Speech and Motor Speech Characteristics of a Consensus Group of 28 Children with Childhood Apraxia of Speech

Technical Report No. 25

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PART I

BACKGROUND

The text in this section is adapted (with changes as needed) from**:** *Speech and motor speech assessment findings in eight complex neurodevelopmental disorders.* (Technical Report No. 24). Phonology Project, Waisman Center, University of Wisconsin-Madison.

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 or in the context of complex neurodevelopmental disorders. The research plan 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 were used in research presentations, publications, and in other technical reports. The present technical report provides speech and motor speech information on 28 children with Childhood Apraxia of Speech (CAS). Shriberg et al. (2017; see Table 3 and associated discussion) describes the rationale for constituting a group of children, termed the Consensus CAS Group, classified as positive for

CAS using both the Pause Marker criteria and Mayo Clinic criteria. The motivation for the report is to provide additional information on a group of children with CAS, with and without concurrent Childhood Dysarthria at assessment, who did and did not meet criteria for Speech Motor Delay (see Table 1). Information in the current technical report, including the individual participant information in the present Table 1, provides reference data for a number of issues and questions discussed in associated research on childhood motor speech disorders.

As is customary in this laboratory series, the information in this report is presented without interpretive analyses or comment. Constraints on the internal and external validity of information include the possibility of sampling errors due to limitations in the number and diversity of participants, and potential limitations in the 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, instructors, and clinicians.

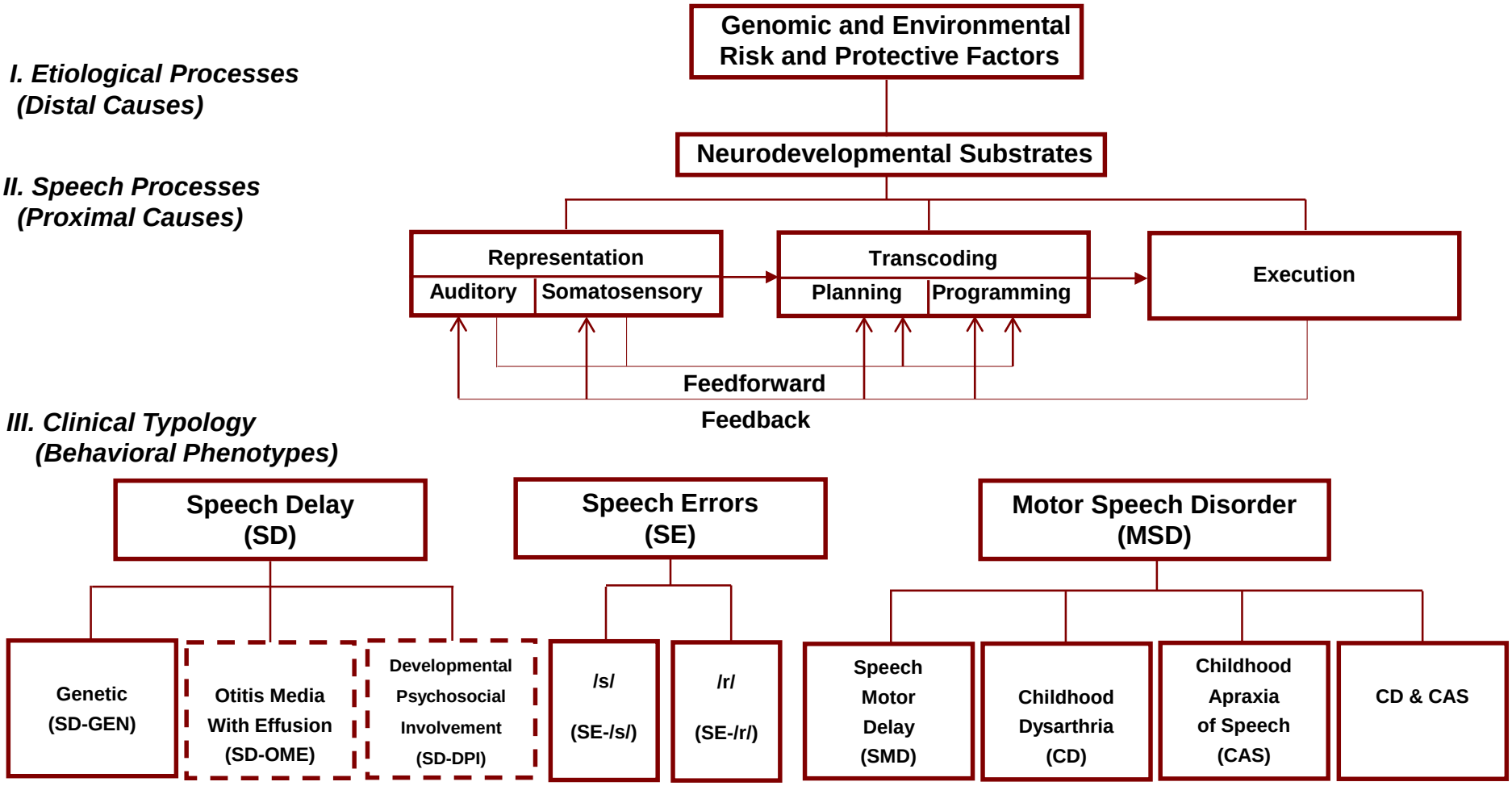
The Speech Disorders Classification System (SDCS)

Figure 1 is a graphic description of the finalized version of the SDCS (Shriberg, Strand, & Mabie, 2018). 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, 2017); Shriberg, Austin, Lewis, McSweeny, and Wilson (1997); Shriberg et al. (2010); and Shriberg, Strand, and Mabie (2018). 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.

I. Etiological Processes (Distal Causes)

II. Speech Processes (Proximal Causes)

III. Clinical Typology (Behavioral Phenotypes)



–	–	–	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

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, however, 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 of SD-GEN to that date). The dashed borders for the other two risk factors at Level II indicate that although research findings in otitis media with effusion and developmental 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 (SE-/s/) and a subtype limited to distortions of rhotic vowels and rhotic consonants (SE-/r/).

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

Reference Databases, Standardization Criteria, and SDCS Classification Procedures

Phonology Project Technical Report 23 (Mabie & Shriberg, 2017) includes information on the reference databases, standardization criteria, and SDCS classification procedures used to obtain scores on the measures of speech and motor speech disorders described in Table 1 of Technical Report 23. Additional information on the 200 typically-speaking participants assessed on a two-hour speech-assessment protocol is described in Potter et al. (2012) and Scheer-Cohen et al. (2013). The latter 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 of age.

Phonology Project Technical Report 24 (Shriberg & Mabie, 2017) includes speech and motor speech information on 362 participants with eight types of complex neurodevelopmental disorders. The information in Part II of the present technical report uses the same format as the format in Technical Report 24 to present findings for ten measures and summaries of speech and motor speech data.

Description of 28 Participants with Childhood Apraxia of Speech (CAS)

As indicated previously, Table 1 of the present report includes brief descriptions of 28 children with CAS, including information on age, sex, cognition, language, and speech. As indicated previously, some of the information in Table 1 was added for research in childhood motor speech disorders described in Shriberg, Strand, and Mabie (2018) and Shriberg, Campbell, Mabie, and McGlothlin (2018).

Table 1. Consensus CAS participants. Shriberg et al. (2017) includes rationale for and additional information on participants. Research since that publication motivated inclusion of individual participant data on CAS status (idiopathic, neurogenetic), Speech Motor Delay status, and for Ordinal Intelligibility Index classification.

	CAS Cohort	SDCS Motor Speech Classification		Demographic		Cognitive-Language		Speech			
Participant No.	CASI = CAS-Idiopathic; CASN= CAS Neurogenetic	CAS	CD & CAS	Age (yrs)	Sex (M=Male; F=Female)	Cognition[a]	Language[b]	Percentage of Consonants Correct[c]	Percentage of Vowels Correct[c]	Intelligibility Index[d]	Ordinal Intelligibility Index[e]
1	CASN	X		10	M	105	95	53.6	90.6	95.3	H
2	CASN	X		8	F	80	60	92.2	97.8	96.6	H
3	CASN	X		12	F	63	66	74.1	89.8	92.7	H
4	CASN	X		8	M	82	82	76.1	90.1	81.8	M
5	CASN	X		5	F	109	83	67.1	76.3	68.4	L
6	CASN	X		7	M	86	73	72.5	89.7	95.1	H
7	CASI	X		16	F	40	40	66.9	77.0	54.9	L
8	CASI	X		6	M	89	73	77.8	88.9	90.8	H
9	CASI	X		11	F	56	58	63.5	83.4	67.6	L
10	CASI	X		6	M	94	73	61.2	86.9	74.0	L
11	CASI	X		4	M	118	90	68.5	95.6	80.4	M
12	CASI	X		4	F	109	95	69.0	80.1	82.4	M
13	CASI	X		7	M	71	72	70.5	92.5	93.3	H
14	CASI	X		13	F	45	40	69.2	76.1	69.7	L
15	CASI	X		4	M	110	88	74.0	87.3	94.2	H
16	CASN		X	19	F	81	*	85.7	95.4	98.3	H
17	CASN		X	11	M	67	55	70.0	93.7	97.2	H
18	CASN		X	15	M	103	95	86.1	92.7	95.3	H
19	CASN		X	6	F	85	77	67.5	78.9	79.6	L
20	CASN		X	11	M	89	81	92.1	98.4	99.1	H
21	CASN		X	12	F	62	60	78.1	89.1	96.1	H
22	CASI		X	10	M	63	62	67.6	90.8	83.6	M
23	CASI		X	7	M	97	91	77.0	85.4	93.4	H
24	CASI		X	23	F	107	*	94.3	97.3	99.0	H
25	CASI		X	7	F	84	50	78.6	91.0	93.1	H
26	CASI		X	12	F	40	40	36.8	77.1	91.9	H
27	CASI		X	7	M	104	105	80.1	89.8	93.5	H
28	CASI		X	8	M	*	*	78.6	86.3	96.5	H

		SDCS Motor Speech Classification		Demographic		Cognitive-Language		Speech			
		CAS	CD & CAS	Age (yrs)	Sex (M=Male; F=Female)	Cognition[a]	Language[b]	Percentage of Consonants Correct[c]	Percentage of Vowels Correct[c]	Intelligibility Index[d]	Ordinal Intelligibility Index[e]
	n	15	13	28	% Males = 53.6	27	25	28	28	28	% H = 64.3
	M			9.6		82.9	72.2	73.2	88.1	87.6	% M = 14.3
	SD			4.6		22.5	18.7	11.9	6.7	11.6	% L = 21.4
	Range			4-23		40-118	40-105	36.8-94.3	76.1-98.4	54.9-99.1	

[a] Standard scores for IQ Composite: *Kaufman Brief Intelligence Test – Second Edition*; Kaufman and Kaufman (2004). IQ Scores: *Stanford-Binet-4th Edition*; Thorndike, Hagen, and Sattler (1986).

[b]Standard scores for Oral Composite: *Oral and Written Language Scales (OWLS);* Carrow-Woolfolk (1995). Standard scores for Core Language: *Clinical Evaluation of Language Fundamentals-4 (CELF–4);* Semel, Wiig, and Secord (2003).

[c]Shriberg, Austin, Lewis, McSweeny, and Wilson (1997)

[d] Shriberg (1993).

[e] Mabie and Shriberg (2017). H = High; M = Moderate; L = Low

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
ms	milliseconds
n	count
%	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
CND	Complex Neurodevelopmental Disorders
DI	Dysarthria Index
DSI	Dysarthria Subtypes Indices
II	Intelligibility Index
ISSD	Idiopathic Speech Sound Disorders
MSD	Motor Speech Disorder
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
PMS	Pause Marker Summary
PSD	Persistent Speech Delay
PSE	Persistent Speech Errors
PSI	Precision-Stability Index
PVSP	Prosody-Voice Screening Profile
SCI	Speech Competence Index
SD	Speech Delay
SD-DPI	Speech Delay-Developmental Psychosocial Disorder
SD-GEN	Speech Delay-Genetic
SD-OME	Speech Delay-Otitis Media with Effusion
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

TEN SDCS SPEECH AND MOTOR SPEECH OUTPUTS

A. Speech and Motor Speech and Motor Speech Outputs for 28 Participants with CAS or CD & CAS

The following outline describes the format of the ten speech and motor speech outputs described in Mabie and Shriberg (2017) and Shriberg and Mabie (2017). Note that for two of the speech measures, detailed outputs are not available; summative findings are available in the Competence Measures Summary (CMS).

Speech Measures and Summaries

Percentage Consonants Correct (PCC)

Intelligibility Index (II) and Ordinal Intelligibility Index (OII)
The II and OII findings are in the Competence Measures Summary

Prosody-Voice Screening Profile (PVSP)

Speech Competence Index (SCI)

Syllable Repetition Task (SRT)
The SRT findings are in the Competence Measures Summary

Competence Measures Summary (CMS)

Motor Speech Measures and Summaries

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

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

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

Summary Speech and Motor Speech Classifications

Speech Disorders Classification System Summary (SDCSS)

SPEECH MEASURES AND SUMMARIES:

28 Participants with CAS or CD & CAS

PERCENTAGE CONSONANTS CORRECT (PCC)

Participants with CAS or CD & CAS

Child_____
Study Identification_____
DOB_____
Age at Sampling Date_____
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	343	6	133	13	252	13	728	760	7.02	95.79
	n	307	5	146	37	897	102	1350	1494	13.80	90.36
	ŋ	0	0	7	4	52	26	59	89	0.82	66.29
Glides	w	314	75	32	9	0	0	346	430	3.97	80.47
	j	215	25	16	7	0	0	231	263	2.43	87.83
Stops	p	226	21	82	9	74	4	382	416	3.84	91.83
	b	198	15	88	8	10	4	296	323	2.98	91.64
	t	278	27	163	71	428	225	869	1192	11.01	72.90
	d	219	16	84	29	190	91	493	629	5.81	78.38
	k	179	51	107	38	217	43	503	635	5.86	79.21
	g	233	43	33	11	29	13	295	362	3.34	81.49
Fricatives and Affricates	f	175	14	22	7	42	7	239	267	2.47	89.51
	v	9	1	63	12	91	20	163	196	1.81	83.16
	θ	37	20	12	16	40	35	89	160	1.48	55.62
	ð	180	186	14	15	0	0	194	395	3.65	49.11
	s	241	130	107	48	198	112	546	836	7.72	65.31
	z	0	1	23	15	180	205	203	424	3.92	47.88
	ʃ	19	28	13	14	6	4	38	84	0.78	45.24
	ʒ	0	0	1	1	1	0	2	3	0.03	66.67
	h	267	51	32	1	0	0	299	351	3.24	85.19
	tʃ	5	15	10	7	19	30	34	86	0.79	39.53
	ʤ	23	46	5	10	1	7	29	92	0.85	31.52
Liquids	l	192	153	75	64	103	145	370	732	6.76	50.55
	r	93	175	32	85	64	160	189	609	5.62	31.03
Percent Correct		77.27		71.00		69.90		7947	10828		
								Correct	Total		

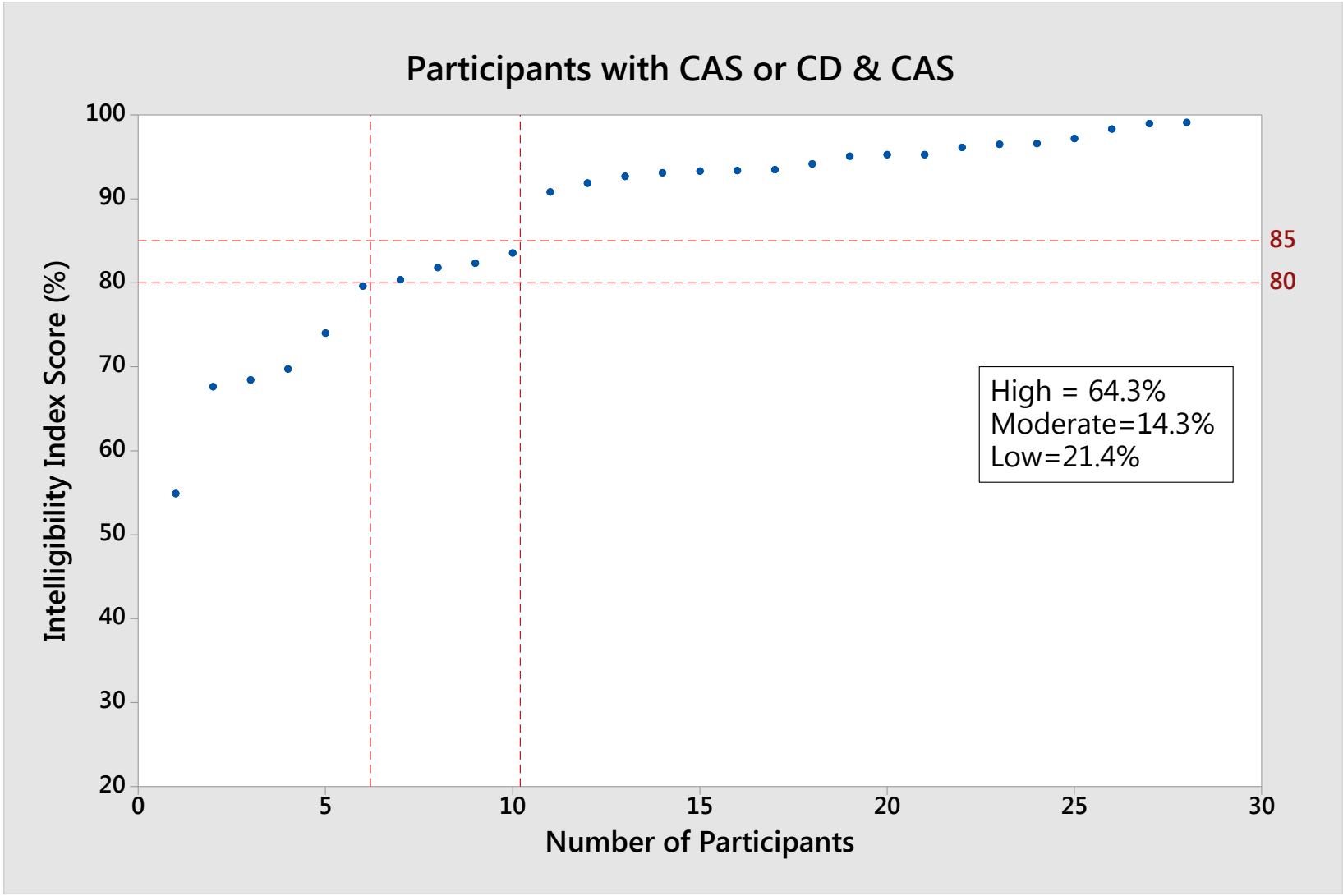
Word Coding Summary	N	%
"Words" entered	8809	100.00
"Words" used	5921	67.22
Disregard	1883	21.38
Either/Or	12	0.14
Unsure	313	3.55
Unintelligible	680	7.72
INTELLIGIBILITY INDEX		85.49

73.39

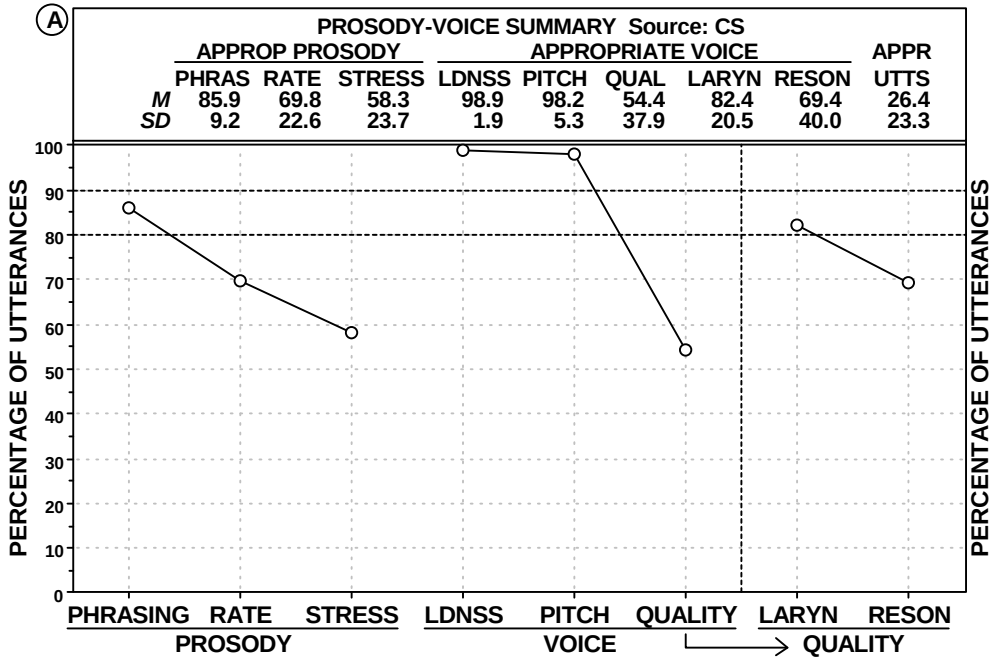
Percentage Consonants Correct (PCC)

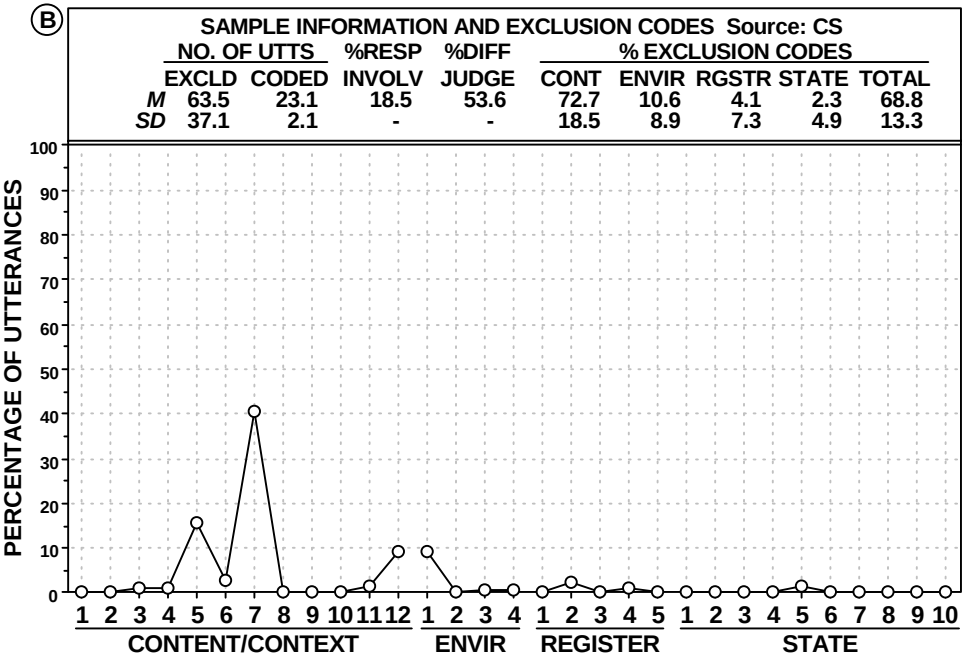
Severity Adjective

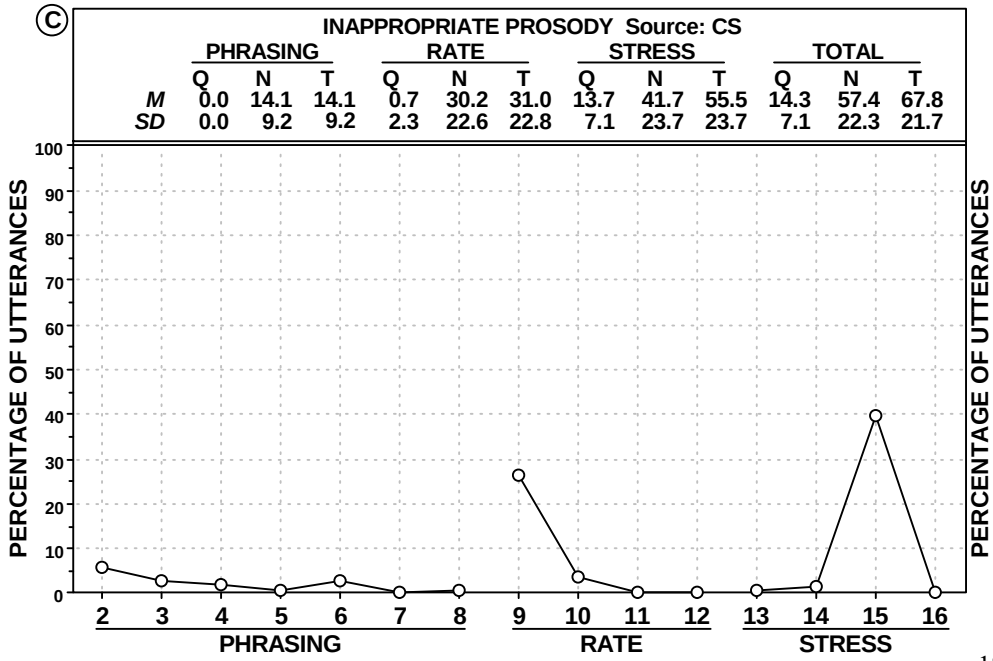
MILD-MODERATE

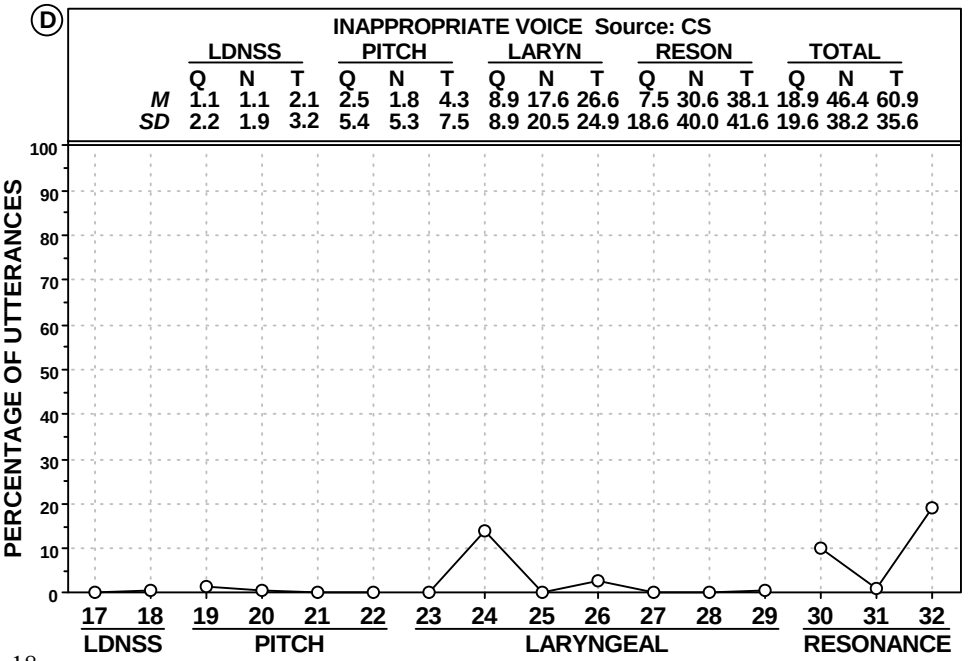

Participants with CAS or CD & CAS
Intelligibility Index Score (%)
100
90
80
70
60
50
40
30
20
0
5
10
15
20
25
30
Number of Participants
85
80
High = 64.3%
Moderate=14.3%
Low=21.4%

Participants with CAS or CD & CAS









Speech Competence Index (SCI): Group

	SCI Sign		Participants Positive on Sign		Ordinal Classification[b]
Linguistic Domain	No.	Description	Findings	%[a]	
Vowels					
	1	Decreased Percent vowels correct	27/28	96.4	VF
	2	Decreased Percent vowels correct non-rhotic	28/28	100.0	VF
	3	Decreased Percent vowels correct revised	27/28	96.4	VF
Consonants					
	4	Decreased Percent consonants correct	27/28	96.4	VF
	5	Decreased Percent consonants correct - early	26/28	92.9	VF
	6	Decreased Percent consonants correct - middle	24/28	85.7	VF
	7	Decreased Percent consonants correct - late	21/28	75.0	F
	8	Decreased Percent consonants correct adjusted	26/28	92.9	VF
	9	Decreased Percent consonants correct revised	26/28	92.9	VF
	10	Decreased Percent consonants correct revised - early	26/28	92.9	VF
	11	Decreased Percent consonants correct revised - middle	24/28	85.7	VF
	12	Decreased Percent consonants correct revised - late	26/28	92.9	VF
	13	Decreased Percent consonants in the inventory	21/28	75.0	F
	14	Decreased Percent consonants in the inventory - early	4/28	14.3	I
	15	Decreased Percent consonants in the inventory - middle	20/28	71.4	F
	16	Decreased Percent consonants in the inventory - late	16/28	57.1	SF
	17	Increased Absolute omission index	26/28	92.9	VF
	18	Increased Absolute omission index - early	25/28	89.3	VF
	19	Increased Absolute omission index - middle	22/28	78.6	F
	20	Increased Absolute omission index - late	25/28	89.3	VF
	21	Increased Absolute substitution index	26/28	92.9	VF
	22	Increased Absolute substitution index - early	20/28	71.4	F
	23	Increased Absolute substitution index - middle	21/28	75.0	F
	24	Increased Absolute substitution index - late	22/28	78.6	F
	25	Increased Absolute distortion index	17/28	60.7	F
	26	Increased Absolute distortion index - early	24/28	85.7	VF
	27	Increased Absolute distortion index - middle	14/28	50.0	SF
	28	Increased Absolute distortion index - late	15/28	53.6	SF
Vowels and Consonants					
	29	Decreased Intelligibility index	25/28	89.3	VF
	30	Decreased Percentage of phonemes correct	27/28	96.4	VF
	31	Decreased Percentage of phonemes correct revised	27/28	96.4	VF

Phrasing					
	32	**Decreased Percent Prosody Phrasing correct**	**5/28**	**17.9**	**I**
Rate					
	33	**Decreased Percent Prosody Rate correct**	**25/28**	**89.3**	**VF**
Stress					
	34	**Decreased Percent Prosody Stress correct**	**20/28**	**71.4**	**F**
Loudness					
	35	**Decreased Percent Prosody Loudness correct**	**0/28**	**0.0**	**I**
Pitch					
	36	**Decreased Percent Prosody Pitch correct**	**1/28**	**3.6**	**I**
Laryngeal Quality					
	37	**Decreased Percent Voice Quality Laryngeal correct**	**3/28**	**10.7**	**I**
Resonance Quality					
	38	**Decreased Percent Voice Quality Resonance correct**	**9/28**	**32.1**	**SI**

SCI Scores Summary			**SCI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**28**		**Very Frequent (VF): 80.0-100%**	**20**
Mean	**27.8**		**Frequent (F): 60.0-79.9%**	**9**
Standard Deviation	**16.1**		**Somewhat Frequent (SF): 40.0-59.9%**	**3**
Range	**10.5 - 94.7**		**Somewhat Infrequent (SI): 20.0-39.9%**	**1**
			Infrequent (I): 0.0-19.9%	**5**
			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%

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		28	**87.6**	**-3.96**	**11.6**	**1.49**	**54.9**	**-5.00**	**99.1**	**-0.66**
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			18	**64.3**	**4**	**14.3**	**6**	**21.4**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		28	**73.2**	**-3.65**	**11.9**	**1.44**	**36.8**	**-5.00**	**94.3**	**0.75**

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		28	**27.8**		**16.1**		**10.5**		**94.7**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**28**	**17.9**
Rate		**28**	**64.3**
Stress		**28**	**78.6**
Loudness		**28**	**0.0**
Pitch		**28**	**3.6**
Laryngeal Quality		**28**	**39.3**
Resonance Quality		**28**	**39.3**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**28**	**66.5**	**-1.74**	**16.5**	**1.75**	**26.0**	**-5.00**	**100.0**	**0.85**
Encoding		**27**	**45.0**	**-0.79**	**13.6**	**0.69**	**14.3**	**-2.17**	**75.0**	**1.49**
Memory		**28**	**57.2**	**-1.79**	**26.5**	**2.08**	**5.6**	**-5.00**	**100.0**	**0.84**
Transcoding		**28**	**69.6**	**-2.49**	**18.0**	**1.93**	**22.2**	**-5.00**	**94.4**	**0.38**

MOTOR SPEECH MEASURES AND SUMMARIES:

28 Participants with CAS or CD & CAS

Precision-Stability Index (PSI): Group

	PSI 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	4/25	16.0	I
	2	Reduced Dispersion of Corner Vowels from ^		X	5/25	20.0	SI
	3	Reduced Average Pairwise Distance of Corner Vowels		X	4/25	16.0	I
	4	Increased Duration of Corner Vowels		X	12/28	42.9	SF
	5	Increased Duration for Middle Vowels and Diphthongs		X	21/28	75.0	F
	6	Reduced % Vowel Phoneme Target Consistency	X		5/11	45.5	SF
	7	Reduced % Vowel Target Consistency	X		3/11	27.3	SI
Consonants							
	8	Reduced % Correct Glides	X		22/28	78.6	F
	9	Increased Relative Distortion Index: Sibilants	X		0/28	0.0	I
	10	Reduced % Dentalized Sibilants of Distorted Sibilants	X		5/28	17.9	I
	11	Increased Relative Distortion Index for Early Consonants	X		18/28	64.3	F
	12	Decreased 1st Moment on /s/ Initial Singletons		X	5/23	21.7	SI
	13	Increased Sqrt 2nd Moment of the /s/ Initial Singletons		X	5/23	21.7	SI
	14	Increased Sqrt 2nd Moment of the /s/ initial, and /s/ and /z/ final singletons		X	2/27	7.4	I
	15	Increased All Consonant-Consonant Duration		X	13/25	52.0	SF
Vowels and Consonants							
	16	Increased Diacritic Modificatiion Index (DMI) Class: Place %	X		23/28	82.1	VF
	17	Increased DMI Class: Duration %	X		20/28	71.4	F
	18	Increased % of Epenthesis Errors	X		21/28	75.0	F
Phrasing							
	19	Increased PM errors: % of Addition, Breath, Repeat, or Long	X		23/28	82.1	VF
Rate							
	20	Reduced Average Syllable Artic Rate (without pauses)		X	17/28	60.7	F
	21	Increased Average Syllable ms (without pauses)		X	16/28	57.1	SF
Stress							
	22	Increased % of Prosody Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration. (uncircled & circled)	X		24/28	85.7	VF
	23	Increased % of PV15/16 EE codes of all PV15/16 codes. (uncircled & circled)	X		19/28	67.9	F
Loudness							
	24	Decreased Intensity Difference dB Fricative+Vowel		X	2/24	8.3	I
Pitch							
	25	Decreased F0 for all delimited Vowels & Diphthongs		X	3/28	10.7	I
	26	Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs		X	6/28	21.4	SI

Laryngeal Quality							
	27	**Increased % Jitter for Vowels**		**X**	**2/28**	**7.1**	**I**
	28	**Increased % Shimmer for Vowels**		**X**	**2/28**	**7.1**	**I**
	29	**Decreased HNR dB for Vowels**		**X**	**3/28**	**10.7**	**I**
Resonance Quality							
	30	**Increased % Inappropriate Resonance**	**X**		**11/28**	**39.3**	**SI**
	31	**Decreased F1 /ɑ/ (Nasal)**		**X**	**0/28**	**0.0**	**I**
	32	**Decreased F2 for High Vowels (Nasopharyngeal)**		**X**	**7/28**	**25.0**	**SI**

PSI Scores Summary			**PSI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**28**		**Very Frequent (VF): 80.0-100%**	**3**
Mean	**61.2**		**Frequent (F): 60.0-79.9%**	**7**
Standard Deviation	**10.1**		**Somewhat Frequent (SF): 40.0-59.9%**	**4**
Range	**41.7 - 76.7**		**Somewhat Infrequent (SI): 20.0-39.9%**	**7**
			Infrequent (I): 0.0-19.9%	**11**
			Not Used	**0**

[a] A: Acoustic; P: Perceptual

[b] Increased/Decreased reference ≥ 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%

Participants with CAS or CD & CAS

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

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**		**22**	**78.6**	**F**	**X(2)**		**X(2)**		
Consonants												
	2	**Number of Nasal Emissions**	**X**		**8**	**28.6**	**SI**					**X(2)**
	3	**Increased Percentage of Weak Consonants**	**X**		**25**	**89.3**	**VF**					X(1)
Vowels and Consonants												
	4	**Increased Diacritic Modification Index Class Duration**	**X**		**16**	**57.1**	**SF**	X(1)		X(1)		
Phrasing												
	5	**Increased Slow/Pause Time**	**X**		**10**	**35.7**	**SI**			X(1)	**X(2)**	
Rate												
	6	**Increased Slow Articulation/Pause Time**	**X**		**23**	**82.1**	**VF**	X(1)	**X(2)**	X(1)		
	7	**Decreased Average syllable speaking rate (with pauses)**		**X**	**16**	**57.1**	**SF**	X(1)	**X(2)**	X(1)		
	8	**Decreased Average syllable articulation rate (without pauses)**		**X**	**16**	**57.1**	**SF**	X(1)	**X(2)**	X(1)		
	9	**Increased Fast Rate**	**X**		**0**	**0.0**	**I**				**X(2)**	
	10	**Decreased Stability of syllable speaking rate**		**X**	**1**	**3.6**	**I**			X(1)	**X(2)**	
Stress												
	11	**Increased Excessive/Equal/Misplaced Stress**	**X**		**20**	**71.4**	**F**	**X(2)**	X(1)			
	12	**Increased Reduced/Equal Stress**	**X**		**7**	**25.0**	**SI**				**X(2)**	
Loudness												
	13	**Decreased Stability of Speech Intensity Index**		**X**	**4**	**14.3**	**I**	**X(2)**		**X(2)**		
	14	**Increased Stability of Speech Intensity Index**		**X**	**3**	**10.7**	**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**	**3**	**10.7**	**I**				**X(2)**	X(1)

Pitch												
	17	**Increased Low Pitch/Glottal Fry**	**X**		**3**	**10.7**	**I**		**X(2)**	X(1)		
	18	**Increased Low Pitch**	**X**		**1**	**3.6**	**I**		**X(2)**	X(1)		
	19	**Decreased F0 for all vowels & diphthongs**		**X**	**1**	**3.6**	**I**		**X(2)**	X(1)		
	20	**Decreased Range of char. F0 among vowels & diphthongs**		**X**	**4**	**14.3**	**I**		X(1)	X(1)	**X(2)**	X(1)
	21	**Decreased Stability of F0 for all vowels & diphthongs**		**X**	**2**	**7.1**	**I**	X(1)				
Laryngeal Quality												
	22	**Increased Breathy**	**X**		**0**	**0.0**	**I**				X(1)	**X(2)**
	23	**Increased Rough**	**X**		**3**	**10.7**	**I**		X(1)	X(1)		
	24	**Increased Strained**	**X**		**1**	**3.6**	**I**		X(1)	X(1)		
	25	**Number of utterances with [TREM] (tremulous) comment**	**X**		**4**	**14.3**	**I**			X(1)		
	26	**Increased Break/Shift/Tremulous**	**X**		**8**	**28.6**	**SI**		**X(2)**	X(1)		
	27	**Increased Multiple Features**	**X**		**2**	**7.1**	**I**		**X(2)**	**X(2)**		
	28	**Number of Diplophonia**	**X**		**0**	**0.0**	**I**					**X(2)**
	29	**Increased % jitter for vowels**		**X**	**1**	**3.6**	**I**	X(1)				
	30	**Decreased Stability of jitter for vowels**		**X**	**3**	**10.7**	**I**	X(1)				
	31	**Increased % shimmer for vowels**		**X**	**1**	**3.6**	**I**	X(1)				
	32	**Decreased Stability of shimmer for vowels**		**X**	**4**	**14.3**	**I**	X(1)				
Resonance Quality												
	33	**Increased Nasal**	**X**		**10**	**35.7**	**SI**		X(1)	X(1)	X(1)	**X(2)**
	34	**Decreased F1 for /ɑ/ (Nasal)**		**X**	**0**	**0.0**	**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	**28**
Mean Percentage Score	**76.7**
Standard Deviation	**7.4**
Range	**58.8 - 88.2**

DSI Summary					
	Ataxia	**Spastic**	**Hyper-kinetic**	**Hypo-kinetic**	**Flaccid**
Mean DSI Percentage Score	**58.6**	**71.9**	**71.3**	**87.6**	**83.1**
Mean DSI Percentile Score	**26.5**	**30.8**	**29.9**	**45.7**	**37.3**
Percentage of Participants $\leq 10^{th}$ %ile	**28.6**	**17.9**	**14.3**	**10.7**	**25.0**

Participants with CAS or CD & CAS

Pause Marker Summary (PMS): Group

Group: All *n*: 28

Pause Marker (PM)					Supplemental Pause Marker Signs (SPMS)							Pause Marker Index (PMI)[b]			Inappropriate Pauses					
	Before		After			Rate		Stress		Transcoding			n	%	Type I	n	%	Type II	n	%
	n	%	n	%		n	%	n	%	n	%	Mild	14	50.0	Abrupt	28	9.7	Long	28	2.0
PM+	25	89.3	28	100.0	Code 1	3	100.0	3	100.0	2	66.7	Mild-Moderate	5	17.9	Alone	28	1.7	Repeat/Revise	28	2.2
PM-	0	0.0	0	0.0	Code 0	0	0.0	0	0.0	1	33.3	Moderate-Severe	4	14.3	Change	28	1.8	Breath	28	0.8
?[a]	3	10.7	0	0.0								Severe	5	17.9	Grope	28	0.6	Addition	28	0.3

[a] **? = Indeterminate (Shriberg, Strand, Fourakis et al., 2017)**

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

SUMMARY SPEECH AND MOTOR SPEECH CLASSIFICATIONS:

28 Participants with CAS or CD & CAS

Participants with CAS or CD & CAS

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**	**0**	**1**	**2**		**3**	**10.7**
Speech Errors (SE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
Persistent Speech Errors (PSE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
(SE/PSE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
Speech Delay (SD)		**0**	**0**	**0**	**9**	**5**		**14**	**50.0**
Persistent Speech Delay (PSD)		**0**	**0**	**0**	**5**	**6**		**11**	**39.3**
(SD/PSD)		**0**	**0**	**0**	**14**	**11**		**25**	**89.3**
Totals	**n**	**0**	**0**	**0**	**15**	**13**		**28**	
	%	**0.0**	**0.0**	**0.0**	**53.6**	**46.4**			**100.0**

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

B. Speech and Motor Speech Outputs for 15 Participants with CAS

Speech Measures and Summaries

Percentage Consonants Correct (PCC)

Intelligibility Index (II) and Ordinal Intelligibility Index (OII)
The II and OII findings are in the Competence Measures Summary

Prosody-Voice Screening Profile (PVSP)

Speech Competence Index (SCI)

Syllable Repetition Task (SRT)
The SRT findings are in the Competence Measures Summary

Competence Measures Summary (CMS)

Motor Speech Measures and Summaries

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

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

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

Summary Speech and Motor Speech Classifications

Speech Disorders Classification System Summary (SDCSS)

SPEECH MEASURES AND SUMMARIES:

15 Participants with CAS

PERCENTAGE CONSONANTS CORRECT (PCC)

Participants with CAS

Child_____
Study Identification_____
DOB_____
Age at Sampling Date_____
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	216	4	80	11	152	8	448	471	8.32	95.12
	n	190	5	56	16	412	69	658	748	13.22	87.97
	ŋ	0	0	6	3	27	18	33	54	0.95	61.11
Glides	w	151	41	13	4	0	0	164	209	3.69	78.47
	j	121	14	12	2	0	0	133	149	2.63	89.26
Stops	p	121	15	42	4	43	0	206	225	3.98	91.56
	b	97	10	43	6	3	2	143	161	2.85	88.82
	t	121	21	74	33	180	131	375	560	9.90	66.96
	d	121	12	40	17	102	56	263	348	6.15	75.57
	k	75	35	56	28	119	19	250	332	5.87	75.30
	g	140	21	23	11	24	9	187	228	4.03	82.02
Fricatives and Affricates	f	90	9	6	3	14	1	110	123	2.17	89.43
	v	2	0	26	4	37	11	65	80	1.41	81.25
	θ	19	14	3	5	17	25	39	83	1.47	46.99
	ð	71	121	3	11	0	0	74	206	3.64	35.92
	s	120	70	57	30	103	59	280	439	7.76	63.78
	z	0	1	10	7	80	129	90	227	4.01	39.65
	ʃ	11	20	4	7	1	2	16	45	0.80	35.56
	ʒ	0	0	0	0	0	0	0	0	0.00	*
	h	158	39	25	1	0	0	183	223	3.94	82.06
	tʃ	4	8	0	4	6	14	10	36	0.64	27.78
	ʤ	18	31	1	1	1	3	20	55	0.97	36.36
Liquids	l	86	99	17	32	38	79	141	351	6.20	40.17
	r	46	106	4	38	22	90	72	306	5.41	23.53
Percent Correct		73.97		68.37		65.57		3960	5659		
								Correct	Total		

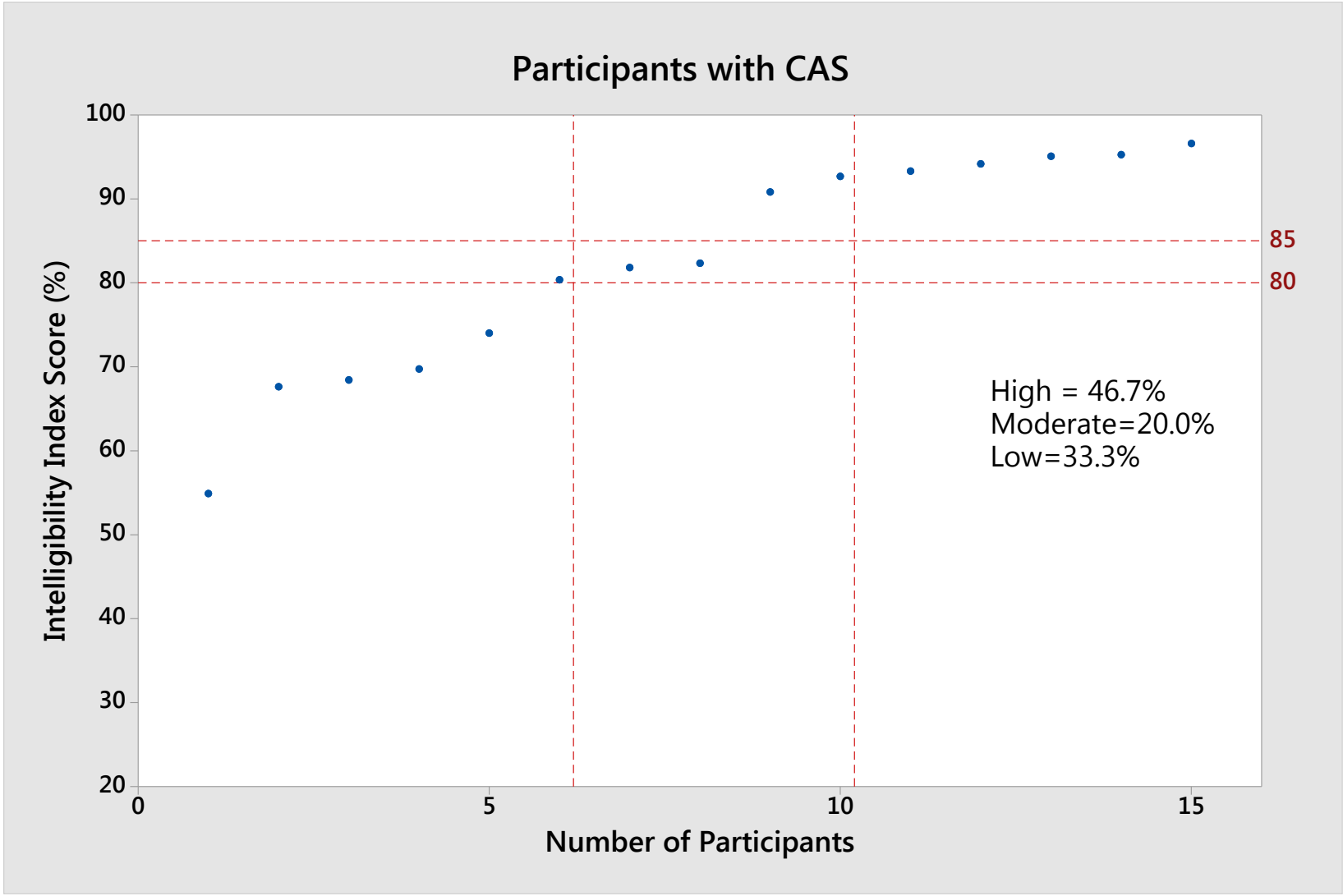
Word Coding Summary	N	%
"Words" entered	5271	100.00
"Words" used	3177	60.27
Disregard	1282	24.32
Either/Or	5	0.09
Unsure	234	4.44
Unintelligible	573	10.87
INTELLIGIBILITY INDEX		79.64

69.98

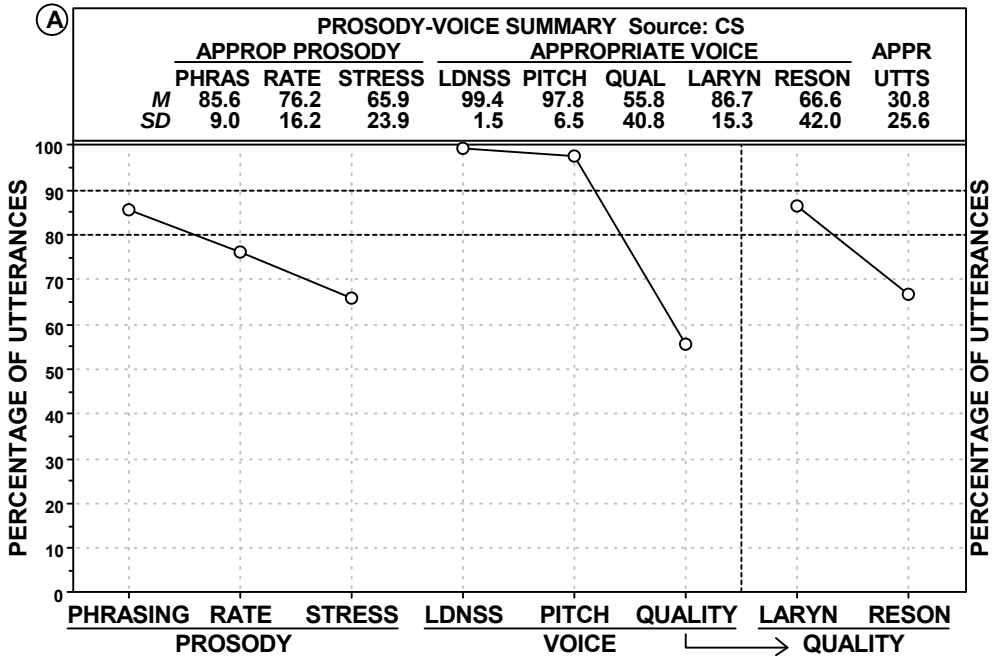
Percentage Consonants Correct (PCC)

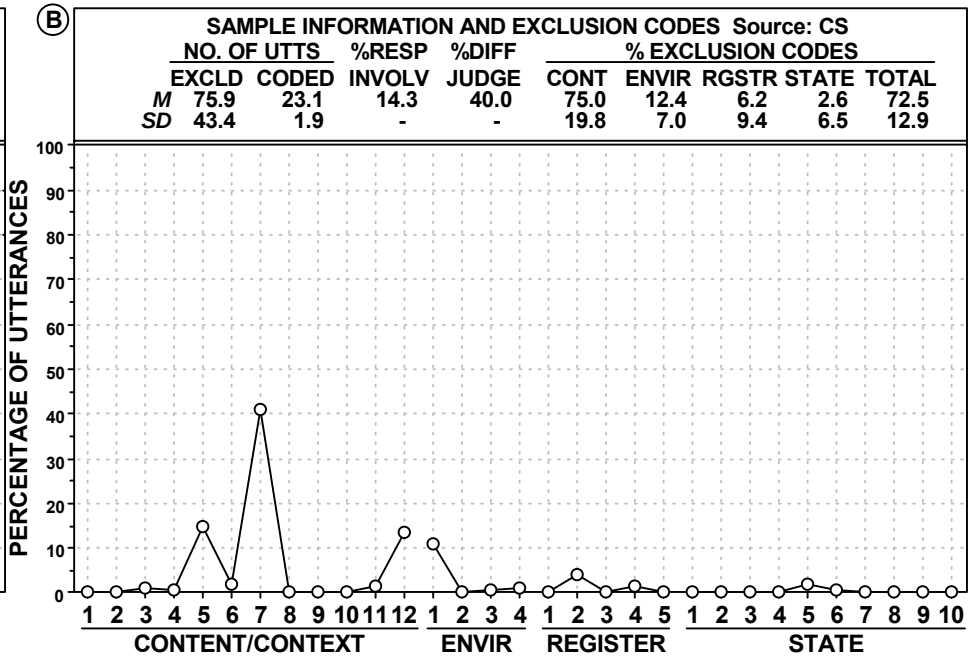
Severity Adjective

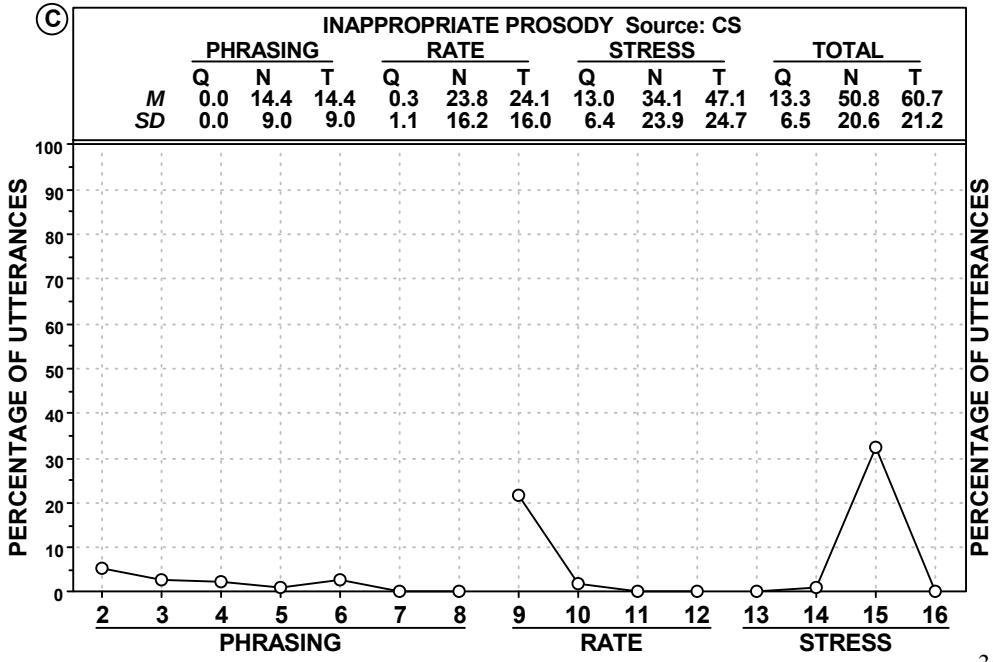
MILD-MODERATE

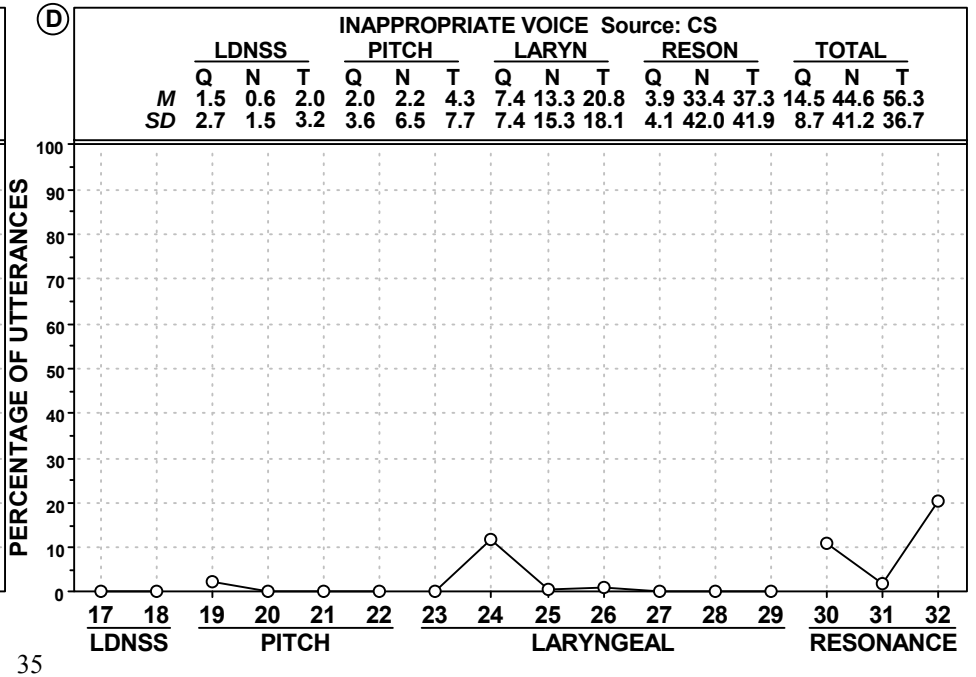

Participants with CAS
Intelligibility Index Score (%)
100
90
80
70
60
50
40
30
20
0
5
10
15
Number of Participants
85
80
High = 46.7%
Moderate=20.0%
Low=33.3%

Participants with CAS









Speech Competence Index (SCI): Group

Linguistic Domain	SCI Sign No.	SCI Sign Description	Participants Positive on Sign Findings	Participants Positive on Sign %[a]	Ordinal Classification[b]
Vowels					
	1	**Decreased Percent vowels correct**	**14/15**	**93.3**	**VF**
	2	**Decreased Percent vowels correct non-rhotic**	**15/15**	**100.0**	**VF**
	3	**Decreased Percent vowels correct revised**	**14/15**	**93.3**	**VF**
Consonants					
	4	**Decreased Percent consonants correct**	**14/15**	**93.3**	**VF**
	5	**Decreased Percent consonants correct - early**	**14/15**	**93.3**	**VF**
	6	**Decreased Percent consonants correct - middle**	**13/15**	**86.7**	**VF**
	7	**Decreased Percent consonants correct - late**	**9/15**	**60.0**	**F**
	8	**Decreased Percent consonants correct adjusted**	**14/15**	**93.3**	**VF**
	9	**Decreased Percent consonants correct revised**	**14/15**	**93.3**	**VF**
	10	**Decreased Percent consonants correct revised - early**	**14/15**	**93.3**	**VF**
	11	**Decreased Percent consonants correct revised - middle**	**13/15**	**86.7**	**VF**
	12	**Decreased Percent consonants correct revised - late**	**14/15**	**93.3**	**VF**
	13	**Decreased Percent consonants in the inventory**	**10/15**	**66.7**	**F**
	14	**Decreased Percent consonants in the inventory - early**	**3/15**	**20.0**	**SI**
	15	**Decreased Percent consonants in the inventory - middle**	**11/15**	**73.3**	**F**
	16	**Decreased Percent consonants in the inventory - late**	**8/15**	**53.3**	**SF**
	17	**Increased Absolute omission index**	**14/15**	**93.3**	**VF**
	18	**Increased Absolute omission index - early**	**13/15**	**86.7**	**VF**
	19	**Increased Absolute omission index - middle**	**13/15**	**86.7**	**VF**
	20	**Increased Absolute omission index - late**	**14/15**	**93.3**	**VF**
	21	**Increased Absolute substitution index**	**14/15**	**93.3**	**VF**
	22	**Increased Absolute substitution index - early**	**12/15**	**80.0**	**VF**
	23	**Increased Absolute substitution index - middle**	**11/15**	**73.3**	**F**
	24	**Increased Absolute substitution index - late**	**11/15**	**73.3**	**F**
	25	**Increased Absolute distortion index**	**8/15**	**53.3**	**SF**
	26	**Increased Absolute distortion index - early**	**13/15**	**86.7**	**VF**
	27	**Increased Absolute distortion index - middle**	**8/15**	**53.3**	**SF**
	28	**Increased Absolute distortion index - late**	**7/15**	**46.7**	**SF**
Vowels and Consonants					
	29	**Decreased Intelligibility index**	**14/15**	**93.3**	**VF**
	30	**Decreased Percentage of phonemes correct**	**14/15**	**93.3**	**VF**
	31	**Decreased Percentage of phonemes correct revised**	**14/15**	**93.3**	**VF**

Phrasing					
	32	**Decreased Percent Prosody Phrasing correct**	**1/15**	**6.7**	**I**
Rate					
	33	**Decreased Percent Prosody Rate correct**	**13/15**	**86.7**	**VF**
Stress					
	34	**Decreased Percent Prosody Stress correct**	**8/15**	**53.3**	**SF**
Loudness					
	35	**Decreased Percent Prosody Loudness correct**	**0/15**	**0.0**	**I**
Pitch					
	36	**Decreased Percent Prosody Pitch correct**	**1/15**	**6.7**	**I**
Laryngeal Quality					
	37	**Decreased Percent Voice Quality Laryngeal correct**	**0/15**	**0.0**	**I**
Resonance Quality					
	38	**Decreased Percent Voice Quality Resonance correct**	**6/15**	**40.0**	**SF**

SCI Scores Summary			**SCI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**15**		**Very Frequent (VF): 80.0-100%**	**22**
Mean	**29.3**		**Frequent (F): 60.0-79.9%**	**5**
Standard Deviation	**20.2**		**Somewhat Frequent (SF): 40.0-59.9%**	**6**
Range	**10.5 - 94.7**		**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%

Participants with CAS

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		15	**82.5**	**-4.27**	**13.0**	**1.33**	**54.9**	**-5.00**	**96.6**	**-0.66**
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			7	**46.7**	**3**	**20.0**	**5**	**33.3**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		15	**70.4**	**-3.31**	**8.6**	**1.66**	**53.6**	**-5.00**	**92.2**	**0.75**

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		15	**29.3**		**20.2**		**10.5**		**94.7**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**15**	**13.3**
Rate		**15**	**60.0**
Stress		**15**	**66.7**
Loudness		**15**	**0.0**
Pitch		**15**	**6.7**
Laryngeal Quality		**15**	**33.3**
Resonance Quality		**15**	**46.7**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**15**	**65.1**	**-1.39**	**12.5**	**1.21**	**44.0**	**-3.51**	**88.0**	**0.36**
Encoding		**15**	**44.0**	**-0.80**	**15.5**	**0.87**	**14.3**	**-2.17**	**75.0**	**1.49**
Memory		**15**	**49.0**	**-1.69**	**25.0**	**1.82**	**5.6**	**-5.00**	**94.7**	**0.61**
Transcoding		**15**	**67.4**	**-2.42**	**13.9**	**1.80**	**33.3**	**-5.00**	**88.9**	**-0.06**

MOTOR SPEECH MEASURES AND SUMMARIES:

15 Participants with CAS

Precision-Stability Index (PSI): Group

	PSI 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	3/13	23.1	SI
	2	Reduced Dispersion of Corner Vowels from ^		X	3/13	23.1	SI
	3	Reduced Average Pairwise Distance of Corner Vowels		X	3/13	23.1	SI
	4	Increased Duration of Corner Vowels		X	4/15	26.7	SI
	5	Increased Duration for Middle Vowels and Diphthongs		X	9/15	60.0	F
	6	Reduced % Vowel Phoneme Target Consistency	X		3/7	42.9	SF
	7	Reduced % Vowel Target Consistency	X		3/7	42.9	SF
Consonants							
	8	Reduced % Correct Glides	X		11/15	73.3	F
	9	Increased Relative Distortion Index: Sibilants	X		0/15	0.0	I
	10	Reduced % Dentalized Sibilants of Distorted Sibilants	X		4/15	26.7	SI
	11	Increased Relative Distortion Index for Early Consonants	X		9/15	60.0	F
	12	Decreased 1st Moment on /s/ Initial Singletons		X	2/12	16.7	I
	13	Increased Sqrt 2nd Moment of the /s/ Initial Singletons		X	2/12	16.7	I
	14	Increased Sqrt 2nd Moment of the /s/ initial, and /s/ and /z/ final singletons		X	1/15	6.7	I
	15	Increased All Consonant-Consonant Duration		X	7/13	53.8	SF
Vowels and Consonants							
	16	Increased Diacritic Modificatiion Index (DMI) Class: Place %	X		11/15	73.3	F
	17	Increased DMI Class: Duration %	X		10/15	66.7	F
	18	Increased % of Epenthesis Errors	X		11/15	73.3	F
Phrasing							
	19	Increased PM errors: % of Addition, Breath, Repeat, or Long	X		12/15	80.0	VF
Rate							
	20	Reduced Average Syllable Artic Rate (without pauses)		X	6/15	40.0	SF
	21	Increased Average Syllable ms (without pauses)		X	5/15	33.3	SI
Stress							
	22	Increased % of Prosody Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration. (uncircled & circled)	X		12/15	80.0	VF
	23	Increased % of PV15/16 EE codes of all PV15/16 codes. (uncircled & circled)	X		9/15	60.0	F
Loudness							
	24	Decreased Intensity Difference dB Fricative+Vowel		X	2/13	15.4	I
Pitch							
	25	Decreased F0 for all delimited Vowels & Diphthongs		X	0/15	0.0	I
	26	Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs		X	2/15	13.3	I

Laryngeal Quality							
	27	**Increased % Jitter for Vowels**		**X**	**2/15**	**13.3**	**I**
	28	**Increased % Shimmer for Vowels**		**X**	**1/15**	**6.7**	**I**
	29	**Decreased HNR dB for Vowels**		**X**	**2/15**	**13.3**	**I**
Resonance Quality							
	30	**Increased % Inappropriate Resonance**	**X**		**6/15**	**40.0**	**SF**
	31	**Decreased F1 /ɑ/ (Nasal)**		**X**	**0/15**	**0.0**	**I**
	32	**Decreased F2 for High Vowels (Nasopharyngeal)**		**X**	**3/15**	**20.0**	**SI**

PSI Scores Summary			**PSI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**15**		**Very Frequent (VF): 80.0-100%**	**2**
Mean	**64.8**		**Frequent (F): 60.0-79.9%**	**7**
Standard Deviation	**9.6**		**Somewhat Frequent (SF): 40.0-59.9%**	**5**
Range	**50.0 - 76.7**		**Somewhat Infrequent (SI): 20.0-39.9%**	**7**
			Infrequent (I): 0.0-19.9%	**11**
			Not Used	**0**

[a] A: Acoustic; P: Perceptual

[b] Increased/Decreased reference ≥ 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%

Participants with CAS

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

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**		**10**	**66.7**	**F**	**X(2)**		**X(2)**		
Consonants												
	2	**Number of Nasal Emissions**	**X**		**3**	**20.0**	**SI**					**X(2)**
	3	**Increased Percentage of Weak Consonants**	**X**		**14**	**93.3**	**VF**					X(1)
Vowels and Consonants												
	4	**Increased Diacritic Modification Index Class Duration**	**X**		**8**	**53.3**	**SF**	X(1)		X(1)		
Phrasing												
	5	**Increased Slow/Pause Time**	**X**		**4**	**26.7**	**SI**			X(1)	**X(2)**	
Rate												
	6	**Increased Slow Articulation/Pause Time**	**X**		**12**	**80.0**	**VF**	X(1)	**X(2)**	X(1)		
	7	**Decreased Average syllable speaking rate (with pauses)**		**X**	**5**	**33.3**	**SI**	X(1)	**X(2)**	X(1)		
	8	**Decreased Average syllable articulation rate (without pauses)**		**X**	**5**	**33.3**	**SI**	X(1)	**X(2)**	X(1)		
	9	**Increased Fast Rate**	**X**		**0**	**0.0**	**I**				**X(2)**	
	10	**Decreased Stability of syllable speaking rate**		**X**	**1**	**6.7**	**I**			X(1)	**X(2)**	
Stress												
	11	**Increased Excessive/Equal/Misplaced Stress**	**X**		**8**	**53.3**	**SF**	**X(2)**	X(1)			
	12	**Increased Reduced/Equal Stress**	**X**		**3**	**20.0**	**SI**				**X(2)**	
Loudness												
	13	**Decreased Stability of Speech Intensity Index**		**X**	**2**	**13.3**	**I**	**X(2)**		**X(2)**		
	14	**Increased Stability of Speech Intensity Index**		**X**	**1**	**6.7**	**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**	**6.7**	**I**				**X(2)**	X(1)

Pitch												
	17	**Increased Low Pitch/Glottal Fry**	**X**		**2**	**13.3**	**I**		**X(2)**	X(1)		
	18	**Increased Low Pitch**	**X**		**0**	**0.0**	**I**		**X(2)**	X(1)		
	19	**Decreased F0 for all vowels & diphthongs**		**X**	**0**	**0.0**	**I**		**X(2)**	X(1)		
	20	**Decreased Range of char. F0 among vowels & diphthongs**		**X**	**1**	**6.7**	**I**		X(1)	X(1)	**X(2)**	X(1)
	21	**Decreased Stability of F0 for all vowels & diphthongs**		**X**	**1**	**6.7**	**I**	X(1)				
Laryngeal Quality												
	22	**Increased Breathy**	**X**		**0**	**0.0**	**I**				X(1)	**X(2)**
	23	**Increased Rough**	**X**		**0**	**0.0**	**I**		X(1)	X(1)		
	24	**Increased Strained**	**X**		**1**	**6.7**	**I**		X(1)	X(1)		
	25	**Number of utterances with [TREM] (tremulous) comment**	**X**		**0**	**0.0**	**I**			X(1)		
	26	**Increased Break/Shift/Tremulous**	**X**		**2**	**13.3**	**I**		**X(2)**	X(1)		
	27	**Increased Multiple Features**	**X**		**0**	**0.0**	**I**		**X(2)**	**X(2)**		
	28	**Number of Diplophonia**	**X**		**0**	**0.0**	**I**					**X(2)**
	29	**Increased % jitter for vowels**		**X**	**1**	**6.7**	**I**	X(1)				
	30	**Decreased Stability of jitter for vowels**		**X**	**2**	**13.3**	**I**	X(1)				
	31	**Increased % shimmer for vowels**		**X**	**1**	**6.7**	**I**	X(1)				
	32	**Decreased Stability of shimmer for vowels**		**X**	**1**	**6.7**	**I**	X(1)				
Resonance Quality												
	33	**Increased Nasal**	**X**		**5**	**33.3**	**SI**		X(1)	X(1)	X(1)	**X(2)**
	34	**Decreased F1 for /ɑ/ (Nasal)**		**X**	**0**	**0.0**	**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	**15**
Mean Percentage Score	**81.6**
Standard Deviation	**4.2**
Range	**73.5 - 88.2**

DSI Summary					
	Ataxia	**Spastic**	**Hyper-kinetic**	**Hypo-kinetic**	**Flaccid**
Mean DSI Percentage Score	**66.2**	**80.3**	**78.2**	**90.5**	**85.3**
Mean DSI Percentile Score	**35.7**	**42.1**	**40.7**	**52.9**	**38.9**
Percentage of Participants $\leq 10^{th}$ %ile	**6.7**	**0.0**	**0.0**	**0.0**	**13.3**

Participants with CAS

Pause Marker Summary (PMS): Group

Group: All *n*: 15

Pause Marker (PM)					Supplemental Pause Marker Signs (SPMS)							Pause Marker Index (PMI)[b]			Inappropriate Pauses					
	Before		After			Rate		Stress		Transcoding			n	%	Type I	n	%	Type II	n	%
	n	%	n	%		n	%	n	%	n	%	Mild	7	46.7	Abrupt	15	10.2	Long	15	1.9
PM+	14	93.3	15	100.0	Code 1	1	100.0	1	100.0	1	100.0	Mild-Moderate	3	20.0	Alone	15	1.7	Repeat/Revise	15	1.7
PM-	0	0.0	0	0.0	Code 0	0	0.0	0	0.0	0	0.0	Moderate-Severe	1	6.7	Change	15	1.8	Breath	15	0.4
?[a]	1	6.7	0	0.0								Severe	4	26.7	Grope	15	0.3	Addition	15	0.1

[a] **? = Indeterminate (Shriberg, Strand, Fourakis et al., 2017)**

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

SUMMARY SPEECH AND MOTOR SPEECH CLASSIFICATIONS:

15 Participants with CAS

Participants with CAS

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**	**0**	**1**	**0**		**1**	**6.7**
Speech Errors (SE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
Persistent Speech Errors (PSE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
(SE/PSE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
Speech Delay (SD)		**0**	**0**	**0**	**9**	**0**		**9**	**60.0**
Persistent Speech Delay (PSD)		**0**	**0**	**0**	**5**	**0**		**5**	**33.3**
(SD/PSD)		**0**	**0**	**0**	**14**	**0**		**14**	**93.3**
Totals	**n**	**0**	**0**	**0**	**15**	**0**		**15**	
	%	**0.0**	**0.0**	**0.0**	**100.0**	**0.0**			**100.0**

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

C. Speech and Motor Speech Outputs for 13 Participants with CD & CAS

Speech Measures and Summaries

Percentage Consonants Correct (PCC)

Intelligibility Index (II) and Ordinal Intelligibility Index (OII)
The II and OII findings are in the Competence Measures Summary

Prosody-Voice Screening Profile (PVSP)

Speech Competence Index (SCI)

Syllable Repetition Task (SRT)
The SRT findings are in the Competence Measures Summary

Competence Measures Summary (CMS)

Motor Speech Measures and Summaries

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

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

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

Summary Speech and Motor Speech Classifications

Speech Disorders Classification System Summary (SDCSS)

SPEECH MEASURES AND SUMMARIES:

13 Participants with CD & CAS

PERCENTAGE CONSONANTS CORRECT (PCC)

Participants with CD & CAS

Child_____
Study Identification_____
DOB_____

Age at Sampling Date_____
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	127	2	53	2	100	5	280	289	5.59	96.89
	n	117	0	90	21	485	33	692	746	14.43	92.76
	ŋ	0	0	1	1	25	8	26	35	0.68	74.29
Glides	w	163	34	19	5	0	0	182	221	4.28	82.35
	j	94	11	4	5	0	0	98	114	2.21	85.96
Stops	p	105	6	40	5	31	4	176	191	3.70	92.15
	b	101	5	45	2	7	2	153	162	3.13	94.44
	t	157	6	89	38	248	94	494	632	12.23	78.16
	d	98	4	44	12	88	35	230	281	5.44	81.85
	k	104	16	51	10	98	24	253	303	5.86	83.50
	g	93	22	10	0	5	4	108	134	2.59	80.60
Fricatives and Affricates	f	85	5	16	4	28	6	129	144	2.79	89.58
	v	7	1	37	8	54	9	98	116	2.24	84.48
	θ	18	6	9	11	23	10	50	77	1.49	64.94
	ð	109	65	11	4	0	0	120	189	3.66	63.49
	s	121	60	50	18	95	53	266	397	7.68	67.00
	z	0	0	13	8	100	76	113	197	3.81	57.36
	ʃ	8	8	9	7	5	2	22	39	0.75	56.41
	ʒ	0	0	1	1	1	0	2	3	0.06	66.67
	h	109	12	7	0	0	0	116	128	2.48	90.63
	tʃ	1	7	10	3	13	16	24	50	0.97	48.00
	ʤ	5	15	4	9	0	4	9	37	0.72	24.32
Liquids	l	106	54	58	32	65	66	229	381	7.37	60.10
	r	47	69	28	47	42	70	117	303	5.86	38.61
Percent Correct		81.31		73.42		74.39		3987	5169		
								Correct	Total		

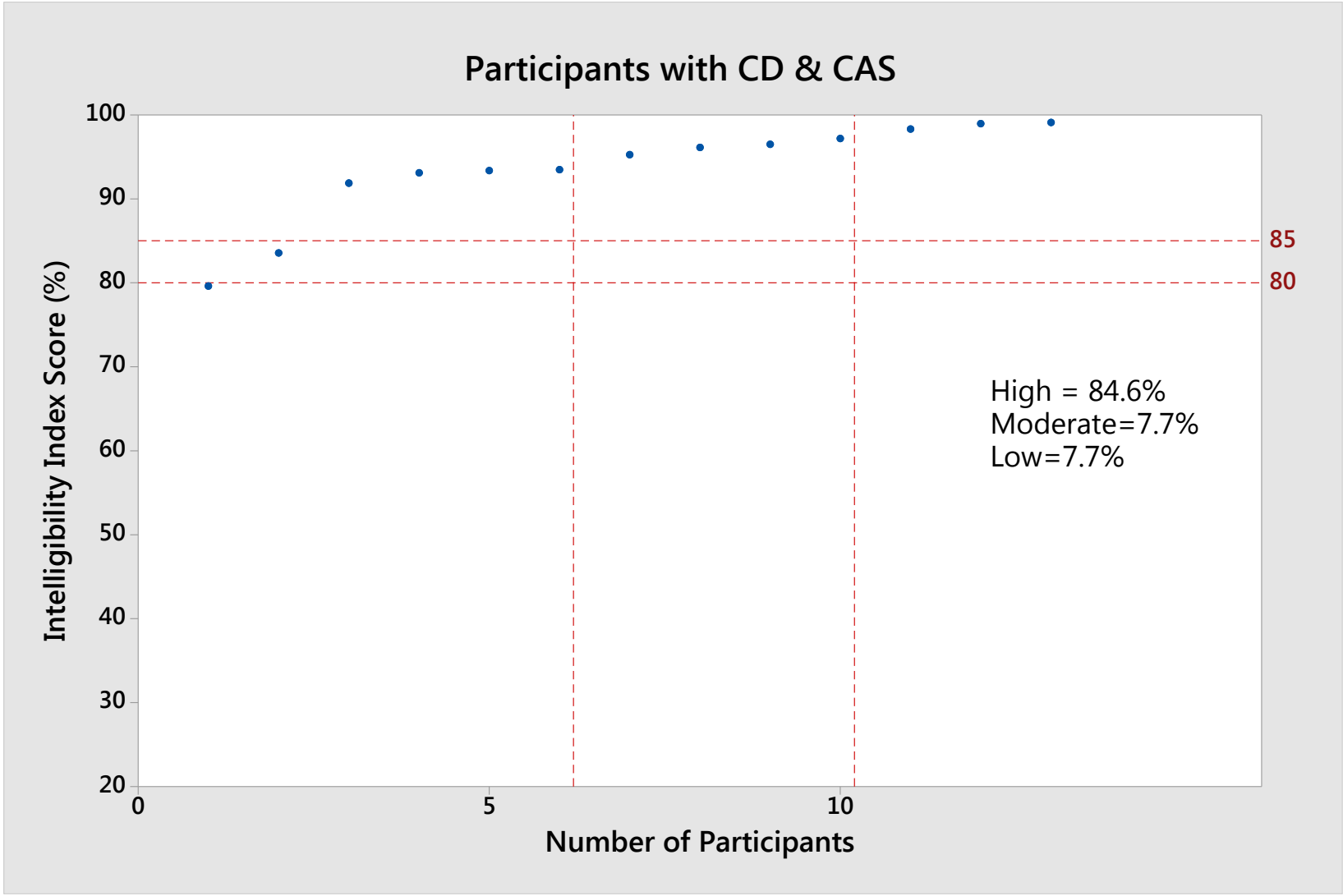
Word Coding Summary	N	%
"Words" entered	3538	100.00
"Words" used	2744	77.56
Disregard	601	16.99
Either/Or	7	0.20
Unsure	79	2.23
Unintelligible	107	3.02
INTELLIGIBILITY INDEX		93.43

77.13

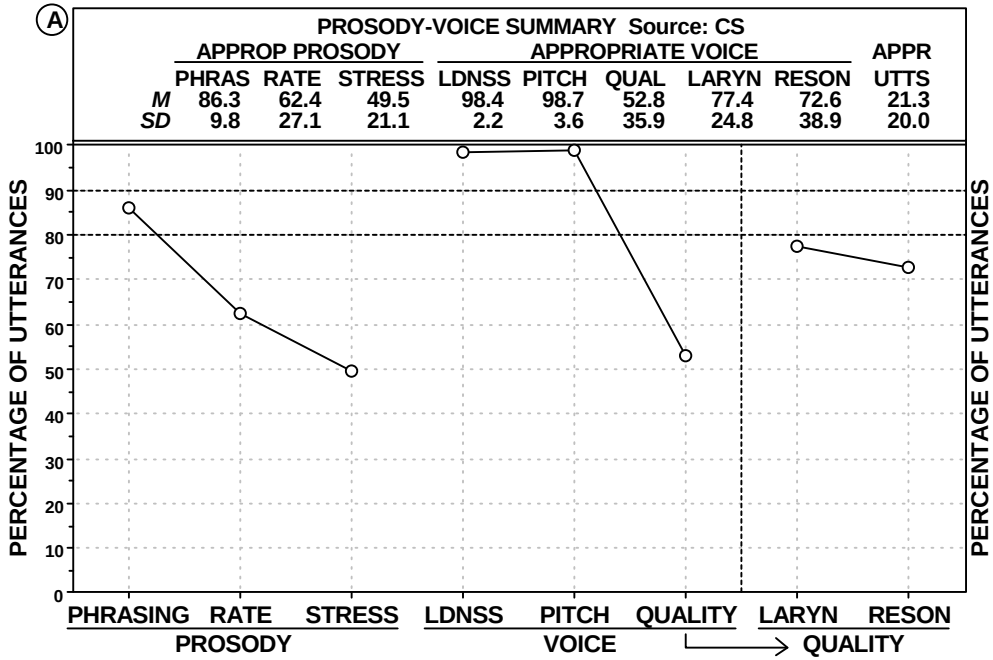
Percentage Consonants Correct (PCC)

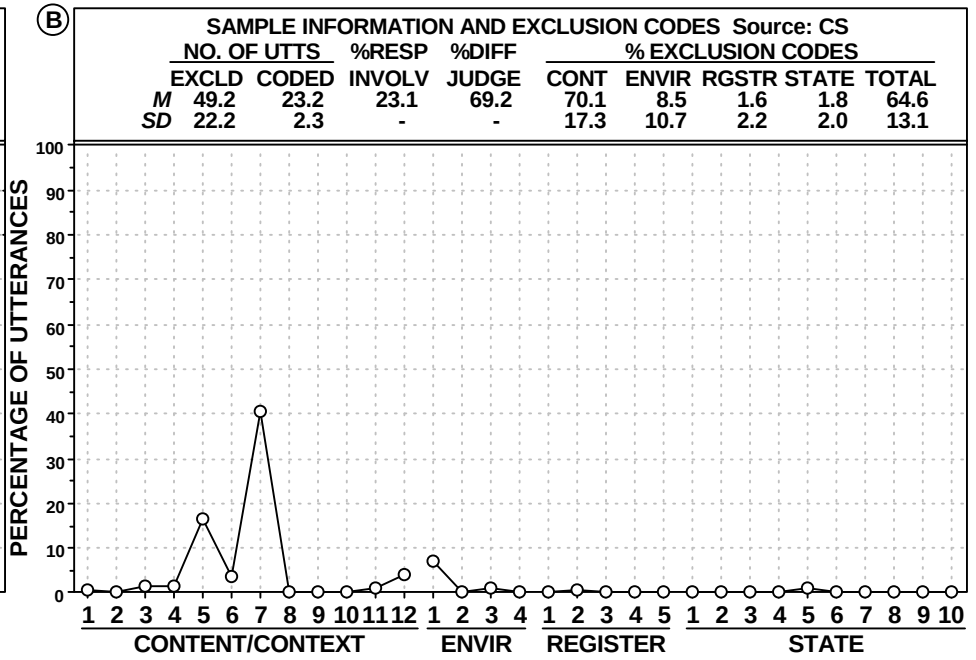
Severity Adjective

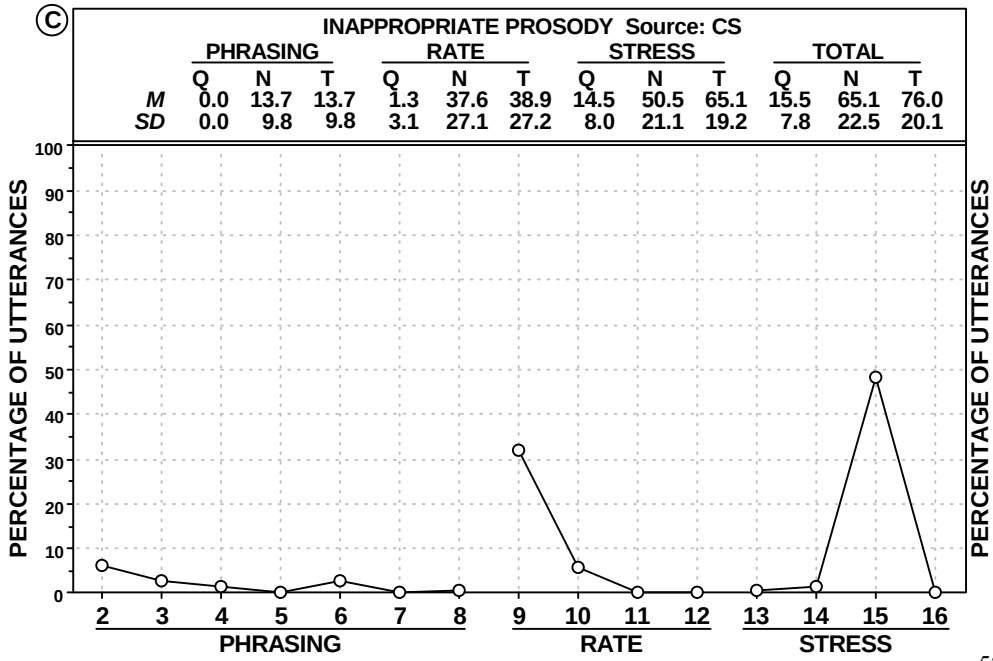
MILD-MODERATE

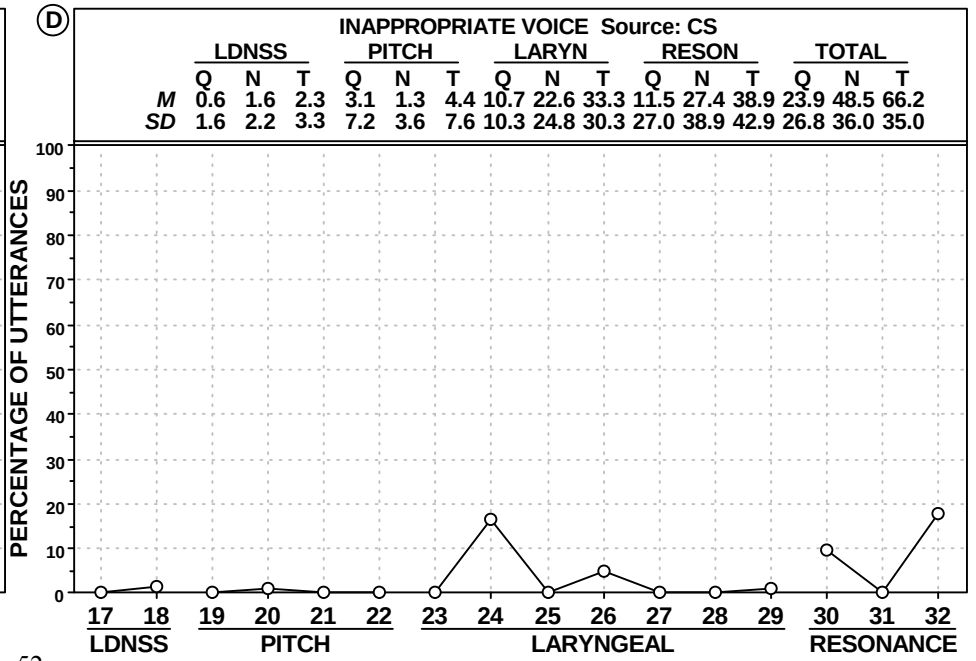

Participants with CD & CAS
Intelligibility Index Score (%)
100
90
80
70
60
50
40
30
20
0
5
10
Number of Participants
85
80
High = 84.6%
Moderate=7.7%
Low=7.7%

Participants with CD & CAS









Speech Competence Index (SCI): Group

	SCI Sign		Participants Positive on Sign		Ordinal Classification[b]
Linguistic Domain	No.	Description	Findings	%[a]	
Vowels					
	1	Decreased Percent vowels correct	13/13	100.0	VF
	2	Decreased Percent vowels correct non-rhotic	13/13	100.0	VF
	3	Decreased Percent vowels correct revised	13/13	100.0	VF
Consonants					
	4	Decreased Percent consonants correct	13/13	100.0	VF
	5	Decreased Percent consonants correct - early	12/13	92.3	VF
	6	Decreased Percent consonants correct - middle	11/13	84.6	VF
	7	Decreased Percent consonants correct - late	12/13	92.3	VF
	8	Decreased Percent consonants correct adjusted	12/13	92.3	VF
	9	Decreased Percent consonants correct revised	12/13	92.3	VF
	10	Decreased Percent consonants correct revised - early	12/13	92.3	VF
	11	Decreased Percent consonants correct revised - middle	11/13	84.6	VF
	12	Decreased Percent consonants correct revised - late	12/13	92.3	VF
	13	Decreased Percent consonants in the inventory	11/13	84.6	VF
	14	Decreased Percent consonants in the inventory - early	1/13	7.7	I
	15	Decreased Percent consonants in the inventory - middle	9/13	69.2	F
	16	Decreased Percent consonants in the inventory - late	8/13	61.5	F
	17	Increased Absolute omission index	12/13	92.3	VF
	18	Increased Absolute omission index - early	12/13	92.3	VF
	19	Increased Absolute omission index - middle	9/13	69.2	F
	20	Increased Absolute omission index - late	11/13	84.6	VF
	21	Increased Absolute substitution index	12/13	92.3	VF
	22	Increased Absolute substitution index - early	8/13	61.5	F
	23	Increased Absolute substitution index - middle	10/13	76.9	F
	24	Increased Absolute substitution index - late	11/13	84.6	VF
	25	Increased Absolute distortion index	9/13	69.2	F
	26	Increased Absolute distortion index - early	11/13	84.6	VF
	27	Increased Absolute distortion index - middle	6/13	46.2	SF
	28	Increased Absolute distortion index - late	8/13	61.5	F
Vowels and Consonants					
	29	Decreased Intelligibility index	11/13	84.6	VF
	30	Decreased Percentage of phonemes correct	13/13	100.0	VF
	31	Decreased Percentage of phonemes correct revised	13/13	100.0	VF

Phrasing					
	32	**Decreased Percent Prosody Phrasing correct**	**4/13**	**30.8**	**SI**
Rate					
	33	**Decreased Percent Prosody Rate correct**	**12/13**	**92.3**	**VF**
Stress					
	34	**Decreased Percent Prosody Stress correct**	**12/13**	**92.3**	**VF**
Loudness					
	35	**Decreased Percent Prosody Loudness correct**	**0/13**	**0.0**	**I**
Pitch					
	36	**Decreased Percent Prosody Pitch correct**	**0/13**	**0.0**	**I**
Laryngeal Quality					
	37	**Decreased Percent Voice Quality Laryngeal correct**	**3/13**	**23.1**	**SI**
Resonance Quality					
	38	**Decreased Percent Voice Quality Resonance correct**	**3/13**	**23.1**	**SI**

SCI Scores Summary			**SCI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**13**		**Very Frequent (VF): 80.0-100%**	**24**
Mean	**26.1**		**Frequent (F): 60.0-79.9%**	**7**
Standard Deviation	**10.3**		**Somewhat Frequent (SF): 40.0-59.9%**	**1**
Range	**13.2 - 52.6**		**Somewhat Infrequent (SI): 20.0-39.9%**	**3**
			Infrequent (I): 0.0-19.9%	**3**
			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%

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		13	**93.6**	**-3.61**	**5.9**	**1.63**	**79.6**	**-5.00**	**99.1**	**-0.86**
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			11	**84.6**	**1**	**7.7**	**1**	**7.7**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		13	**76.3**	**-4.04**	**14.6**	**1.07**	**36.8**	**-5.00**	**94.3**	**-2.28**

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		13	**26.1**		**10.3**		**13.2**		**52.6**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**13**	**23.1**
Rate		**13**	**69.2**
Stress		**13**	**92.3**
Loudness		**13**	**0.0**
Pitch		**13**	**0.0**
Laryngeal Quality		**13**	**46.2**
Resonance Quality		**13**	**30.8**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**13**	**68.2**	**-2.14**	**20.6**	**2.20**	**26.0**	**-5.00**	**100.0**	**0.85**
Encoding		**12**	**46.3**	**-0.78**	**11.3**	**0.40**	**28.6**	**-1.59**	**62.5**	**-0.30**
Memory		**13**	**66.6**	**-1.90**	**26.0**	**2.41**	**18.9**	**-5.00**	**100.0**	**0.84**
Transcoding		**13**	**72.2**	**-2.57**	**22.2**	**2.15**	**22.2**	**-5.00**	**94.4**	**0.38**

MOTOR SPEECH MEASURES AND SUMMARIES:

13 Participants with CD & CAS

Precision-Stability Index (PSI): Group

	PSI 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	1/12	8.3	I
	2	Reduced Dispersion of Corner Vowels from ^		X	2/12	16.7	I
	3	Reduced Average Pairwise Distance of Corner Vowels		X	1/12	8.3	I
	4	Increased Duration of Corner Vowels		X	8/13	61.5	F
	5	Increased Duration for Middle Vowels and Diphthongs		X	12/13	92.3	VF
	6	Reduced % Vowel Phoneme Target Consistency	X		2/4	50.0	SF
	7	Reduced % Vowel Target Consistency	X		0/4	0.0	I
Consonants							
	8	Reduced % Correct Glides	X		11/13	84.6	VF
	9	Increased Relative Distortion Index: Sibilants	X		0/13	0.0	I
	10	Reduced % Dentalized Sibilants of Distorted Sibilants	X		1/13	7.7	I
	11	Increased Relative Distortion Index for Early Consonants	X		9/13	69.2	F
	12	Decreased 1st Moment on /s/ Initial Singletons		X	3/11	27.3	SI
	13	Increased Sqrt 2nd Moment of the /s/ Initial Singletons		X	3/11	27.3	SI
	14	Increased Sqrt 2nd Moment of the /s/ initial, and /s/ and /z/ final singletons		X	1/12	8.3	I
	15	Increased All Consonant-Consonant Duration		X	6/12	50.0	SF
Vowels and Consonants							
	16	Increased Diacritic Modificatiion Index (DMI) Class: Place %	X		12/13	92.3	VF
	17	Increased DMI Class: Duration %	X		10/13	76.9	F
	18	Increased % of Epenthesis Errors	X		10/13	76.9	F
Phrasing							
	19	Increased PM errors: % of Addition, Breath, Repeat, or Long	X		11/13	84.6	VF
Rate							
	20	Reduced Average Syllable Artic Rate (without pauses)		X	11/13	84.6	VF
	21	Increased Average Syllable ms (without pauses)		X	11/13	84.6	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		12/13	92.3	VF
	23	Increased % of PV15/16 EE codes of all PV15/16 codes. (uncircled & circled)	X		10/13	76.9	F
Loudness							
	24	Decreased Intensity Difference dB Fricative+Vowel		X	0/11	0.0	I
Pitch							
	25	Decreased F0 for all delimited Vowels & Diphthongs		X	3/13	23.1	SI
	26	Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs		X	4/13	30.8	SI

Laryngeal Quality							
	27	**Increased % Jitter for Vowels**		**X**	**0/13**	**0.0**	**I**
	28	**Increased % Shimmer for Vowels**		**X**	**1/13**	**7.7**	**I**
	29	**Decreased HNR dB for Vowels**		**X**	**1/13**	**7.7**	**I**
Resonance Quality							
	30	**Increased % Inappropriate Resonance**	**X**		**5/13**	**38.5**	**SI**
	31	**Decreased F1 /ɑ/ (Nasal)**		**X**	**0/13**	**0.0**	**I**
	32	**Decreased F2 for High Vowels (Nasopharyngeal)**		**X**	**4/13**	**30.8**	**SI**

PSI Scores Summary			**PSI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**13**		**Very Frequent (VF): 80.0-100%**	**7**
Mean	**57.1**		**Frequent (F): 60.0-79.9%**	**5**
Standard Deviation	**9.5**		**Somewhat Frequent (SF): 40.0-59.9%**	**2**
Range	**41.7 - 76.7**		**Somewhat Infrequent (SI): 20.0-39.9%**	**6**
			Infrequent (I): 0.0-19.9%	**12**
			Not Used	**0**

[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%

Participants with CD & CAS

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

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**		**12**	**92.3**	**VF**	**X(2)**		**X(2)**		
Consonants												
	2	**Number of Nasal Emissions**	**X**		**5**	**38.5**	**SI**					**X(2)**
	3	**Increased Percentage of Weak Consonants**	**X**		**11**	**84.6**	**VF**					X(1)
Vowels and Consonants												
	4	**Increased Diacritic Modification Index Class Duration**	**X**		**8**	**61.5**	**F**	X(1)		X(1)		
Phrasing												
	5	**Increased Slow/Pause Time**	**X**		**6**	**46.2**	**SF**			X(1)	**X(2)**	
Rate												
	6	**Increased Slow Articulation/Pause Time**	**X**		**11**	**84.6**	**VF**	X(1)	**X(2)**	X(1)		
	7	**Decreased Average syllable speaking rate (with pauses)**		**X**	**11**	**84.6**	**VF**	X(1)	**X(2)**	X(1)		
	8	**Decreased Average syllable articulation rate (without pauses)**		**X**	**11**	**84.6**	**VF**	X(1)	**X(2)**	X(1)		
	9	**Increased Fast Rate**	**X**		**0**	**0.0**	**I**				**X(2)**	
	10	**Decreased Stability of syllable speaking rate**		**X**	**0**	**0.0**	**I**			X(1)	**X(2)**	
Stress												
	11	**Increased Excessive/Equal/Misplaced Stress**	**X**		**12**	**92.3**	**VF**	**X(2)**	X(1)			
	12	**Increased Reduced/Equal Stress**	**X**		**4**	**30.8**	**SI**				**X(2)**	
Loudness												
	13	**Decreased Stability of Speech Intensity Index**		**X**	**2**	**15.4**	**I**	**X(2)**		**X(2)**		
	14	**Increased Stability of Speech Intensity Index**		**X**	**2**	**15.4**	**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**	**2**	**15.4**	**I**				**X(2)**	X(1)

Pitch												
	17	**Increased Low Pitch/Glottal Fry**	**X**		**1**	**7.7**	**I**		**X(2)**	X(1)		
	18	**Increased Low Pitch**	**X**		**1**	**7.7**	**I**		**X(2)**	X(1)		
	19	**Decreased F0 for all vowels & diphthongs**		**X**	**1**	**7.7**	**I**		**X(2)**	X(1)		
	20	**Decreased Range of char. F0 among vowels & diphthongs**		**X**	**3**	**23.1**	**SI**		X(1)	X(1)	**X(2)**	X(1)
	21	**Decreased Stability of F0 for all vowels & diphthongs**		**X**	**1**	**7.7**	**I**	X(1)				
Laryngeal Quality												
	22	**Increased Breathy**	**X**		**0**	**0.0**	**I**				X(1)	**X(2)**
	23	**Increased Rough**	**X**		**3**	**23.1**	**SI**		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**		**4**	**30.8**	**SI**			X(1)		
	26	**Increased Break/Shift/Tremulous**	**X**		**6**	**46.2**	**SF**		**X(2)**	X(1)		
	27	**Increased Multiple Features**	**X**		**2**	**15.4**	**I**		**X(2)**	**X(2)**		
	28	**Number of Diplophonia**	**X**		**0**	**0.0**	**I**					**X(2)**
	29	**Increased % jitter for vowels**		**X**	**0**	**0.0**	**I**	X(1)				
	30	**Decreased Stability of jitter for vowels**		**X**	**1**	**7.7**	**I**	X(1)				
	31	**Increased % shimmer for vowels**		**X**	**0**	**0.0**	**I**	X(1)				
	32	**Decreased Stability of shimmer for vowels**		**X**	**3**	**23.1**	**SI**	X(1)				
Resonance Quality												
	33	**Increased Nasal**	**X**		**5**	**38.5**	**SI**		X(1)	X(1)	X(1)	**X(2)**
	34	**Decreased F1 for /ɑ/ (Nasal)**		**X**	**0**	**0.0**	**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	**13**
Mean Percentage Score	**71.0**
Standard Deviation	**6.1**
Range	**58.8 - 76.5**

DSI Summary					
	Ataxia	**Spastic**	**Hyper-kinetic**	**Hypo-kinetic**	**Flaccid**
Mean DSI Percentage Score	**49.7**	**62.2**	**63.3**	**84.2**	**80.5**
Mean DSI Percentile Score	**15.8**	**17.8**	**17.4**	**37.4**	**35.4**
Percentage of Participants $\leq 10^{th}$ %ile	**53.8**	**38.5**	**30.8**	**23.1**	**38.5**

Participants with CD & CAS

Pause Marker Summary (PMS): Group

Group: All *n*: 13

Pause Marker (PM)					Supplemental Pause Marker Signs (SPMS)							Pause Marker Index (PMI)[b]			Inappropriate Pauses					
	Before		After			Rate		Stress		Transcoding			n	%	Type I	n	%	Type II	n	%
	n	%	n	%		n	%	n	%	n	%	Mild	7	53.8	Abrupt	13	9.2	Long	13	2.1
PM+	11	84.6	13	100.0	Code 1	2	100.0	2	100.0	1	50.0	Mild-Moderate	2	15.4	Alone	13	1.8	Repeat/Revise	13	2.7
PM-	0	0.0	0	0.0	Code 0	0	0.0	0	0.0	1	50.0	Moderate-Severe	3	23.1	Change	13	1.7	Breath	13	1.2
?[a]	2	15.4	0	0.0								Severe	1	7.7	Grope	13	0.9	Addition	13	0.6

[a] ? = Indeterminate (Shriberg, Strand, Fourakis et al., 2017)

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

SUMMARY SPEECH AND MOTOR SPEECH CLASSIFICATIONS:

13 Participants with CD & CAS

Participants with CD & CAS

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**	**0**	**0**	**2**		**2**	**15.4**
Speech Errors (SE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
Persistent Speech Errors (PSE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
(SE/PSE)		**0**	**0**	**0**	**0**	**0**		**0**	**0.0**
Speech Delay (SD)		**0**	**0**	**0**	**0**	**5**		**5**	**38.5**
Persistent Speech Delay (PSD)		**0**	**0**	**0**	**0**	**6**		**6**	**46.2**
(SD/PSD)		**0**	**0**	**0**	**0**	**11**		**11**	**84.6**
Totals	**n**	**0**	**0**	**0**	**0**	**13**		**13**	
	%	**0.0**	**0.0**	**0.0**	**0.0**	**100.0**			**100.0**

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

REFERENCES

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