in children with idiopathic speech delay.* Manuscript submitted for publication.

Tilkens, C. M., Karlsson, H. B., Fourakis, M., Hall, S. D., Mabie, H. L., McSweeny, J. L., . . . Shriberg, L. D. (2017). *A diagnostic marker of Childhood Apraxia of Speech: The Pause Marker.* (Tech. Rep. No. 22). Phonology Project, Waisman Center, University of Wisconsin-Madison.

Wilson, E. M., Abbeduto, L., & Camarata, S. M. & Shriberg, L. D. (2017). *Prevalence of speech and motor speech disorders and intelligibility correlates in persons with Down syndrome*. Manuscript submitted for publication.