Reference Data for Children with Idiopathic Speech Delay

With and Without Concurrent Speech Motor Delay

Technical Report No. 26

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PART I

BACKGROUND

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 to develop diagnostic measures and behavioral (speech-prosody-voice) classification markers for two classes of SSD and four types of motor speech disorders. Each of the disorders can occur in *idiopathic* contexts or in the context of *complex neurodevelopmental disorders* (CND). 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, 2019).

Phonology Project Technical Reports

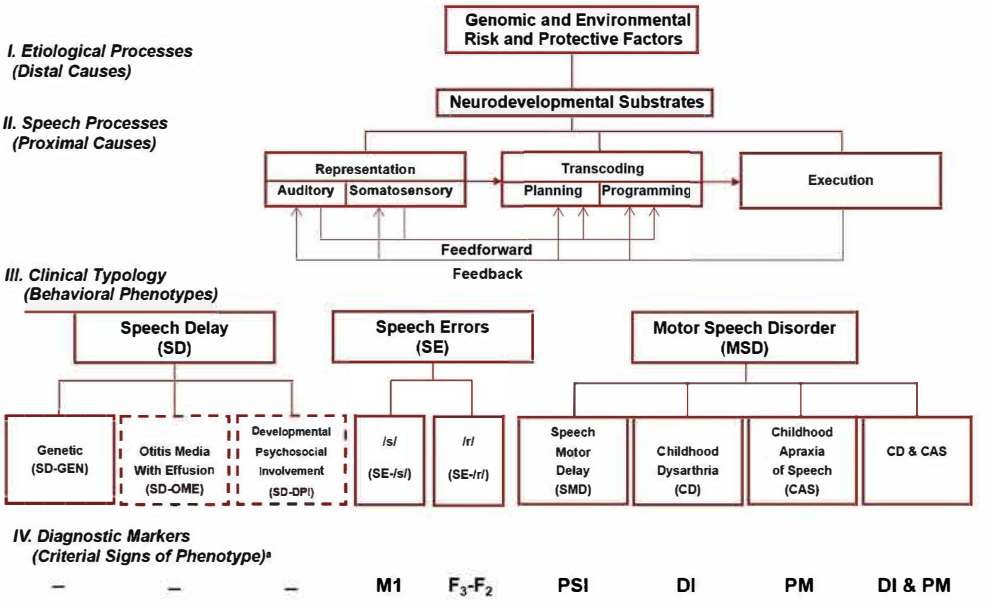
Phonology Project Technical Reports provide technical information, reference data, and additional data on measures and analyses available in the PEPPER software suite that were used in research presentations, publications, and in other Phonology Project technical reports. The present technical report provides speech and motor speech data from the 391children with idiopathic Speech Delay (SD) described in Shriberg, Campbell, Mabie, and McGlothlin (2019). As described in Shriberg, Campbell, et al. (2019), 50 of the participants met SDCS criteria for Speech Motor Delay (SMD) and 341 children met SDCS criteria for No Motor Speech Disorder (No MSD). Shriberg, Campbell, et al. (2019) includes descriptions of the participants, methods, and findings.

This technical report provides comparative reference data for children with SD with and without concurrent SMD. The individual Speech and Motor Speech outputs for Part II are provided first for the SD group with concurrent SMD (labeled as Idiopathic Speech Delay and Speech Motor Delay [SMD]), followed by outputs for the SD group without concurrent SMD (labeled as Idiopathic Speech Delay and No Motor Speech Disorder [No MSD]). The individual Analyses for Part III are similarly provided first for the Idiopathic Speech Delay and SMD group (labeled "S" on the outputs), followed by the data for the Idiopathic Speech Delay and No MSD group (labeled "N" on the outputs). The Profiles in Part IV contain the data for both groups on the individual profiles. As with Part III, the Idiopathic Speech Delay and SMD group is labeled "S" and the Idiopathic Speech Delay and No MSD group is labeled "N" on the profiles.

The data from Parts II-IV could be used to pose and answer a number of questions discussed in Shriberg, Campbell, et al. (2019) and in associated research on childhood motor speech disorders. As is customary in this series of technical reports, the information 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.

The Speech Disorders Classification System (SDCS)

Figure 1 is a graphic description of the finalized version of the SDCS (Shriberg, Kwiatkowski, & Mabie, 2019). 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, Kwiatkowski, and Mabie (2019). The



[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

Figure 1. The Speech Disorders Classification System (SDCS).

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 several types of speech and motor speech disorders that may or may not be concurrent in a given speaker. The first class of SSD, Speech Delay (SD), posits three risk factors for early and possibly persistent SD — genetic findings, early fluctuant conductive hearing loss, and/or psychosocial 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. The dashed borders for the other two risk factors indicate that although research findings in otitis media with effusion (SD-OME in Figure 1) and developmental psychosocial involvement (SD-DPI in Figure 1) since the 1980s report 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 English: 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 Disorder (MSD), includes the four remaining subtypes of SSD proposed in more recent research using the finalized version of the SDCS referenced previously: SMD, Childhood Dysarthria (CD), Childhood Apraxia of Speech (CAS), and concurrent CD & CAS.

Reference Databases, Standardization Criteria, and SDCS Classification Procedures

As described previously, a number of Phonology Project Technical Reports provide

psychometric information and reference data on measures in the SDCS. 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.

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, III, and IV.

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
DI	Dysarthria Index
DSI	Dysarthria Subtypes Indices
II	Intelligibility Index
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:

SPEECH AND MOTOR SPEECH MEASURES AND SUMMARIES

SPEECH MEASURES AND SUMMARIES

PERCENTAGE CONSONANTS CORRECT (PCC)

Child ___Group___SMD_____
Study Identification_____
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	612	16	284	14	445	32	1341	1403	7.35	95.58
	n	625	25	321	54	1327	147	2273	2499	13.09	90.96
	ŋ	0	0	28	7	120	28	148	183	0.96	80.87
Glides	w	710	60	40	7	0	0	750	817	4.28	91.80
	j	466	49	7	7	0	0	473	529	2.77	89.41
Stops	p	256	60	113	15	146	13	515	603	3.16	85.41
	b	548	23	146	18	3	4	697	742	3.89	93.94
	t	377	105	234	115	1162	450	1773	2443	12.79	72.57
	d	452	54	137	46	347	80	936	1116	5.84	83.87
	k	269	123	226	82	322	129	817	1151	6.03	70.98
	g	274	143	51	18	86	41	411	613	3.21	67.05
Fricatives and Affricates	f	188	68	33	11	74	7	295	381	2.00	77.43
	v	4	5	62	12	103	40	169	226	1.18	74.78
	θ	14	37	16	31	23	57	53	178	0.93	29.78
	ð	228	611	22	34	0	1	250	896	4.69	27.90
	s	248	224	123	78	409	221	780	1303	6.82	59.86
	z	3	3	22	19	396	246	421	689	3.61	61.10
	ʃ	47	38	8	13	13	21	68	140	0.73	48.57
	ʒ	0	0	0	0	0	0	0	0	0.00	*
	h	478	130	75	0	0	0	553	683	3.58	80.97
	tʃ	30	33	11	16	30	34	71	154	0.81	46.10
	ʤ	32	60	11	9	4	7	47	123	0.64	38.21
Liquids	l	246	213	100	106	199	203	545	1067	5.59	51.08
	r	128	332	39	131	143	382	310	1155	6.05	26.84
Percent Correct		72.11		71.44		71.41		13696	19094		
								Correct	Total		

Word Coding Summary	N	%
"Words" entered	15029	100.00
"Words" used	10878	72.38
Disregard	2522	16.78
Either/Or	1	0.01
Unsure	273	1.82
Unintelligible	1354	9.01
INTELLIGIBILITY INDEX		86.98

71.73

Percentage Consonants Correct (PCC)

Severity Adjective

MILD-MODERATE

341 Participants with Idiopathic Speech Delay and

No Motor Speech Disorder (No MSD)

PERCENTAGE CONSONANTS CORRECT (PCC)

Child ___Group___NoMSD_____
Study Identification ___ _____
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	3483	60	1657	74	2937	158	8077	8369	6.60	96.51
	n	3539	97	2190	300	10451	822	16180	17399	13.73	92.99
	ŋ	0	0	119	26	841	171	960	1157	0.91	82.97
Glides	w	5143	294	244	23	1	0	5388	5705	4.50	94.44
	j	2822	140	60	10	0	0	2882	3032	2.39	95.05
Stops	p	1890	252	629	69	1017	74	3536	3931	3.10	89.95
	b	3698	161	1011	79	35	10	4744	4994	3.94	94.99
	t	2813	445	1681	452	8330	1906	12824	15627	12.33	82.06
	d	2672	242	860	196	2495	478	6027	6943	5.48	86.81
	k	1717	731	1258	425	2475	582	5450	7188	5.67	75.82
	g	2104	643	415	128	537	178	3056	4005	3.16	76.30
Fricatives and Affricates	f	1388	332	248	87	358	58	1994	2471	1.95	80.70
	v	60	26	368	116	919	217	1347	1706	1.35	78.96
	θ	238	320	90	119	187	348	515	1302	1.03	39.55
	ð	1813	4090	161	295	5	5	1979	6369	5.03	31.07
	s	1557	1358	668	657	2678	1639	4903	8557	6.75	57.30
	z	34	20	125	102	2888	2023	3047	5192	4.10	58.69
	ʃ	277	184	99	98	64	87	440	809	0.64	54.39
	ʒ	0	0	20	7	3	2	23	32	0.03	71.88
	h	4342	341	522	2	4	0	4868	5211	4.11	93.42
	tʃ	225	171	100	100	130	127	455	853	0.67	53.34
	ʤ	311	321	83	41	60	71	454	887	0.70	51.18
Liquids	l	1755	1396	790	511	1477	1199	4022	7128	5.62	56.43
	r	835	2207	421	894	1044	2478	2300	7879	6.22	29.19
Percent Correct		75.54		74.18		75.50		95471	126746		
								Correct	Total		

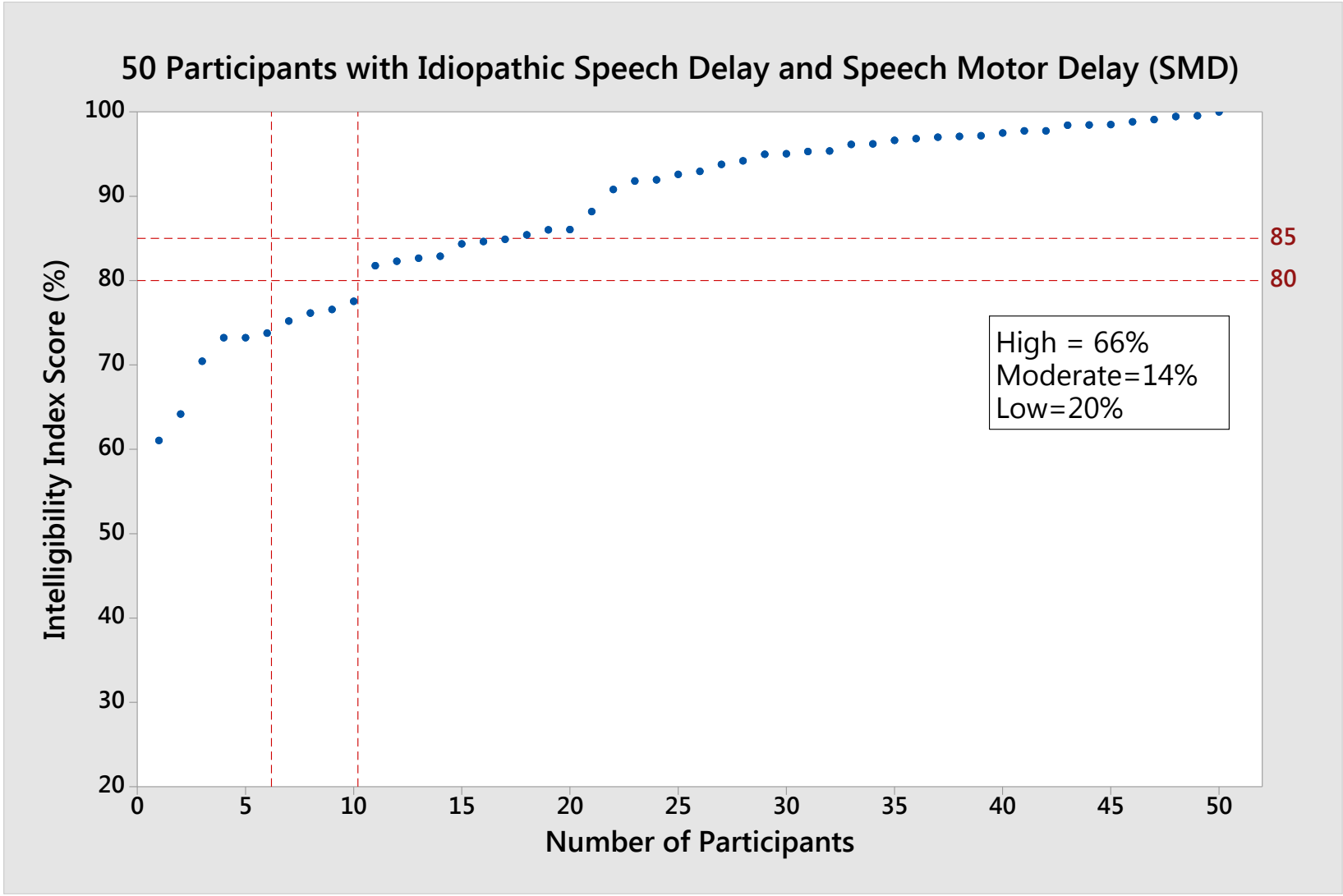
Word Coding Summary	N	%
"Words" entered	94333	100.00
"Words" used	72600	76.96
Disregard	14505	15.38
Either/Or	64	0.07
Unsure	1373	1.46
Unintelligible	5791	6.14
INTELLIGIBILITY INDEX		90.95

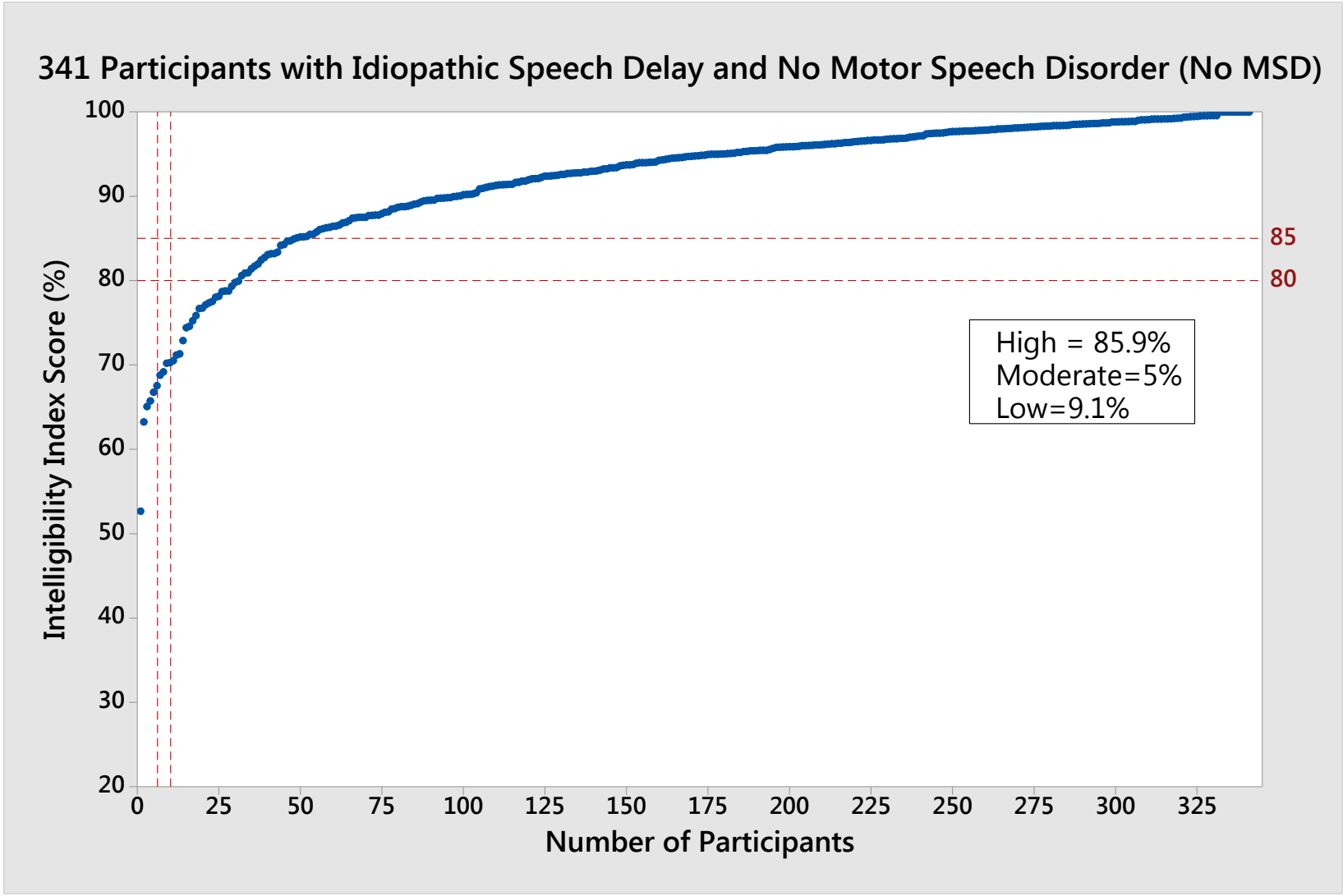
75.32

Percentage Consonants Correct (PCC)

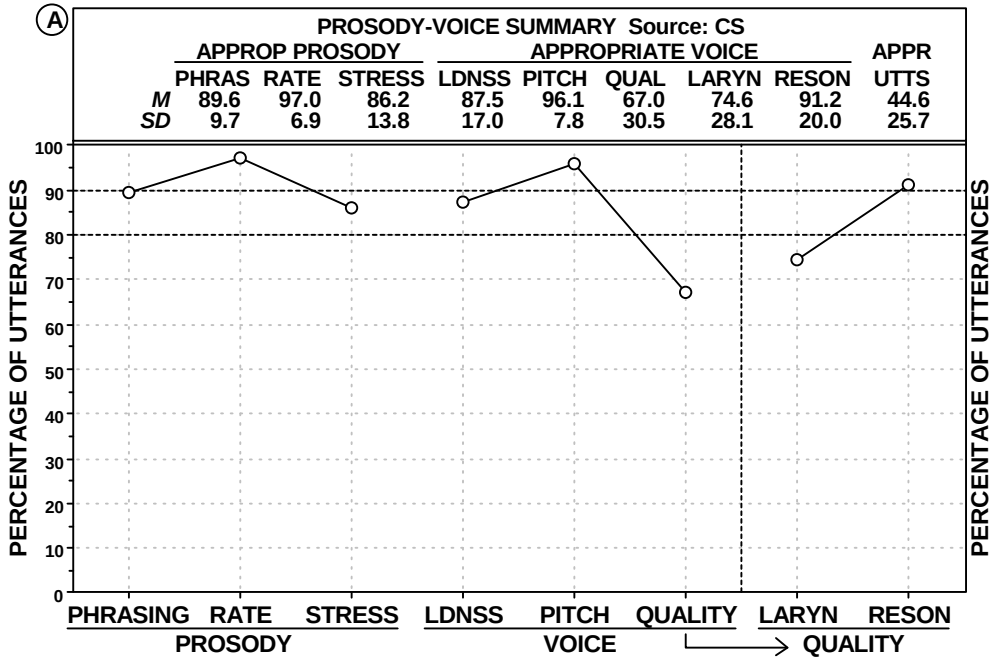
Severity Adjective

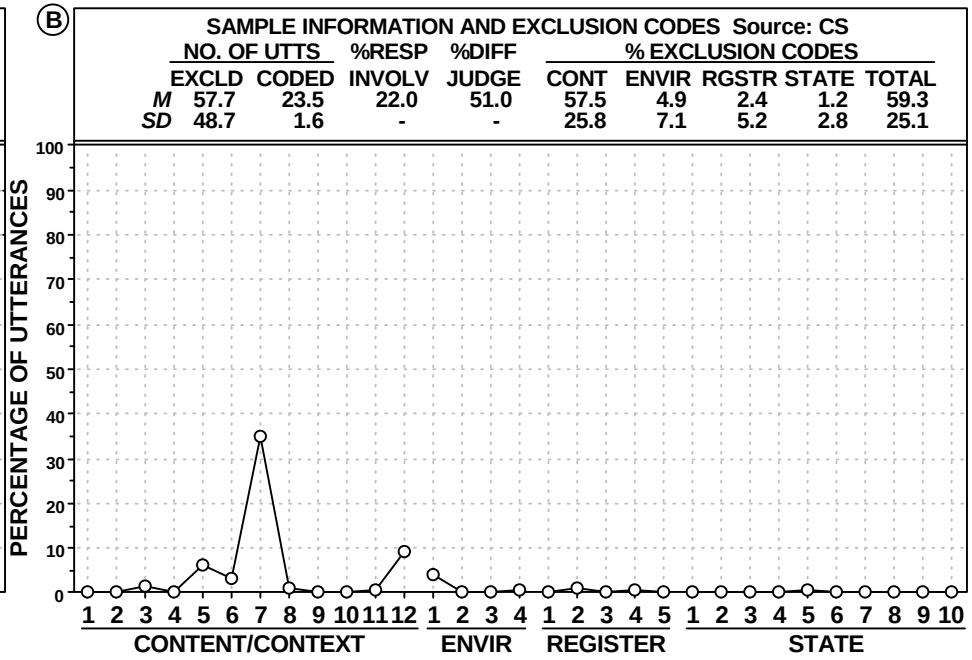
MILD-MODERATE

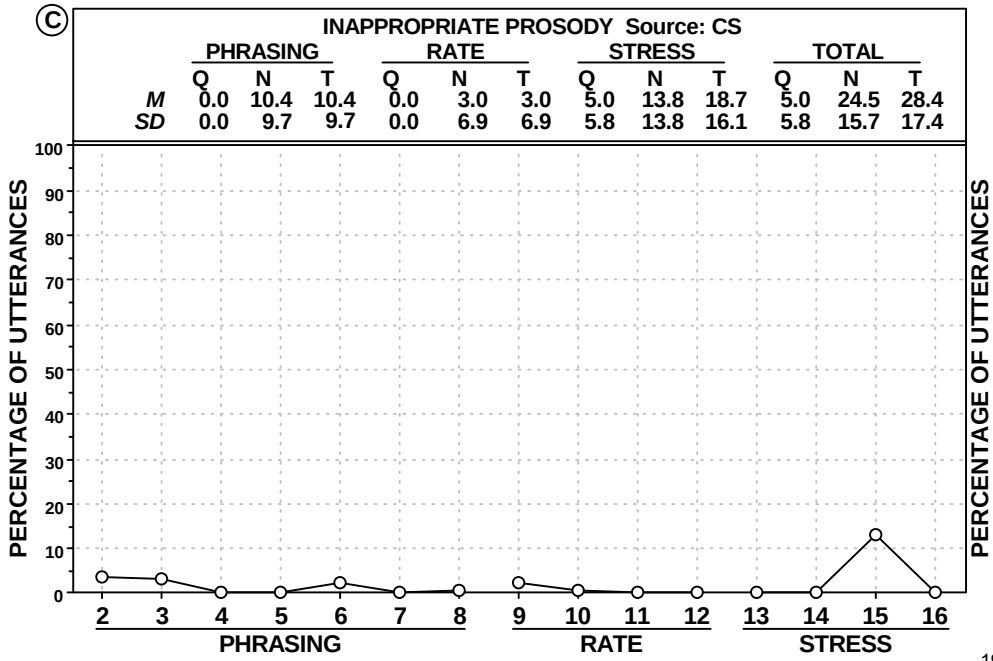

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)
Intelligibility Index Score (%)
100
90
80
70
60
50
40
30
20
0
5
10
15
20
25
30
35
40
45
50
Number of Participants
85
80
High = 66%
Moderate=14%
Low=20%

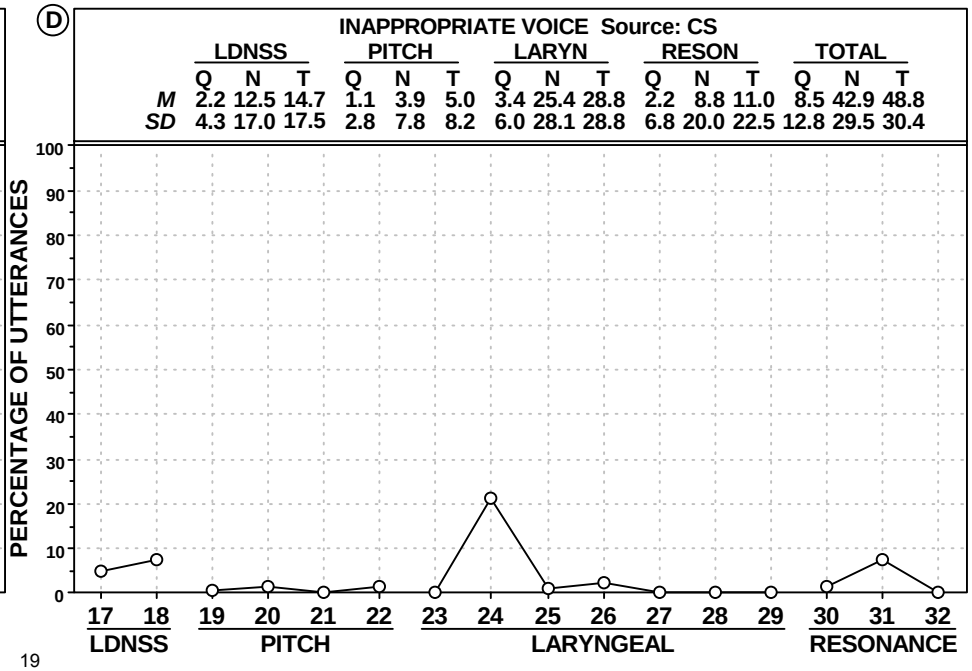

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)
Intelligibility Index Score (%)
100
90
80
70
60
50
40
30
20
85
80
High = 85.9%
Moderate=5%
Low=9.1%
0
25
50
75
100
125
150
175
200
225
250
275
300
325
Number of Participants

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

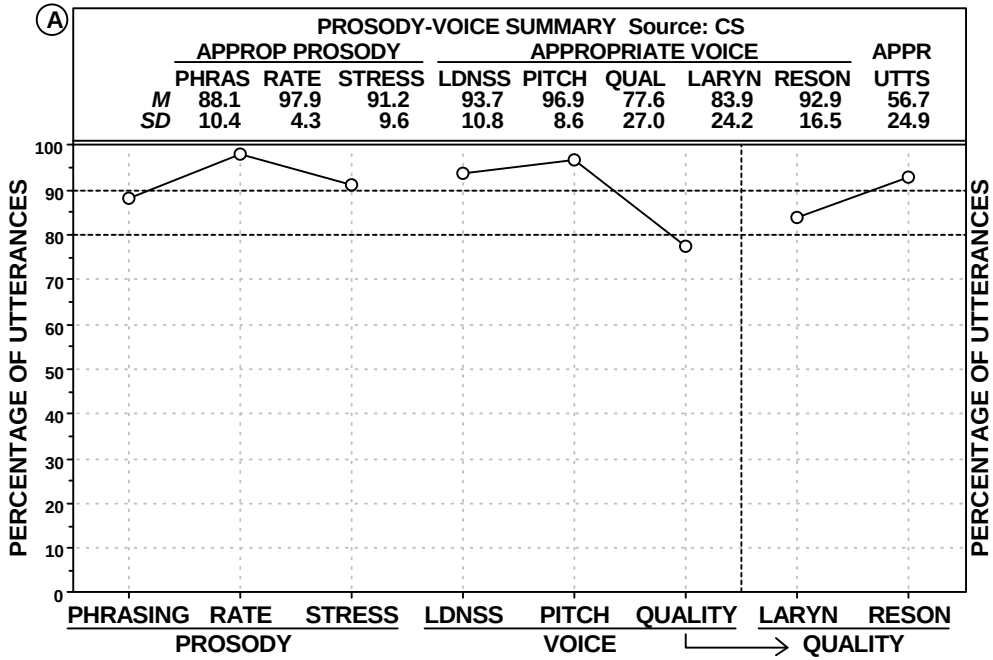


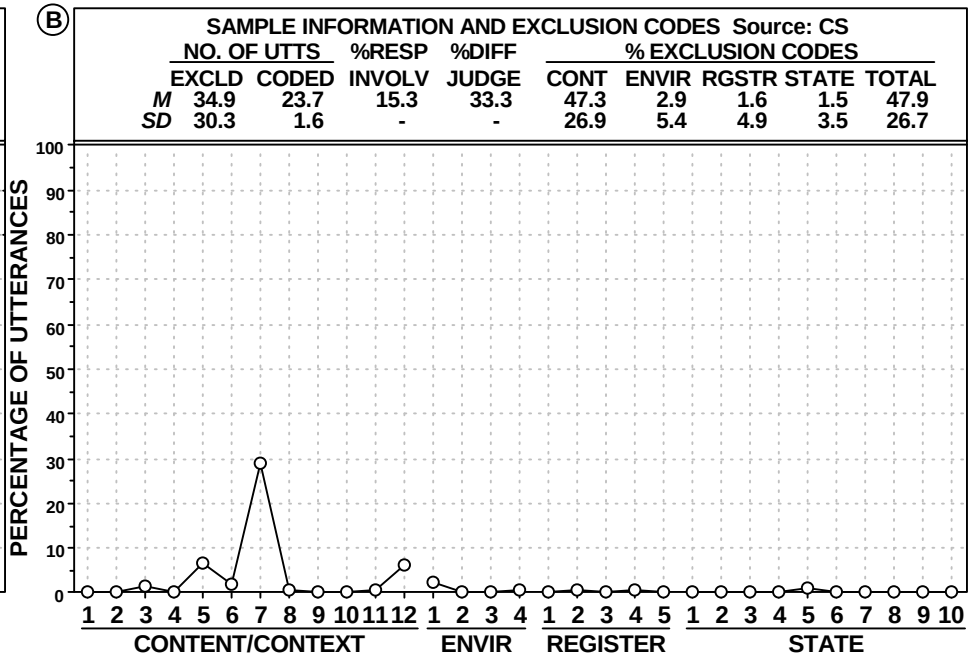


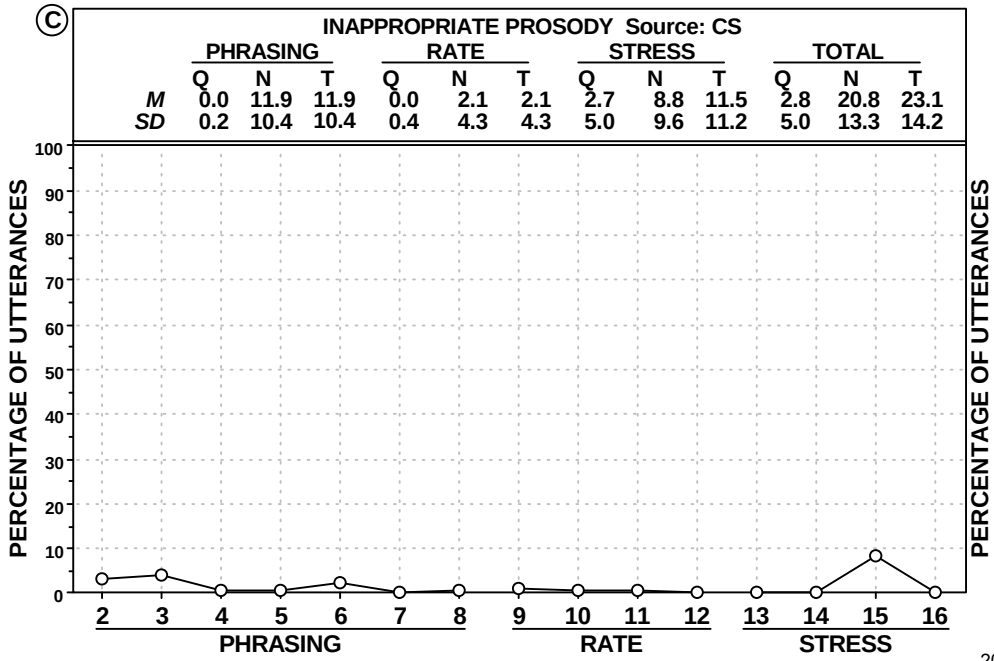


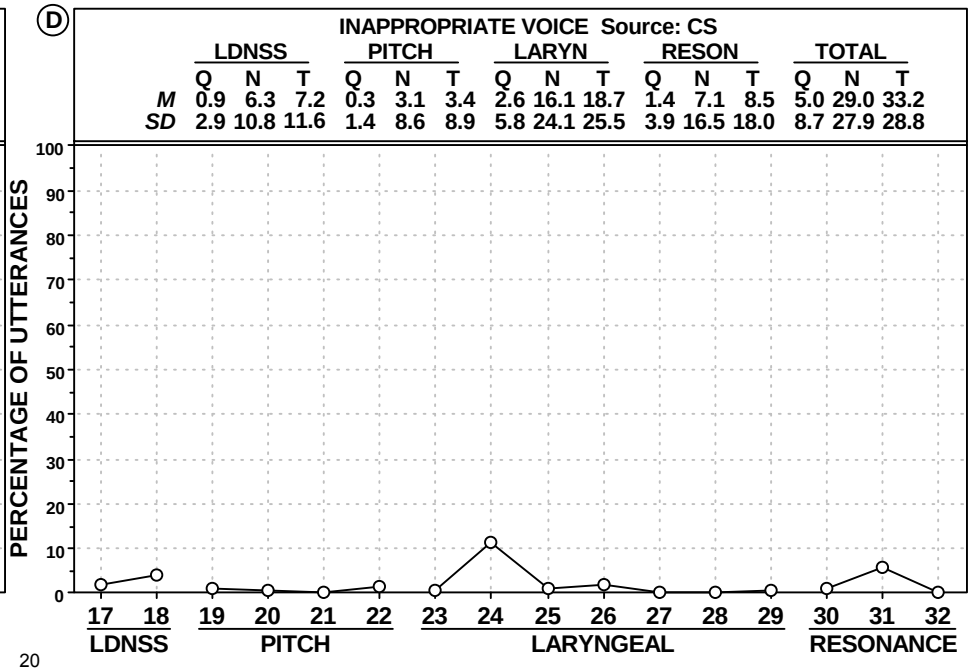


341 Particpants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)









PVSP Profile 1, No Stat. Test, No Trans., NoMSD, Sep 04, 2018, p. 1

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

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	40/50	80.0	VF
	2	Decreased Percent vowels correct non-rhotic	41/50	82.0	VF
	3	Decreased Percent vowels correct revised	41/50	82.0	VF
Consonants					
	4	Decreased Percent consonants correct	45/50	90.0	VF
	5	Decreased Percent consonants correct - early	36/50	72.0	F
	6	Decreased Percent consonants correct - middle	39/50	78.0	F
	7	Decreased Percent consonants correct - late	39/50	78.0	F
	8	Decreased Percent consonants correct adjusted	44/50	88.0	VF
	9	Decreased Percent consonants correct revised	44/50	88.0	VF
	10	Decreased Percent consonants correct revised - early	32/50	64.0	F
	11	Decreased Percent consonants correct revised - middle	39/50	78.0	F
	12	Decreased Percent consonants correct revised - late	44/50	88.0	VF
	13	Decreased Percent consonants in the inventory	38/50	76.0	F
	14	Decreased Percent consonants in the inventory - early	6/50	12.0	I
	15	Decreased Percent consonants in the inventory - middle	35/50	70.0	F
	16	Decreased Percent consonants in the inventory - late	29/50	58.0	SF
	17	Increased Absolute omission index	43/50	86.0	VF
	18	Increased Absolute omission index - early	34/50	68.0	F
	19	Increased Absolute omission index - middle	36/50	72.0	F
	20	Increased Absolute omission index - late	43/50	86.0	VF
	21	Increased Absolute substitution index	43/50	86.0	VF
	22	Increased Absolute substitution index - early	26/50	52.0	SF
	23	Increased Absolute substitution index - middle	34/50	68.0	F
	24	Increased Absolute substitution index - late	39/50	78.0	F
	25	Increased Absolute distortion index	11/50	22.0	SI
	26	Increased Absolute distortion index - early	26/50	52.0	SF
	27	Increased Absolute distortion index - middle	14/50	28.0	SI
	28	Increased Absolute distortion index - late	12/50	24.0	SI
Vowels and Consonants					
	29	Decreased Intelligibility index	36/50	72.0	F
	30	Decreased Percentage of phonemes correct	45/50	90.0	VF
	31	Decreased Percentage of phonemes correct revised	45/50	90.0	VF

Phrasing					
	32	**Decreased Percent Prosody Phrasing correct**	**3/50**	**6.0**	**I**
Rate					
	33	**Decreased Percent Prosody Rate correct**	**9/50**	**18.0**	**I**
Stress					
	34	**Decreased Percent Prosody Stress correct**	**11/50**	**22.0**	**SI**
Loudness					
	35	**Decreased Percent Prosody Loudness correct**	**7/50**	**14.0**	**I**
Pitch					
	36	**Decreased Percent Prosody Pitch correct**	**3/50**	**6.0**	**I**
Laryngeal Quality					
	37	**Decreased Percent Voice Quality Laryngeal correct**	**12/50**	**24.0**	**SI**
Resonance Quality					
	38	**Decreased Percent Voice Quality Resonance correct**	**6/50**	**12.0**	**I**

SCI Scores Summary			**SCI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**50**		**Very Frequent (VF): 80.0-100%**	**12**
Mean	**40.5**		**Frequent (F): 60.0-79.9%**	**12**
Standard Deviation	**18.3**		**Somewhat Frequent (SF): 40.0-59.9%**	**3**
Range	**21.1 - 97.4**		**Somewhat Infrequent (SI): 20.0-39.9%**	**5**
			Infrequent (I): 0.0-19.9%	**6**
			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%

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

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	245/341	71.8	F
	2	Decreased Percent vowels correct non-rhotic	222/341	65.1	F
	3	Decreased Percent vowels correct revised	234/341	68.6	F
Consonants					
	4	Decreased Percent consonants correct	263/341	77.1	F
	5	Decreased Percent consonants correct - early	196/341	57.5	SF
	6	Decreased Percent consonants correct - middle	244/341	71.6	F
	7	Decreased Percent consonants correct - late	220/341	64.5	F
	8	Decreased Percent consonants correct adjusted	292/341	85.6	VF
	9	Decreased Percent consonants correct revised	291/341	85.3	VF
	10	Decreased Percent consonants correct revised - early	175/341	51.3	SF
	11	Decreased Percent consonants correct revised - middle	247/341	72.4	F
	12	Decreased Percent consonants correct revised - late	275/341	80.6	VF
	13	Decreased Percent consonants in the inventory	199/341	58.4	SF
	14	Decreased Percent consonants in the inventory - early	42/341	12.3	I
	15	Decreased Percent consonants in the inventory - middle	183/341	53.7	SF
	16	Decreased Percent consonants in the inventory - late	156/341	45.7	SF
	17	Increased Absolute omission index	279/341	81.8	VF
	18	Increased Absolute omission index - early	174/341	51.0	SF
	19	Increased Absolute omission index - middle	210/341	61.6	F
	20	Increased Absolute omission index - late	266/341	78.0	F
	21	Increased Absolute substitution index	269/341	78.9	F
	22	Increased Absolute substitution index - early	107/341	31.4	SI
	23	Increased Absolute substitution index - middle	211/341	61.9	F
	24	Increased Absolute substitution index - late	248/341	72.7	F
	25	Increased Absolute distortion index	72/341	21.1	SI
	26	Increased Absolute distortion index - early	139/341	40.8	SF
	27	Increased Absolute distortion index - middle	68/341	19.9	I
	28	Increased Absolute distortion index - late	65/341	19.1	I
Vowels and Consonants					
	29	Decreased Intelligibility index	230/341	67.4	F
	30	Decreased Percentage of phonemes correct	279/341	81.8	VF
	31	Decreased Percentage of phonemes correct revised	296/341	86.8	VF

Phrasing					
	32	**Decreased Percent Prosody Phrasing correct**	**29/341**	**8.5**	**I**
Rate					
	33	**Decreased Percent Prosody Rate correct**	**53/341**	**15.5**	**I**
Stress					
	34	**Decreased Percent Prosody Stress correct**	**36/341**	**10.6**	**I**
Loudness					
	35	**Decreased Percent Prosody Loudness correct**	**17/341**	**5.0**	**I**
Pitch					
	36	**Decreased Percent Prosody Pitch correct**	**13/339**	**3.8**	**I**
Laryngeal Quality					
	37	**Decreased Percent Voice Quality Laryngeal correct**	**39/340**	**11.5**	**I**
Resonance Quality					
	38	**Decreased Percent Voice Quality Resonance correct**	**25/341**	**7.3**	**I**

SCI Scores Summary			**SCI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**341**		**Very Frequent (VF): 80.0-100%**	**6**
Mean	**49.0**		**Frequent (F): 60.0-79.9%**	**13**
Standard Deviation	**18.6**		**Somewhat Frequent (SF): 40.0-59.9%**	**7**
Range	**18.4 - 100.0**		**Somewhat Infrequent (SI): 20.0-39.9%**	**2**
			Infrequent (I): 0.0-19.9%	**10**
			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%

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		50	**88.8**	**-3.35**	**10.2**	**2.02**	**61.0**	**-5.00**	**100.0**	**1.08**
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			33	**66.0**	**7**	**14.0**	**10**	**20.0**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		50	71.8	-3.06	14.3	1.42	42.1	-5.00	99.3	0.62

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		%		%		%	
		50	40.5		18.3		21.1		97.4	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		50	18.0
Rate		50	6.0
Stress		50	24.0
Loudness		50	20.0
Pitch		50	8.0
Laryngeal Quality		50	48.0
Resonance Quality		50	14.0

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
Performance		24	69.1	-1.18	15.2	1.39	40.0	-4.77	94.0	0.91
Encoding		25	43.1	-0.71	23.5	0.79	0.0	-2.24	100.0	1.01
Memory		25	66.2	-1.02	28.4	1.91	0.0	-5.00	100.0	1.02
Transcoding		24	80.3	-1.24	17.8	1.71	22.2	-5.00	100.0	1.19

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

Competence Measures Summary (CMS): Group

Measure	Abbreviation	n	Mean		Standard Deviation		Minimum		Maximum	
Intelligibility Index	**II**		**%**	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		341	**92.1**	**-2.65**	**7.8**	**2.10**	**52.7**	**-5.00**	**100.0**	**0.95**
Ordinal Intelligibility Index	**OII**		**High**		**Moderate**		**Low**			
			n	**%**	**n**	**%**	**n**	**%**		
			293	**85.9**	**17**	**5.0**	**31**	**9.1**		

Percentage of Consonants Correct	PCC		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
		341	**74.5**	**-2.51**	**12.2**	**1.51**	**17.5**	**-5.00**	**99.1**	**0.93**

Speech Competence Index	SCI		Mean		Standard Deviation		Minimum		Maximum	
			%		**%**		**%**		**%**	
		341	**49.0**		**18.6**		**18.4**		**100.0**	

Prosody-Voice Screening Profile	PVSP		% of Participants with Inappropriate (<80%) Scores
			%
Phrasing		**341**	**20.2**
Rate		**341**	**0.9**
Stress		**341**	**13.8**
Loudness		**341**	**8.5**
Pitch		**339**	**3.5**
Laryngeal Quality		**340**	**23.2**
Resonance Quality		**341**	**10.3**

Syllable Repetition Task	SRT		Mean		Standard Deviation		Minimum		Maximum	
			%	**Z**	**%**	**Z**	**%**	**Z**	**%**	**Z**
Performance		**174**	**68.3**	**-0.83**	**18.2**	**1.36**	**12.0**	**-5.00**	**100.0**	**1.58**
Encoding		**171**	**50.9**	**-0.25**	**21.1**	**1.10**	**0.0**	**-3.33**	**100.0**	**5.00**
Memory		**177**	**69.0**	**-0.49**	**27.3**	**1.48**	**0.0**	**-5.00**	**100.0**	**1.17**
Transcoding		**174**	**84.5**	**-0.69**	**14.1**	**1.56**	**44.4**	**-5.00**	**100.0**	**1.23**

MOTOR SPEECH MEASURES AND SUMMARIES

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

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	10/36	27.8	SI
	2	Reduced Dispersion of Corner Vowels from ^		X	9/36	25.0	SI
	3	Reduced Average Pairwise Distance of Corner Vowels		X	12/36	33.3	SI
	4	Increased Duration of Corner Vowels		X	13/50	26.0	SI
	5	Increased Duration for Middle Vowels and Diphthongs		X	28/50	56.0	SF
	6	Reduced % Vowel Phoneme Target Consistency	X		13/20	65.0	F
	7	Reduced % Vowel Target Consistency	X		14/21	66.7	F
Consonants							
	8	Reduced % Correct Glides	X		26/50	52.0	SF
	9	Increased Relative Distortion Index: Sibilants	X		0/50	0.0	I
	10	Reduced % Dentalized Sibilants of Distorted Sibilants	X		12/49	24.5	SI
	11	Increased Relative Distortion Index for Early Consonants	X		18/48	37.5	SI
	12	Decreased 1st Moment on /s/ Initial Singletons		X	16/30	53.3	SF
	13	Increased Sqrt 2nd Moment of the /s/ Initial Singletons		X	9/30	30.0	SI
	14	Increased Sqrt 2nd Moment of the /s/ initial, and /s/ and /z/ final singletons		X	5/44	11.4	I
	15	Increased All Consonant-Consonant Duration		X	10/29	34.5	SI
Vowels and Consonants							
	16	Increased Diacritic Modificatiion Index (DMI) Class: Place %	X		16/50	32.0	SI
	17	Increased DMI Class: Duration %	X		27/50	54.0	SF
	18	Increased % of Epenthesis Errors	X		30/50	60.0	F
Phrasing							
	19	Increased PM errors: % of Addition, Breath, Repeat, or Long	X		19/50	38.0	SI
Rate							
	20	Reduced Average Syllable Artic Rate (without pauses)		X	25/50	50.0	SF
	21	Increased Average Syllable ms (without pauses)		X	26/50	52.0	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		25/50	50.0	SF
	23	Increased % of PV15/16 EE codes of all PV15/16 codes. (uncircled & circled)	X		23/44	52.3	SF
Loudness							
	24	Decreased Intensity Difference dB Fricative+Vowel		X	11/38	28.9	SI
Pitch							
	25	Decreased F0 for all delimited Vowels & Diphthongs		X	11/50	22.0	SI
	26	Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs		X	3/50	6.0	I

Laryngeal Quality							
	27	**Increased % Jitter for Vowels**		**X**	**14/50**	**28.0**	**SI**
	28	**Increased % Shimmer for Vowels**		**X**	**23/50**	**46.0**	**SF**
	29	**Decreased HNR dB for Vowels**		**X**	**26/50**	**52.0**	**SF**
Resonance Quality							
	30	**Increased % Inappropriate Resonance**	**X**		**9/50**	**18.0**	**I**
	31	**Decreased F1 /ɑ/ (Nasal)**		**X**	**15/46**	**32.6**	**SI**
	32	**Decreased F2 for High Vowels (Nasopharyngeal)**		**X**	**10/50**	**20.0**	**SI**

PSI Scores Summary			**PSI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**50**		**Very Frequent (VF): 80.0-100%**	**0**
Mean	**63.8**		**Frequent (F): 60.0-79.9%**	**3**
Standard Deviation	**5.2**		**Somewhat Frequent (SF): 40.0-59.9%**	**10**
Range	**46.7 - 69.2**		**Somewhat Infrequent (SI): 20.0-39.9%**	**15**
			Infrequent (I): 0.0-19.9%	**4**
			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%

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

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	36/301	12.0	I
	2	Reduced Dispersion of Corner Vowels from ^		X	25/297	8.4	I
	3	Reduced Average Pairwise Distance of Corner Vowels		X	40/301	13.3	I
	4	Increased Duration of Corner Vowels		X	39/341	11.4	I
	5	Increased Duration for Middle Vowels and Diphthongs		X	78/341	22.9	SI
	6	Reduced % Vowel Phoneme Target Consistency	X		47/143	32.9	SI
	7	Reduced % Vowel Target Consistency	X		53/182	29.1	SI
Consonants							
	8	Reduced % Correct Glides	X		102/341	29.9	SI
	9	Increased Relative Distortion Index: Sibilants	X		0/340	0.0	I
	10	Reduced % Dentalized Sibilants of Distorted Sibilants	X		59/315	18.7	I
	11	Increased Relative Distortion Index for Early Consonants	X		81/321	25.2	SI
	12	Decreased 1st Moment on /s/ Initial Singletons		X	90/202	44.6	SF
	13	Increased Sqrt 2nd Moment of the /s/ Initial Singletons		X	48/202	23.8	SI
	14	Increased Sqrt 2nd Moment of the /s/ initial, and /s/ and /z/ final singletons		X	42/300	14.0	I
	15	Increased All Consonant-Consonant Duration		X	53/246	21.5	SI
Vowels and Consonants							
	16	Increased Diacritic Modificatiion Index (DMI) Class: Place %	X		96/341	28.2	SI
	17	Increased DMI Class: Duration %	X		85/341	24.9	SI
	18	Increased % of Epenthesis Errors	X		104/341	30.5	SI
Phrasing							
	19	Increased PM errors: % of Addition, Breath, Repeat, or Long	X		73/341	21.4	SI
Rate							
	20	Reduced Average Syllable Artic Rate (without pauses)		X	32/341	9.4	I
	21	Increased Average Syllable ms (without pauses)		X	31/341	9.1	I
Stress							
	22	Increased % of Prosody Voice (PV) 15/16 EE (Excessive/Equal Stress) codes of all coded utterances without fast/acceleration. (uncircled & circled)	X		39/341	11.4	I
	23	Increased % of PV15/16 EE codes of all PV15/16 codes. (uncircled & circled)	X		26/252	10.3	I
Loudness							
	24	Decreased Intensity Difference dB Fricative+Vowel		X	31/276	11.2	I
Pitch							
	25	Decreased F0 for all delimited Vowels & Diphthongs		X	15/341	4.4	I
	26	Decreased Range of Characteristic F0 for delimited Vowels/Diphthongs		X	23/341	6.7	I

Laryngeal Quality							
	27	**Increased % Jitter for Vowels**		**X**	**24/340**	**7.1**	**I**
	28	**Increased % Shimmer for Vowels**		**X**	**40/340**	**11.8**	**I**
	29	**Decreased HNR dB for Vowels**		**X**	**67/340**	**19.7**	**I**
Resonance Quality							
	30	**Increased % Inappropriate Resonance**	**X**		**29/341**	**8.5**	**I**
	31	**Decreased F1 /ɑ/ (Nasal)**		**X**	**66/329**	**20.1**	**SI**
	32	**Decreased F2 for High Vowels (Nasopharyngeal)**		**X**	**42/338**	**12.4**	**I**

PSI Scores Summary			**PSI Signs Summary**	
			Number of signs with each ordinal classification	
Count	**341**		**Very Frequent (VF): 80.0-100%**	**0**
Mean	**83.5**		**Frequent (F): 60.0-79.9%**	**0**
Standard Deviation	**7.3**		**Somewhat Frequent (SF): 40.0-59.9%**	**1**
Range	**70.0 - 100.0**		**Somewhat Infrequent (SI): 20.0-39.9%**	**12**
			Infrequent (I): 0.0-19.9%	**19**
			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%

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

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**		**21**	**42.0**	**SF**	**X(2)**		**X(2)**		
Consonants												
	2	**Number of Nasal Emissions**	**X**		**0**	**0.0**	**I**					**X(2)**
	3	**Increased Percentage of Weak Consonants**	**X**		**21**	**42.0**	**SF**					X(1)
Vowels and Consonants												
	4	**Increased Diacritic Modification Index Class Duration**	**X**		**20**	**40.0**	**SF**	X(1)		X(1)		
Phrasing												
	5	**Increased Slow/Pause Time**	**X**		**7**	**14.0**	**I**			X(1)	**X(2)**	
Rate												
	6	**Increased Slow Articulation/Pause Time**	**X**		**12**	**24.0**	**SI**	X(1)	**X(2)**	X(1)		
	7	**Decreased Average syllable speaking rate (with pauses)**		**X**	**12**	**24.0**	**SI**	X(1)	**X(2)**	X(1)		
	8	**Decreased Average syllable articulation rate (without pauses)**		**X**	**17**	**34.0**	**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**	**0**	**0.0**	**I**			X(1)	**X(2)**	
Stress												
	11	**Increased Excessive/Equal/Misplaced Stress**	**X**		**8**	**16.0**	**I**	**X(2)**	X(1)			
	12	**Increased Reduced/Equal Stress**	**X**		**1**	**2.0**	**I**				**X(2)**	
Loudness												
	13	**Decreased Stability of Speech Intensity Index**		**X**	**5**	**10.0**	**I**	**X(2)**		**X(2)**		
	14	**Increased Stability of Speech Intensity Index**		**X**	**13**	**26.0**	**SI**		X(1)		**X(2)**	X(1)
	15	**Increased Soft**	**X**		**6**	**12.0**	**I**				**X(2)**	X(1)
	16	**Decreased Speech Intensity Index**		**X**	**13**	**26.0**	**SI**				**X(2)**	X(1)

Pitch												
	17	**Increased Low Pitch/Glottal Fry**	**X**		**7**	**14.0**	**I**		**X(2)**	X(1)		
	18	**Increased Low Pitch**	**X**		**3**	**6.0**	**I**		**X(2)**	X(1)		
	19	**Decreased F0 for all vowels & diphthongs**		**X**	**8**	**16.0**	**I**		**X(2)**	X(1)		
	20	**Decreased Range of char. F0 among vowels & diphthongs**		**X**	**3**	**6.0**	**I**		X(1)	X(1)	**X(2)**	X(1)
	21	**Decreased Stability of F0 for all vowels & diphthongs**		**X**	**22**	**44.0**	**SF**	X(1)				
Laryngeal Quality												
	22	**Increased Breathy**	**X**		**0**	**0.0**	**I**				X(1)	**X(2)**
	23	**Increased Rough**	**X**		**10**	**20.0**	**SI**		X(1)	X(1)		
	24	**Increased Strained**	**X**		**3**	**6.0**	**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**		**7**	**14.0**	**I**		**X(2)**	X(1)		
	27	**Increased Multiple Features**	**X**		**2**	**4.0**	**I**		**X(2)**	**X(2)**		
	28	**Number of Diplophonia**	**X**		**0**	**0.0**	**I**					**X(2)**
	29	**Increased % jitter for vowels**		**X**	**13**	**26.0**	**SI**	X(1)				
	30	**Decreased Stability of jitter for vowels**		**X**	**5**	**10.0**	**I**	X(1)				
	31	**Increased % shimmer for vowels**		**X**	**17**	**34.0**	**SI**	X(1)				
	32	**Decreased Stability of shimmer for vowels**		**X**	**1**	**2.0**	**I**	X(1)				
Resonance Quality												
	33	**Increased Nasal**	**X**		**5**	**10.0**	**I**		X(1)	X(1)	X(1)	**X(2)**
	34	**Decreased F1 for /ɑ/ (Nasal)**		**X**	**10**	**21.7**	**SI**		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	**50**
Mean Percentage Score	**84.0**
Standard Deviation	**5.3**
Range	**73.5 - 94.1**

DSI Summary					
	Ataxia	**Spastic**	**Hyper-kinetic**	**Hypo-kinetic**	**Flaccid**
Mean DSI Percentage Score	**75.1**	**83.5**	**83.1**	**89.3**	**88.4**
Mean DSI Percentile Score	**50.2**	**47.8**	**51.1**	**48.7**	**46.2**
Percentage of Participants $\leq 10^{th}$ %ile	**2.0**	**0.0**	**0.0**	**2.0**	**8.0**

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

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**		**147**	**43.1**	**SF**	**X(2)**		**X(2)**		
Consonants												
	2	**Number of Nasal Emissions**	**X**		**17**	**5.0**	**I**					**X(2)**
	3	**Increased Percentage of Weak Consonants**	**X**		**158**	**46.3**	**SF**					X(1)
Vowels and Consonants												
	4	**Increased Diacritic Modification Index Class Duration**	**X**		**58**	**17.0**	**I**	X(1)		X(1)		
Phrasing												
	5	**Increased Slow/Pause Time**	**X**		**28**	**8.2**	**I**			X(1)	**X(2)**	
Rate												
	6	**Increased Slow Articulation/Pause Time**	**X**		**35**	**10.3**	**I**	X(1)	**X(2)**	X(1)		
	7	**Decreased Average syllable speaking rate (with pauses)**		**X**	**9**	**2.6**	**I**	X(1)	**X(2)**	X(1)		
	8	**Decreased Average syllable articulation rate (without pauses)**		**X**	**12**	**3.5**	**I**	X(1)	**X(2)**	X(1)		
	9	**Increased Fast Rate**	**X**		**18**	**5.3**	**I**				**X(2)**	
	10	**Decreased Stability of syllable speaking rate**		**X**	**12**	**3.5**	**I**			X(1)	**X(2)**	
Stress												
	11	**Increased Excessive/Equal/Misplaced Stress**	**X**		**22**	**6.5**	**I**	**X(2)**	X(1)			
	12	**Increased Reduced/Equal Stress**	**X**		**14**	**4.1**	**I**				**X(2)**	
Loudness												
	13	**Decreased Stability of Speech Intensity Index**		**X**	**31**	**9.2**	**I**	**X(2)**		**X(2)**		
	14	**Increased Stability of Speech Intensity Index**		**X**	**46**	**13.6**	**I**		X(1)		**X(2)**	X(1)
	15	**Increased Soft**	**X**		**24**	**7.0**	**I**				**X(2)**	X(1)
	16	**Decreased Speech Intensity Index**		**X**	**35**	**10.3**	**I**				**X(2)**	X(1)

Pitch												
	17	**Increased Low Pitch/Glottal Fry**	**X**		**32**	**9.4**	**I**		**X(2)**	X(1)		
	18	**Increased Low Pitch**	**X**		**2**	**0.6**	**I**		**X(2)**	X(1)		
	19	**Decreased F0 for all vowels & diphthongs**		**X**	**11**	**3.2**	**I**		**X(2)**	X(1)		
	20	**Decreased Range of char. F0 among vowels & diphthongs**		**X**	**13**	**3.8**	**I**		X(1)	X(1)	**X(2)**	X(1)
	21	**Decreased Stability of F0 for all vowels & diphthongs**		**X**	**68**	**19.9**	**I**	X(1)				
Laryngeal Quality												
	22	**Increased Breathy**	**X**		**12**	**3.5**	**I**				X(1)	**X(2)**
	23	**Increased Rough**	**X**		**30**	**8.8**	**I**		X(1)	X(1)		
	24	**Increased Strained**	**X**		**19**	**5.6**	**I**		X(1)	X(1)		
	25	**Number of utterances with [TREM] (tremulous) comment**	**X**		**11**	**3.2**	**I**			X(1)		
	26	**Increased Break/Shift/Tremulous**	**X**		**48**	**14.1**	**I**		**X(2)**	X(1)		
	27	**Increased Multiple Features**	**X**		**22**	**6.5**	**I**		**X(2)**	**X(2)**		
	28	**Number of Diplophonia**	**X**		**0**	**0.0**	**I**					**X(2)**
	29	**Increased % jitter for vowels**		**X**	**22**	**6.5**	**I**	X(1)				
	30	**Decreased Stability of jitter for vowels**		**X**	**21**	**6.2**	**I**	X(1)				
	31	**Increased % shimmer for vowels**		**X**	**34**	**10.0**	**I**	X(1)				
	32	**Decreased Stability of shimmer for vowels**		**X**	**20**	**5.9**	**I**	X(1)				
Resonance Quality												
	33	**Increased Nasal**	**X**		**31**	**9.1**	**I**		X(1)	X(1)	X(1)	**X(2)**
	34	**Decreased F1 for /ɑ/ (Nasal)**		**X**	**44**	**13.4**	**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	**341**
Mean Percentage Score	**90.4**
Standard Deviation	**5.3**
Range	**76.5 - 100.0**

DSI Summary					
	Ataxia	**Spastic**	**Hyper-kinetic**	**Hypo-kinetic**	**Flaccid**
Mean DSI Percentage Score	**86.7**	**93.0**	**89.1**	**92.8**	**90.5**
Mean DSI Percentile Score	**69.9**	**68.2**	**65.5**	**61.3**	**53.8**
Percentage of Participants $\leq 10^{th}$ %ile	**0.0**	**0.0**	**0.0**	**4.1**	**7.9**

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

Pause Marker Summary (PMS): Group

Group: All *n*: 50

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	50	100.0	Abrupt	50	0.5	Long	50	0.4
PM+	0	0.0	0	0.0	Code 1	0	0.0	0	0.0	0	0.0	Mild-Moderate	0	0.0	Alone	50	0.1	Repeat/Revise	50	0.3
PM-	48	96.0	50	100.0	Code 0	2	100.0	2	100.0	0	0.0	Moderate-Severe	0	0.0	Change	50	0.1	Breath	50	0.1
?[a]	2	4.0	0	0.0								Severe	0	0.0	Grope	50	0.1	Addition	50	0.0

[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

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

Pause Marker Summary (PMS): Group

Group: All *n*: 341

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	341	100.0	Abrupt	341	0.4	Long	341	0.2
PM+	0	0.0	0	0.0	Code 1	1	16.7	1	16.7	1	16.7	Mild-Moderate	0	0.0	Alone	341	0.1	Repeat/Revise	341	0.2
PM-	335	98.2	341	100.0	Code 0	5	83.3	5	83.3	3	50.0	Moderate-Severe	0	0.0	Change	341	0.1	Breath	341	0.2
?[a]	6	1.8	0	0.0								Severe	0	0.0	Grope	341	0.0	Addition	341	0.0

[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

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

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	8	0	0	0	8	16.0
Speech Errors (SE)		0	0	0	0	0	0	0.0
Persistent Speech Errors (PSE)		0	1	0	0	0	1	2.0
(SE/PSE)		0	1	0	0	0	1	2.0
Speech Delay (SD)		0	40	0	0	0	40	80.0
Persistent Speech Delay (PSD)		0	1	0	0	0	1	2.0
(SD/PSD)		0	41	0	0	0	41	82.0
Totals	n	0	50	0	0	0	50	
	%	0.0	100.0	0.0	0.0	0.0		100.0

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

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

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]		45	0	0	0	0		45	13.2
Speech Errors (SE)		10	0	0	0	0		10	2.9
Persistent Speech Errors (PSE)		2	0	0	0	0		2	0.6
(SE/PSE)		12	0	0	0	0		12	3.5
Speech Delay (SD)		284	0	0	0	0		284	83.3
Persistent Speech Delay (PSD)		0	0	0	0	0		0	0.0
(SD/PSD)		284	0	0	0	0		284	83.3
Totals	n	341	0	0	0	0		341	
	%	100.0	0.0	0.0	0.0	0.0			100.0

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

PART III:

SPEECH ANALYSES

VOWEL/DIPHTHONG ANALYSES

PHONEME ANALYSIS: VOWELS

Filename: Group S
Sampling Date: *
Date of Birth: *
Sampling Clinician: *
Age at Sampling Date: 0 yrs 0 mos
Analysis Date:

Sound	Position In Word	Correct N	Correct %	Deletion N	Deletion %	Substitution N	Substitution %	Distortion N	Distortion %	Total Sounds
i	Initial	55	96.49			1	1.75	1	1.75	57
	Medial	304	96.82			6	1.91	4	1.27	314
	Final	430	95.98			8	1.79	10	2.23	448
	Total	789	96.34			15	1.83	15	1.83	819
I	Initial	561	96.56	4	0.69	12	2.07	4	0.69	581
	Medial	1247	95.12	11	0.84	45	3.43	8	0.61	1311
	Final	307	93.60	8	2.44	12	3.66	1	0.30	328
	Total	2115	95.27	23	1.04	69	3.11	13	0.59	2220
e	Initial	9	100.00							9
	Medial	1	100.00							1
	Final									
	Total	10	100.00							10
ɛ	Initial	130	98.48			1	0.76	1	0.76	132
	Medial	661	93.23	3	0.42	39	5.50	6	0.85	709
	Final	22	95.65					1	4.35	23
	Total	813	94.10	3	0.35	40	4.63	8	0.93	864
æ	Initial	271	92.18			20	6.80	3	1.02	294
	Medial	686	91.47			63	8.40	1	0.13	750
	Final	220	97.78			3	1.33	2	0.89	225
	Total	1177	92.75			86	6.78	6	0.47	1269
ɜ	Initial									
	Medial									
	Final									
	Total									
ɝ	Initial	2	66.67			1	33.33			3
	Medial	28	30.43			27	29.35	37	40.22	92
	Final	31	40.26			13	16.88	33	42.86	77
	Total	61	35.47			41	23.84	70	40.70	172
ə	Initial	459	96.43	4	0.84	7	1.47	6	1.26	476
	Medial	213	85.89	23	9.27	12	4.84			248
	Final	356	97.80	4	1.10	2	0.55	2	0.55	364
	Total	1028	94.49	31	2.85	21	1.93	8	0.74	1088
ɚ	Initial	1	25.00			1	25.00	2	50.00	4
	Medial	27	31.03	7	8.05	35	40.23	18	20.69	87
	Final	81	31.03	6	2.30	140	53.64	34	13.03	261
	Total	109	30.97	13	3.69	176	50.00	54	15.34	352
ʌ	Initial	162	88.04			18	9.78	4	2.17	184
	Medial	798	95.34	5	0.60	33	3.94	1	0.12	837
	Final	59	100.00							59
	Total	1019	94.35	5	0.46	51	4.72	5	0.46	1080
a	Initial									
	Medial									
	Final									
	Total									

Filename Group S Sampling Date *
Date of Birth * Sampling Clinician *
Age at Sampling Date 0 yrs 0 mos Analysis Date

Sound	Position In Word	Correct N	Correct %	Deletion N	Deletion %	Substitution N	Substitution %	Distortion N	Distortion %	Total Sounds
ʉ	Initial	10	100.00							10
	Medial	140	92.11			8	5.26	4	2.63	152
	Final	311	94.53			8	2.43	10	3.04	329
	Total	461	93.89			16	3.26	14	2.85	491
ʊ	Initial	7	100.00							7
	Medial	157	98.13			2	1.25	1	0.63	160
	Final	35	100.00							35
	Total	199	98.51			2	0.99	1	0.50	202
o	Initial									
	Medial	9	90.00			1	10.00			10
	Final	6	100.00							6
	Total	15	93.75			1	6.25			16
ɔ	Initial	99	94.29			4	3.81	2	1.90	105
	Medial	315	88.48			36	10.11	5	1.40	356
	Final	12	92.31					1	7.69	13
	Total	426	89.87			40	8.44	8	1.69	474
ɒ	Initial									
	Medial									
	Final									
	Total									
ɑ	Initial	146	91.82			10	6.29	3	1.89	159
	Medial	488	95.13			24	4.68	1	0.19	513
	Final	10	100.00							10
	Total	644	94.43			34	4.99	4	0.59	682
ɑ͡ɪ	Initial	529	95.66			17	3.07	7	1.27	553
	Medial	484	94.53			25	4.88	3	0.59	512
	Final	281	95.90			9	3.07	3	1.02	293
	Total	1294	95.29			51	3.76	13	0.96	1358
ɑ͡ʊ	Initial	57	93.44			1	1.64	3	4.92	61
	Medial	113	92.62			7	5.74	2	1.64	122
	Final	38	95.00			2	5.00			40
	Total	208	93.27			10	4.48	5	2.24	223
e͡ɪ	Initial	12	92.31			1	7.69			13
	Medial	333	94.33			16	4.53	4	1.13	353
	Final	215	91.49			18	7.66	2	0.85	235
	Total	560	93.18			35	5.82	6	1.00	601
o͡ʊ	Initial	104	96.30			3	2.78	1	0.93	108
	Medial	310	97.18	1	0.31	7	2.19	1	0.31	319
	Final	540	97.12			11	1.98	5	0.90	556
	Total	954	97.05	1	0.10	21	2.14	7	0.71	983
ɔ͡ɪ	Initial									
	Medial	13	92.86			1	7.14			14
	Final	19	90.48			1	4.76	1	4.76	21
	Total	32	91.43			2	5.71	1	2.86	35

Filename Group S Sampling Date *
Date of Birth * Sampling Clinician *
Age at Sampling Date 0 yrs 0 mos Analysis Date

Sound	Position In Word	Correct N	Correct %	Deletion N	Deletion %	Substitution N	Substitution %	Distortion N	Distortion %	Total Sounds
Total Row %	Initial	2614	94.85	8	0.29	97	3.52	37	1.34	2756
	Medial	6327	92.23	50	0.73	387	5.64	96	1.40	6860
	Final	2973	89.47	18	0.54	227	6.83	105	3.16	3323
	Total	11914	92.08	76	0.59	711	5.50	238	1.84	12939
Total Col %	Initial	2614	21.94	8	10.53	97	13.64	37	15.55	2756
	Medial	6327	53.11	50	65.79	387	54.43	96	40.34	6860
	Final	2973	24.95	18	23.68	227	31.93	105	44.12	3323
	Total	11914	100.00	76	100.00	711	100.00	238	100.00	12939
Total Sum %	Initial	2614	20.20	8	0.06	97	0.75	37	0.29	2756
	Medial	6327	48.90	50	0.39	387	2.99	96	0.74	6860
	Final	2973	22.98	18	0.14	227	1.75	105	0.81	3323
	Total	11914	92.08	76	0.59	711	5.50	238	1.84	12939

Notes:

Filename Group N Sampling Date *
Date of Birth * Sampling Clinician *
Age at Sampling Date 0 yrs 0 mos Analysis Date

Sound	Position In Word	Correct N	Correct %	Deletion N	Deletion %	Substitution N	Substitution %	Distortion N	Distortion %	Total Sounds
i	Initial	435	98.42	1	0.23	4	0.90	2	0.45	442
	Medial	2455	98.28	3	0.12	28	1.12	12	0.48	2498
	Final	2970	98.44			27	0.89	20	0.66	3017
	Total	5860	98.37	4	0.07	59	0.99	34	0.57	5957
I	Initial	3792	97.71	12	0.31	56	1.44	21	0.54	3881
	Medial	8783	96.63	38	0.42	231	2.54	37	0.41	9089
	Final	2029	96.85	21	1.00	36	1.72	9	0.43	2095
	Total	14604	96.94	71	0.47	323	2.14	67	0.44	15065
e	Initial	40	100.00							40
	Medial	15	100.00							15
	Final	4	100.00							4
	Total	59	100.00							59
ɛ	Initial	1212	95.73	3	0.24	44	3.48	7	0.55	1266
	Medial	4582	94.87	5	0.10	216	4.47	27	0.56	4830
	Final	96	97.96			2	2.04			98
	Total	5890	95.09	8	0.13	262	4.23	34	0.55	6194
æ	Initial	2241	96.59	1	0.04	73	3.15	5	0.22	2320
	Medial	4018	94.83	3	0.07	204	4.81	12	0.28	4237
	Final	1199	99.01			8	0.66	4	0.33	1211
	Total	7458	96.01	4	0.05	285	3.67	21	0.27	7768
ɜ	Initial									
	Medial	2	100.00							2
	Final					1	100.00			1
	Total	2	66.67			1	33.33			3
ɝ	Initial	9	26.47			7	20.59	18	52.94	34
	Medial	237	34.40	1	0.15	193	28.01	258	37.45	689
	Final	200	39.06			74	14.45	238	46.48	512
	Total	446	36.11	1	0.08	274	22.19	514	41.62	1235
ə	Initial	3395	98.21	25	0.72	28	0.81	9	0.26	3457
	Medial	1754	91.02	117	6.07	56	2.91			1927
	Final	2738	96.89	49	1.73	36	1.27	3	0.11	2826
	Total	7887	96.07	191	2.33	120	1.46	12	0.15	8210
ɚ	Initial	17	56.67			6	20.00	7	23.33	30
	Medial	155	32.77	6	1.27	150	31.71	162	34.25	473
	Final	429	25.10	18	1.05	806	47.16	456	26.68	1709
	Total	601	27.17	24	1.08	962	43.49	625	28.25	2212
ʌ	Initial	1063	95.08	1	0.09	42	3.76	12	1.07	1118
	Medial	5449	97.99	6	0.11	97	1.74	9	0.16	5561
	Final	409	97.85			9	2.15			418
	Total	6921	97.52	7	0.10	148	2.09	21	0.30	7097
ɑ	Initial									
	Medial	4	100.00							4
	Final									
	Total	4	100.00							4

Filename Group N Sampling Date *
Date of Birth * Sampling Clinician *
Age at Sampling Date 0 yrs 0 mos Analysis Date

Sound	Position In Word	Correct N	Correct %	Deletion N	Deletion %	Substitution N	Substitution %	Distortion N	Distortion %	Total Sounds
ʉ	Initial	22	95.65			1	4.35			23
	Medial	881	94.02			53	5.66	3	0.32	937
	Final	2226	96.78			57	2.48	17	0.74	2300
	Total	3129	95.98			111	3.40	20	0.61	3260
ʊ	Initial	17	94.44			1	5.56			18
	Medial	1141	93.22	2	0.16	70	5.72	11	0.90	1224
	Final	133	100.00							133
	Total	1291	93.89	2	0.15	71	5.16	11	0.80	1375
o	Initial	19	100.00							19
	Medial	57	98.28			1	1.72			58
	Final	26	96.30			1	3.70			27
	Total	102	98.08			2	1.92			104
ɔ	Initial	701	94.22			39	5.24	4	0.54	744
	Medial	2198	93.41	3	0.13	136	5.78	16	0.68	2353
	Final	76	95.00			3	3.75	1	1.25	80
	Total	2975	93.64	3	0.09	178	5.60	21	0.66	3177
ɒ	Initial									
	Medial									
	Final									
	Total									
ɑ	Initial	1033	97.82	1	0.09	14	1.33	8	0.76	1056
	Medial	3097	96.93	6	0.19	84	2.63	8	0.25	3195
	Final	121	98.37			1	0.81	1	0.81	123
	Total	4251	97.19	7	0.16	99	2.26	17	0.39	4374
a͡ɪ	Initial	3544	95.65			125	3.37	36	0.97	3705
	Medial	3127	96.16	1	0.03	116	3.57	8	0.25	3252
	Final	1545	96.20			56	3.49	5	0.31	1606
	Total	8216	95.95	1	0.01	297	3.47	49	0.57	8563
a͡ʊ	Initial	287	91.69			24	7.67	2	0.64	313
	Medial	770	95.42			36	4.46	1	0.12	807
	Final	381	92.70			27	6.57	3	0.73	411
	Total	1438	93.93			87	5.68	6	0.39	1531
e͡ɪ	Initial	106	97.25			2	1.83	1	0.92	109
	Medial	2100	95.45	1	0.05	92	4.18	7	0.32	2200
	Final	1373	94.95			64	4.43	9	0.62	1446
	Total	3579	95.31	1	0.03	158	4.21	17	0.45	3755
o͡ʊ	Initial	737	97.62	2	0.26	13	1.72	3	0.40	755
	Medial	1771	97.36	2	0.11	41	2.25	5	0.27	1819
	Final	2720	97.74	4	0.14	50	1.80	9	0.32	2783
	Total	5228	97.59	8	0.15	104	1.94	17	0.32	5357
ɔ͡ɪ	Initial	6	100.00							6
	Medial	120	97.56			3	2.44			123
	Final	100	93.46			7	6.54			107
	Total	226	95.76			10	4.24			236

Filename Group N Sampling Date *
Date of Birth * Sampling Clinician *
Age at Sampling Date 0 yrs 0 mos Analysis Date

Sound	Position In Word	Correct N	Correct %	Deletion N	Deletion %	Substitution N	Substitution %	Distortion N	Distortion %	Total Sounds
Total Row %	Initial	18676	96.59	46	0.24	479	2.48	135	0.70	19336
	Medial	42716	94.31	194	0.43	1807	3.99	576	1.27	45293
	Final	18775	89.80	92	0.44	1265	6.05	775	3.71	20907
	Total	80167	93.72	332	0.39	3551	4.15	1486	1.74	85536
Total Col %	Initial	18676	23.30	46	13.86	479	13.49	135	9.08	19336
	Medial	42716	53.28	194	58.43	1807	50.89	576	38.76	45293
	Final	18775	23.42	92	27.71	1265	35.62	775	52.15	20907
	Total	80167	100.00	332	100.00	3551	100.00	1486	100.00	85536
Total Sum %	Initial	18676	21.83	46	0.05	479	0.56	135	0.16	19336
	Medial	42716	49.94	194	0.23	1807	2.11	576	0.67	45293
	Final	18775	21.95	92	0.11	1265	1.48	775	0.91	20907
	Total	80167	93.72	332	0.39	3551	4.15	1486	1.74	85536

Notes:

CONSONANT ANALYSES

PERCENTAGE CONSONANTS CORRECT (PCC)

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	612	16	284	14	445	32	1341	1403	7.35	95.58
	n	625	25	321	54	1327	147	2273	2499	13.09	90.96
	ŋ	0	0	28	7	120	28	148	183	0.96	80.87
Glides	w	710	60	40	7	0	0	750	817	4.28	91.80
	j	466	49	7	7	0	0	473	529	2.77	89.41
Stops	p	256	60	113	15	146	13	515	603	3.16	85.41
	b	548	23	146	18	3	4	697	742	3.89	93.94
	t	377	105	234	115	1162	450	1773	2443	12.79	72.57
	d	452	54	137	46	347	80	936	1116	5.84	83.87
	k	269	123	226	82	322	129	817	1151	6.03	70.98
	g	274	143	51	18	86	41	411	613	3.21	67.05
Fricatives and Affricates	f	188	68	33	11	74	7	295	381	2.00	77.43
	v	4	5	62	12	103	40	169	226	1.18	74.78
	θ	14	37	16	31	23	57	53	178	0.93	29.78
	ð	228	611	22	34	0	1	250	896	4.69	27.90
	s	248	224	123	78	409	221	780	1303	6.82	59.86
	z	3	3	22	19	396	246	421	689	3.61	61.10
	ʃ	47	38	8	13	13	21	68	140	0.73	48.57
	ʒ	0	0	0	0	0	0	0	0	0.00	*
	h	478	130	75	0	0	0	553	683	3.58	80.97
	tʃ	30	33	11	16	30	34	71	154	0.81	46.10
	ʤ	32	60	11	9	4	7	47	123	0.64	38.21
Liquids	l	246	213	100	106	199	203	545	1067	5.59	51.08
	r	128	332	39	131	143	382	310	1155	6.05	26.84
Percent Correct		72.11		71.44		71.41		13696	19094		
								Correct	Total		

Word Coding Summary	N	%
"Words" entered	15029	100.00
"Words" used	10878	72.38
Disregard	2522	16.78
Either/Or	1	0.01
Unsure	273	1.82
Unintelligible	1354	9.01
INTELLIGIBILITY INDEX		86.98

71.73

Percentage Consonants Correct (PCC)

Severity Adjective

MILD-MODERATE

341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

PERCENTAGE CONSONANTS CORRECT (PCC)

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	3483	60	1657	74	2937	158	8077	8369	6.60	96.51
	n	3539	97	2190	300	10451	822	16180	17399	13.73	92.99
	ŋ	0	0	119	26	841	171	960	1157	0.91	82.97
Glides	w	5143	294	244	23	1	0	5388	5705	4.50	94.44
	j	2822	140	60	10	0	0	2882	3032	2.39	95.05
Stops	p	1890	252	629	69	1017	74	3536	3931	3.10	89.95
	b	3698	161	1011	79	35	10	4744	4994	3.94	94.99
	t	2813	445	1681	452	8330	1906	12824	15627	12.33	82.06
	d	2672	242	860	196	2495	478	6027	6943	5.48	86.81
	k	1717	731	1258	425	2475	582	5450	7188	5.67	75.82
	g	2104	643	415	128	537	178	3056	4005	3.16	76.30
Fricatives and Affricates	f	1388	332	248	87	358	58	1994	2471	1.95	80.70
	v	60	26	368	116	919	217	1347	1706	1.35	78.96
	θ	238	320	90	119	187	348	515	1302	1.03	39.55
	ð	1813	4090	161	295	5	5	1979	6369	5.03	31.07
	s	1557	1358	668	657	2678	1639	4903	8557	6.75	57.30
	z	34	20	125	102	2888	2023	3047	5192	4.10	58.69
	ʃ	277	184	99	98	64	87	440	809	0.64	54.39
	ʒ	0	0	20	7	3	2	23	32	0.03	71.88
	h	4342	341	522	2	4	0	4868	5211	4.11	93.42
	tʃ	225	171	100	100	130	127	455	853	0.67	53.34
	ʤ	311	321	83	41	60	71	454	887	0.70	51.18
Liquids	l	1755	1396	790	511	1477	1199	4022	7128	5.62	56.43
	r	835	2207	421	894	1044	2478	2300	7879	6.22	29.19
Percent Correct		75.54		74.18		75.50		95471	126746		
								Correct	Total		

Word Coding Summary	N	%
"Words" entered	94333	100.00
"Words" used	72600	76.96
Disregard	14505	15.38
Either/Or	64	0.07
Unsure	1373	1.46
Unintelligible	5791	6.14
INTELLIGIBILITY INDEX		90.95

75.32

Percentage Consonants Correct (PCC)

Severity Adjective

MILD-MODERATE

50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)

PERCENTAGE CONSONANTS CORRECT - SPLIT (PCCS)

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 Class	Consonant Sound	Initial				Medial				Final			
		Single		Cluster		Single		Cluster		Single		Cluster	
		+	-	+	-	+	-	+	-	+	-	+	-
Nasals	m	607	15	5	1	135	5	149	9	373	29	72	3
	n	606	19	19	6	199	38	122	16	1072	110	255	37
	ŋ	0	0	0	0	3	0	25	7	90	19	30	9
Glides	w	687	57	23	3	22	3	18	4	0	0	0	0
	j	464	48	2	1	0	0	7	7	0	0	0	0
Stops	p	157	35	99	25	79	12	34	3	96	11	50	2
	b	478	16	70	7	101	8	45	10	1	4	2	0
	t	285	55	92	50	115	60	119	55	847	370	315	80
	d	430	45	22	9	77	23	60	23	211	53	136	27
	k	231	86	38	37	139	33	87	49	239	93	83	36
	g	250	127	24	16	38	15	13	3	78	34	8	7
Fricatives and Affricates	f	137	61	51	7	17	10	16	1	68	5	6	2
	v	4	5	0	0	47	11	15	1	98	39	5	1
	θ	10	15	4	22	10	11	6	20	22	57	1	0
	ð	228	611	0	0	21	33	1	1	0	0	0	1
	s	162	103	86	121	43	22	80	56	170	135	239	86
	z	3	3	0	0	19	14	3	5	259	184	137	62
	ʃ	45	38	2	0	4	4	4	9	10	20	3	1
	ʒ	0	0	0	0	0	0	0	0	0	0	0	0
	h	477	130	1	0	11	0	64	0	0	0	0	0
	tʃ	30	33	0	0	6	13	5	3	22	31	8	3
	ʤ	32	60	0	0	3	0	8	9	2	2	2	5
Liquids	l	171	123	75	90	59	45	41	61	154	150	45	53
	r	35	115	93	217	12	46	27	85	107	316	36	66
Percent Correct		75.44		53.57		74.07		68.47		70.22		74.87	

Consonant Class	Consonant Sound	Number of Consonants Correct		Total Number of Consonants		Percentage Consonants Correct	
		Single	Cluster	Single	Cluster	Single	Cluster
Nasals	m	1115	226	1164	239	95.79	94.56
	n	1877	396	2044	455	91.83	87.03
	ŋ	93	55	112	71	83.04	77.46
Glides	w	709	41	769	48	92.20	85.42
	j	464	9	512	17	90.63	52.94
Stops	p	332	183	390	213	85.13	85.92
	b	580	117	608	134	95.39	87.31
	t	1247	526	1732	711	72.00	73.98
	d	718	218	839	277	85.58	78.70
	k	609	208	821	330	74.18	63.03
	g	366	45	542	71	67.53	63.38
Fricatives and Affricates	f	222	73	298	83	74.50	87.95
	v	149	20	204	22	73.04	90.91
	θ	42	11	125	53	33.60	20.75
	ð	249	1	893	3	27.88	33.33
	s	375	405	635	668	59.06	60.63
	z	281	140	482	207	58.30	67.63
	ʃ	59	9	121	19	48.76	47.37
	ʒ	0	0	0	0	*	*
	h	488	65	618	65	78.96	100.00
	tʃ	58	13	135	19	42.96	68.42
	ʤ	37	10	99	24	37.37	41.67
Liquids	l	384	161	702	365	54.70	44.11
	r	154	156	631	524	24.41	29.77
		10608	3088	14476	4618	73.28	66.87

Single	Cluster	Single	Cluster	Single	Cluster
Number of Consonants Correct		Total Number of Consonants		Percentage Consonants Correct (PCCS)	

Total "words" entered 15029
Total "words" used 10878
Percent "words" used 72.38

Single: MILD-MODERATE

Cluster: MILD-MODERATE

MONOSYLLABLE WORDS

	Number of Consonants Correct	Total Number of Consonants	Percentage Consonants Correct
Single	Initial: 4481 Final: 3225 Total: 7706	Initial: 5936 Final: 4648 Total:10584	Initial: 75.49 Final: 69.38 Total: 72.81
Cluster	Initial: 496 Final: 1190 Total: 1686	Initial: 922 Final: 1575 Total: 2497	Initial: 53.80 Final: 75.56 Total: 67.52
Total	Initial: 4977 Final: 4415 Total: 9392	Initial: 6858 Final: 6223 Total:13081	Initial: 72.57 Final: 70.95 Total: 71.80

MULTISYLLABLE WORDS

	Number of Consonants Correct	Total Number of Consonants	Percentage Consonants Correct
Single	Initial: 1048 Medial: 1160 Final: 694 Total: 2902	Initial: 1393 Medial: 1566 Final: 933 Total: 3892	Initial: 75.23 Medial: 74.07 Final: 74.38 Total: 74.56
Cluster	Initial: 210 Medial: 949 Final: 243 Total: 1402	Initial: 396 Medial: 1386 Final: 339 Total: 2121	Initial: 53.03 Medial: 68.47 Final: 71.68 Total: 66.10
Total	Initial: 1258 Medial: 2109 Final: 937 Total: 4304	Initial: 1789 Medial: 2952 Final: 1272 Total: 6013	Initial: 70.32 Medial: 71.44 Final: 73.66 Total: 71.58

Notes: _____

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341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)

PERCENTAGE CONSONANTS CORRECT - SPLIT (PCCS)

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 Class	Consonant Sound	Initial				Medial				Final			
		Single		Cluster		Single		Cluster		Single		Cluster	
		+	-	+	-	+	-	+	-	+	-	+	-
Nasals	m	3437	58	46	2	747	28	910	46	2613	141	324	17
	n	3431	75	108	22	1335	194	855	106	8282	650	2169	172
	ŋ	0	0	0	0	17	10	102	16	537	131	304	40
Glides	w	4995	257	148	37	129	2	115	21	1	0	0	0
	j	2789	130	33	10	8	0	52	10	0	0	0	0
Stops	p	1246	115	644	137	448	37	181	32	801	59	216	15
	b	3152	123	546	38	646	41	365	38	30	7	5	3
	t	2230	257	583	188	782	227	899	225	6187	1446	2143	460
	d	2584	208	88	34	479	105	381	91	1501	283	994	195
	k	1431	565	286	166	805	190	453	235	1832	395	643	187
	g	1935	563	169	80	341	93	74	35	476	159	61	19
Fricatives and Affricates	f	1084	253	304	79	85	23	163	64	300	54	58	4
	v	60	26	0	0	277	85	91	31	874	207	45	10
	θ	171	183	67	137	48	42	42	77	178	344	9	4
	ð	1813	4090	0	0	160	277	1	18	5	5	0	0
	s	1061	716	496	642	238	216	430	441	1379	1021	1299	618
	z	34	20	0	0	97	71	28	31	1917	1515	971	508
	ʃ	273	179	4	5	56	67	43	31	60	85	4	2
	ʒ	0	0	0	0	20	7	0	0	3	2	0	0
	h	4328	341	14	0	196	2	326	0	4	0	0	0
	tʃ	225	171	0	0	57	54	43	46	106	100	24	27
	ʤ	311	321	0	0	31	12	52	29	40	37	20	34
Liquids	l	1304	745	451	651	446	258	344	253	1176	893	301	306
	r	327	868	508	1339	134	334	287	560	788	1918	256	560
Percent Correct		78.83		55.76		76.15		71.91		75.48		75.58	

Consonant Class	Consonant Sound	Number of Consonants Correct		Total Number of Consonants		Percentage Consonants Correct	
		Single	Cluster	Single	Cluster	Single	Cluster
Nasals	m	6797	1280	7024	1345	96.77	95.17
	n	13048	3132	13967	3432	93.42	91.26
	ŋ	554	406	695	462	79.71	87.88
Glides	w	5125	263	5384	321	95.19	81.93
	j	2797	85	2927	105	95.56	80.95
Stops	p	2495	1041	2706	1225	92.20	84.98
	b	3828	916	3999	995	95.72	92.06
	t	9199	3625	11129	4498	82.66	80.59
	d	4564	1463	5160	1783	88.45	82.05
	k	4068	1382	5218	1970	77.96	70.15
	g	2752	304	3567	438	77.15	69.41
Fricatives and Affricates	f	1469	525	1799	672	81.66	78.13
	v	1211	136	1529	177	79.20	76.84
	θ	397	118	966	336	41.10	35.12
	ð	1978	1	6350	19	31.15	5.26
	s	2678	2225	4631	3926	57.83	56.67
	z	2048	999	3654	1538	56.05	64.95
	ʃ	389	51	720	89	54.03	57.30
	ʒ	23	0	32	0	71.88	*
	h	4528	340	4871	340	92.96	100.00
	tʃ	388	67	713	140	54.42	47.86
	ʤ	382	72	752	135	50.80	53.33
Liquids	l	2926	1096	4822	2306	60.68	47.53
	r	1249	1051	4369	3510	28.59	29.94
		74893	20578	96984	29762	77.22	69.14

Single	Cluster	Single	Cluster	Single	Cluster
Number of Consonants Correct		Total Number of Consonants		Percentage Consonants Correct (PCCS)	

Total "words" entered 94333
Total "words" used 72600
Percent "words" used 76.96

Single MILD-MODERATE

Cluster MILD-MODERATE

MONOSYLLABLE WORDS

	Number of Consonants Correct	Total Number of Consonants	Percentage Consonants Correct
Single	Initial:31494 Final:24908 Total:56402	Initial:40071 Final:32968 Total:73039	Initial: 78.60 Final: 75.55 Total: 77.22
Cluster	Initial: 3159 Final: 8136 Total:11295	Initial: 5667 Final:10635 Total:16302	Initial: 55.74 Final: 76.50 Total: 69.29
Total	Initial:34653 Final:33044 Total:67697	Initial:45738 Final:43603 Total:89341	Initial: 75.76 Final: 75.78 Total: 75.77

MULTISYLLABLE WORDS

	Number of Consonants Correct	Total Number of Consonants	Percentage Consonants Correct
Single	Initial: 6727 Medial: 7582 Final: 4182 Total:18491	Initial: 8414 Medial: 9957 Final: 5574 Total:23945	Initial: 79.95 Medial: 76.15 Final: 75.03 Total: 77.22
Cluster	Initial: 1336 Medial: 6237 Final: 1710 Total: 9283	Initial: 2395 Medial: 8673 Final: 2392 Total:13460	Initial: 55.78 Medial: 71.91 Final: 71.49 Total: 68.97
Total	Initial: 8063 Medial:13819 Final: 5892 Total:27774	Initial:10809 Medial:18630 Final: 7966 Total:37405	Initial: 74.60 Medial: 74.18 Final: 73.96 Total: 74.25

Notes: _____

_____

_____

_____

VOWEL & CONSONANT ANALYSES

STRUCTURAL STATISTICS

Filename_____
Study Identification_____
DOB_____
Age at Sampling Date_____

Sampling Date *_____
Sampling Clinician *_____
Pepfile Entry Date *_____
Transcriber *_____

TYPE	CANONICAL FORM	INTENDED (Y)		OBTAINED (Z)		OBTAINED=INTENDED	
		n	%	n	%	n	%
1	V	1332	10.19	1612	12.33	1321	99.17
2	CV	3074	23.52	3540	27.08	2953	96.06
3	VC	1642	12.56	1622	12.41	1463	89.10
4	CVC	3491	26.71	2877	22.01	2704	77.46
5	CnV	139	1.06	95	0.73	82	58.99
6	CnVC	259	1.98	158	1.21	146	56.37
7	VCn	150	1.15	137	1.05	115	76.67
8	C(n)VCn	660	5.05	546	4.18	458	69.39
9	2-Syllable	1923	14.71	2094	16.02	1487	77.33
10	3+-Syllable	315	2.41	301	2.30	191	60.63
0	No Vowel	86	0.66	89	0.68	86	100.00
		13071		13071			

Average Words / Utterance	Type-Token Percentage
15029 / 5008 = 3.00	1434 / 10781 = 13.30

Notes: _____

341 Participants with Idiopathic Speech Delay and No Motor Disorder (No MSD)

STRUCTURAL STATISTICS

Filename_____
Study Identification_____
DOB_____
Age at Sampling Date_____

Sampling Date *_____
Sampling Clinician *_____
Pepfile Entry Date *_____
Transcriber *_____

TYPE	CANONICAL FORM	INTENDED (Y)		OBTAINED (Z)		OBTAINED=INTENDED	
		n	%	n	%	n	%
1	V	8044	9.46	9236	10.86	8002	99.48
2	CV	18479	21.72	21078	24.78	18094	97.92
3	VC	11997	14.10	11605	13.64	11043	92.05
4	CVC	23686	27.84	21275	25.01	20176	85.18
5	CnV	1004	1.18	723	0.85	617	61.45
6	CnVC	1579	1.86	1004	1.18	913	57.82
7	VCn	1155	1.36	1089	1.28	997	86.32
8	C(n)VCn	4345	5.11	3499	4.11	3294	75.81
9	2-Syllable	12074	14.19	12903	15.17	9928	82.23
10	3+-Syllable	2087	2.45	2022	2.38	1395	66.84
0	No Vowel	614	0.72	630	0.74	613	99.84
		85064		85064			

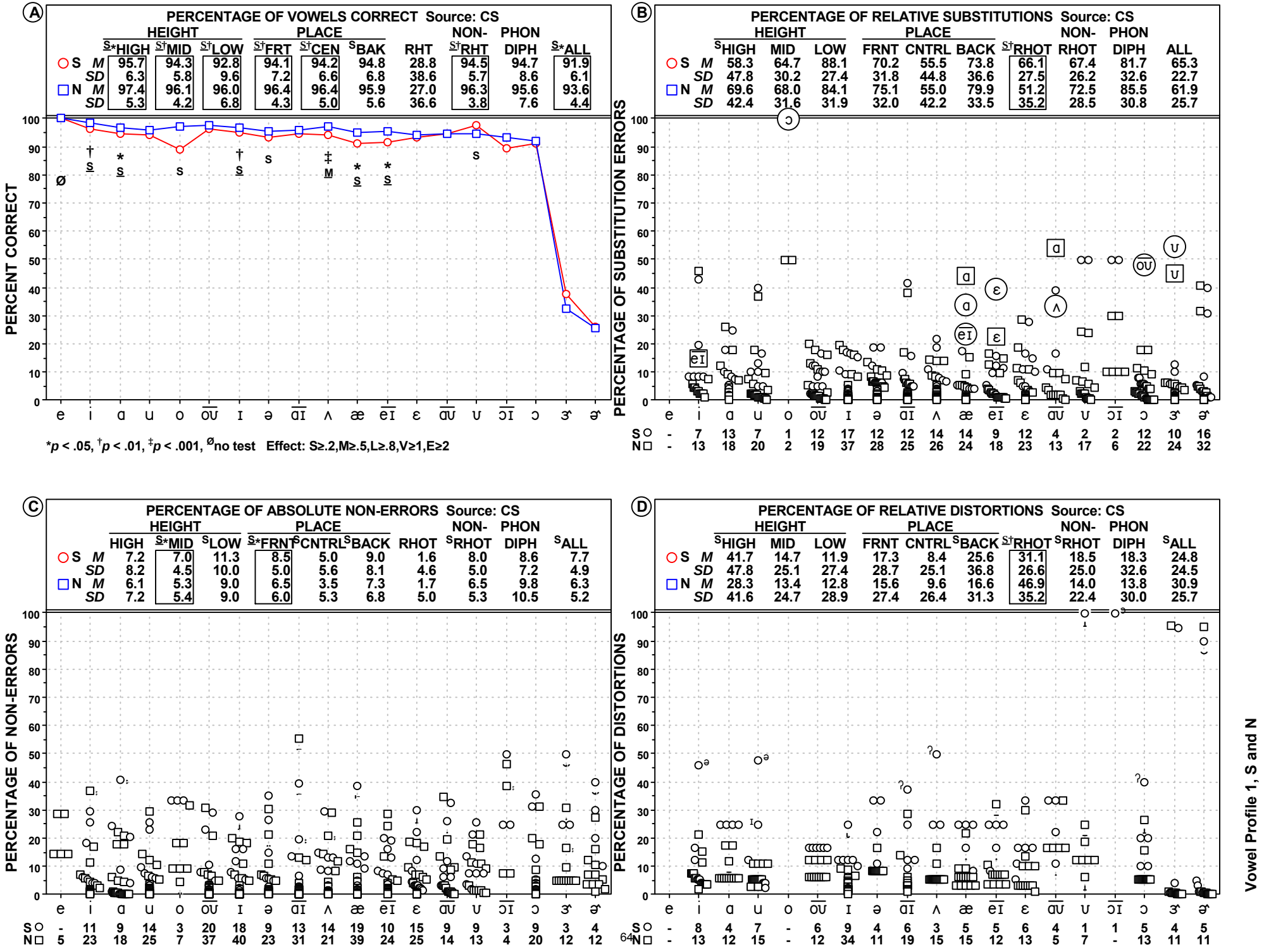
Average Words / Utterance	Type-Token Percentage
94333 / 26636 = 3.54	4130 / 72053 = 5.73

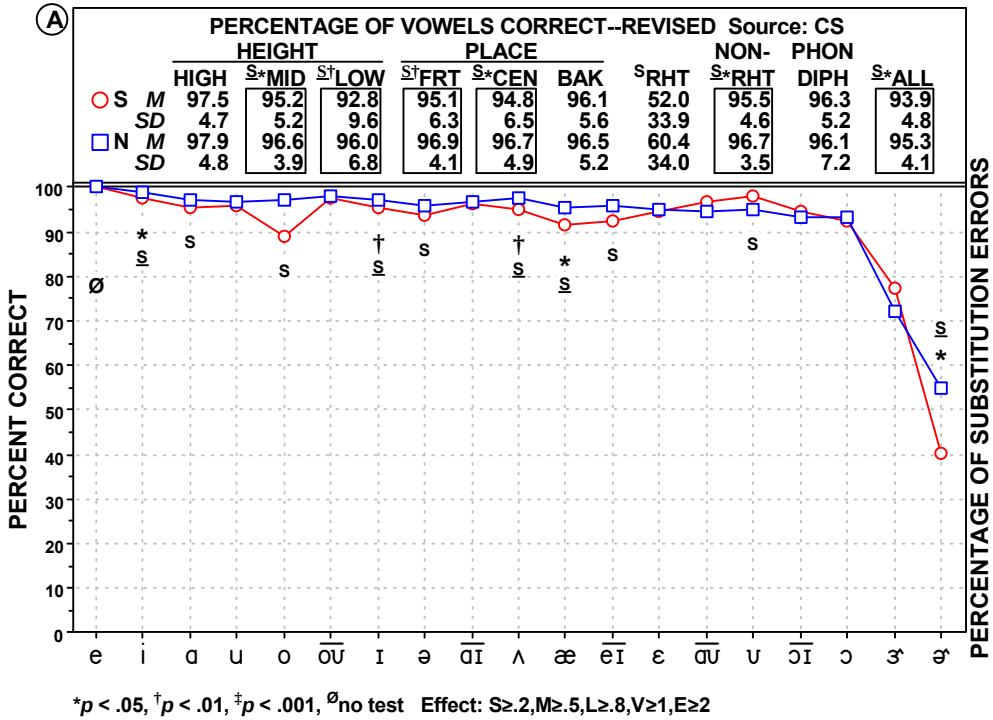
Notes: _____

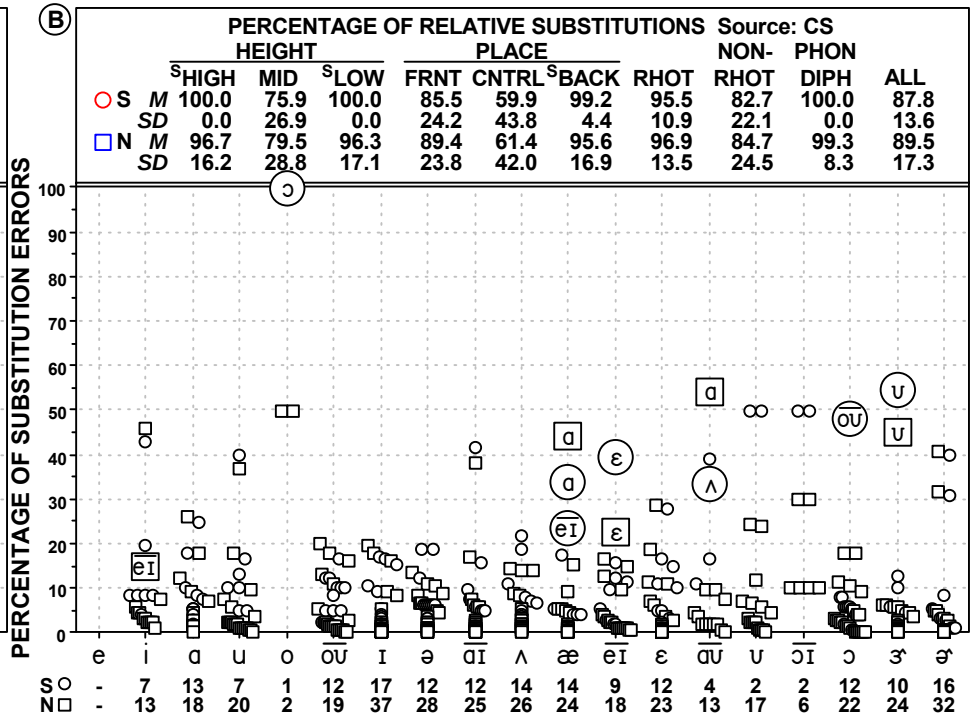
PART IV:

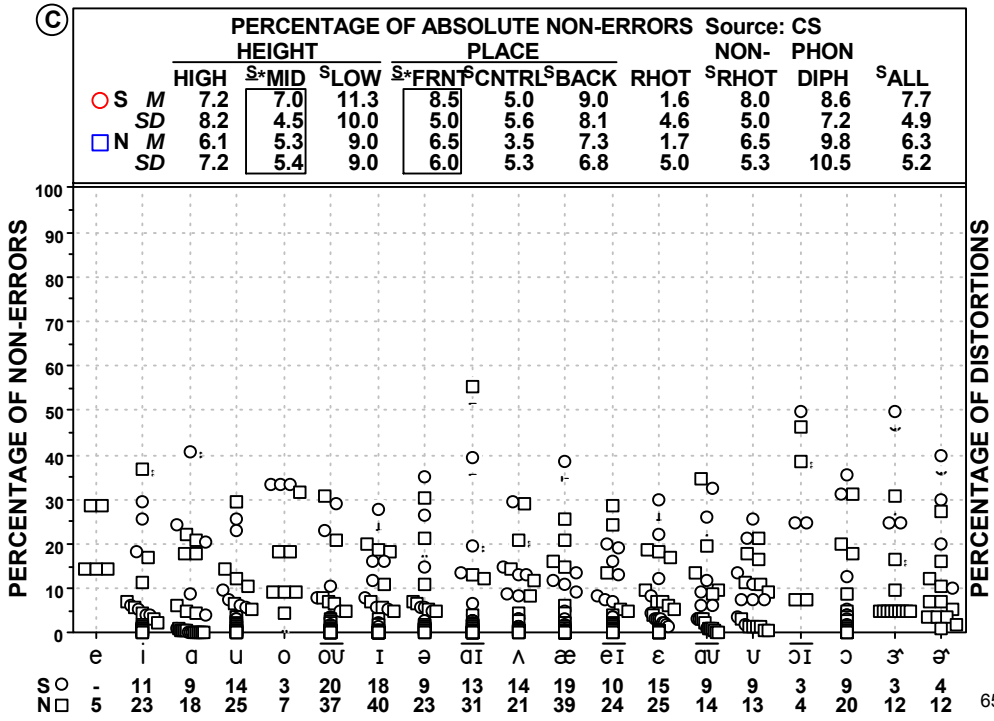
TEN LINGUISTIC DOMAINS PROFILES

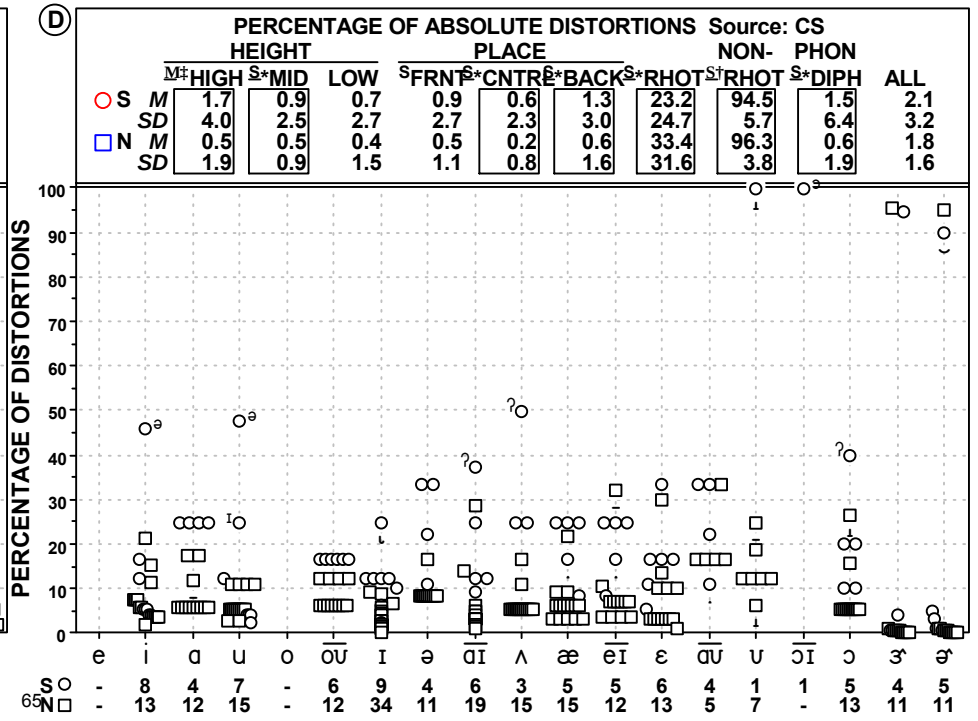
VOWEL PROFILES


A
PERCENTAGE OF VOWELS CORRECT Source: CS
HEIGHT PLACE NON- PHON
S*HIGH S†MID S†LOW S†FRT S†CEN SBAK RHT S†RHT DIPH S*ALL
S M 95.7 94.3 92.8 94.1 94.2 94.8 28.8 94.5 94.7 91.9
SD 6.3 5.8 9.6 7.2 6.6 6.8 38.6 5.7 8.6 6.1
N M 97.4 96.1 96.0 96.4 96.4 95.9 27.0 96.3 95.6 93.6
SD 5.3 4.2 6.8 4.3 5.0 5.6 36.6 3.8 7.6 4.4
PERCENT CORRECT
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2
B
PERCENTAGE OF RELATIVE SUBSTITUTIONS Source: CS
HEIGHT PLACE NON- PHON
SHIGH MID LOW FRNT CNTRL BACK S†RHOT RHOT DIPH ALL
S M 58.3 64.7 88.1 70.2 55.5 73.8 66.1 67.4 81.7 65.3
SD 47.8 30.2 27.4 31.8 44.8 36.6 27.5 26.2 32.6 22.7
N M 69.6 68.0 84.1 75.1 55.0 79.9 51.2 72.5 85.5 61.9
SD 42.4 31.6 31.9 32.0 42.2 33.5 35.2 28.5 30.8 25.7
PERCENTAGE OF SUBSTITUTION ERRORS
S 7 13 7 1 12 17 12 12 14 14 9 12 4 2 2 12 10 16
N 13 18 20 2 19 37 28 25 26 24 18 23 13 17 6 22 24 32
C
PERCENTAGE OF ABSOLUTE NON-ERRORS Source: CS
HEIGHT PLACE NON- PHON
HIGH S*MID SLOW S*FRNT SCNTRL SBACK RHOT SRHOT DIPH SALL
S M 7.2 7.0 11.3 8.5 5.0 9.0 1.6 8.0 8.6 7.7
SD 8.2 4.5 10.0 5.0 5.6 8.1 4.6 5.0 7.2 4.9
N M 6.1 5.3 9.0 6.5 3.5 7.3 1.7 6.5 9.8 6.3
SD 7.2 5.4 9.0 6.0 5.3 6.8 5.0 5.3 10.5 5.2
PERCENTAGE OF NON-ERRORS
S 11 9 14 3 20 18 9 13 14 19 10 15 9 9 3 9 3 4
N 5 23 18 25 7 37 40 23 31 21 39 24 25 14 13 4 20 12 12
D
PERCENTAGE OF RELATIVE DISTORTIONS Source: CS
HEIGHT PLACE NON- PHON
SHIGH MID LOW FRNT CNTRL SBACK S†RHOT SRHOT DIPH SALL
S M 41.7 14.7 11.9 17.3 8.4 25.6 31.1 18.5 18.3 24.8
SD 47.8 25.1 27.4 28.7 25.1 36.8 26.6 25.0 32.6 24.5
N M 28.3 13.4 12.8 15.6 9.6 16.6 46.9 14.0 13.8 30.9
SD 41.6 24.7 28.9 27.4 26.4 31.3 35.2 22.4 30.0 25.7
PERCENTAGE OF DISTORTIONS
S 8 4 7 - 6 9 4 6 3 5 5 6 4 1 1 5 4 5
64N 13 12 15 - 12 34 11 19 15 15 12 13 5 7 - 13 11 11
Vowel Profile 1, S and N


A
PERCENTAGE OF VOWELS CORRECT--REVISED Source: CS
HEIGHT PLACE NON- PHON
HIGH S*MID S†LOW S†FRT S*CEN BAK SRHT S*RHT DIPH S*ALL
S M 97.5 95.2 92.8 95.1 94.8 96.1 52.0 95.5 96.3 93.9
SD 4.7 5.2 9.6 6.3 6.5 5.6 33.9 4.6 5.2 4.8
N M 97.9 96.6 96.0 96.9 96.7 96.5 60.4 96.7 96.1 95.3
SD 4.8 3.9 6.8 4.1 4.9 5.2 34.0 3.5 7.2 4.1
PERCENT CORRECT
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


B
PERCENTAGE OF RELATIVE SUBSTITUTIONS Source: CS
HEIGHT PLACE NON- PHON
SHIGH MID SLOW FRNT CNTRL SBACK RHOT RHOT DIPH ALL
S M 100.0 75.9 100.0 85.5 59.9 99.2 95.5 82.7 100.0 87.8
SD 0.0 26.9 0.0 24.2 43.8 4.4 10.9 22.1 0.0 13.6
N M 96.7 79.5 96.3 89.4 61.4 95.6 96.9 84.7 99.3 89.5
SD 16.2 28.8 17.1 23.8 42.0 16.9 13.5 24.5 8.3 17.3
PERCENTAGE OF SUBSTITUTION ERRORS

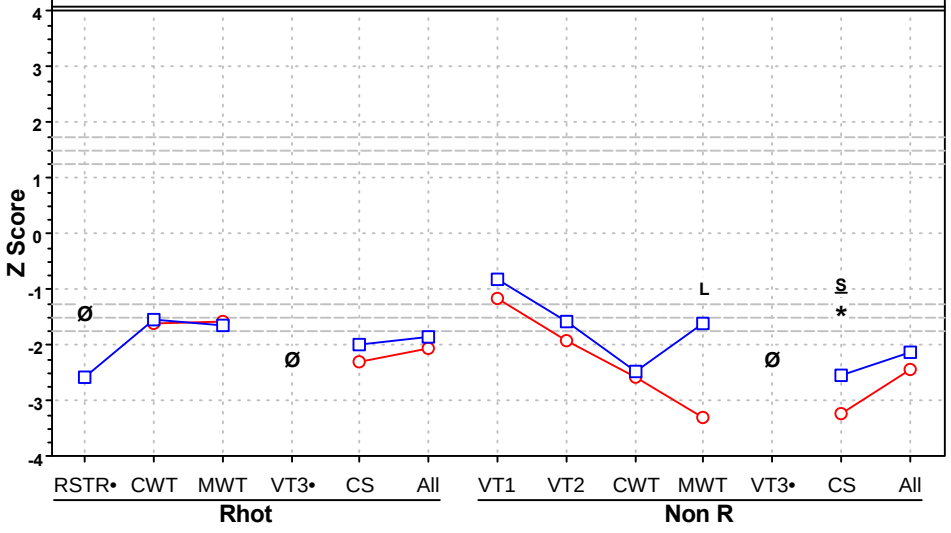

C
PERCENTAGE OF ABSOLUTE NON-ERRORS Source: CS
HEIGHT PLACE NON- PHON
HIGH S*MID SLOW S*FRNT SCNTRL SBACK RHOT SRHOT DIPH SALL
S M 7.2 7.0 11.3 8.5 5.0 9.0 1.6 8.0 8.6 7.7
SD 8.2 4.5 10.0 5.0 5.6 8.1 4.6 5.0 7.2 4.9
N M 6.1 5.3 9.0 6.5 3.5 7.3 1.7 6.5 9.8 6.3
SD 7.2 5.4 9.0 6.0 5.3 6.8 5.0 5.3 10.5 5.2
PERCENTAGE OF NON-ERRORS


D
PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS
HEIGHT PLACE NON- PHON
M‡HIGH S*MID LOW SFRNT S*CNTRL S*BACK S*RHOT S†RHOT S*DIPH ALL
S M 1.7 0.9 0.7 0.9 0.6 1.3 23.2 94.5 1.5 2.1
SD 4.0 2.5 2.7 2.7 2.3 3.0 24.7 5.7 6.4 3.2
N M 0.5 0.5 0.4 0.5 0.2 0.6 33.4 96.3 0.6 1.8
SD 1.9 0.9 1.5 1.1 0.8 1.6 31.6 3.8 1.9 1.6
PERCENTAGE OF DISTORTIONS

A

Percent Vowels Correct Z Scores

		Rhot						Non R					
		Ø RSTR	CWT	MWT	Ø VT3	CS	All	VT1	VT2	CWT	L MWT	Ø VT3	S* CS	All
S	*M*	-1.60	-1.57		-2.29	-2.04		-1.15	-1.92	-2.59	-3.29		-3.24	-2.43
	SD	2.02	1.28		1.81	1.86		1.76	2.30	2.36	2.63		2.11	2.26
N	*M*	-2.58	-1.53	-1.65		-2.00	-1.85	-0.82	-1.58	-2.47	-1.60		-2.53	-2.11
	SD	1.71	1.48		1.66	1.68		1.80	2.08	2.17	1.58		2.36	2.28

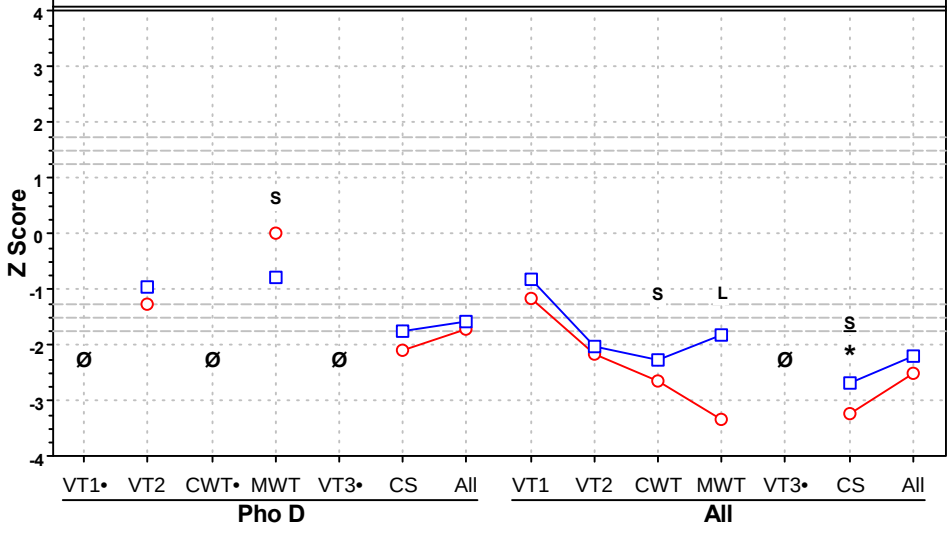


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

B

Percent Vowels Correct Z Scores

		Pho D						All					
		Ø VT1	VT2	Ø CWT	S MWT	Ø VT3	CS	All	VT1	VT2	S CWT	L MWT	Ø VT3	S* CS	All
S	*M*	-1.25		0.00			-2.08	-1.72	-1.15	-2.17	-2.64	-3.34		-3.24	-2.49
	SD	2.31		0.00			2.37	2.34	1.76	2.22	2.16	2.67		1.97	2.15
N	*M*	-0.95		-0.78			-1.74	-1.55	-0.82	-2.03	-2.25	-1.80		-2.68	-2.19
	SD	1.93		1.88			2.38	2.30	1.80	1.86	1.73	1.29		1.84	1.90

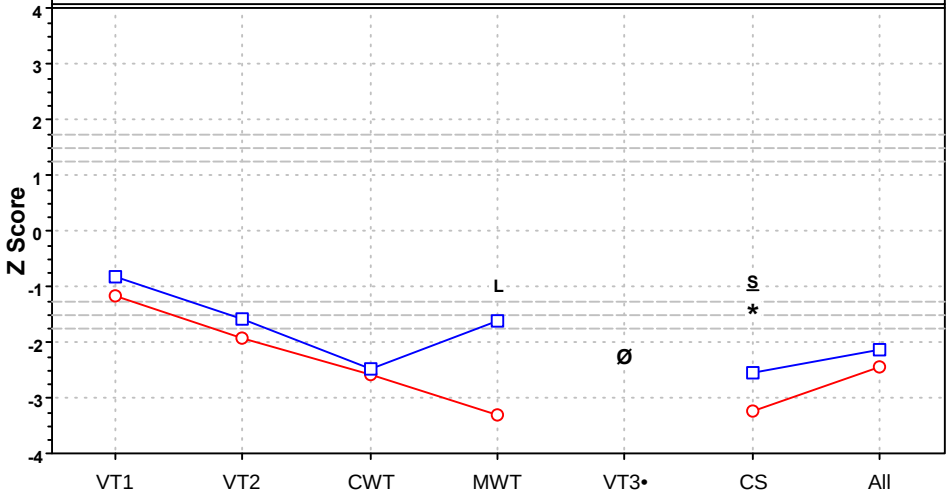


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

C

Percent Non-Rhotic Vowels/Diphthongs Correct

		Percent Correct						Z Scores						
		VT1	VT2	CWT	L MWT	Ø VT3	S† CS	S* All	VT1	VT2	CWT	L MWT	Ø VT3	S* CS	All
S	*M*	92	88	87	62		94	90	-1.15	-1.92	-2.59	-3.29		-3.24	-2.43
	SD	13	14	14	20		6	13	1.76	2.30	2.36	2.63		2.11	2.26
N	*M*	93	88	89	74		96	92	-0.82	-1.58	-2.47	-1.60		-2.53	-2.11
	SD	13	14	11	12		4	10	1.80	2.08	2.17	1.58		2.36	2.28

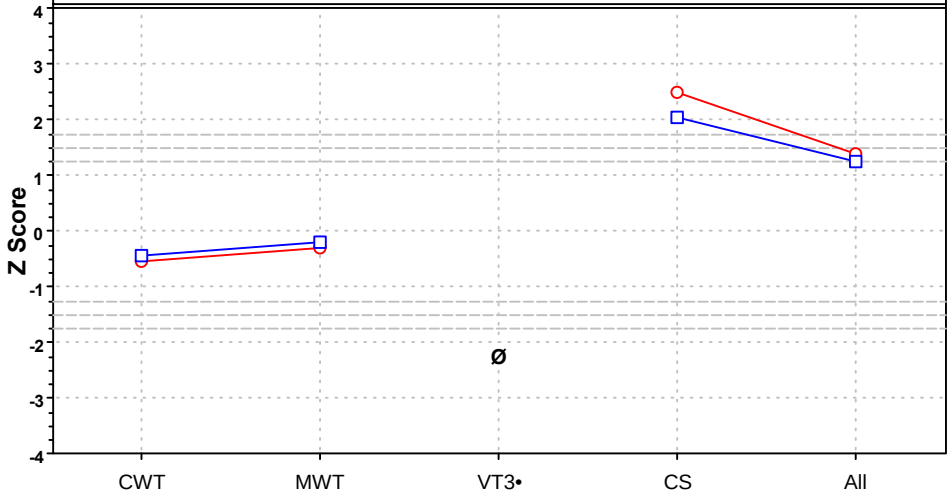


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

D

Percent Relative Non-Rhotic Vowels/Diphthongs Distortions

		Percent Correct						Z Scores					
		CWT	MWT	Ø VT3	S CS	All		CWT	MWT	Ø VT3	CS	All	
S	*M*	3	9		19	13		-0.54	-0.28		2.50	1.40	
	SD	7	13		25	22		0.25	0.95		2.49	2.47	
N	*M*	6	10		14	12		-0.44	-0.19		2.05	1.25	
	SD	17	15		22	21		0.89	1.36		2.49	2.41	

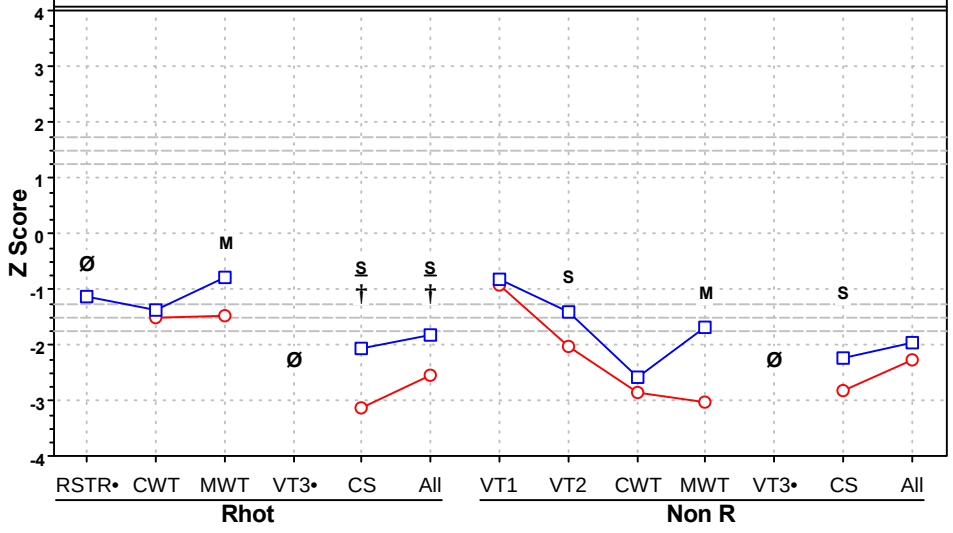


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

E

Percent Vowels/Diphthongs Correct-Revised Z Scores

		Rhot					Non R						
		Ø RSTR	CWT	M MWT	Ø VT3	S† CS	S† All	VT1	S VT2	CWT	M MWT	Ø VT3	S CS	All
S	*M*	-1.51	-1.47			-3.11	2.53	-0.93	-2.00	-2.86	-3.02		-2.80	-2.27
	SD	2.19	1.69			2.18	2.27	1.74	2.27	2.25	2.52		2.20	2.25
N	*M*	-1.12	-1.37	-0.77		-2.05	-1.80	-0.80	-1.41	-2.55	-1.67		-2.22	-1.96
	SD	1.86	1.28			2.29	2.17	1.83	1.99	2.13	1.70		2.39	2.27

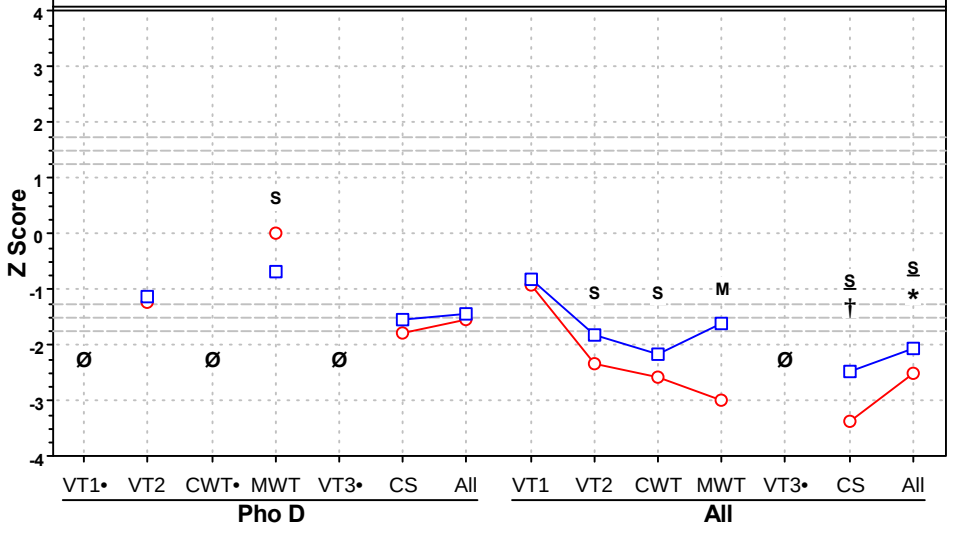


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

F

Percent Vowels/Diphthongs Correct-Revised Z Scores

		Pho D							All						
		Ø VT1	VT2	Ø CWT	S MWT	Ø VT3	CS	All	VT1	S VT2	S CWT	M MWT	Ø VT3	S† CS	S* All
S	*M*	-1.24		0.00		-1.79	-1.53		-0.93	-2.34	-2.57	-2.99		-3.35	2.49
	SD	2.20		0.00		2.26	2.21		1.74	2.36	2.17	2.62		1.95	2.21
N	*M*	-1.10		-0.67		-1.55	-1.43		-0.80	-1.80	-2.16	-1.61		-2.47	-2.04
	SD	2.08		1.88		2.32	2.27		1.83	1.91	1.82	1.51		2.04	2.02



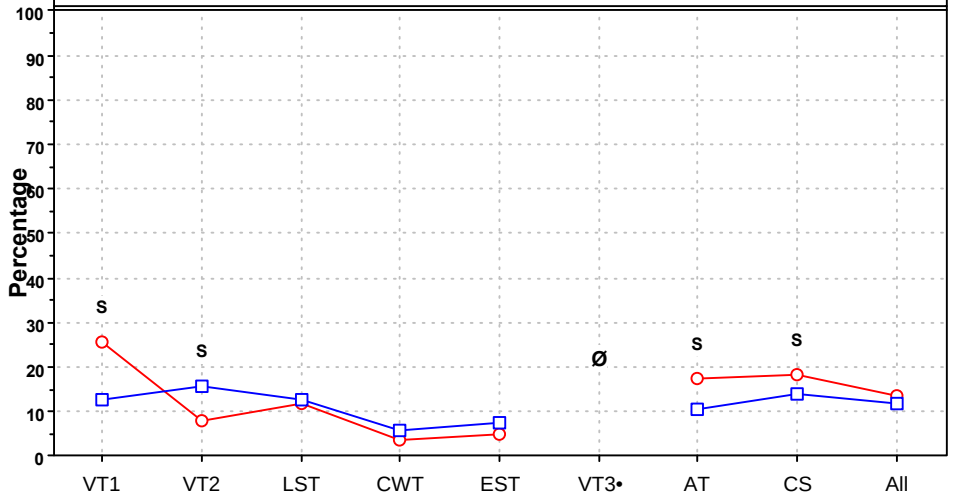
*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

G

Percent Relative Non-Rhotic Vowels/Diphthongs Distortions Values

Percent Correct

		S VT1	S VT2	LST	CWT	EST	Ø VT3	S AT	S CS	All
S	*M*	26	8	12	3	5		17	19	13
	SD	41	16	19	7	14		29	25	24
N	*M*	13	16	13	6	7		10	14	12
	SD	32	29	24	17	18		21	22	23



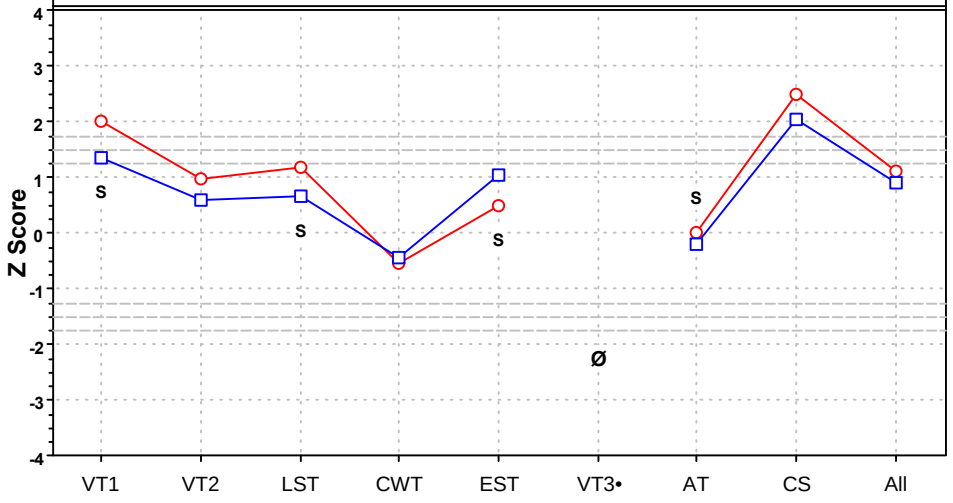
*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

H

Percent Relative Non-Rhotic Vowels/Diphthongs Distortions Z Scores

Z Scores

		S VT1	VT2	S LST	CWT	S EST	Ø VT3	S AT	CS	All
S	*M*	2.00	0.99	1.20	-0.54	0.50		0.01	2.50	1.12
	SD	2.58	2.42	2.33	0.25	1.45		1.29	2.49	2.28
N	*M*	1.35	0.59	0.66	-0.44	1.04		-0.19	2.05	0.91
	SD	2.26	2.14	1.89	0.89	2.11		0.91	2.49	2.20

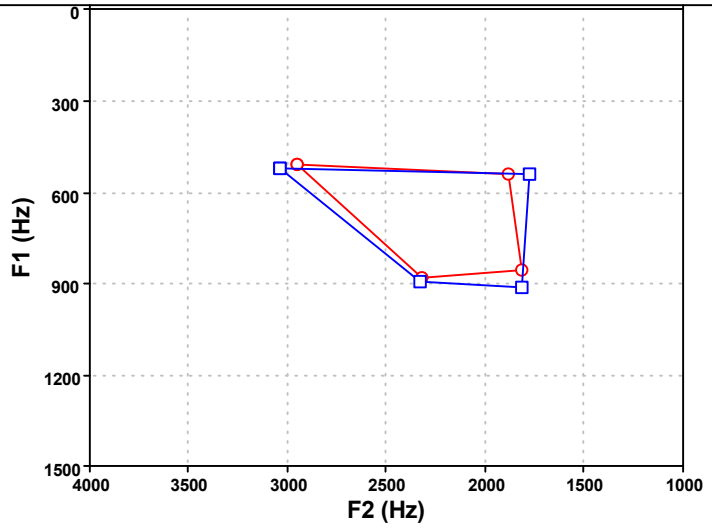


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

Ⓐ

Vowel Space Quadrilateral Source: CS24

		i			æ			u			ɑ			All	Planar Area	
		F1	^{S}F2	^{S†}N	F1	F2	N	F1	^{S}F2	N	^{S}F1	F2	N	^{S}N	^{S*}VSQ	^{M†}VSQL
○ S	*M*	506	2949	2	882	2317	3	537	1878	2	854	1811	2	9	239,765	0.144
	SD	97	405	1	246	301	1	83	490	1	222	228	1	3	188,062	0.107
□ N	*M*	517	3035	3	895	2321	3	540	1771	2	913	1809	3	10	327,882	0.207
	SD	89	369	1	192	269	1	86	434	1	199	250	1	2	199,781	0.121

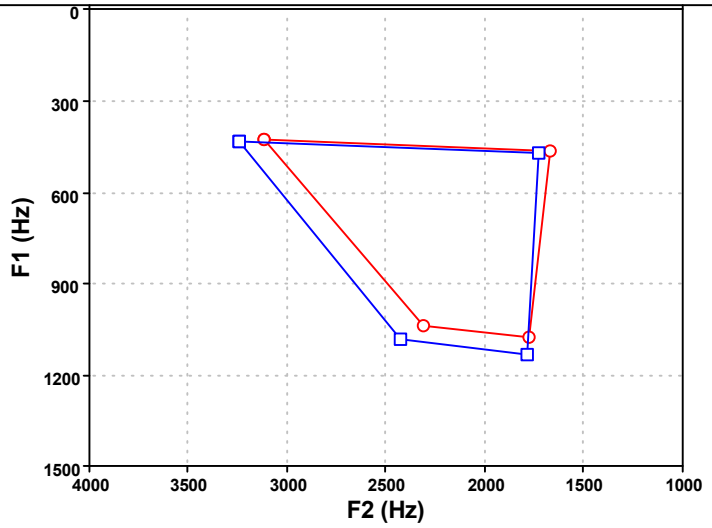


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Ⓑ

Vowel Space Quadrilateral Source: VT1

		i			æ			u			ɑ			All	Planar Area	
		F1	^{S}F2	^{S}N	^{S}F1	^{S*}F2	^{S}N	F1	F2	N	^{S}F1	F2	N	^{S}N	^{S}VSQ	VSQL
○ S	*M*	427	3115	3	1036	2308	3	463	1668	4	1076	1773	3	13	642,777	0.418
	SD	48	317	1	175	219	1	49	341	1	183	225	1	3	242,665	0.148
□ N	*M*	432	3235	4	1081	2421	4	468	1728	4	1129	1782	3	14	714,010	0.432
	SD	62	344	1	187	244	1	65	361	1	214	218	1	3	284,783	0.169

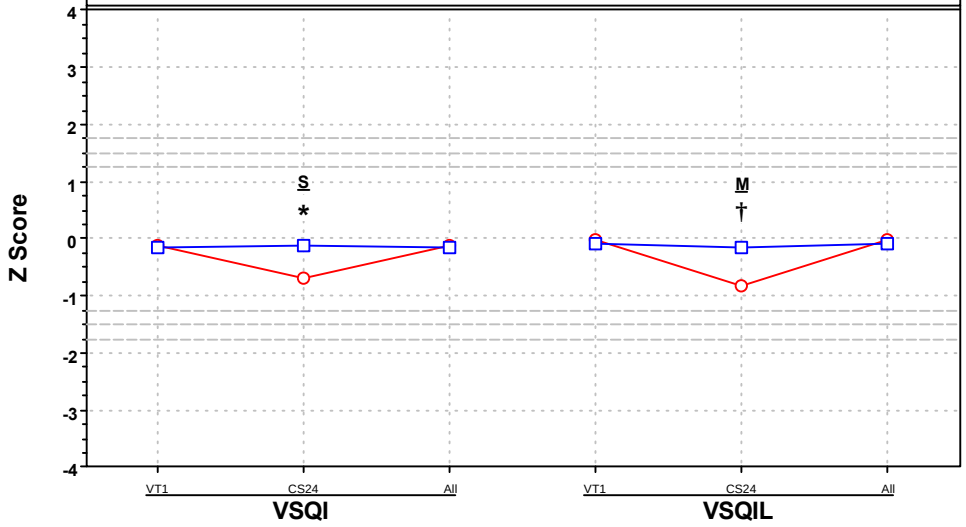


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Ⓒ

Vowel Space Quadrilateral

		VSQI			VSQIL			Z VSQI			Z VSQIL		
		^{S}VT1	^{S*}CS24	^{S}All	VT1	^{M†}CS24	All	VT1	^{S*}CS24	All	VT1	^{M†}CS24	All
○ S	*M*	642777	239765	642777	0.42	0.14	0.42	-0.13	-0.68	-0.13	-0.01	-0.84	-0.01
	SD	242665	188062	242665	0.15	0.11	0.15	1.21	1.33	1.21	1.15	1.28	1.15
□ N	*M*	714010	327882	714010	0.43	0.21	0.43	-0.16	-0.12	-0.16	-0.10	-0.15	-0.10
	SD	284783	199781	284783	0.17	0.12	0.17	1.17	1.24	1.17	1.16	1.27	1.16

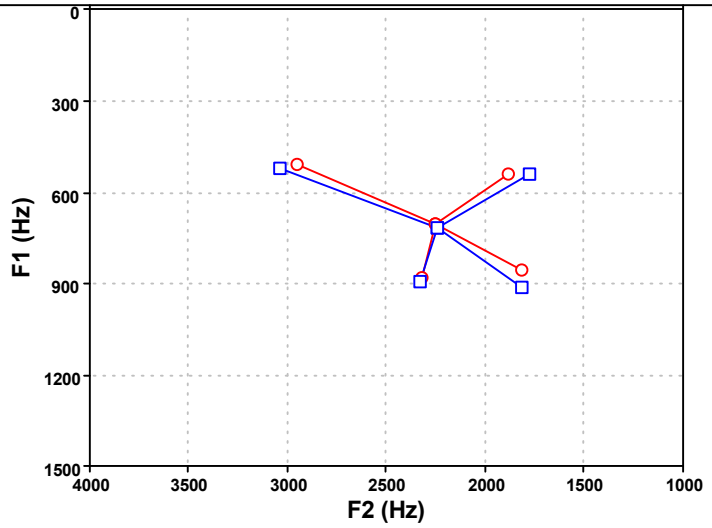


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A

Vowel Space Dispersion--Corner Vowels from Center Source: CS24

		Center		Dist. from Center				Dispersion	
		F1	F2	M‡i	æ	S*u	ɑ	M†VSD	M‡VSDL
○ S	*M*	701	2244	707	415	509	537	545	0.371
	SD	117	214	253	176	209	163	120	0.083
□ N	*M*	716	2233	861	415	609	563	610	0.419
	SD	92	178	250	156	240	180	119	0.080

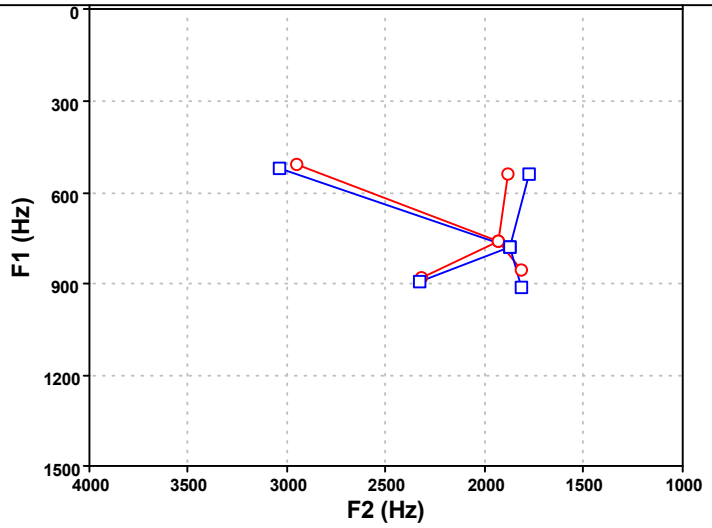


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

Vowel Space Dispersion--Corner Vowels from ʌ Source: CS24

		ʌ		Distance from ʌ				Dispersion	
		F1	F2	S*ɪ	æ	u	ɑ	S*VSD	S*VSDL
○ S	*M*	761	1922	1058	505	490	389	599	0.401
	SD	180	300	375	339	311	212	189	0.118
□ N	*M*	782	1872	1218	553	500	353	655	0.445
	SD	145	270	392	288	272	202	154	0.095

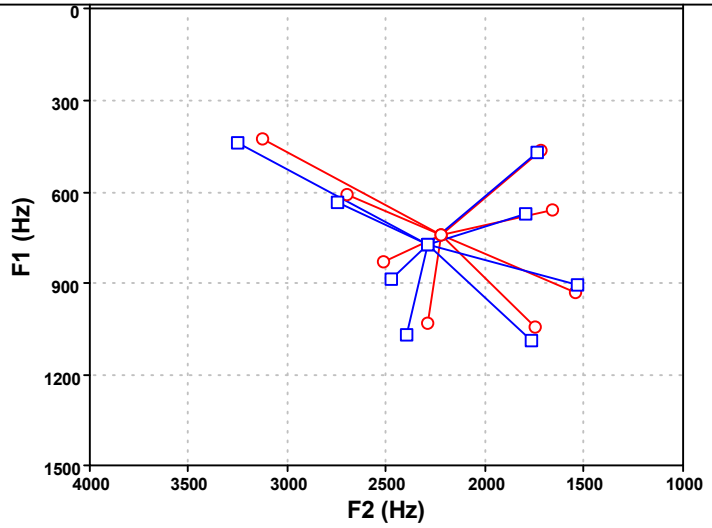


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

Vowel Space Dispersion--8 Vowels from Center Source: VT1+VT2

		Center		Distance from Center							Dispersion	
		S F1	S F2	S i	S æ	u	S ɑ	S ɪ	S ɛ	S ʊ	S ɔ	VSD	VSDL
○ S	*M*	739	2219	959	398	649	634	530	361	594	720	614	0.435
	SD	78	124	265	85	251	176	224	206	248	151	85	0.038
□ N	*M*	769	2284	1051	420	680	674	491	300	544	789	622	0.439
	SD	83	164	261	110	270	129	165	135	210	192	92	0.071

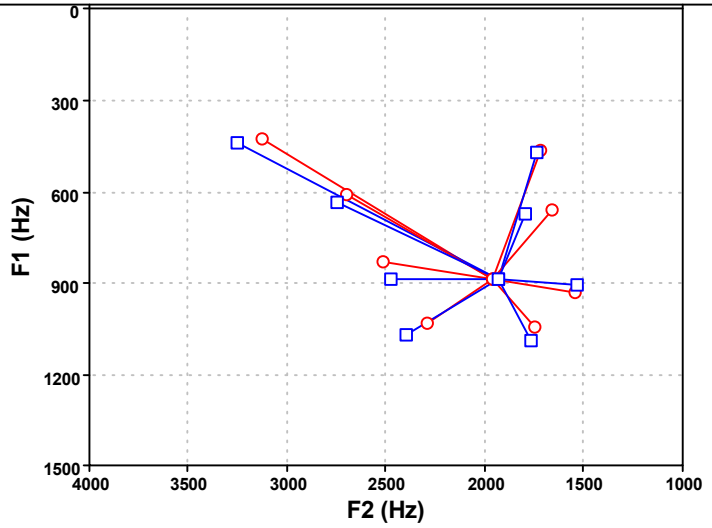


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D

Vowel Space Dispersion--8 Vowels from ʌ Source: VT1+VT2

		ʌ		Distance from ʌ							Dispersion	
		F1	F2	S i	M*æ	u	ɑ	S ɪ	ɛ	S ʊ	ɔ	VSD	S VSDL
○ S	*M*	888	1953	1260	465	585	398	807	584	419	446	637	0.471
	SD	145	234	328	229	228	158	242	256	219	183	91	0.059
□ N	*M*	883	1925	1407	573	564	386	859	565	316	441	647	0.456
	SD	153	228	374	199	238	173	246	240	204	180	97	0.071

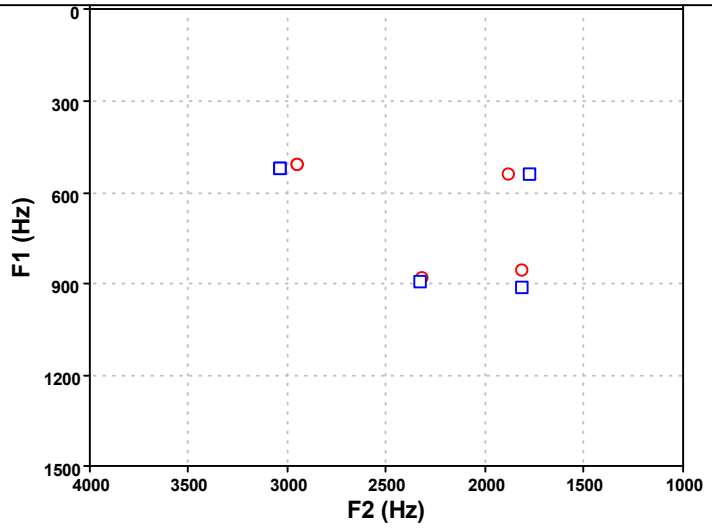


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A

Vowel Space Pairwise--Corner Vowels Source: CS24

		Distance Between Vowels						Pairwise	
		i-æ	^{S}ɪ-ɑ	^{S†}i-u	æ-ɑ	æ-u	^{S}ɑ-u	^{M†}VSP	^{M‡}VSPL
○ S	*M*	829	1203	1029	576	717	553	781	0.523
	SD	366	439	573	281	347	295	201	0.138
□ N	*M*	860	1320	1279	591	771	607	905	0.608
	SD	365	388	520	284	352	270	213	0.132

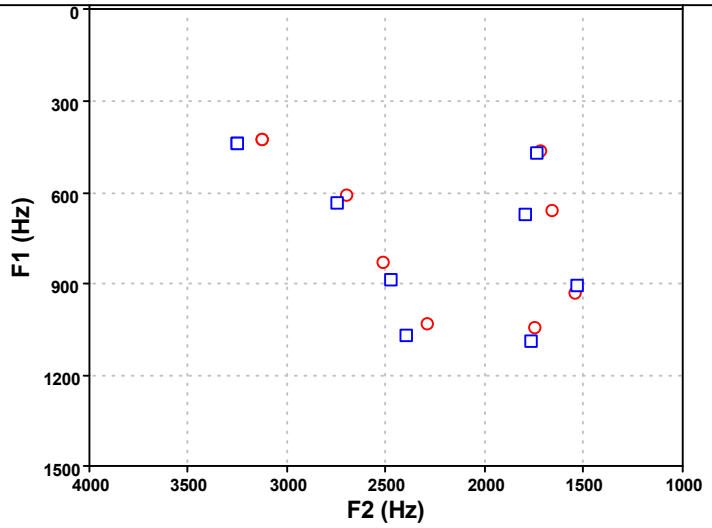


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

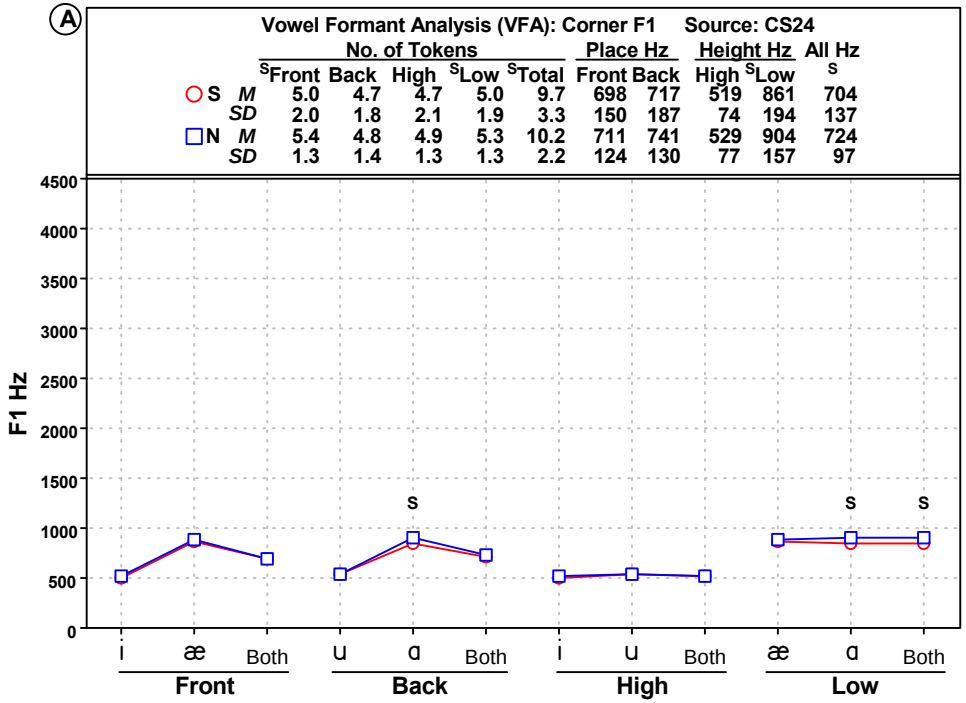
B

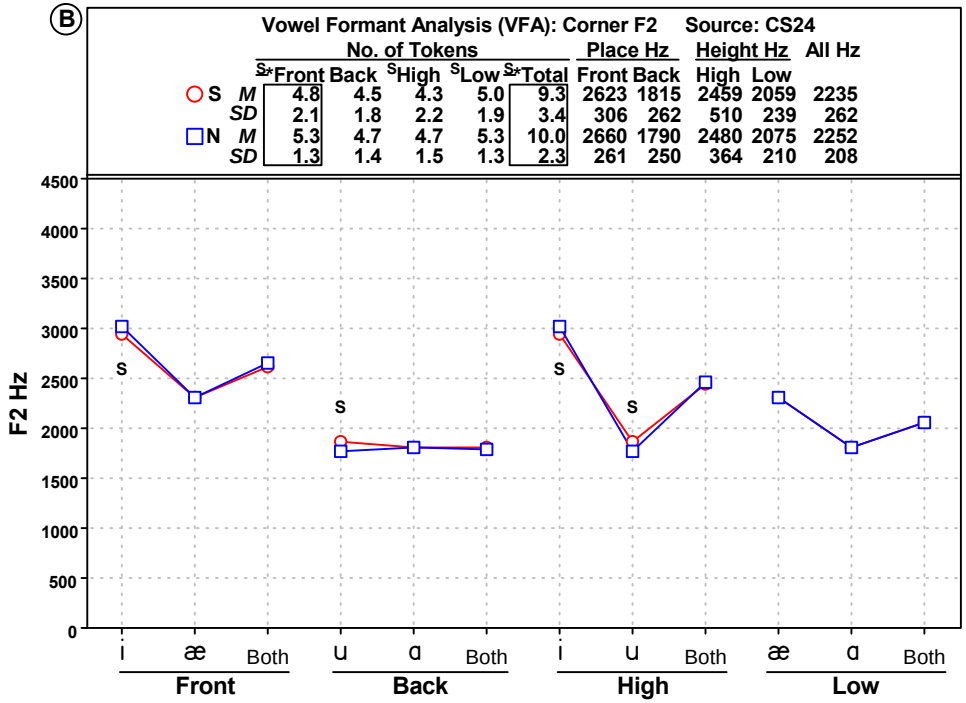
Vowel Space Pairwise--8 Vowels Source: VT1+VT2

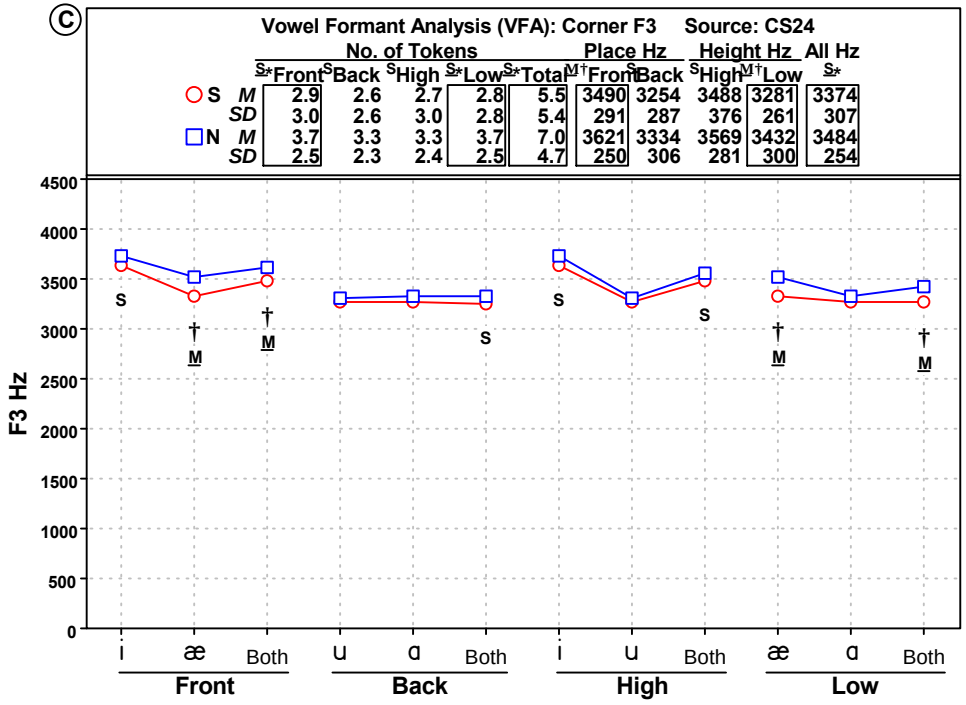
		ɪ			ɛ			ʊ			ɔ			All	Pairwise	
		^{S}F1	^{S}F2	^{M*}N	^{S}F1	F2	^{S}N	F1	^{M*}F2	^{S}N	F1	F2	N	^{S}N	VSP	VSPL
○ S	*M*	607	2699	3	826	2507	3	656	1655	3	931	1538	3	26	869	0.617
	SD	87	208	1	139	216	1	97	173	2	136	168	1	6	112	0.056
□ N	*M*	636	2743	4	883	2473	3	669	1794	3	907	1526	3	27	891	0.620
	SD	90	200	1	162	190	1	107	256	1	154	190	1	5	138	0.100

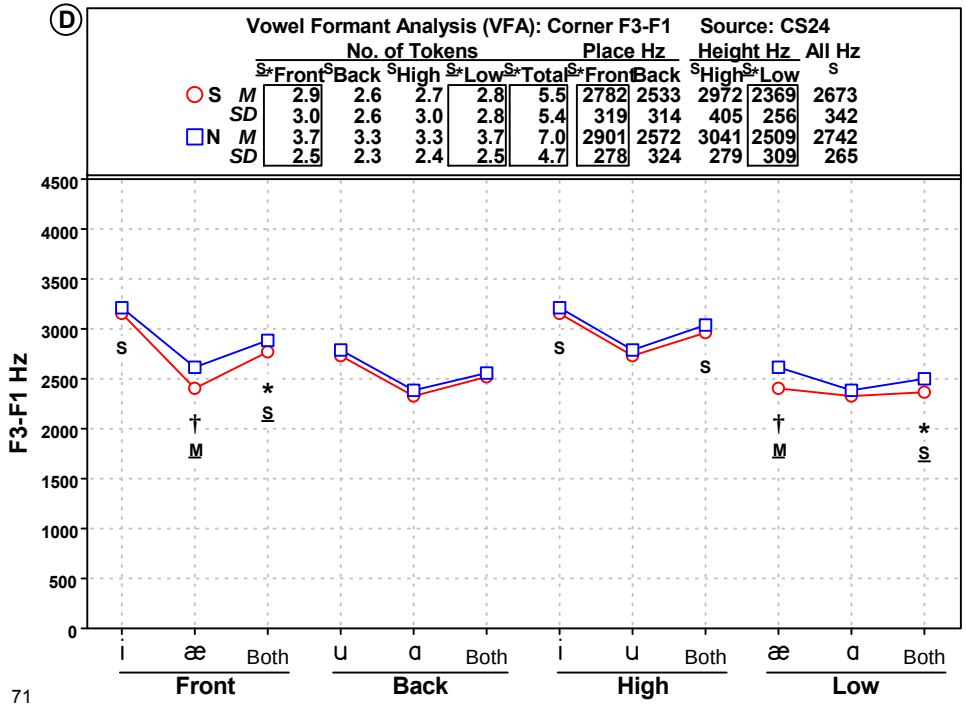


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


A
Vowel Formant Analysis (VFA): Corner F1 Source: CS24
No. of Tokens Place Hz Height Hz All Hz
SFront Back High SLow STotal Front Back High SLow All Hz
S M 5.0 4.7 4.7 5.0 9.7 698 717 519 861 704
SD 2.0 1.8 2.1 1.9 3.3 150 187 74 194 137
N M 5.4 4.8 4.9 5.3 10.2 711 741 529 904 724
SD 1.3 1.4 1.3 1.3 2.2 124 130 77 157 97
F1 Hz
4500
4000
3500
3000
2500
2000
1500
1000
500
0
i æ Both u ɑ Both i u Both æ ɑ Both
Front Back High Low
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

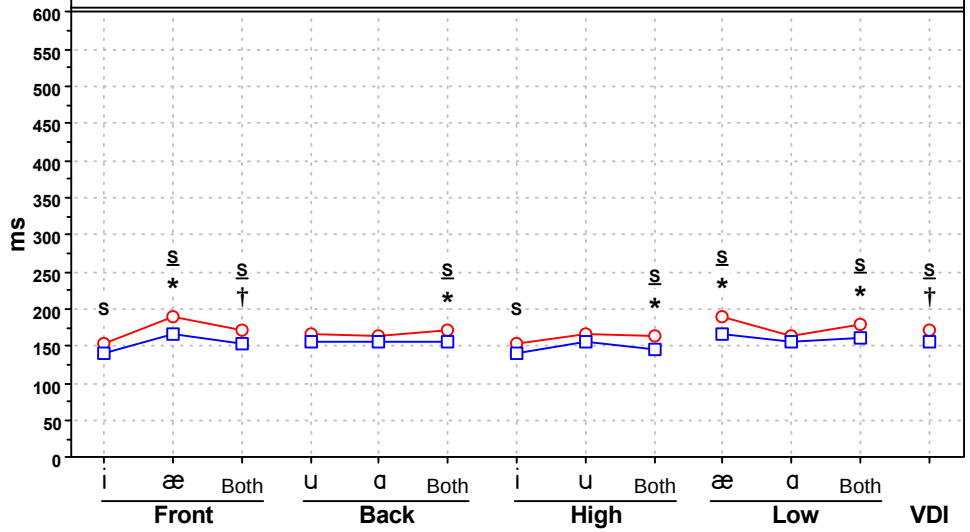

B
Vowel Formant Analysis (VFA): Corner F2 Source: CS24
No. of Tokens Place Hz Height Hz All Hz
S*Front Back SHigh SLow S*Total Front Back High Low
S M 4.8 4.5 4.3 5.0 9.3 2623 1815 2459 2059 2235
SD 2.1 1.8 2.2 1.9 3.4 306 262 510 239 262
N M 5.3 4.7 4.7 5.3 10.0 2660 1790 2480 2075 2252
SD 1.3 1.4 1.5 1.3 2.3 261 250 364 210 208
F2 Hz
4500
4000
3500
3000
2500
2000
1500
1000
500
0
i æ Both u ɑ Both i u Both æ ɑ Both
Front Back High Low
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


C
Vowel Formant Analysis (VFA): Corner F3 Source: CS24
No. of Tokens Place Hz Height Hz All Hz
S*Front SBack SHigh S*Low S*Total M†Front SBack SHigh M†Low S*
S M 2.9 2.6 2.7 2.8 5.5 3490 3254 3488 3281 3374
SD 3.0 2.6 3.0 2.8 5.4 291 287 376 261 307
N M 3.7 3.3 3.3 3.7 7.0 3621 3334 3569 3432 3484
SD 2.5 2.3 2.4 2.5 4.7 250 306 281 300 254
F3 Hz
4500
4000
3500
3000
2500
2000
1500
1000
500
0
i æ Both u ɑ Both i u Both æ ɑ Both
Front Back High Low
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


D
Vowel Formant Analysis (VFA): Corner F3-F1 Source: CS24
No. of Tokens Place Hz Height Hz All Hz
S*Front SBack SHigh S*Low S*Total S*Front Back SHigh S*Low S
S M 2.9 2.6 2.7 2.8 5.5 2782 2533 2972 2369 2673
SD 3.0 2.6 3.0 2.8 5.4 319 314 405 256 342
N M 3.7 3.3 3.3 3.7 7.0 2901 2572 3041 2509 2742
SD 2.5 2.3 2.4 2.5 4.7 278 324 279 309 265
F3-F1 Hz
4500
4000
3500
3000
2500
2000
1500
1000
500
0
i æ Both u ɑ Both i u Both æ ɑ Both
Front Back High Low
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A Vowel Duration Analysis (VDA): Corner Source: CS24

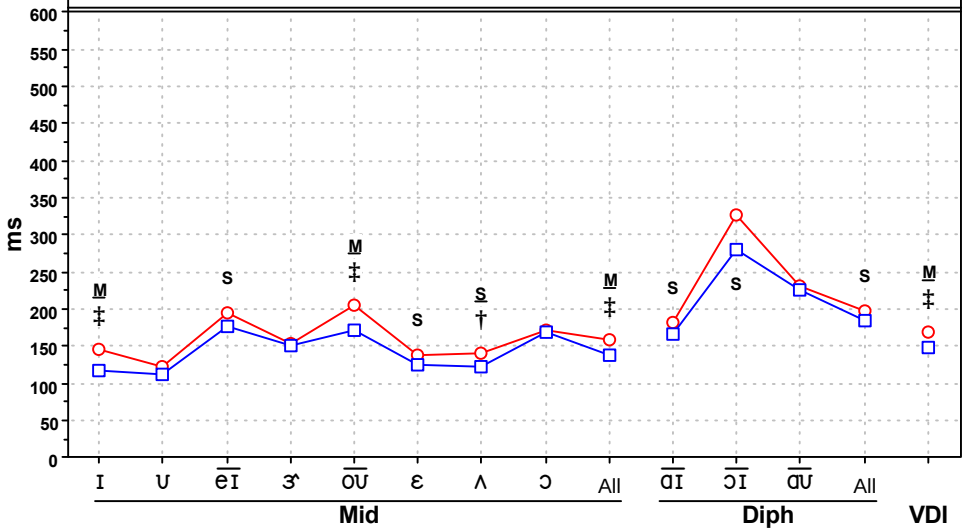
		No. of Tokens					Place ms		Height ms		VDI
		S† Front	S Back	S* High	S* Low	S† Total	S† Front	S* Back	S* High	S* Low	S†
S	*M*	9.7	7.3	7.6	9.4	17.0	172.8	172.9	164.7	178.5	172.6
	SD	3.9	2.8	3.1	3.8	5.7	56.5	73.4	67.7	57.0	54.2
N	*M*	11.7	8.1	8.9	10.9	19.8	155.0	156.6	147.1	162.0	155.7
	SD	4.7	2.9	3.6	4.0	6.4	41.0	44.1	47.4	40.5	35.9



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B Vowel Duration Analysis (VDA): Mid & Dph Source: CS24

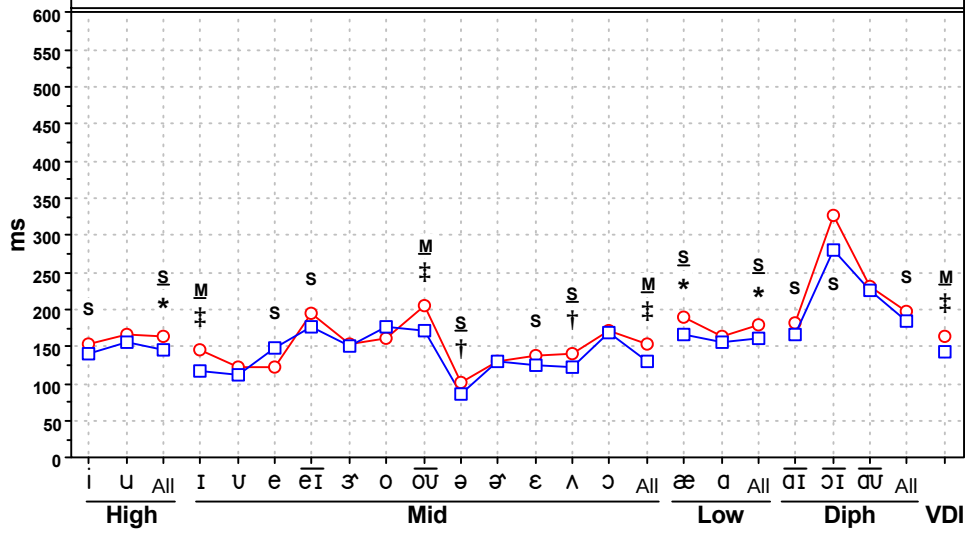
		No. of Tokens						Duration (ms)					VDI
		S† Mid	ɑɪ	ɔɪ	S ɑʊ	Dph	S* All	M‡ Mid	S ɑɪ	S ɔɪ	ɑʊ	S Dph	M‡
S	*M*	36	7	0	2	9	45	160	182	328	231	198	169
	SD	12	4	1	1	4	14	46	56	174	89	58	43
N	*M*	41	7	0	2	10	51	139	168	282	227	184	148
	SD	12	4	1	2	4	15	31	53	124	94	53	32



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C Vowel Duration Analysis (VDA): All Vwls & Dph Source: CS24

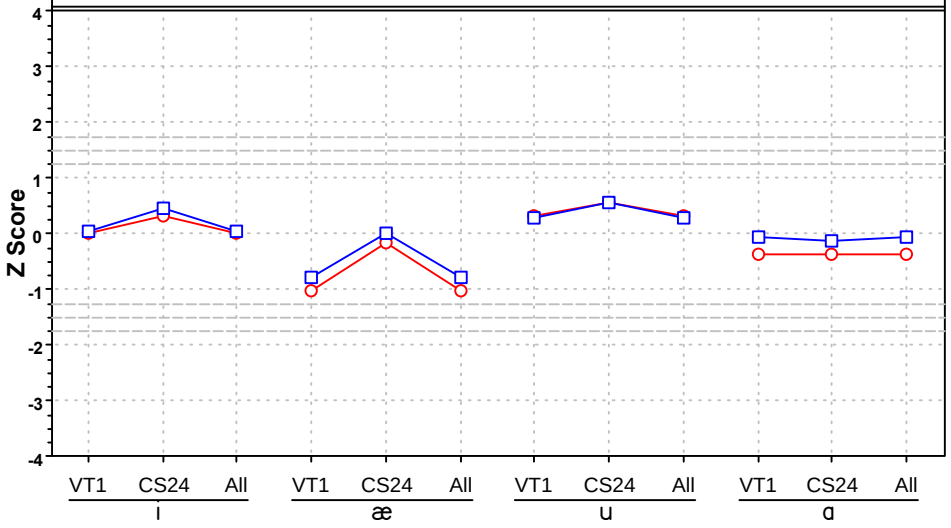
		No. of Tokens								Place ms			Height ms			Dph	VDI
		S† Frt	S† Cen	S Bak	S* Hi	S† Mid	S* Lo	Dph	S† All	M‡ Frt	S† Cen	S† Bak	S* Hi	M‡ Mid	S* Lo	S	M‡
S	*M*	29	13	17	8	43	9	9	69	161	127	177	165	153	178	198	165
	SD	10	6	5	3	14	4	4	20	42	39	55	68	43	57	58	41
N	*M*	34	16	19	9	50	11	10	79	140	112	160	147	132	162	184	144
	SD	11	7	5	4	15	4	4	22	33	31	39	47	29	41	53	30



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A Corner Vowel F1 Z Scores

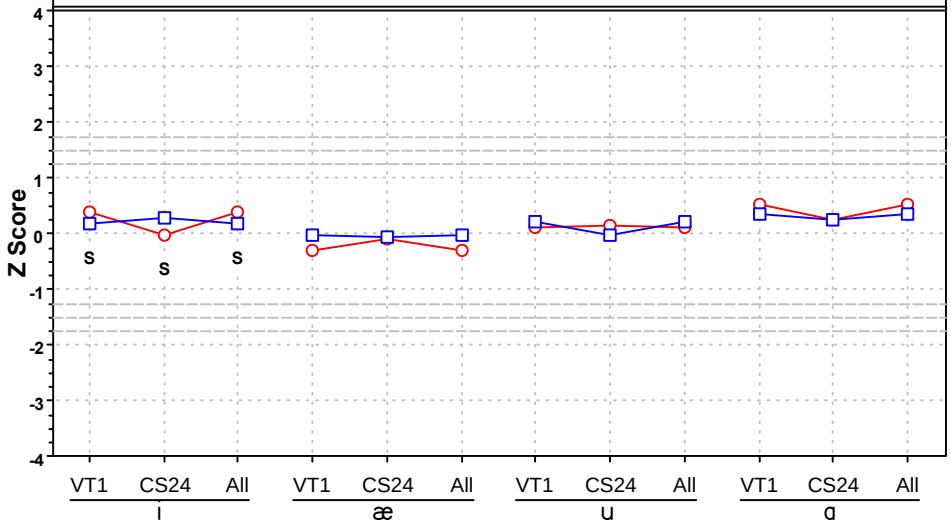
		i			æ			u			ɑ		
		VT1	CS24	All	VT1	CS24	All	VT1	CS24	All	VT1	CS24	All
○ S	*M*	0.02	0.32	0.02	-1.01	-0.16	-1.01	0.32	0.56	0.32	-0.37	-0.36	-0.37
	SD	0.79	1.43	0.79	1.70	1.64	1.70	1.03	1.38	1.03	1.58	1.69	1.58
□ N	*M*	0.06	0.46	0.06	-0.78	0.00	-0.78	0.29	0.56	0.29	-0.05	-0.13	-0.05
	SD	1.03	1.37	1.03	1.64	1.24	1.64	1.31	1.22	1.31	1.69	1.32	1.69



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

B Corner Vowel F2 Z Scores

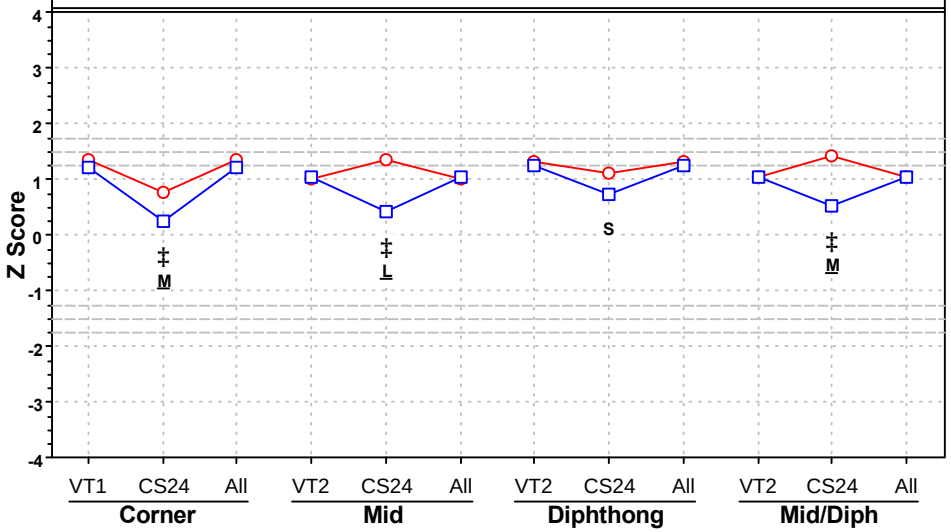
		i			æ			u			ɑ		
		$_{S}$VT1	$_{S}$CS24	$_{S}$All	VT1	CS24	All	VT1	CS24	All	VT1	CS24	All
○ S	*M*	0.41	-0.03	0.41	-0.29	-0.10	-0.29	0.13	0.15	0.13	0.54	0.25	0.54
	SD	1.09	1.70	1.09	1.76	1.30	1.76	1.06	1.64	1.06	1.16	1.16	1.16
□ N	*M*	0.18	0.30	0.18	-0.01	-0.03	-0.01	0.24	-0.03	0.24	0.37	0.25	0.37
	SD	1.01	1.23	1.01	1.40	1.02	1.40	1.27	1.58	1.27	1.17	1.34	1.17



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

C Vowel Duration Z Scores

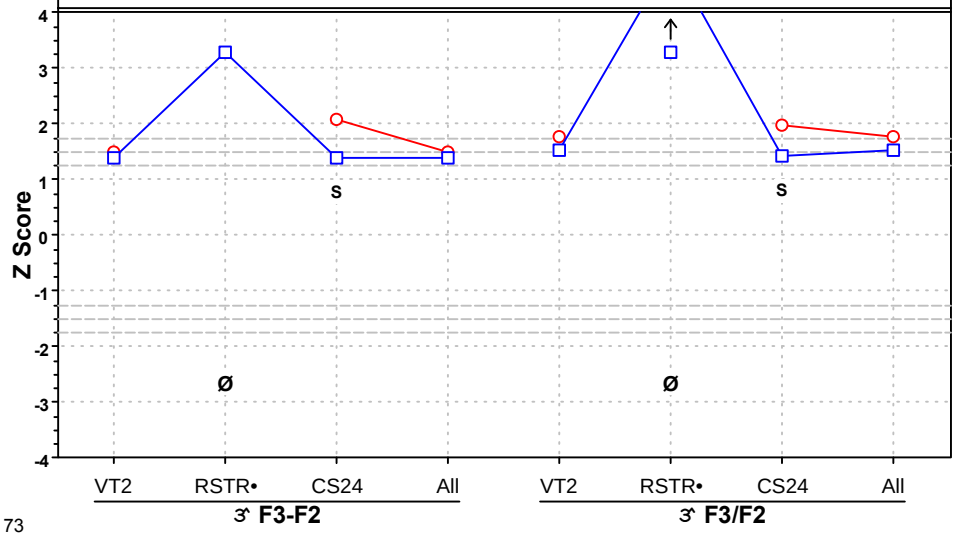
		Corner			Mid			Diphthong			Mid/Diph		
		VT1	M‡CS24	All	VT2	L‡CS24	All	VT2	$_{S}$CS24	All	VT2	M‡CS24	All
○ S	*M*	1.38	0.78	1.38	1.02	1.35	1.02	1.31	1.13	1.31	1.05	1.43	1.05
	SD	2.48	1.30	2.48	2.32	1.48	2.32	1.77	1.58	1.77	2.17	1.40	2.17
□ N	*M*	1.22	0.25	1.22	1.06	0.43	1.06	1.26	0.73	1.26	1.06	0.55	1.06
	SD	1.63	0.93	1.63	1.71	1.08	1.71	1.68	1.46	1.68	1.65	1.12	1.65



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

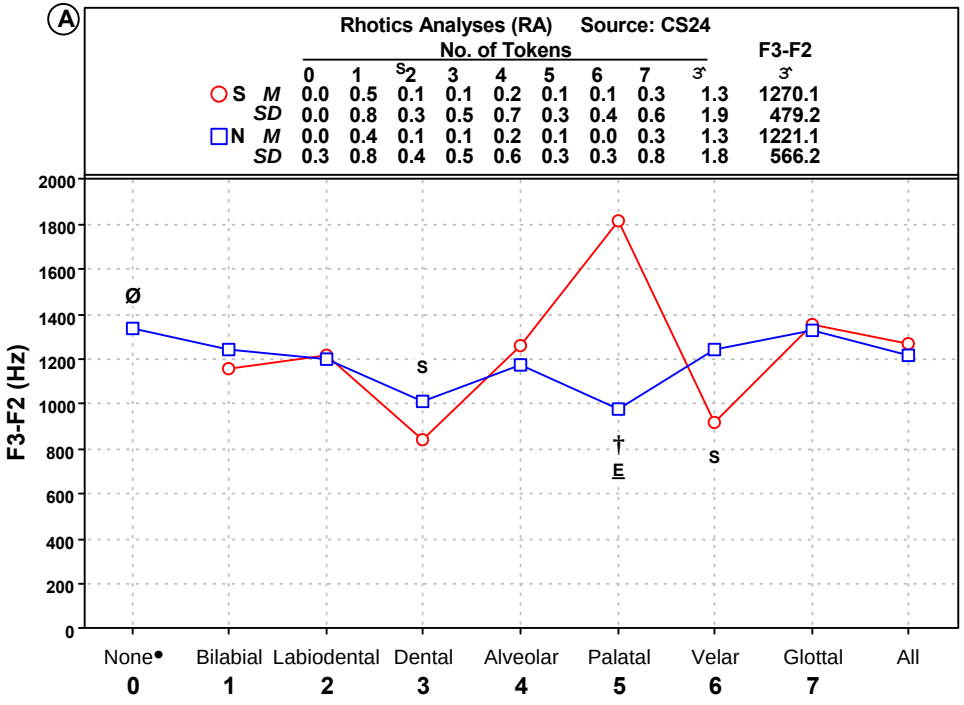
D Rhotics Z Scores

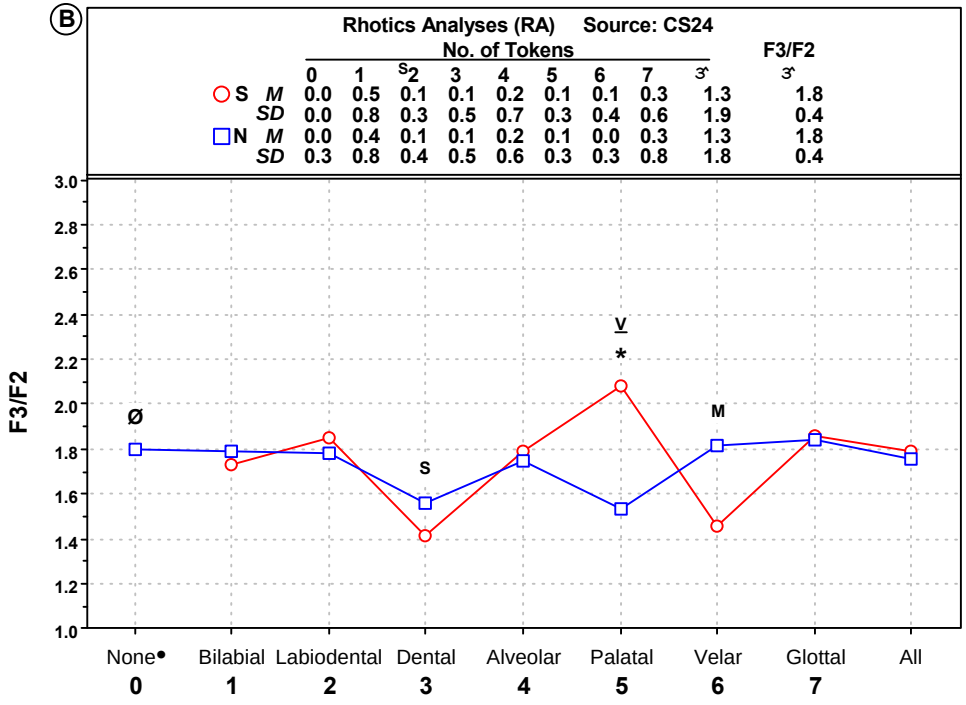
		ɝ F3-F2				ɝ F3/F2			
		VT2	Ø$_{RSTR}$	$_{S}$CS24	All	VT2	Ø$_{RSTR}$	$_{S}$CS24	All
○ S	*M*	1.51		2.10	1.51	1.79		1.97	1.79
	SD	1.72		2.14	1.72	2.12		2.16	2.12
□ N	*M*	1.41	3.30	1.40	1.41	1.54	5.00	1.43	1.54
	SD	1.79		1.81	1.79	1.99		1.92	1.99

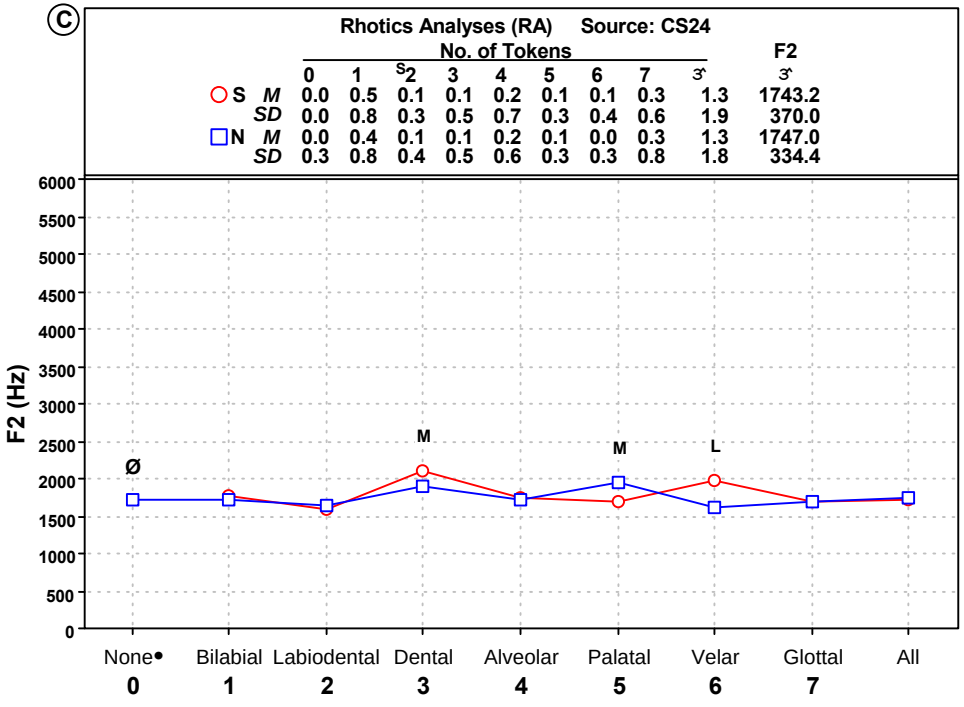


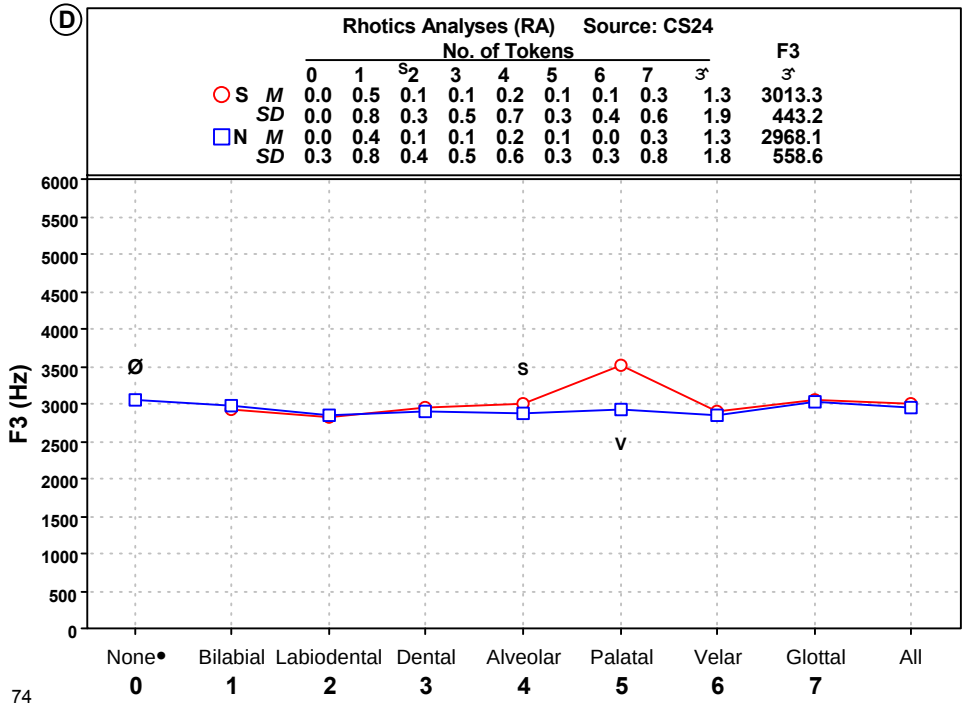
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

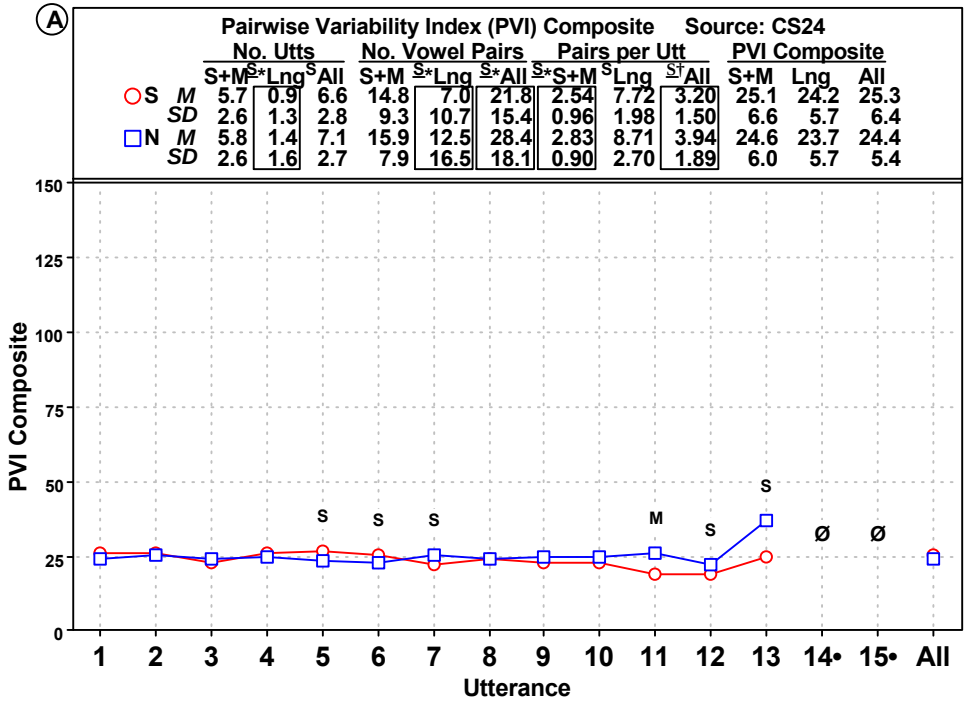
Vowel Profile 9, S and N

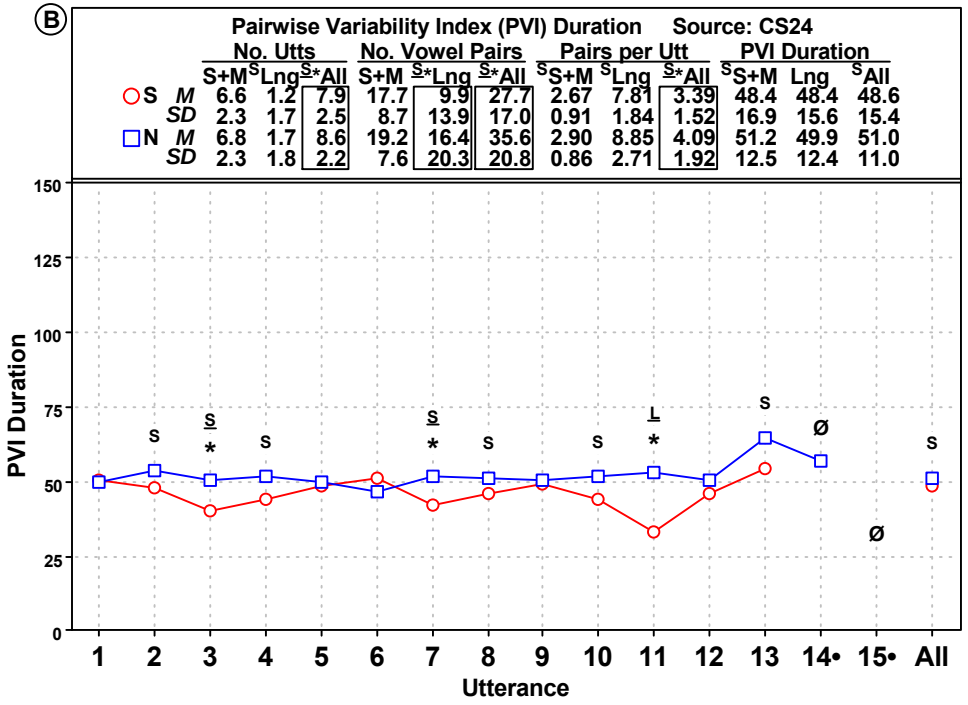

A
Rhotics Analyses (RA) Source: CS24
No. of Tokens
F3-F2
0 1 S2 3 4 5 6 7 ♂ ♂
S M 0.0 0.5 0.1 0.1 0.2 0.1 0.1 0.3 1.3 1270.1
SD 0.0 0.8 0.3 0.5 0.7 0.3 0.4 0.6 1.9 479.2
N M 0.0 0.4 0.1 0.1 0.2 0.1 0.0 0.3 1.3 1221.1
SD 0.3 0.8 0.4 0.5 0.6 0.3 0.3 0.8 1.8 566.2
F3-F2 (Hz)
2000 1800 1600 1400 1200 1000 800 600 400 200 0
Ø
S
†
E
S
None• Bilabial Labiodental Dental Alveolar Palatal Velar Glottal All
0 1 2 3 4 5 6 7
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

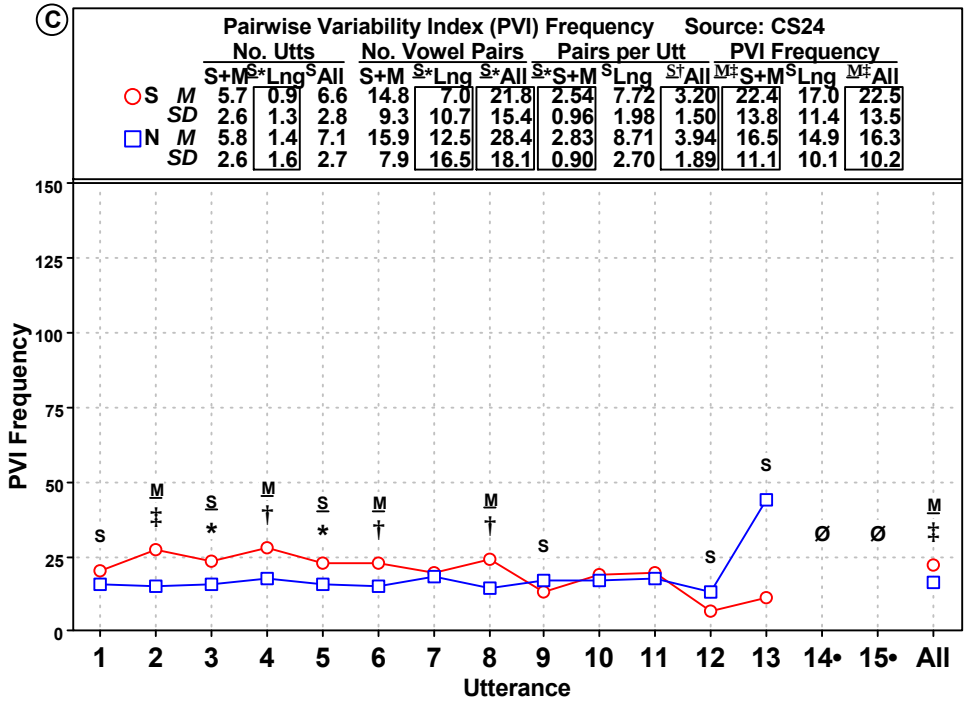

B
Rhotics Analyses (RA) Source: CS24
No. of Tokens
F3/F2
0 1 S2 3 4 5 6 7 ♂ ♂
S M 0.0 0.5 0.1 0.1 0.2 0.1 0.1 0.3 1.3 1.8
SD 0.0 0.8 0.3 0.5 0.7 0.3 0.4 0.6 1.9 0.4
N M 0.0 0.4 0.1 0.1 0.2 0.1 0.0 0.3 1.3 1.8
SD 0.3 0.8 0.4 0.5 0.6 0.3 0.3 0.8 1.8 0.4
F3/F2
3.0 2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0
Ø
S
V
*
M
None• Bilabial Labiodental Dental Alveolar Palatal Velar Glottal All
0 1 2 3 4 5 6 7
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

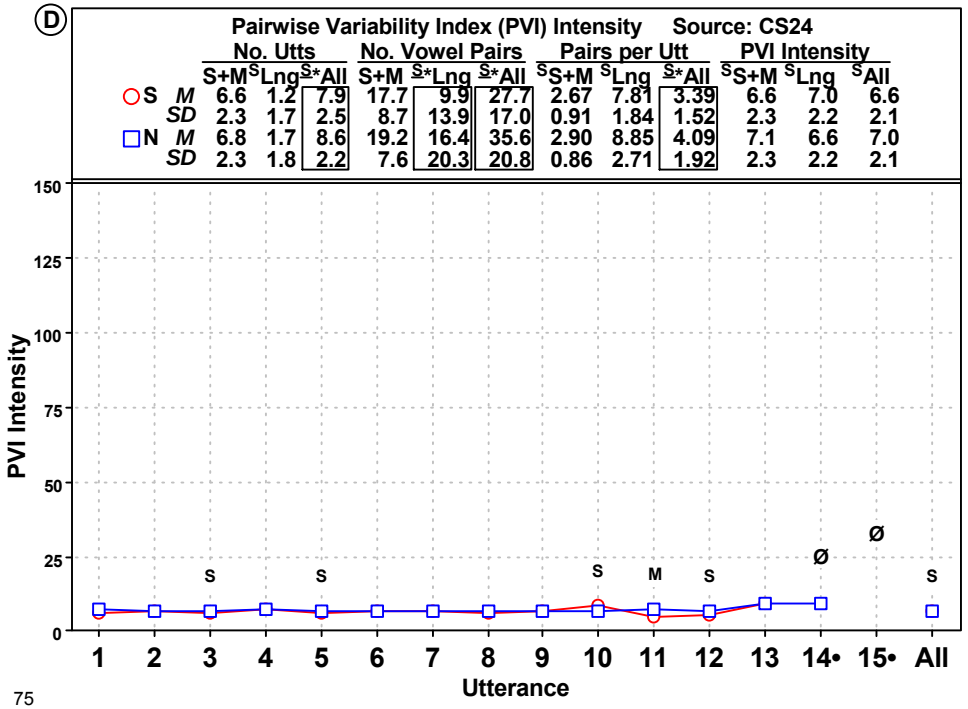

C
Rhotics Analyses (RA) Source: CS24
No. of Tokens
F2
0 1 S2 3 4 5 6 7 ♂ ♂
S M 0.0 0.5 0.1 0.1 0.2 0.1 0.1 0.3 1.3 1743.2
SD 0.0 0.8 0.3 0.5 0.7 0.3 0.4 0.6 1.9 370.0
N M 0.0 0.4 0.1 0.1 0.2 0.1 0.0 0.3 1.3 1747.0
SD 0.3 0.8 0.4 0.5 0.6 0.3 0.3 0.8 1.8 334.4
F2 (Hz)
6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
Ø
M
M
L
None• Bilabial Labiodental Dental Alveolar Palatal Velar Glottal All
0 1 2 3 4 5 6 7
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


D
Rhotics Analyses (RA) Source: CS24
No. of Tokens
F3
0 1 S2 3 4 5 6 7 ♂ ♂
S M 0.0 0.5 0.1 0.1 0.2 0.1 0.1 0.3 1.3 3013.3
SD 0.0 0.8 0.3 0.5 0.7 0.3 0.4 0.6 1.9 443.2
N M 0.0 0.4 0.1 0.1 0.2 0.1 0.0 0.3 1.3 2968.1
SD 0.3 0.8 0.4 0.5 0.6 0.3 0.3 0.8 1.8 558.6
F3 (Hz)
6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
Ø
S
V
None• Bilabial Labiodental Dental Alveolar Palatal Velar Glottal All
0 1 2 3 4 5 6 7
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

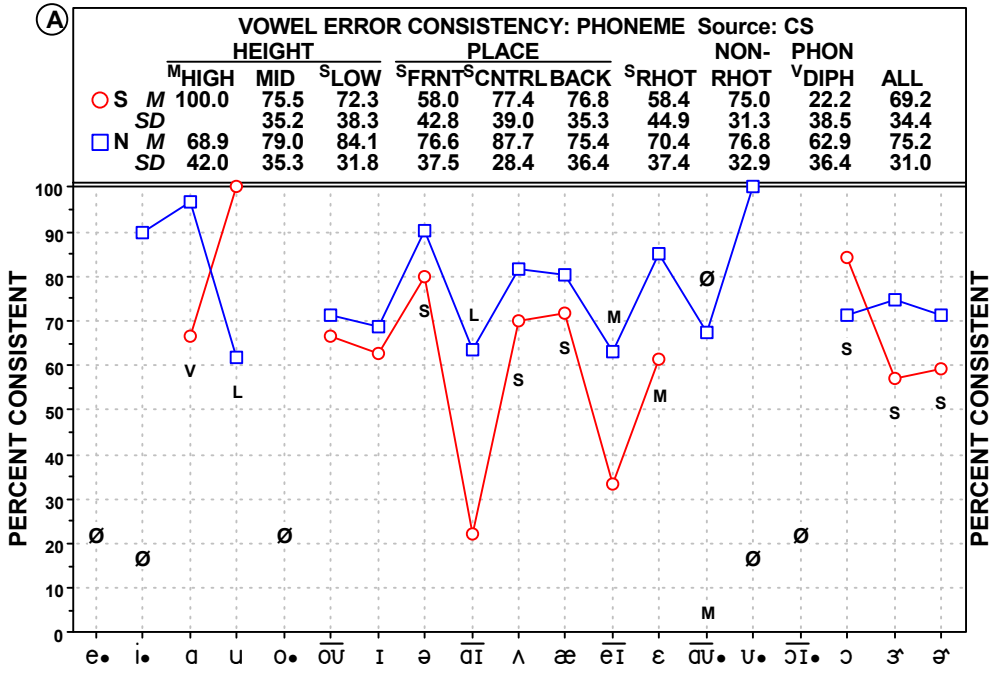


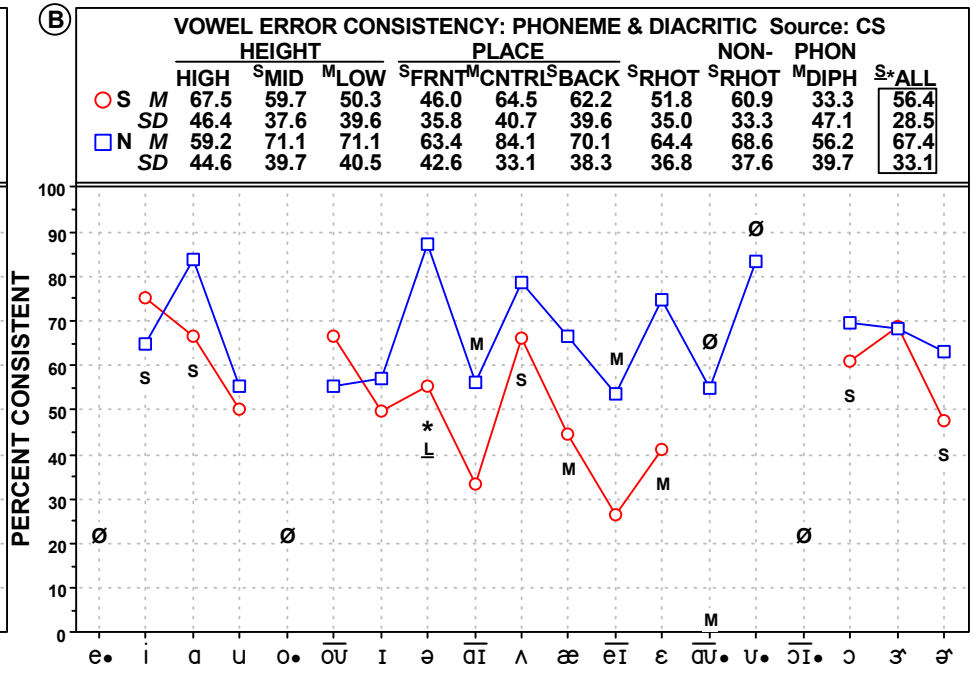


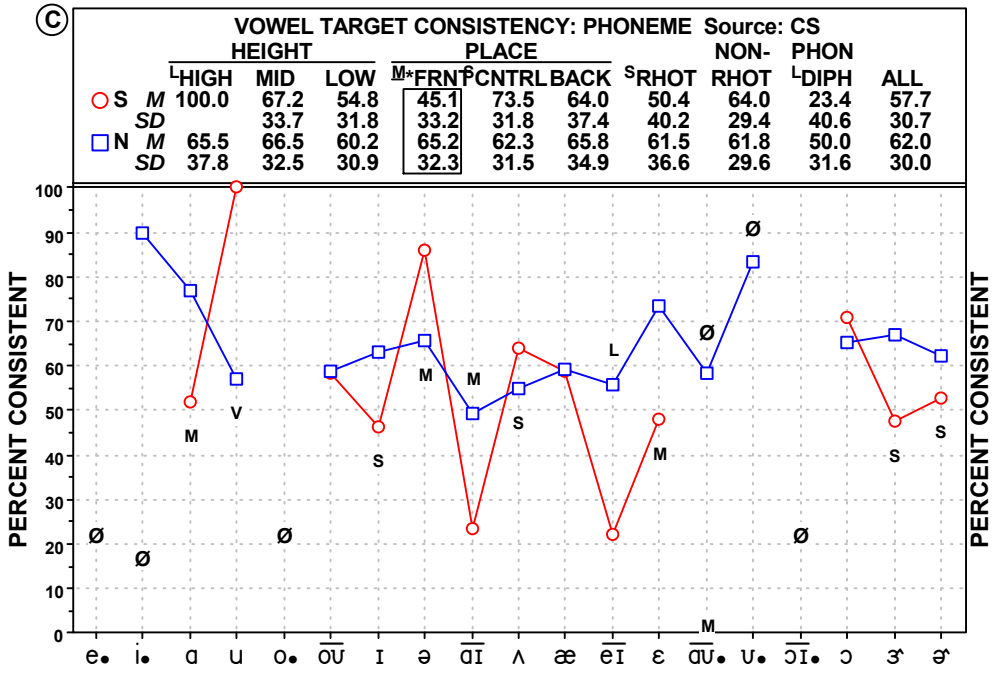


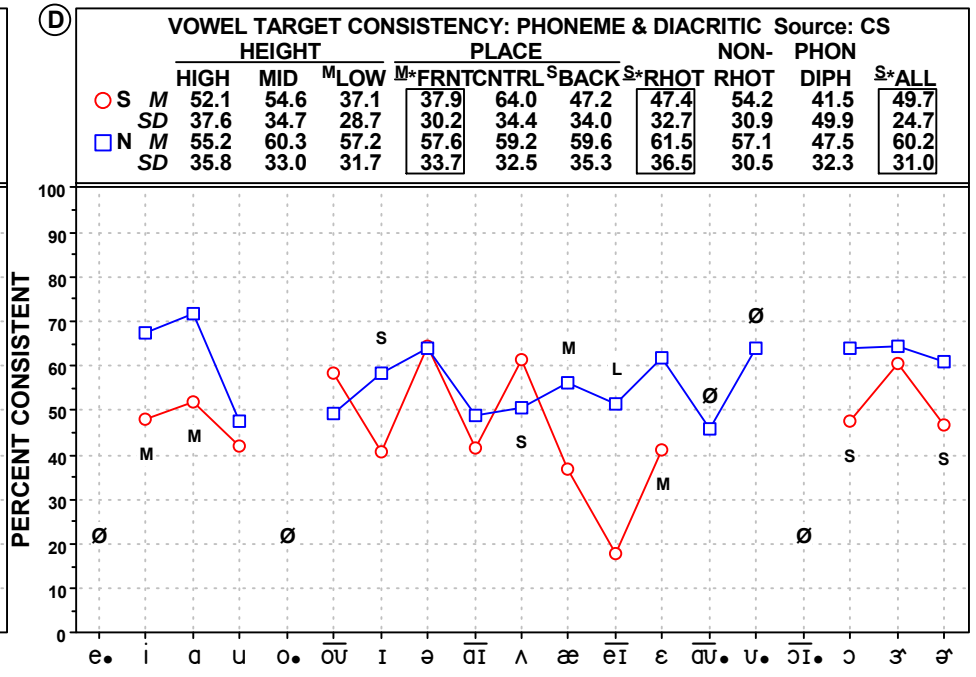


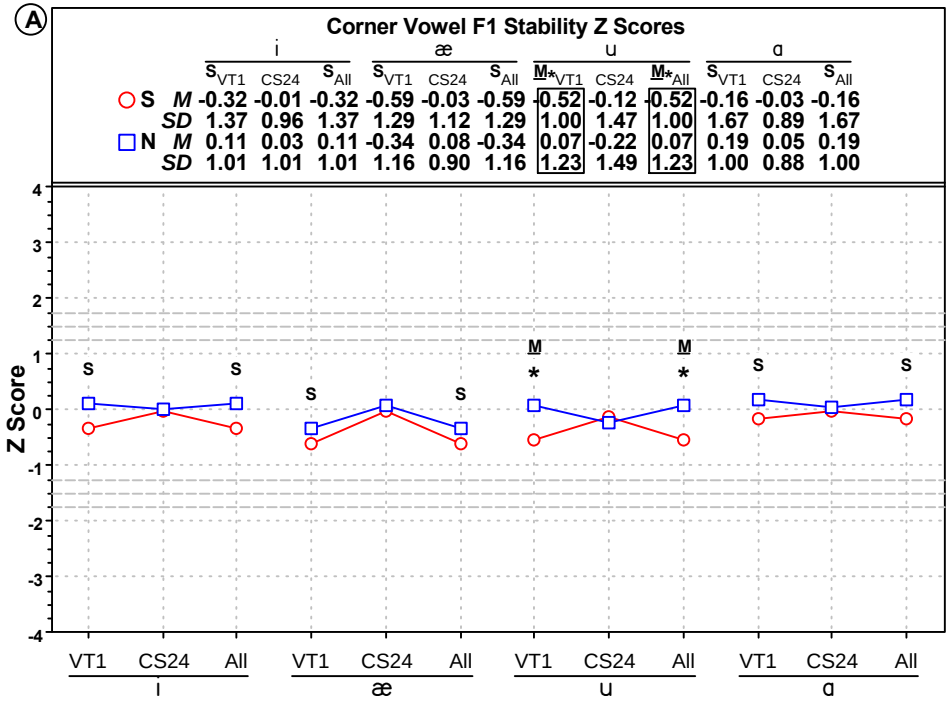
Vowel Profile 11, S and N


A
VOWEL ERROR CONSISTENCY: PHONEME Source: CS
HEIGHT PLACE NON- PHON
MHIGH MID SLOW SFRNT SCNTRL BACK SRHOT RHOT VDIPH ALL
S M 100.0 75.5 72.3 58.0 77.4 76.8 58.4 75.0 22.2 69.2
SD 35.2 38.3 42.8 39.0 35.3 44.9 31.3 38.5 34.4
N M 68.9 79.0 84.1 76.6 87.7 75.4 70.4 76.8 62.9 75.2
SD 42.0 35.3 31.8 37.5 28.4 36.4 37.4 32.9 36.4 31.0
PERCENT CONSISTENT
e• i• ɑ u o• oʊ ɪ ə ɑɪ ʌ æ eɪ ɛ ɑʊ• ʊ• ɔɪ• ɔ ɝ ɚ
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

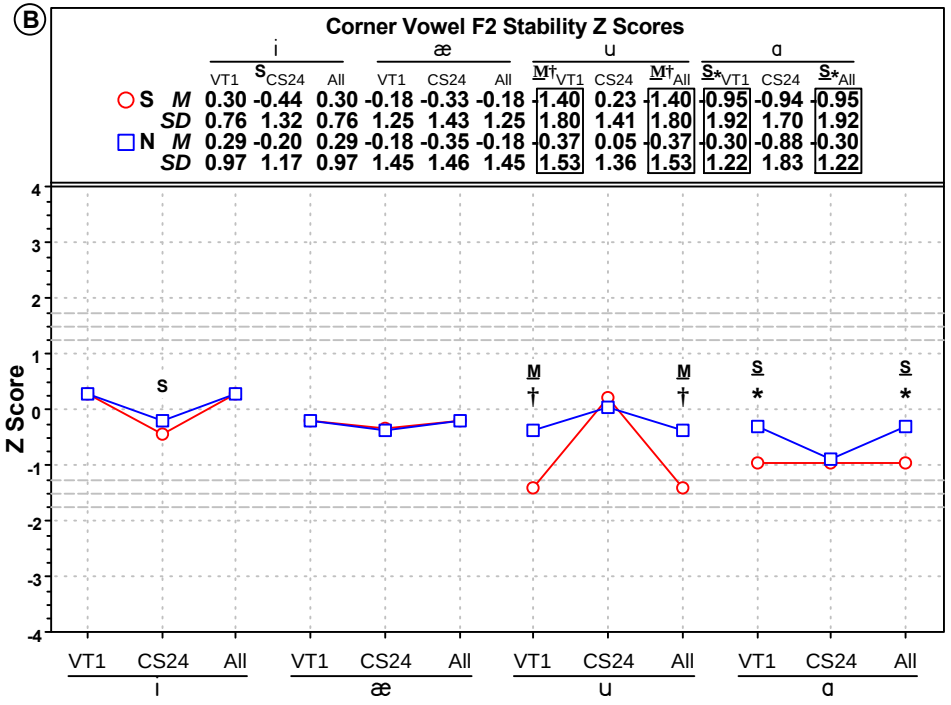

B
VOWEL ERROR CONSISTENCY: PHONEME & DIACRITIC Source: CS
HEIGHT PLACE NON- PHON
HIGH SMID MLOW SFRNT MCNTRL SBACK SRHOT SRHOT MDIPH S*ALL
S M 67.5 59.7 50.3 46.0 64.5 62.2 51.8 60.9 33.3 56.4
SD 46.4 37.6 39.6 35.8 40.7 39.6 35.0 33.3 47.1 28.5
N M 59.2 71.1 71.1 63.4 84.1 70.1 64.4 68.6 56.2 67.4
SD 44.6 39.7 40.5 42.6 33.1 38.3 36.8 37.6 39.7 33.1
PERCENT CONSISTENT
e• i ɑ u o• oʊ ɪ ə ɑɪ ʌ æ eɪ ɛ ɑʊ• ʊ• ɔɪ• ɔ ɝ ɚ
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


C
VOWEL TARGET CONSISTENCY: PHONEME Source: CS
HEIGHT PLACE NON- PHON
LHIGH MID LOW MFRNT SCNTRL BACK SRHOT RHOT LDIPH ALL
S M 100.0 67.2 54.8 45.1 73.5 64.0 50.4 64.0 23.4 57.7
SD 33.7 31.8 33.2 31.8 37.4 40.2 29.4 40.6 30.7
N M 65.5 66.5 60.2 65.2 62.3 65.8 61.5 61.8 50.0 62.0
SD 37.8 32.5 30.9 32.3 31.5 34.9 36.6 29.6 31.6 30.0
PERCENT CONSISTENT
e• i• ɑ u o• oʊ ɪ ə ɑɪ ʌ æ eɪ ɛ ɑʊ• ʊ• ɔɪ• ɔ ɝ ɚ
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

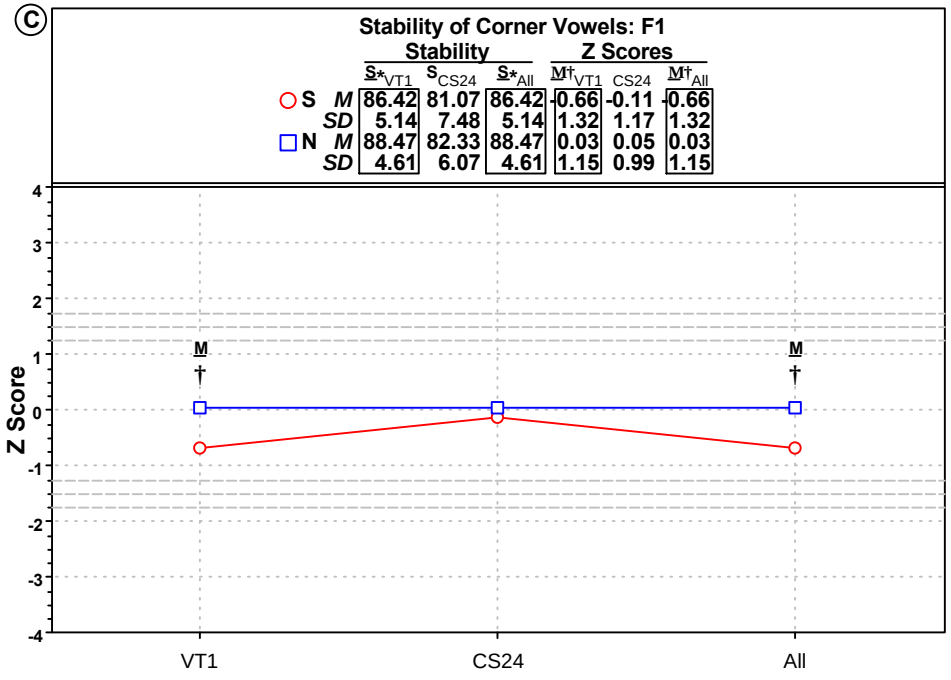

D
VOWEL TARGET CONSISTENCY: PHONEME & DIACRITIC Source: CS
HEIGHT PLACE NON- PHON
HIGH MID MLOW MFRNT CNTRL SBACK S*RHOT RHOT DIPH S*ALL
S M 52.1 54.6 37.1 37.9 64.0 47.2 47.4 54.2 41.5 49.7
SD 37.6 34.7 28.7 30.2 34.4 34.0 32.7 30.9 49.9 24.7
N M 55.2 60.3 57.2 57.6 59.2 59.6 61.5 57.1 47.5 60.2
SD 35.8 33.0 31.7 33.7 32.5 35.3 36.5 30.5 32.3 31.0
PERCENT CONSISTENT
e• i ɑ u o• oʊ ɪ ə ɑɪ ʌ æ eɪ ɛ ɑʊ• ʊ• ɔɪ• ɔ ɝ ɚ
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data



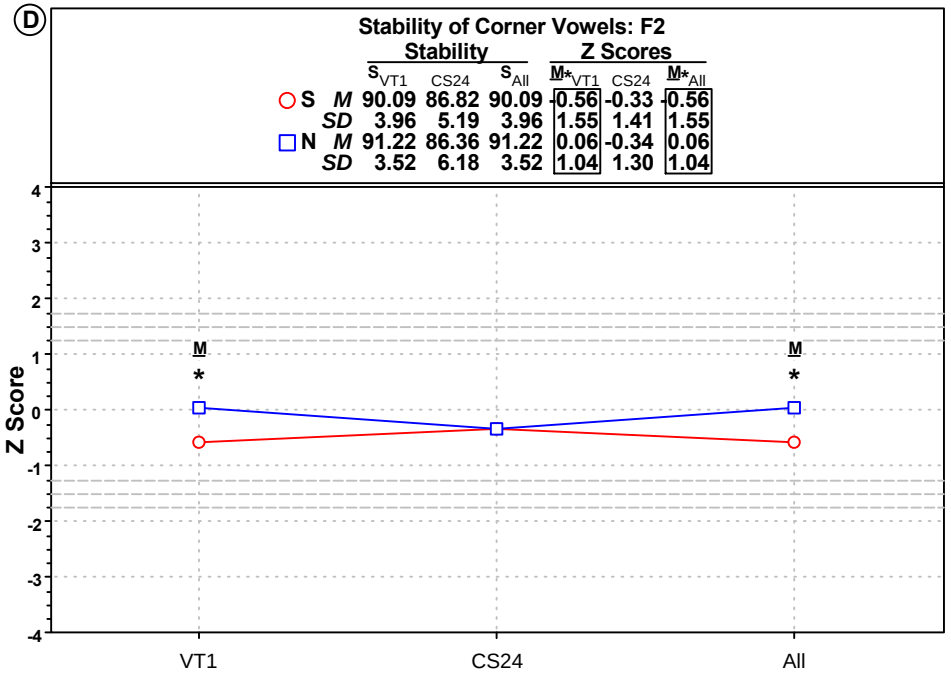
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



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



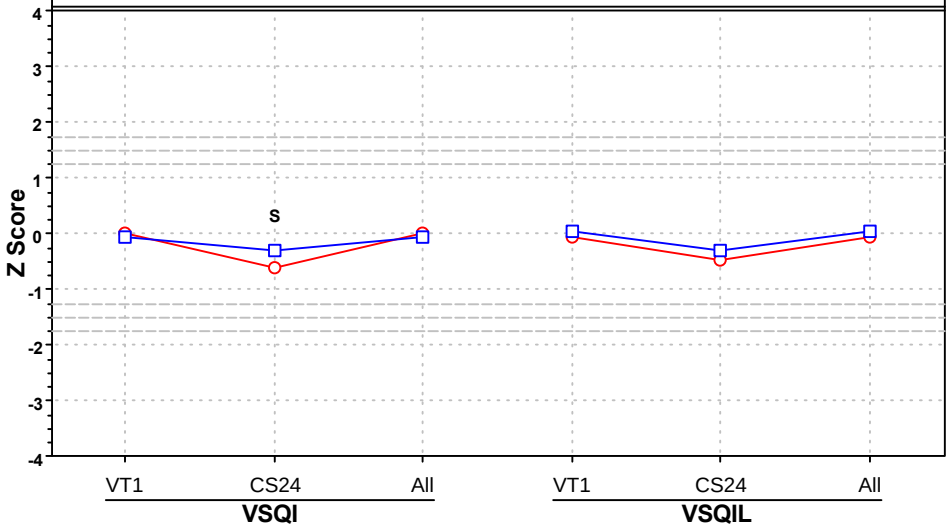
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



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

E — Vowel Space Quadrilateral Stability

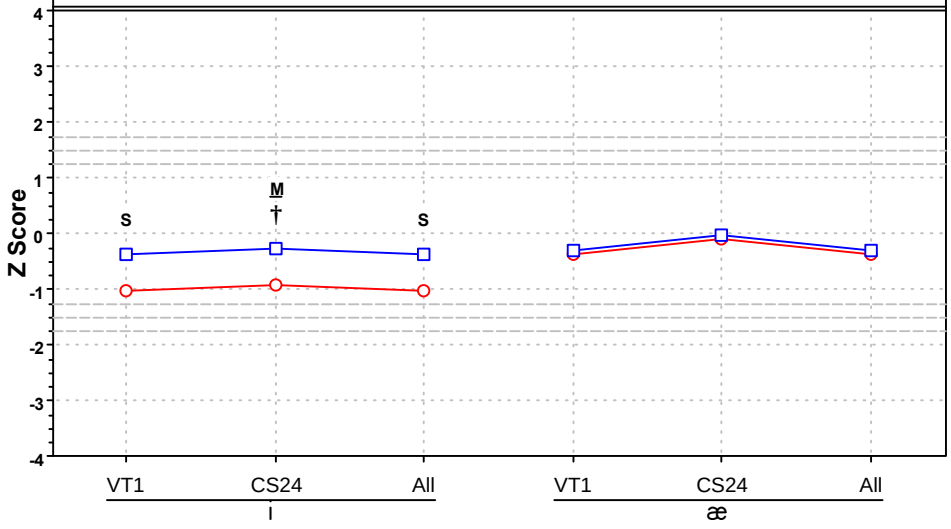
		VSQI			VSQIL			Z VSQI			Z VSQIL		
		VT1	M†CS24	All	VT1	CS24	All	VT1	SCS24	All	VT1	CS24	All
S	*M*	74	229	74	72	13	72	0.01	-0.61	0.01	-0.05	-0.47	-0.05
	SD	15	1462	15	14	111	14	0.91	1.69	0.91	0.90	1.58	0.90
N	*M*	61	26	61	72	23	72	-0.04	-0.30	-0.04	0.04	-0.30	0.04
	SD	127	122	127	21	152	21	1.08	1.38	1.08	0.93	1.44	0.93



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

F — Distance from Center Stability

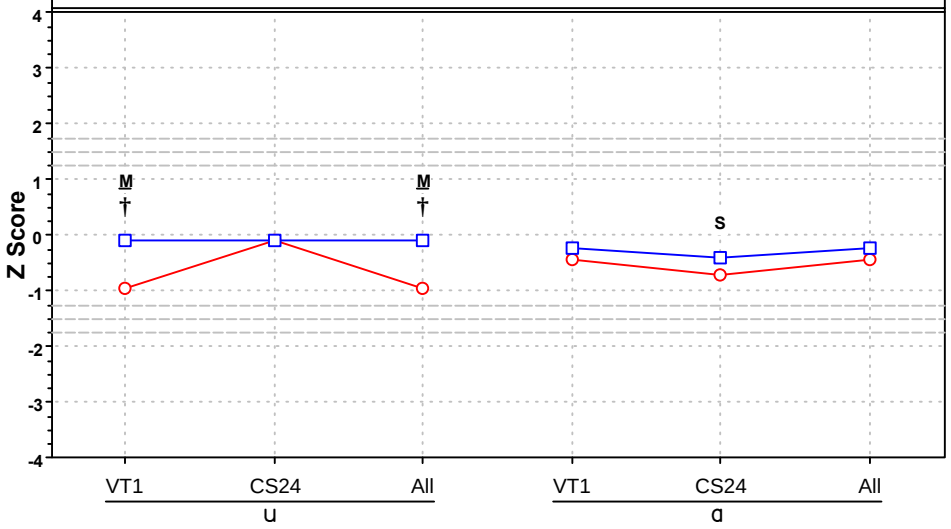
		i			æ			Z i			Z æ		
		VT1	S*CS24	All	VT1	CS24	All	SVT1	M†CS24	SAll	VT1	CS24	All
S	*M*	77	58	77	69	56	69	-1.02	-0.90	-1.02	-0.38	-0.09	-0.38
	SD	16	27	16	17	33	17	1.76	1.52	1.76	0.93	1.71	0.93
N	*M*	79	68	79	71	58	71	-0.36	-0.27	-0.36	-0.30	-0.03	-0.30
	SD	18	22	18	17	24	17	1.66	1.15	1.66	1.24	1.27	1.24



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

G — Distance from Center Stability

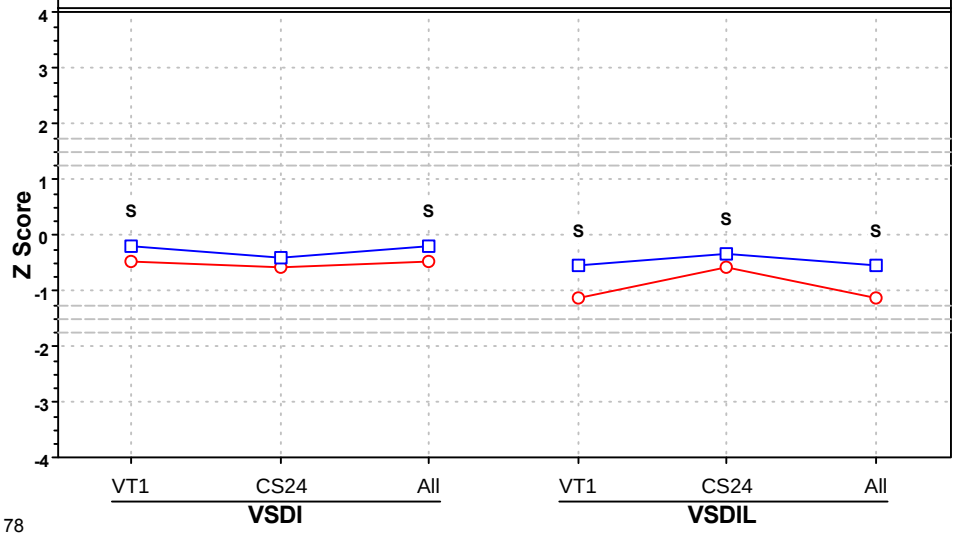
		u			ɑ			Z u			Z ɑ		
		SVT1	CS24	SAll	SVT1	CS24	SAll	M†VT1	CS24	M†All	VT1	SCS24	All
S	*M*	68	56	68	82	65	82	-0.95	-0.08	-0.95	-0.42	-0.72	-0.42
	SD	17	25	17	17	21	17	1.56	1.25	1.56	1.73	1.45	1.73
N	*M*	74	56	74	85	68	85	-0.10	-0.07	-0.10	-0.22	-0.41	-0.22
	SD	16	28	16	9	21	9	1.39	1.34	1.39	1.18	1.21	1.18



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

H — Distance from Center Stability

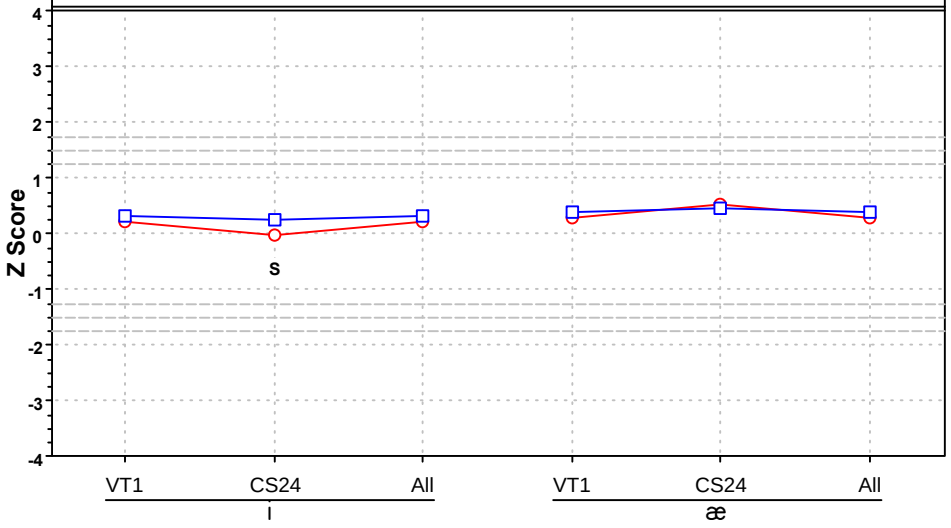
		VSDI			VSDIL			Z VSDI			Z VSDIL		
		SVT1	CS24	SAll	SVT1	CS24	SAll	SVT1	CS24	SAll	SVT1	SCS24	SAll
S	*M*	54	49	54	69	58	69	-0.46	-0.55	-0.46	-1.14	-0.55	-1.14
	SD	8	15	8	10	12	10	0.82	1.61	0.82	1.63	1.20	1.63
N	*M*	57	49	57	72	59	72	-0.19	-0.39	-0.19	-0.55	-0.32	-0.55
	SD	9	12	9	10	11	10	1.08	1.25	1.08	1.63	1.10	1.63



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

(I) Corner Vowel Duration Stability

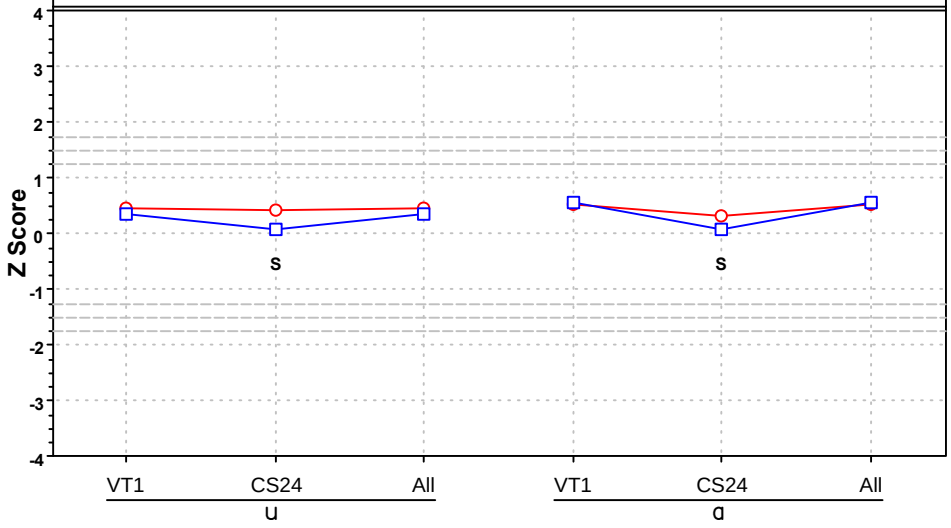
		i			æ			Z i			Z æ		
		VT1	CS24	All	s_{VT1}	CS24	s_{All}	VT1	s_{CS24}	All	VT1	CS24	All
○ S	*M*	83	55	83	86	59	86	0.23	-0.02	0.23	0.28	0.53	0.28
	SD	8	26	8	8	19	8	0.79	1.47	0.79	1.31	0.91	1.31
□ N	*M*	84	56	84	84	58	84	0.33	0.27	0.33	0.38	0.45	0.38
	SD	9	21	9	10	20	10	0.93	1.16	0.93	0.87	0.92	0.87



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

(J) Corner Vowel Duration Stability

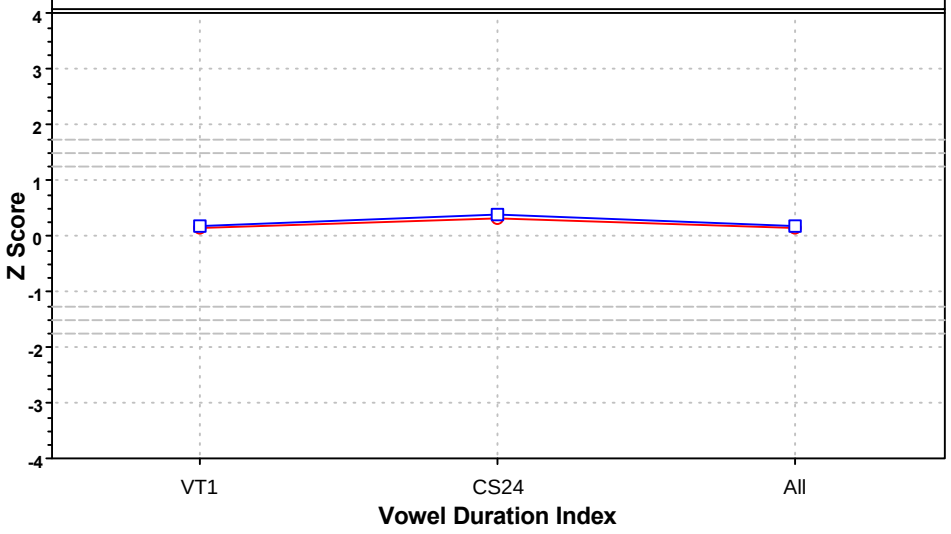
		u			ɑ			Z u			Z ɑ		
		VT1	s_{CS24}	All	VT1	CS24	All	VT1	s_{CS24}	All	VT1	s_{CS24}	All
○ S	*M*	83	61	83	86	66	86	0.47	0.44	0.47	0.54	0.34	0.54
	SD	11	25	11	12	20	12	1.07	0.95	1.07	1.76	1.24	1.76
□ N	*M*	83	55	83	84	62	84	0.37	0.09	0.37	0.58	0.10	0.58
	SD	11	24	11	9	19	9	1.10	1.21	1.10	1.17	1.16	1.17



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

(K) Corner Vowel Duration Stability

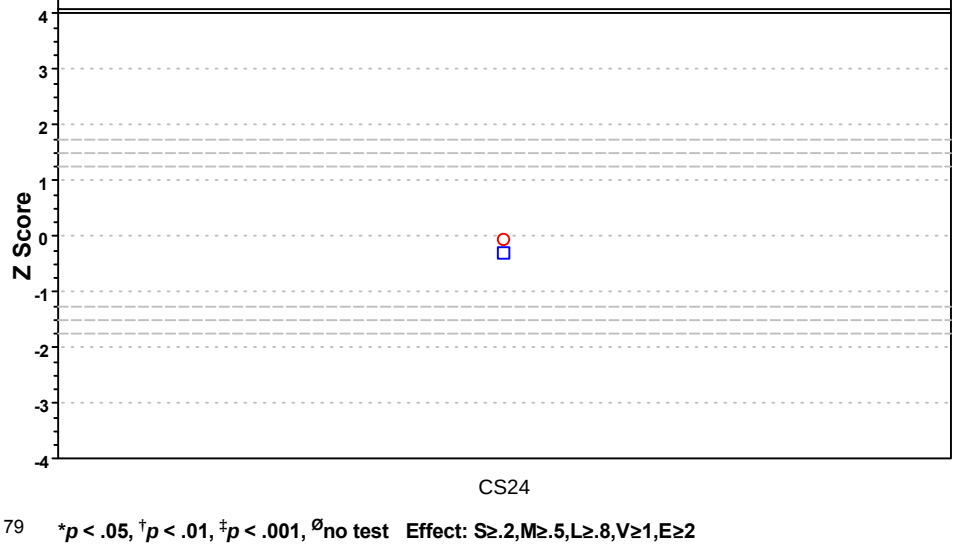
		VDI			Z VDI		
		VT1	CS24	All	VT1	CS24	All
○ S	*M*	76	49	76	0.15	0.33	0.15
	SD	10	18	10	1.48	1.00	1.48
□ N	*M*	75	49	75	0.19	0.40	0.19
	SD	6	16	6	0.82	0.77	0.82



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

(L) Vowel Duration Stability_B

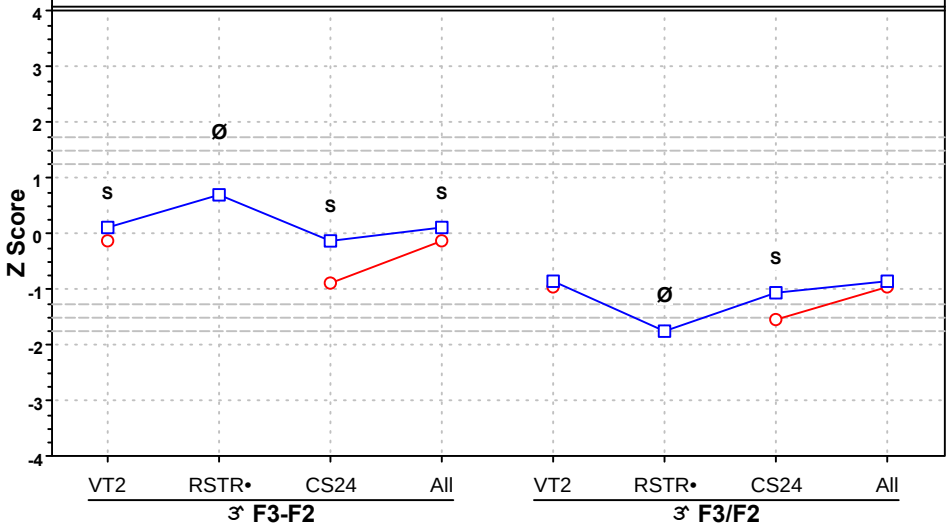
		PVI	Z Scores
		CS24	CS24
○ S	*M*	25.3	-0.06
	SD	6.4	1.81
□ N	*M*	24.4	-0.29
	SD	5.4	1.56



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

M Rhotics Stability Z Scores

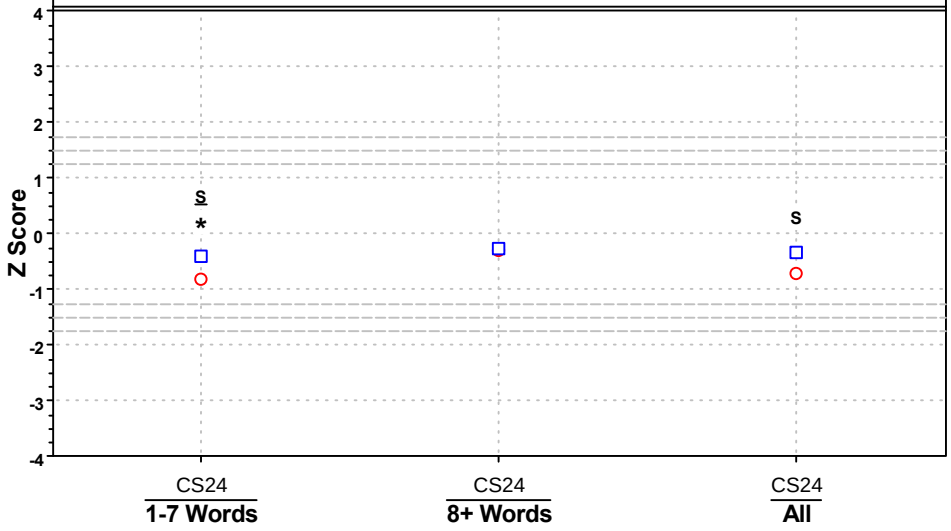
		F3-F2 VT2	F3-F2 ØRSTR	F3-F2 SCS24	F3-F2 SAll	F3/F2 VT2	F3/F2 ØRSTR	F3/F2 SCS24	F3/F2 All
S	M	-0.12		-0.89	-0.12	-0.95		-1.55	-0.95
	SD	0.83		2.27	0.83	1.65		2.27	1.65
N	M	0.12	0.71	-0.12	0.12	-0.85	-1.75	-1.06	-0.85
	SD	0.82		1.93	0.82	1.47		2.00	1.47



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

N Pairwise Vowel Variability

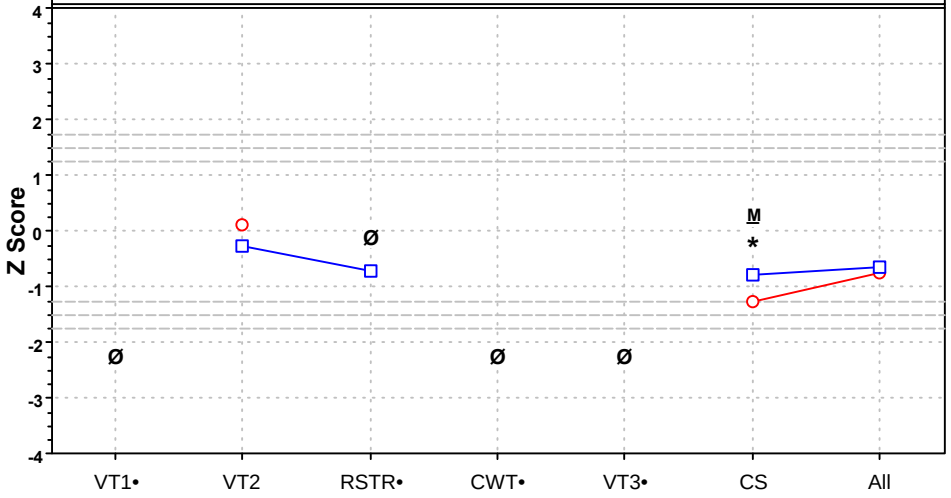
		1-7 Words SCS24	8+ Words CS24	All SCS24	Z 1-7 S*CS24	Z 8+ CS24	Z All SCS24
S	M	48.43	48.45	48.59	-0.83	-0.31	-0.72
	SD	16.86	15.64	15.42	1.46	1.56	1.61
N	M	51.21	49.93	50.98	-0.41	-0.26	-0.34
	SD	12.46	12.43	11.01	1.23	1.26	1.23



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

O Word Type Vowel Target Consistency

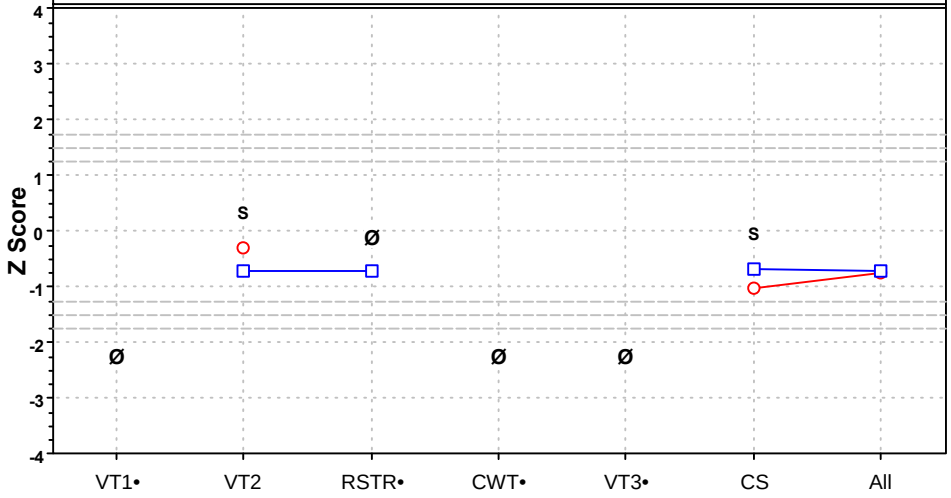
		Consistency SVT1	VT2	ØRSTR	CWT	ØVT3	CS	All	Z Scores ØVT1	VT2	ØRSTR	ØCWT	ØVT3	M*CS	All
S	M	50	51		60		58	57		0.11				-1.26	-0.75
	SD	28	26		25		31	28		2.67				0.89	1.86
N	M	57	55	17	58		62	60		-0.26	-0.71			-0.78	-0.63
	SD	29	27		23		30	27		2.44				0.87	1.49



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

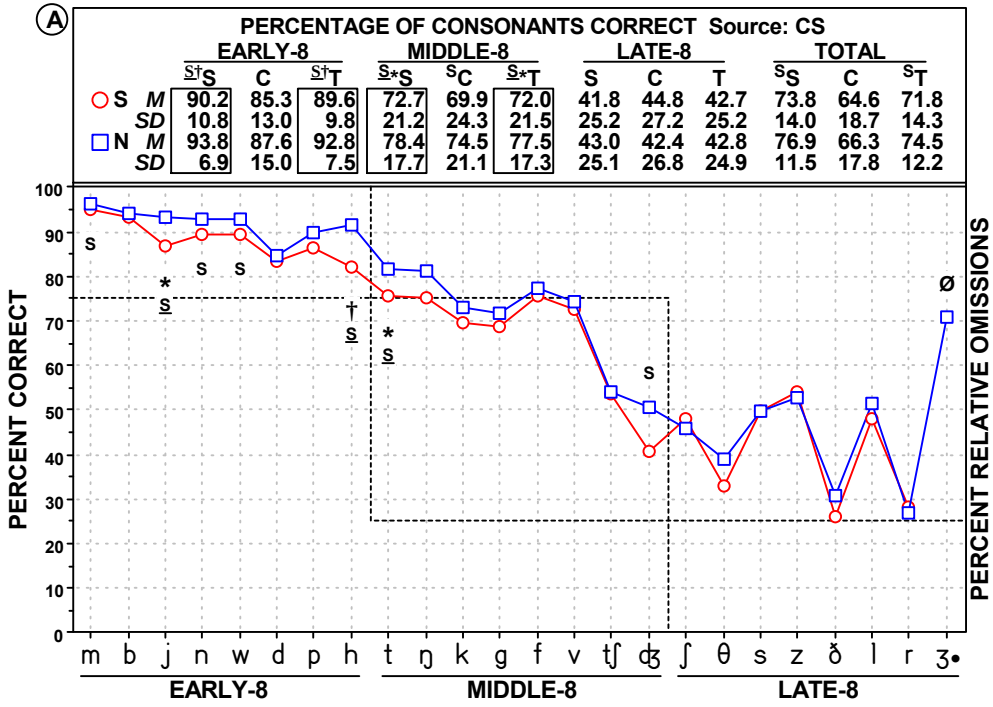
P Word Type Vowel Error Consistency

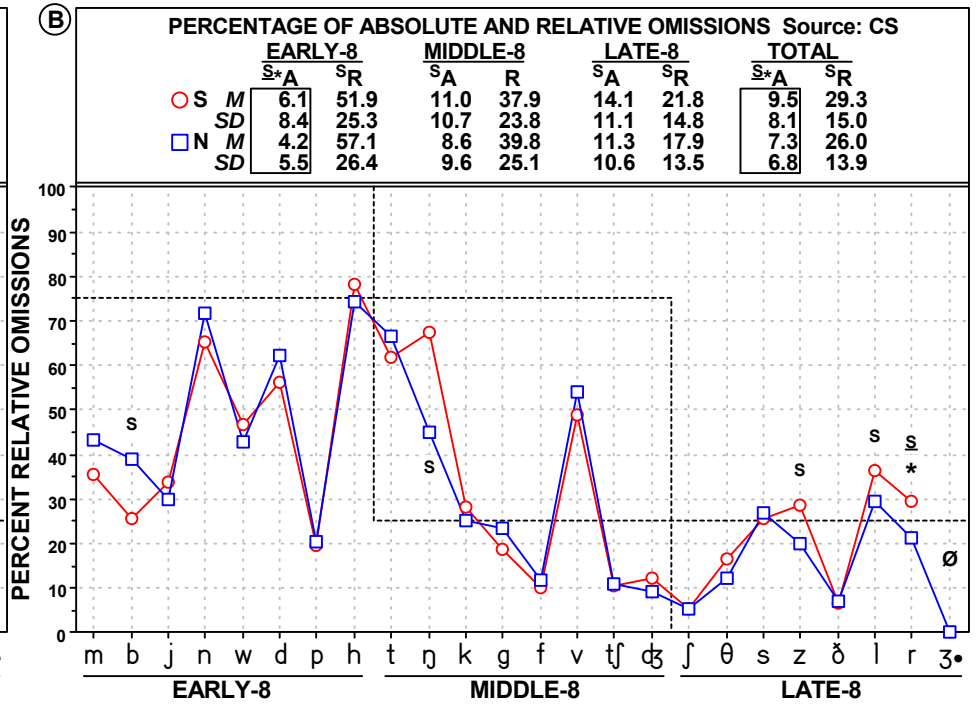
		Consistency SVT1	VT2	ØRSTR	SCWT	ØVT3	CS	All	Z Scores ØVT1	SVT2	ØRSTR	ØCWT	ØVT3	SCS	All
S	M	83	84		79		69	76		-0.28				-1.01	-0.74
	SD	41	29		21		34	31		0.83				1.03	1.01
N	M	95	78	0	73		75	76		-0.72	-0.71			-0.69	-0.69
	SD	21	28		24		31	28		1.47				1.00	1.15

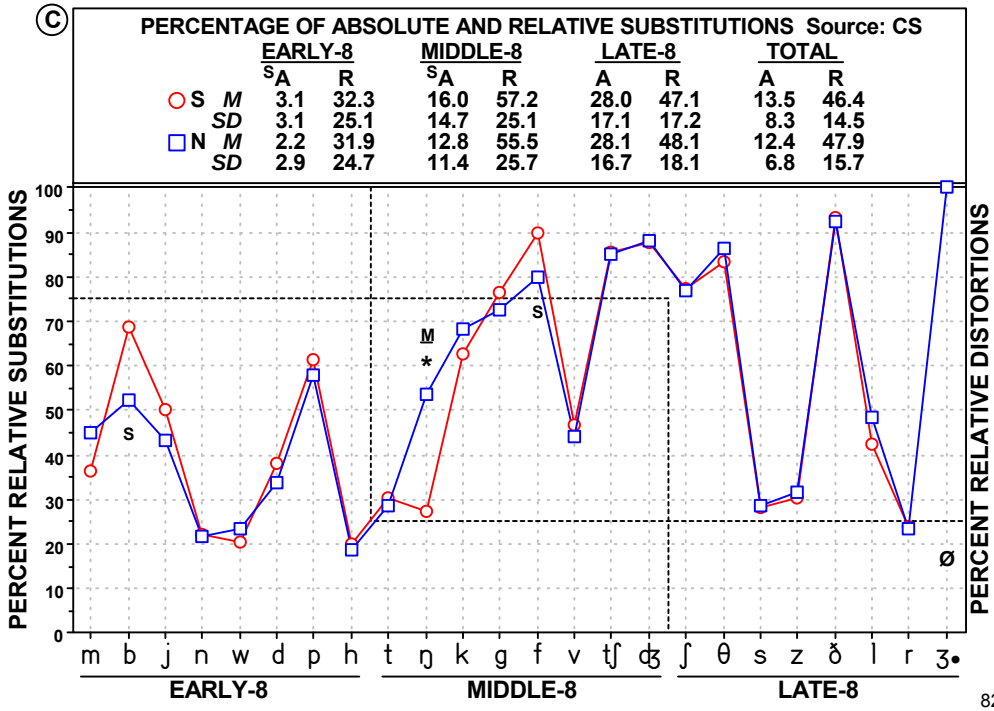


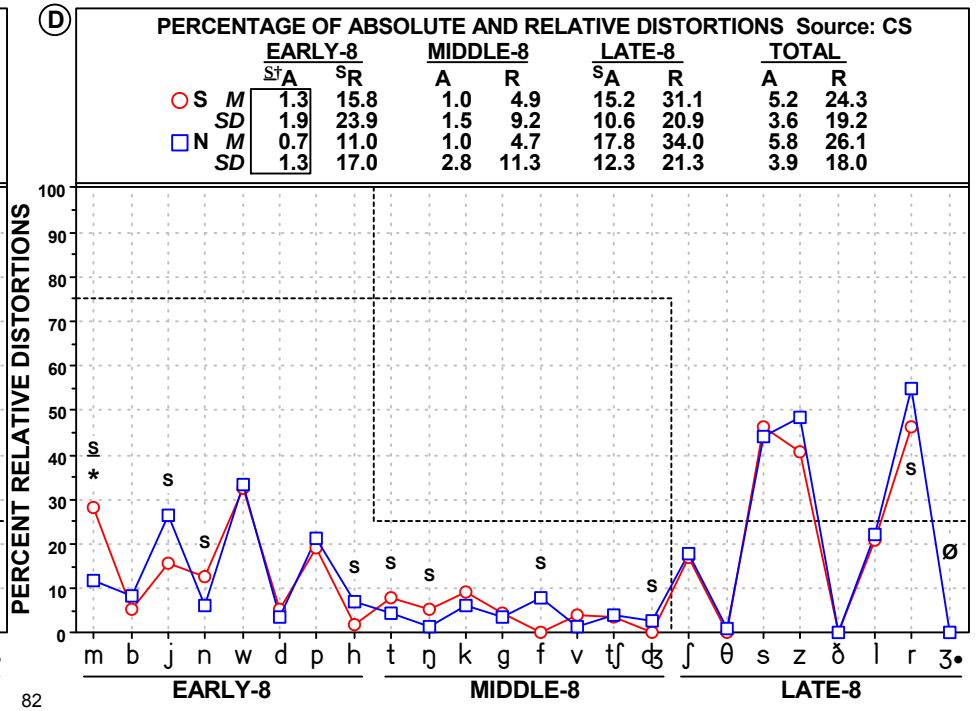
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

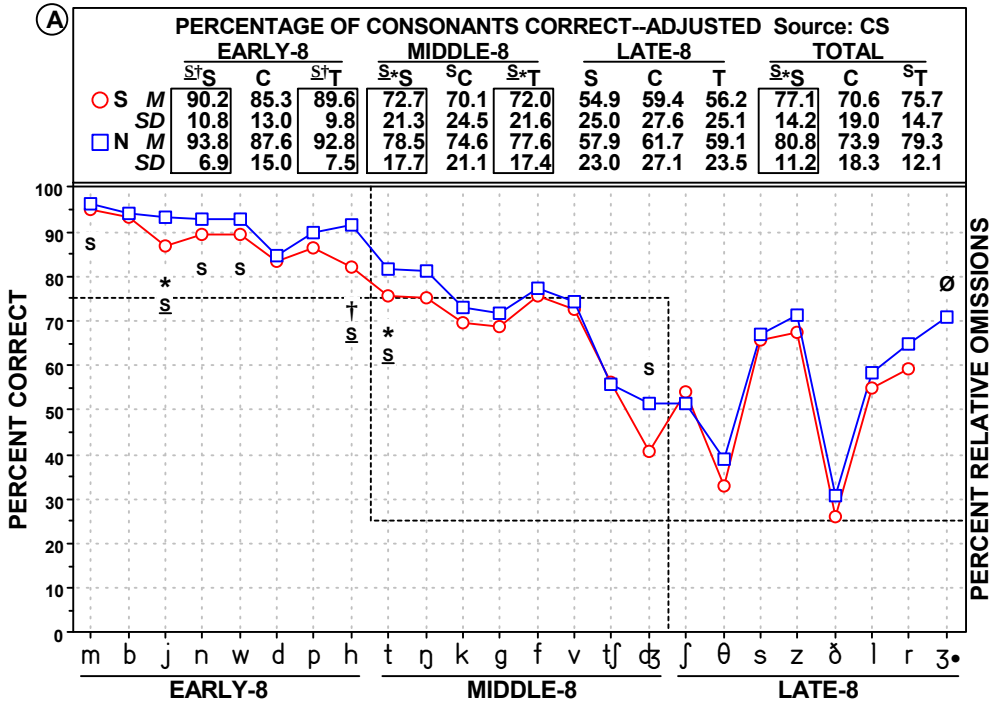
CONSONANT PROFILES

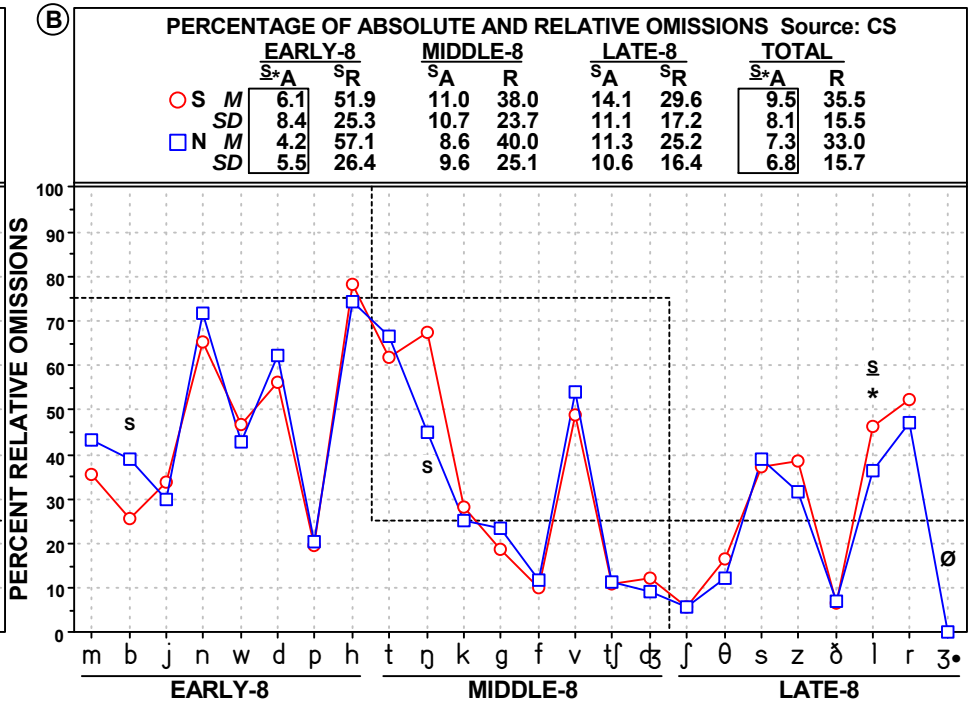

A
PERCENTAGE OF CONSONANTS CORRECT Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 90.2 85.3 89.6 72.7 69.9 72.0 41.8 44.8 42.7 73.8 64.6 71.8
SD 10.8 13.0 9.8 21.2 24.3 21.5 25.2 27.2 25.2 14.0 18.7 14.3
N M 93.8 87.6 92.8 78.4 74.5 77.5 43.0 42.4 42.8 76.9 66.3 74.5
SD 6.9 15.0 7.5 17.7 21.1 17.3 25.1 26.8 24.9 11.5 17.8 12.2
PERCENT CORRECT
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

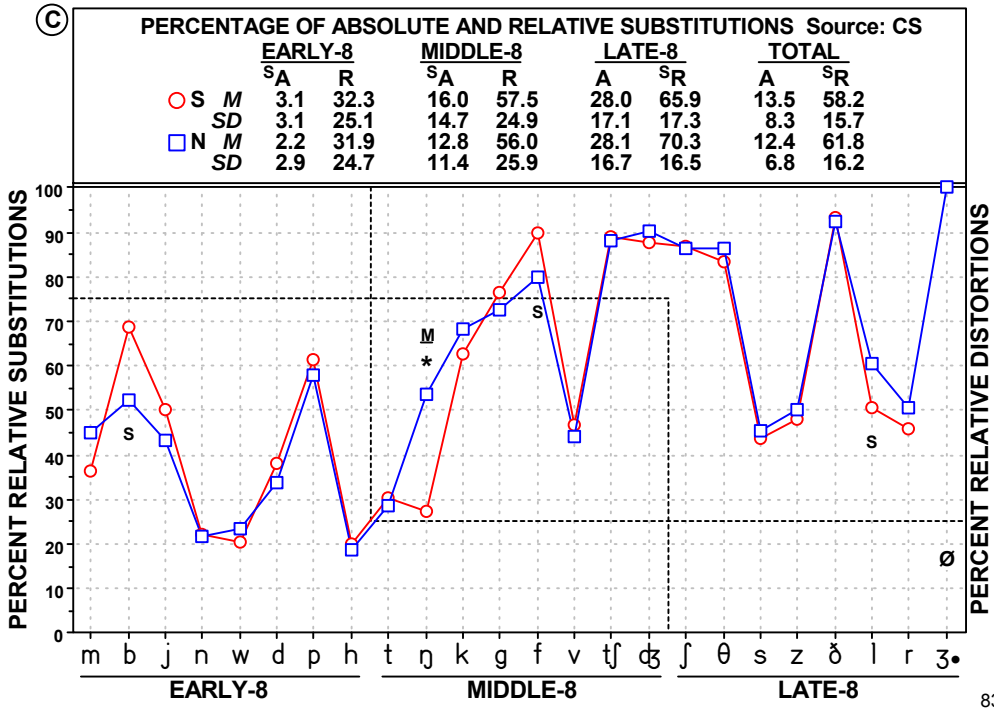

B
PERCENTAGE OF ABSOLUTE AND RELATIVE OMISSIONS Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 6.1 51.9 11.0 37.9 14.1 21.8 9.5 29.3
SD 8.4 25.3 10.7 23.8 11.1 14.8 8.1 15.0
N M 4.2 57.1 8.6 39.8 11.3 17.9 7.3 26.0
SD 5.5 26.4 9.6 25.1 10.6 13.5 6.8 13.9
PERCENT RELATIVE OMISSIONS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

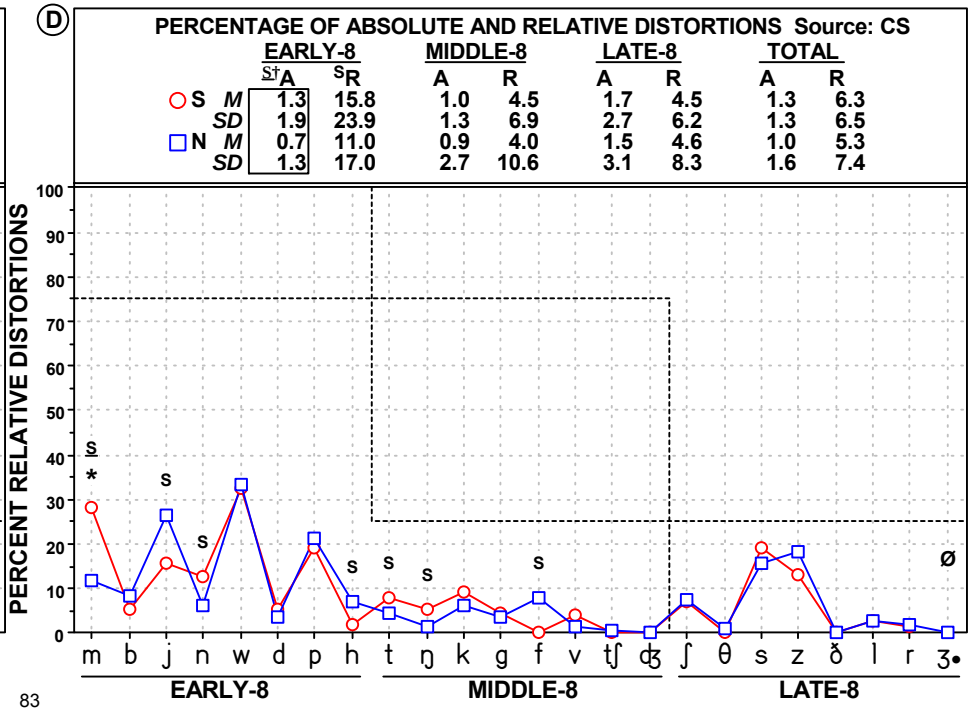

C
PERCENTAGE OF ABSOLUTE AND RELATIVE SUBSTITUTIONS Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 3.1 32.3 16.0 57.2 28.0 47.1 13.5 46.4
SD 3.1 25.1 14.7 25.1 17.1 17.2 8.3 14.5
N M 2.2 31.9 12.8 55.5 28.1 48.1 12.4 47.9
SD 2.9 24.7 11.4 25.7 16.7 18.1 6.8 15.7
PERCENT RELATIVE SUBSTITUTIONS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


D
PERCENTAGE OF ABSOLUTE AND RELATIVE DISTORTIONS Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 1.3 15.8 1.0 4.9 15.2 31.1 5.2 24.3
SD 1.9 23.9 1.5 9.2 10.6 20.9 3.6 19.2
N M 0.7 11.0 1.0 4.7 17.8 34.0 5.8 26.1
SD 1.3 17.0 2.8 11.3 12.3 21.3 3.9 18.0
PERCENT RELATIVE DISTORTIONS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


A
PERCENTAGE OF CONSONANTS CORRECT--ADJUSTED Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 90.2 85.3 89.6 72.7 70.1 72.0 54.9 59.4 56.2 77.1 70.6 75.7
SD 10.8 13.0 9.8 21.3 24.5 21.6 25.0 27.6 25.1 14.2 19.0 14.7
N M 93.8 87.6 92.8 78.5 74.6 77.6 57.9 61.7 59.1 80.8 73.9 79.3
SD 6.9 15.0 7.5 17.7 21.1 17.4 23.0 27.1 23.5 11.2 18.3 12.1
PERCENT CORRECT
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

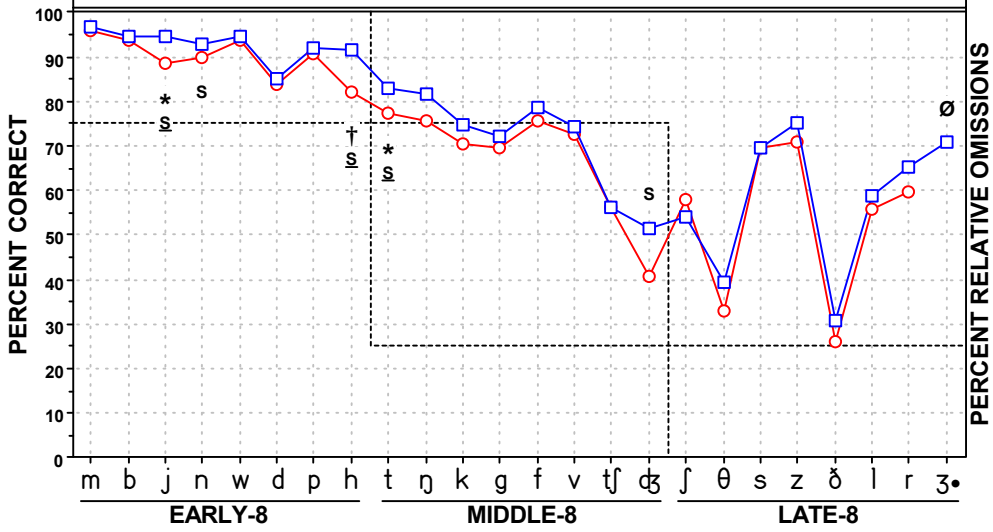

B
PERCENTAGE OF ABSOLUTE AND RELATIVE OMISSIONS Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 6.1 51.9 11.0 38.0 14.1 29.6 9.5 35.5
SD 8.4 25.3 10.7 23.7 11.1 17.2 8.1 15.5
N M 4.2 57.1 8.6 40.0 11.3 25.2 7.3 33.0
SD 5.5 26.4 9.6 25.1 10.6 16.4 6.8 15.7
PERCENT RELATIVE OMISSIONS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


C
PERCENTAGE OF ABSOLUTE AND RELATIVE SUBSTITUTIONS Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 3.1 32.3 16.0 57.5 28.0 65.9 13.5 58.2
SD 3.1 25.1 14.7 24.9 17.1 17.3 8.3 15.7
N M 2.2 31.9 12.8 56.0 28.1 70.3 12.4 61.8
SD 2.9 24.7 11.4 25.9 16.7 16.5 6.8 16.2
PERCENT RELATIVE SUBSTITUTIONS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


D
PERCENTAGE OF ABSOLUTE AND RELATIVE DISTORTIONS Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 1.3 15.8 1.0 4.5 1.7 4.5 1.3 6.3
SD 1.9 23.9 1.3 6.9 2.7 6.2 1.3 6.5
N M 0.7 11.0 0.9 4.0 1.5 4.6 1.0 5.3
SD 1.3 17.0 2.7 10.6 3.1 8.3 1.6 7.4
PERCENT RELATIVE DISTORTIONS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

A — PERCENTAGE OF CONSONANTS CORRECT--REVISED Source: CS

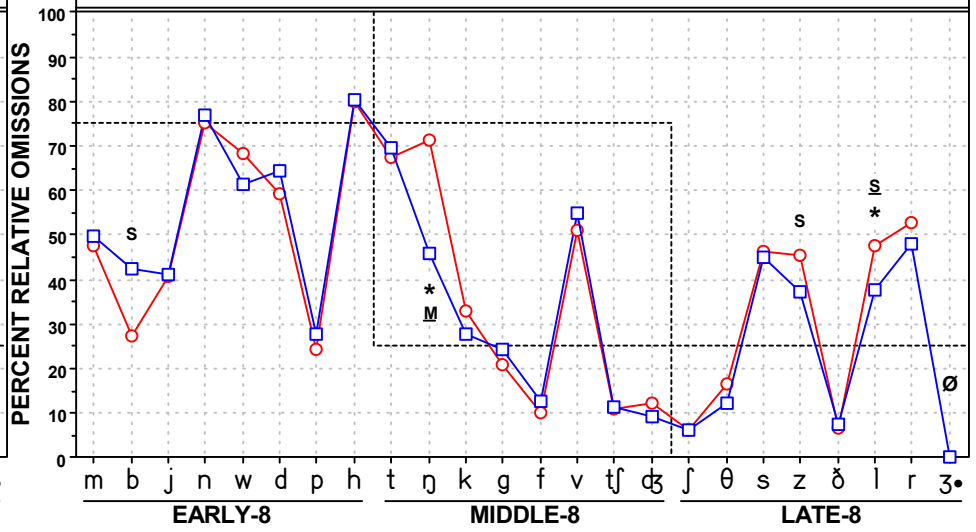
		EARLY-8			MIDDLE-8			LATE-8			TOTAL		
		S†S	C	S*T	S*S	SC	S*T	S	C	T	S*S	C	ST
○ S	*M*	91.4	86.8	90.9	73.6	71.3	73.0	56.8	60.9	57.9	78.4	72.0	77.0
	SD	10.5	11.8	9.4	20.8	23.9	21.0	24.7	27.2	24.8	13.8	18.3	14.1
□ N	*M*	94.5	88.4	93.5	79.4	75.6	78.6	59.5	63.2	60.6	81.8	75.0	80.4
	SD	6.7	14.2	7.2	17.0	20.8	16.8	22.5	26.7	23.0	10.7	17.9	11.6



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

B — PERCENTAGE OF ABSOLUTE AND RELATIVE OMISSIONS Source: CS

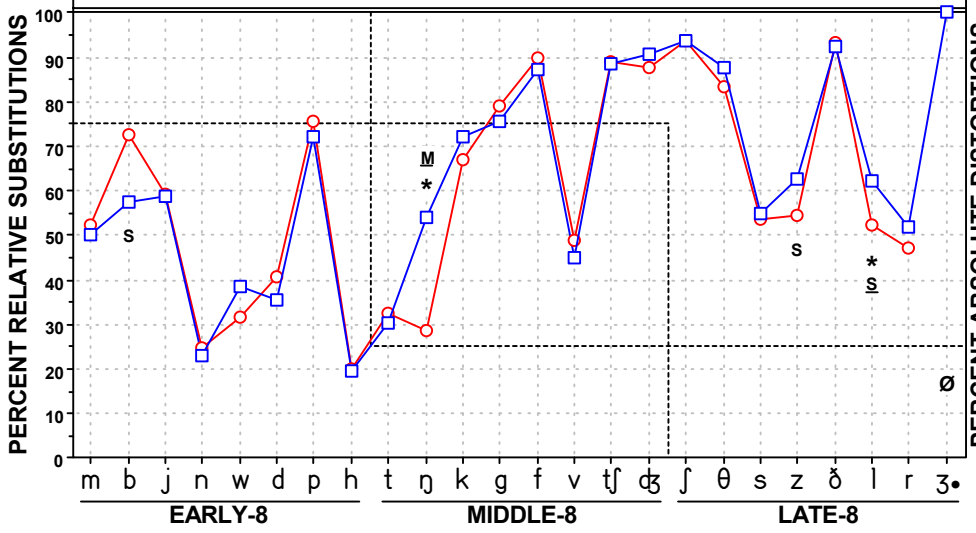
		EARLY-8		MIDDLE-8		LATE-8		TOTAL	
		S*A	R	SA	R	SA	SR	S*A	R
○ S	*M*	6.1	63.3	11.0	40.0	14.1	30.9	9.5	37.9
	SD	8.4	25.4	10.7	24.9	11.1	17.8	8.1	16.0
□ N	*M*	4.2	64.0	8.6	41.9	11.3	26.3	7.3	34.9
	SD	5.5	26.9	9.6	25.9	10.6	17.1	6.8	16.5



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

C — PERCENTAGE OF ABSOLUTE AND RELATIVE SUBSTITUTIONS Source: CS

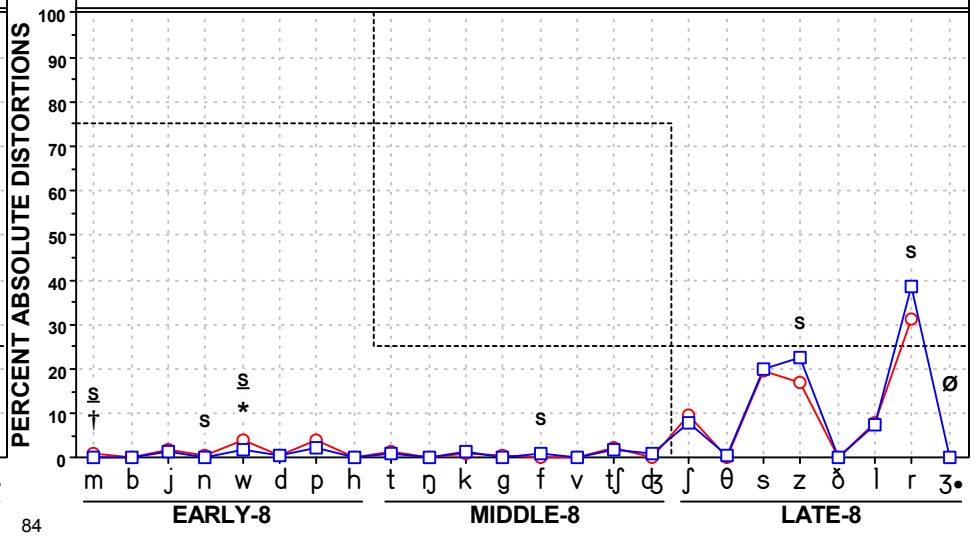
		EARLY-8		MIDDLE-8		LATE-8		TOTAL	
		SA	R	SA	R	A	SR	A	R
○ S	*M*	3.1	36.7	16.0	60.0	28.0	69.1	13.5	62.1
	SD	3.1	25.4	14.7	24.9	17.1	17.8	8.3	16.0
□ N	*M*	2.2	36.0	12.8	58.1	28.1	73.7	12.4	65.1
	SD	2.9	26.9	11.4	25.9	16.7	17.1	6.8	16.5



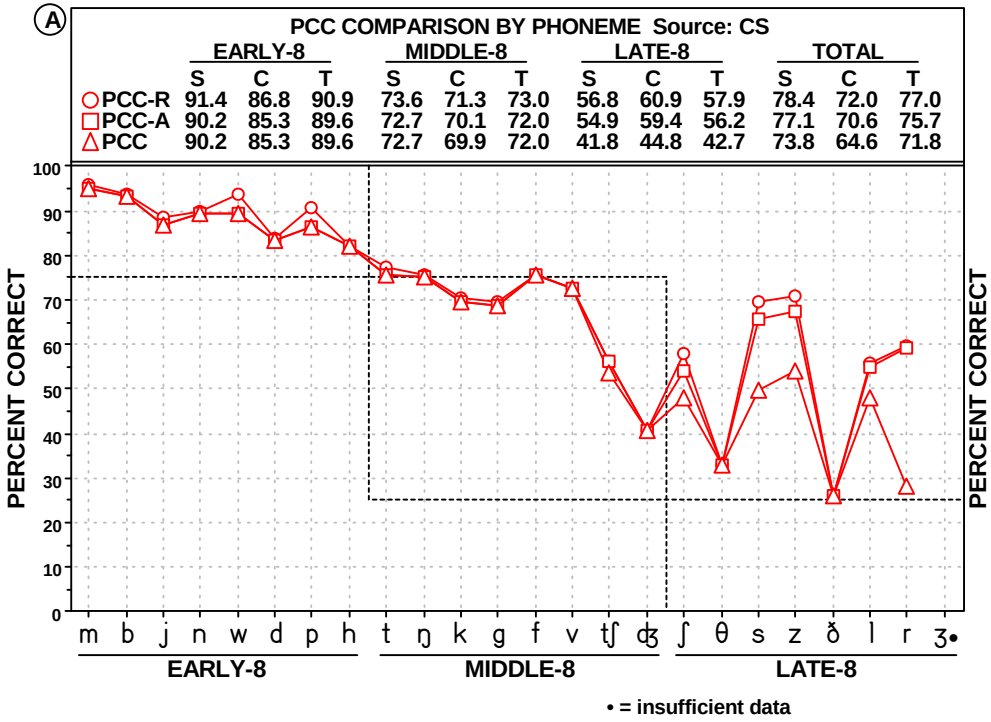
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

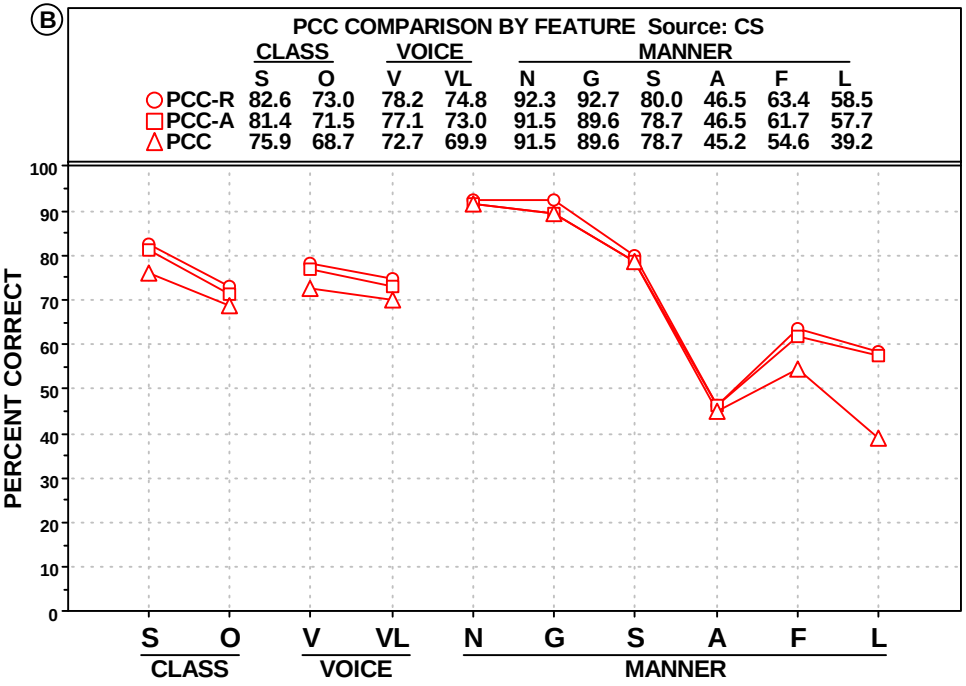
D — PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS

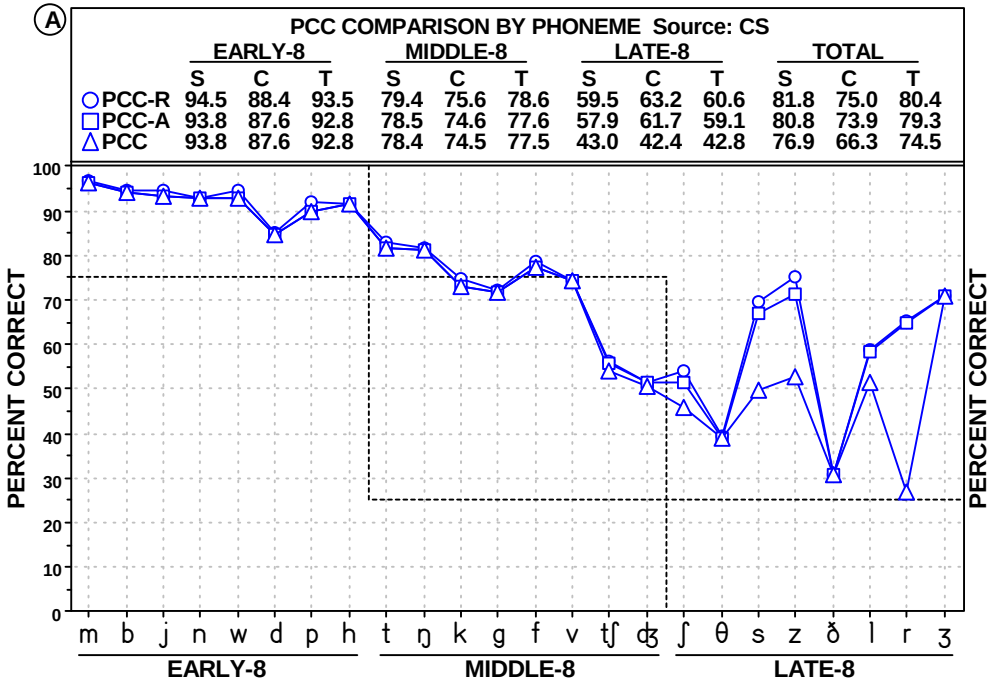
		S†EARLY-8	MIDDLE-8	SLATE-8	TOTAL
○ S	*M*	1.3	1.0	15.2	5.2
	SD	1.9	1.5	10.6	3.6
□ N	*M*	0.7	1.0	17.8	5.8
	SD	1.3	2.8	12.3	3.9

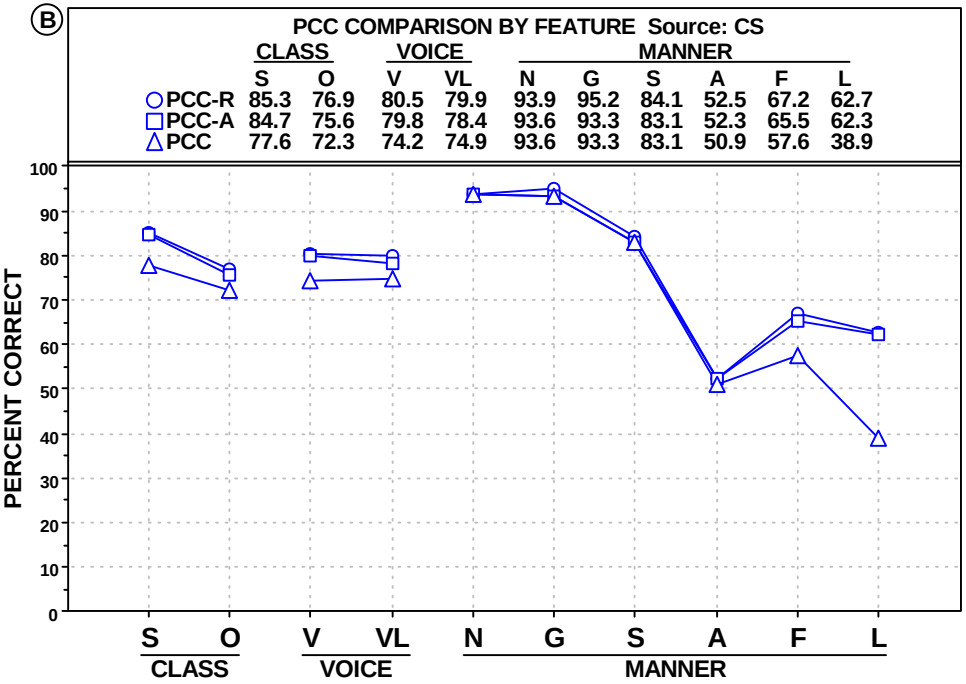


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


A
PCC COMPARISON BY PHONEME Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S C T S C T S C T S C T
PCC-R 91.4 86.8 90.9 73.6 71.3 73.0 56.8 60.9 57.9 78.4 72.0 77.0
PCC-A 90.2 85.3 89.6 72.7 70.1 72.0 54.9 59.4 56.2 77.1 70.6 75.7
PCC 90.2 85.3 89.6 72.7 69.9 72.0 41.8 44.8 42.7 73.8 64.6 71.8
PERCENT CORRECT
100 90 80 70 60 50 40 30 20 10 0
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
• = insufficient data

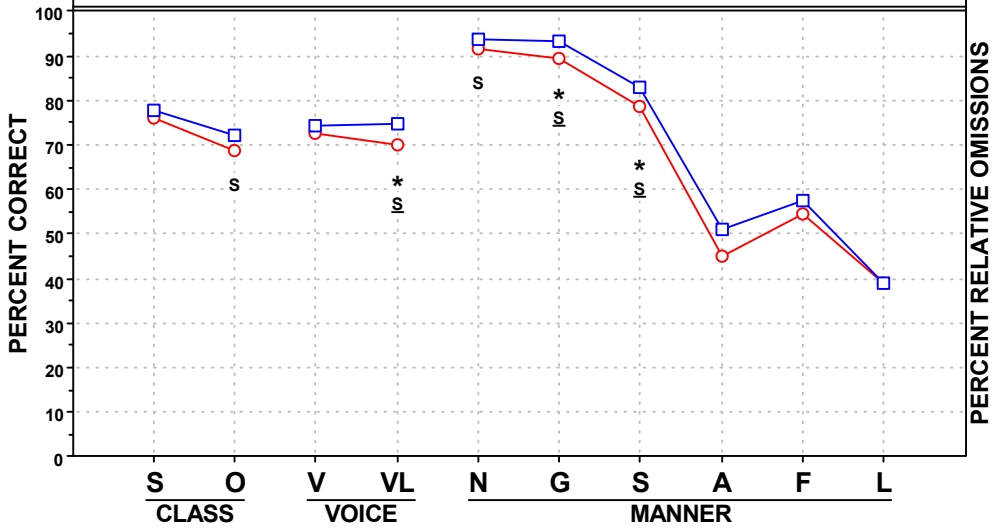

B
PCC COMPARISON BY FEATURE Source: CS
CLASS VOICE MANNER
S O V VL N G S A F L
PCC-R 82.6 73.0 78.2 74.8 92.3 92.7 80.0 46.5 63.4 58.5
PCC-A 81.4 71.5 77.1 73.0 91.5 89.6 78.7 46.5 61.7 57.7
PCC 75.9 68.7 72.7 69.9 91.5 89.6 78.7 45.2 54.6 39.2
PERCENT CORRECT
100 90 80 70 60 50 40 30 20 10 0
S O V VL N G S A F L
CLASS VOICE MANNER


A
PCC COMPARISON BY PHONEME Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S C T S C T S C T S C T
PCC-R 94.5 88.4 93.5 79.4 75.6 78.6 59.5 63.2 60.6 81.8 75.0 80.4
PCC-A 93.8 87.6 92.8 78.5 74.6 77.6 57.9 61.7 59.1 80.8 73.9 79.3
PCC 93.8 87.6 92.8 78.4 74.5 77.5 43.0 42.4 42.8 76.9 66.3 74.5
PERCENT CORRECT
100 90 80 70 60 50 40 30 20 10 0
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ
EARLY-8 MIDDLE-8 LATE-8


B
PCC COMPARISON BY FEATURE Source: CS
CLASS VOICE MANNER
S O V VL N G S A F L
PCC-R 85.3 76.9 80.5 79.9 93.9 95.2 84.1 52.5 67.2 62.7
PCC-A 84.7 75.6 79.8 78.4 93.6 93.3 83.1 52.3 65.5 62.3
PCC 77.6 72.3 74.2 74.9 93.6 93.3 83.1 50.9 57.6 38.9
PERCENT CORRECT
100 90 80 70 60 50 40 30 20 10 0
S O V VL N G S A F L
CLASS VOICE MANNER

A — PERCENTAGE OF CONSONANT FEATURES CORRECT Source: CS

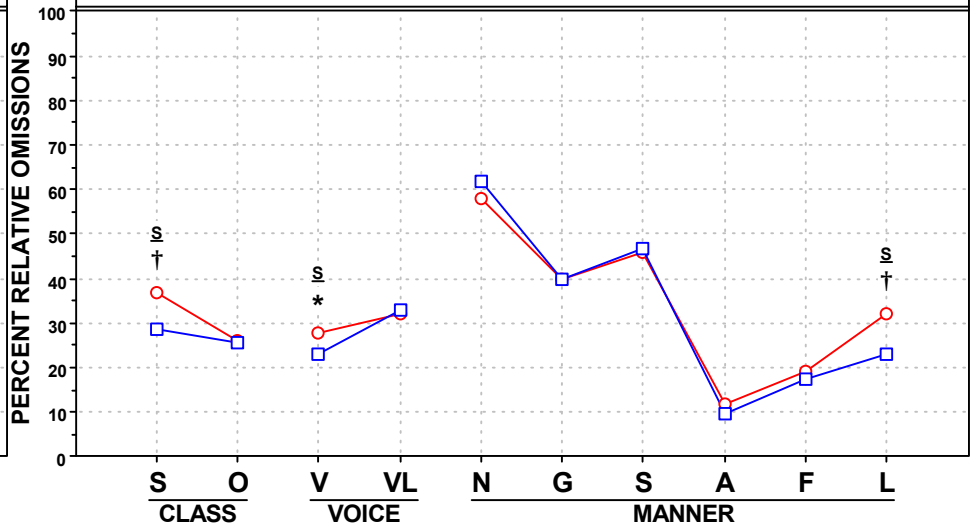
		CLASS		VOICE		MANNER					
		S	SO	V	S*VL	SN	S*G	S*S	A	F	L
S	*M*	75.9	68.7	72.7	69.9	91.5	89.6	78.7	45.2	54.6	39.2
	SD	13.2	16.8	12.8	19.4	8.5	14.2	16.8	36.2	23.3	30.5
N	*M*	77.6	72.3	74.2	74.9	93.6	93.3	83.1	50.9	57.6	38.9
	SD	12.1	14.2	11.7	15.5	9.4	11.1	13.6	38.2	22.2	27.9



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B — PERCENTAGE OF ABSOLUTE OMISSIONS Source: CS

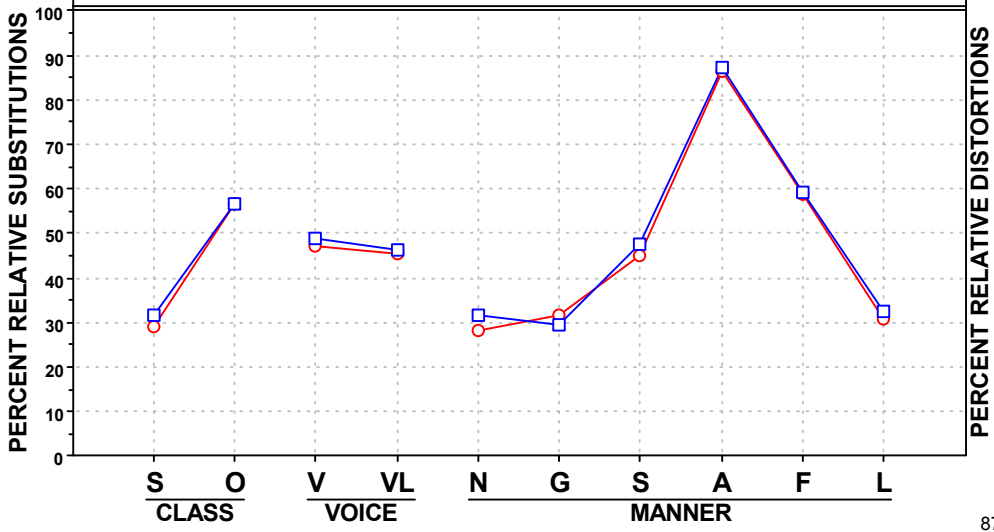
		CLASS		VOICE		MANNER					
		S*S	SO	SV	SVL	N	S*G	SS	A	F	S*L
S	*M*	9.5	9.5	8.4	11.2	5.8	4.4	9.5	7.0	10.4	19.2
	SD	8.2	9.0	7.4	10.5	6.9	11.2	9.5	19.0	10.7	16.3
N	*M*	6.9	7.6	6.6	8.6	4.5	2.3	7.6	4.8	8.3	14.6
	SD	7.1	7.9	6.4	8.9	8.1	5.2	8.3	12.8	10.8	13.9



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C — PERCENTAGE OF ABSOLUTE SUBSTITUTIONS Source: CS

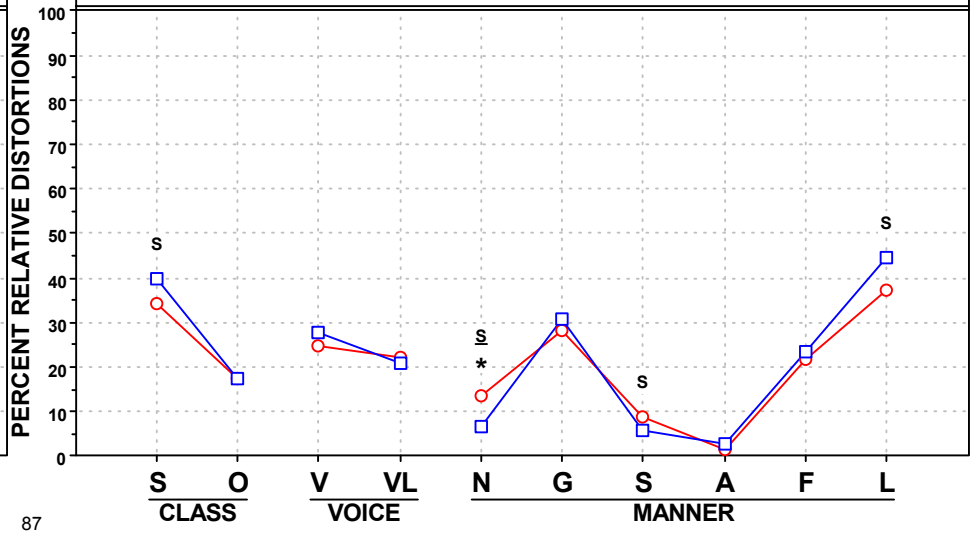
		CLASS		VOICE		MANNER					
		S	SO	V	SVL	N	G	SS	A	F	L
S	*M*	7.9	17.5	13.4	14.1	1.9	2.9	10.5	46.6	26.2	22.3
	SD	6.8	11.0	7.8	11.5	2.8	4.9	10.5	35.1	15.8	21.6
N	*M*	7.8	15.5	12.9	11.5	1.7	2.5	8.4	42.7	24.4	22.7
	SD	6.9	8.7	7.3	8.7	2.7	7.0	8.2	35.8	15.0	21.8



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D — PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS

		CLASS		VOICE		MANNER					
		S	O	SV	VL	M‡N	SG	S	A	F	SL
S	*M*	6.6	4.3	5.5	4.8	0.8	3.0	1.3	1.3	8.8	19.3
	SD	4.4	4.8	3.6	5.1	1.6	8.2	2.3	8.8	11.3	12.2
N	*M*	7.6	4.6	6.4	5.0	0.3	1.9	1.0	1.6	9.6	23.8
	SD	5.3	5.6	4.0	6.1	0.8	4.5	2.5	8.8	12.2	16.5

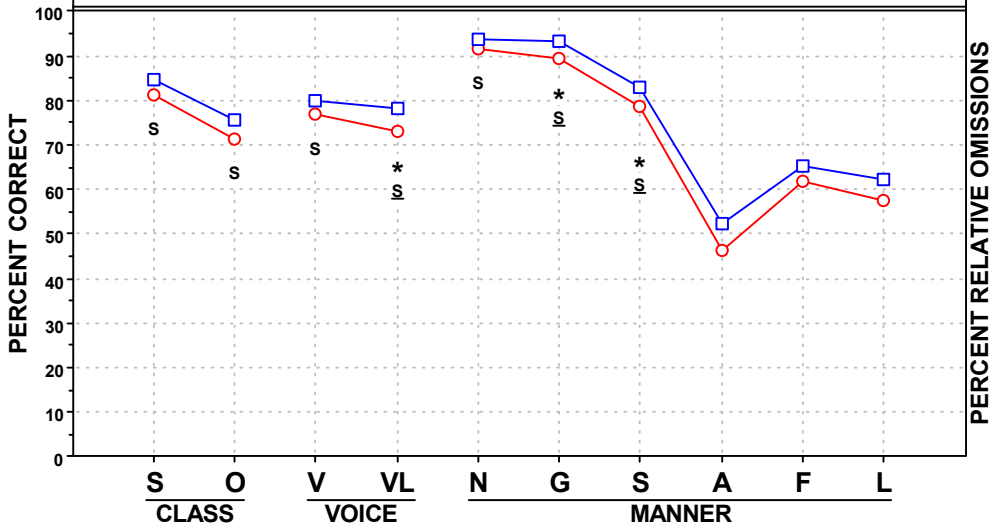


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Consonant Profile 5, S and N

A — PERCENTAGE OF CONSONANT FEATURES CORRECT--ADJUSTED Source: CS

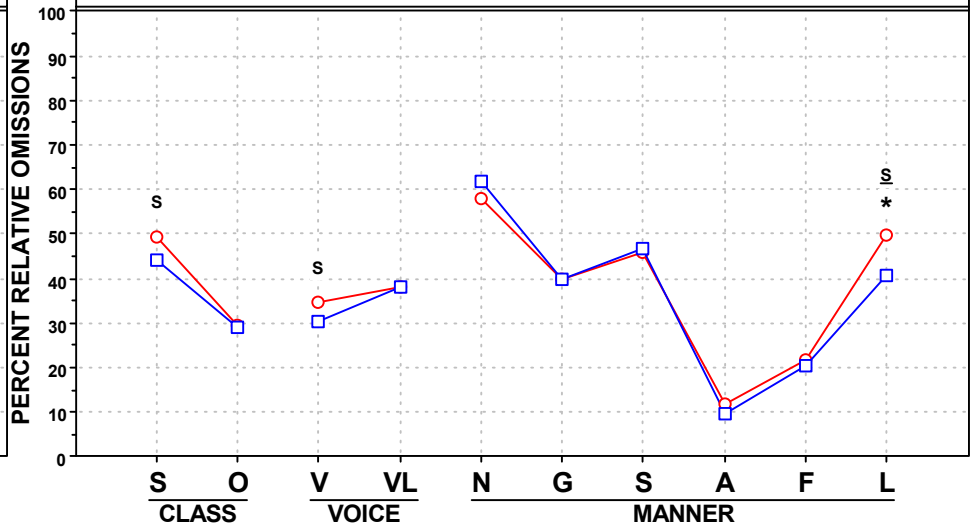
		CLASS		VOICE		MANNER					
		S	O	V	VL	N	G	S	A	F	L
S	*M*	81.4	71.5	77.1	73.0	91.5	89.6	78.7	46.5	61.7	57.7
	SD	12.3	17.5	12.5	20.1	8.5	14.2	16.8	35.6	23.7	29.0
N	*M*	84.7	75.6	79.8	78.4	93.6	93.3	83.1	52.3	65.5	62.3
	SD	11.7	14.2	11.4	15.6	9.4	11.1	13.6	38.0	21.4	28.2



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B — PERCENTAGE OF ABSOLUTE OMISSIONS Source: CS

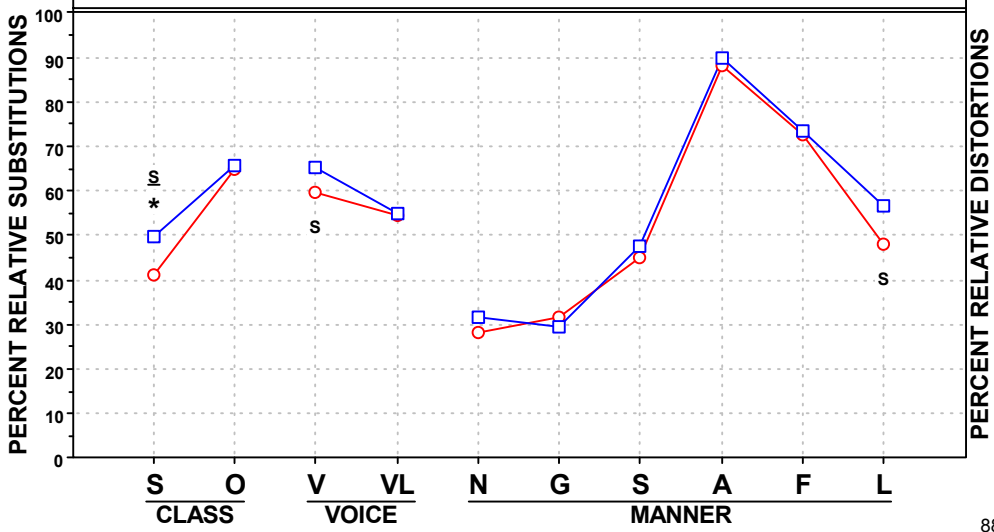
		CLASS		VOICE		MANNER					
		S*S	O	V	VL	N	G	S	A	F	L
S	*M*	9.5	9.5	8.4	11.2	5.8	4.4	9.5	7.0	10.4	19.2
	SD	8.2	9.0	7.4	10.5	6.9	11.2	9.5	19.0	10.7	16.3
N	*M*	6.9	7.6	6.6	8.6	4.5	2.3	7.6	4.8	8.3	14.6
	SD	7.1	7.9	6.4	8.9	8.1	5.2	8.3	12.8	10.8	13.9



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C — PERCENTAGE OF ABSOLUTE SUBSTITUTIONS Source: CS

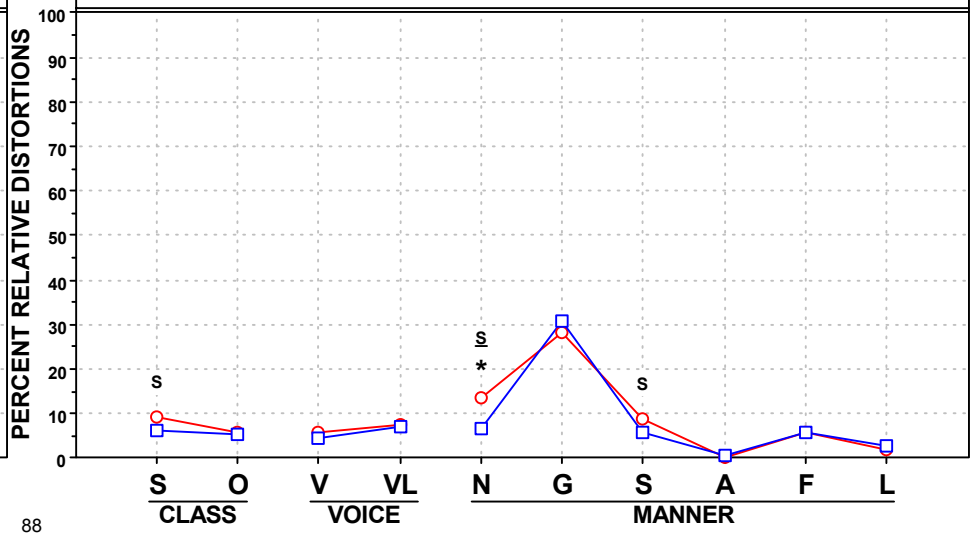
		CLASS		VOICE		MANNER					
		S	O	V	VL	N	G	S	A	F	L
S	*M*	7.9	17.5	13.4	14.1	1.9	2.9	10.5	46.6	26.2	22.3
	SD	6.8	11.0	7.8	11.5	2.8	4.9	10.5	35.1	15.8	21.6
N	*M*	7.8	15.5	12.9	11.5	1.7	2.5	8.4	42.7	24.4	22.7
	SD	6.9	8.7	7.3	8.7	2.7	7.0	8.2	35.8	15.0	21.8



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

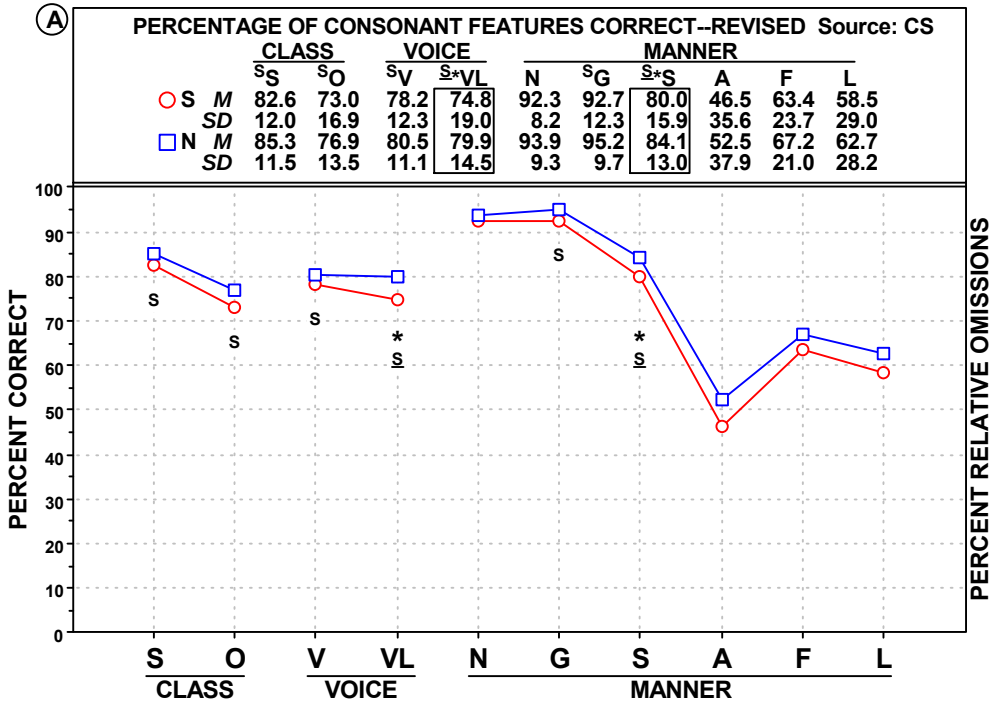
D — PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS

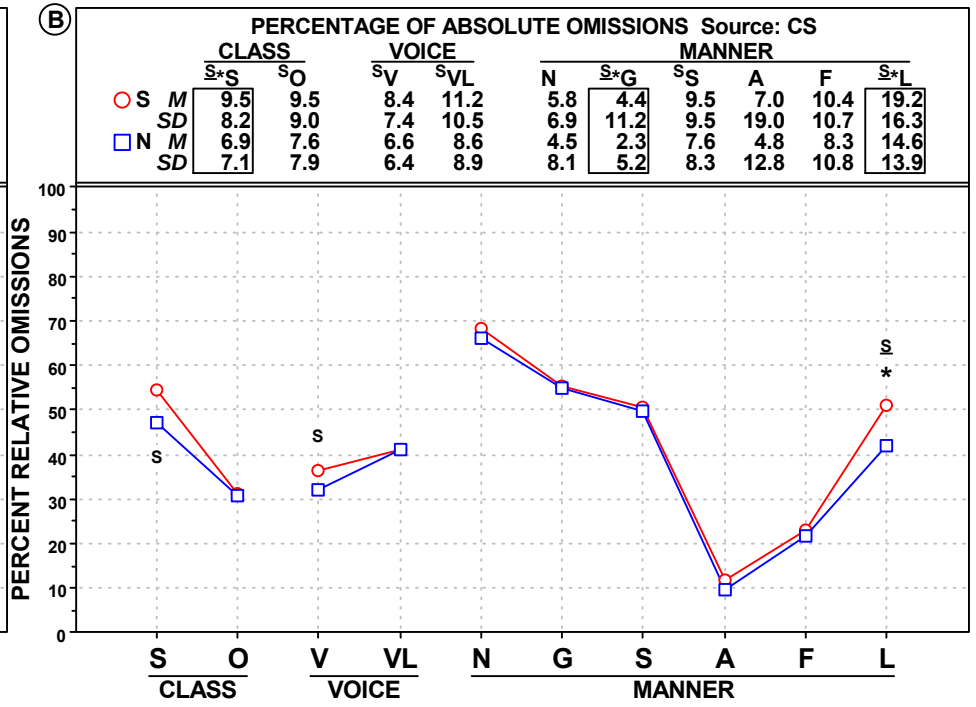
		CLASS		VOICE		MANNER					
		M‡S	O	V	VL	M‡N	G	S	A	F	L
S	*M*	1.1	1.5	1.0	1.8	0.8	3.0	1.3	0.0	1.8	0.8
	SD	1.5	1.8	1.3	2.4	1.6	8.2	2.3	0.0	2.9	1.9
N	*M*	0.6	1.3	0.7	1.5	0.3	1.9	1.0	0.3	1.7	0.4
	SD	0.9	2.5	1.2	3.0	0.8	4.5	2.5	3.7	3.7	1.2

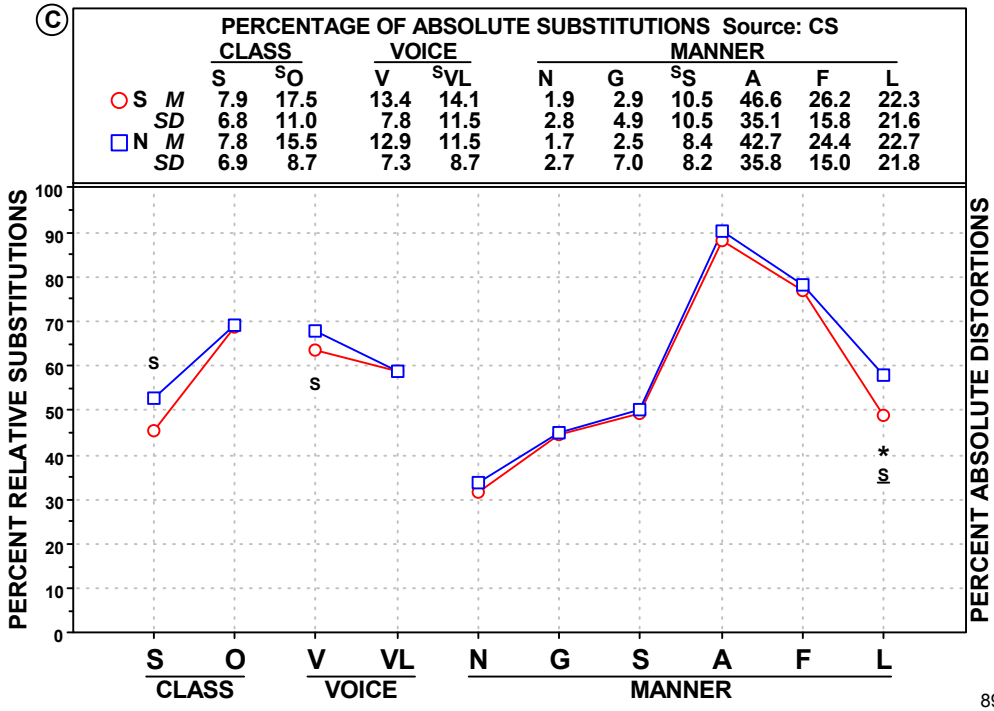


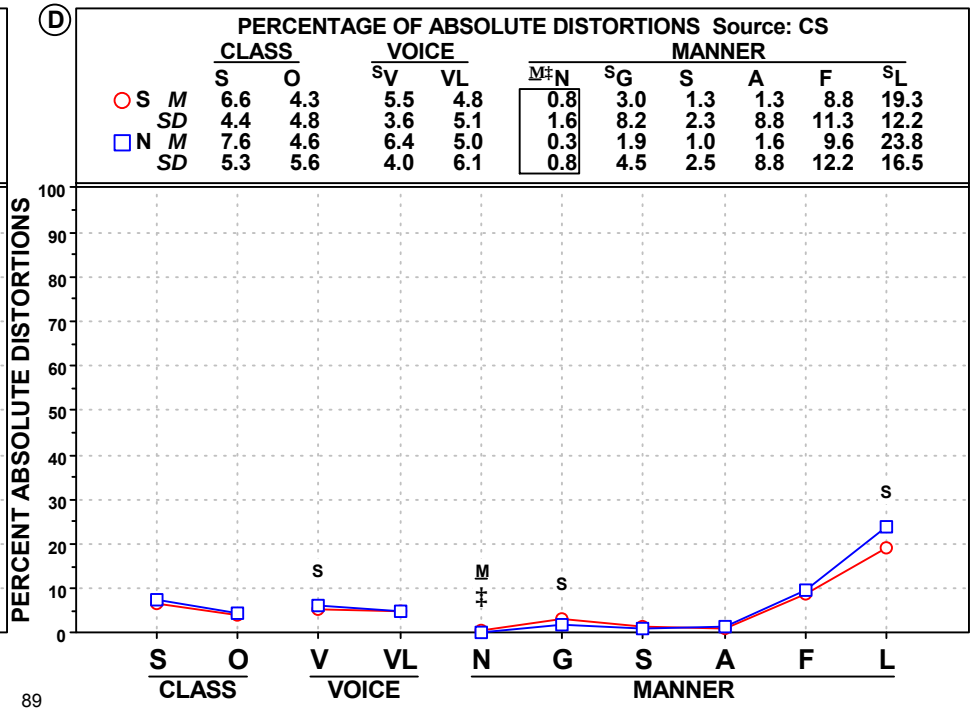
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Consonant Profile 6, S and N


A
PERCENTAGE OF CONSONANT FEATURES CORRECT--REVISED Source: CS
CLASS VOICE MANNER
S O V VL N G S*S A F L
S M 82.6 73.0 78.2 74.8 92.3 92.7 80.0 46.5 63.4 58.5
SD 12.0 16.9 12.3 19.0 8.2 12.3 15.9 35.6 23.7 29.0
N M 85.3 76.9 80.5 79.9 93.9 95.2 84.1 52.5 67.2 62.7
SD 11.5 13.5 11.1 14.5 9.3 9.7 13.0 37.9 21.0 28.2
PERCENT CORRECT
100 90 80 70 60 50 40 30 20 10 0
S O V VL N G S A F L
CLASS VOICE MANNER
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

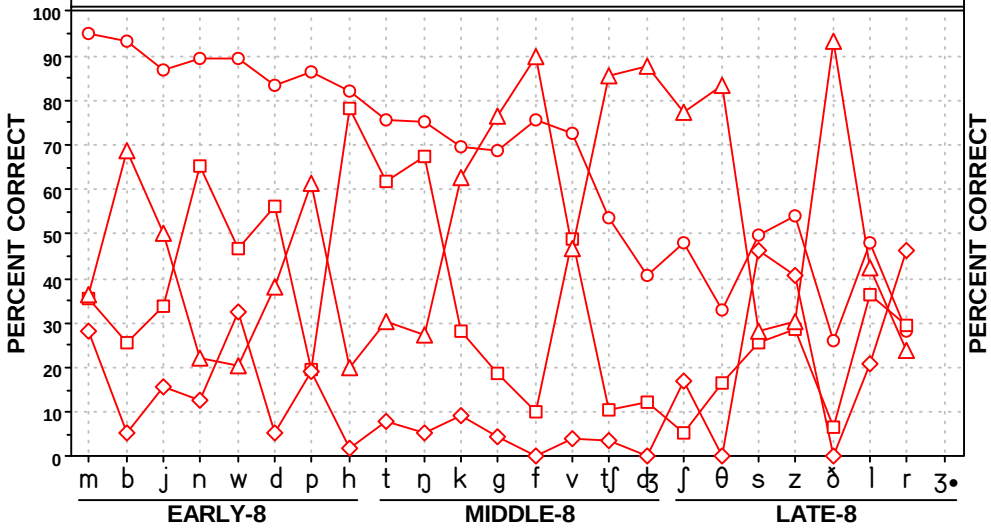

B
PERCENTAGE OF ABSOLUTE OMISSIONS Source: CS
CLASS VOICE MANNER
S*S O V VL N S*G S A F S*L
S M 9.5 9.5 8.4 11.2 5.8 4.4 9.5 7.0 10.4 19.2
SD 8.2 9.0 7.4 10.5 6.9 11.2 9.5 19.0 10.7 16.3
N M 6.9 7.6 6.6 8.6 4.5 2.3 7.6 4.8 8.3 14.6
SD 7.1 7.9 6.4 8.9 8.1 5.2 8.3 12.8 10.8 13.9
PERCENT RELATIVE OMISSIONS
100 90 80 70 60 50 40 30 20 10 0
S O V VL N G S A F L
CLASS VOICE MANNER
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


C
PERCENTAGE OF ABSOLUTE SUBSTITUTIONS Source: CS
CLASS VOICE MANNER
S O V VL N G S A F L
S M 7.9 17.5 13.4 14.1 1.9 2.9 10.5 46.6 26.2 22.3
SD 6.8 11.0 7.8 11.5 2.8 4.9 10.5 35.1 15.8 21.6
N M 7.8 15.5 12.9 11.5 1.7 2.5 8.4 42.7 24.4 22.7
SD 6.9 8.7 7.3 8.7 2.7 7.0 8.2 35.8 15.0 21.8
PERCENT RELATIVE SUBSTITUTIONS
100 90 80 70 60 50 40 30 20 10 0
S O V VL N G S A F L
CLASS VOICE MANNER
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


D
PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS
CLASS VOICE MANNER
S O V VL M‡N G S A F L
S M 6.6 4.3 5.5 4.8 0.8 3.0 1.3 1.3 8.8 19.3
SD 4.4 4.8 3.6 5.1 1.6 8.2 2.3 8.8 11.3 12.2
N M 7.6 4.6 6.4 5.0 0.3 1.9 1.0 1.6 9.6 23.8
SD 5.3 5.6 4.0 6.1 0.8 4.5 2.5 8.8 12.2 16.5
PERCENT ABSOLUTE DISTORTIONS
100 90 80 70 60 50 40 30 20 10 0
S O V VL N G S A F L
CLASS VOICE MANNER
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Ⓐ PERCENTAGE OF CONSONANTS CORRECT RELATIVE ERRORS Source: CS

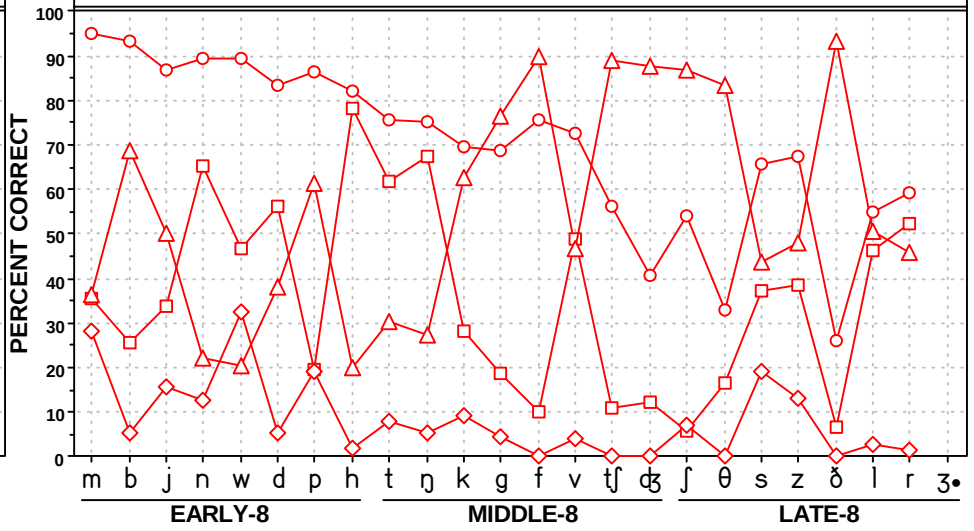
	EARLY-8			MIDDLE-8			LATE-8			TOTAL		
	S	C	T	S	C	T	S	C	T	S	C	T
○ PCC	90.2	85.3	89.6	72.7	69.9	72.0	41.8	44.8	42.7	73.8	64.6	71.8
□ ROI	50.3	59.8	51.9	34.0	42.0	37.9	14.0	39.1	21.8	24.6	41.5	29.3
△ RSI	32.0	33.4	32.3	61.0	52.5	57.2	56.3	24.6	47.1	52.4	31.0	46.4
◇ RDI	17.7	6.8	15.8	5.0	5.4	4.9	29.7	36.3	31.1	23.0	27.5	24.3



• = insufficient data

Ⓑ PERCENTAGE OF CONSONANTS CORRECT--ADJUSTED RELATIVE ERRORS Source: CS

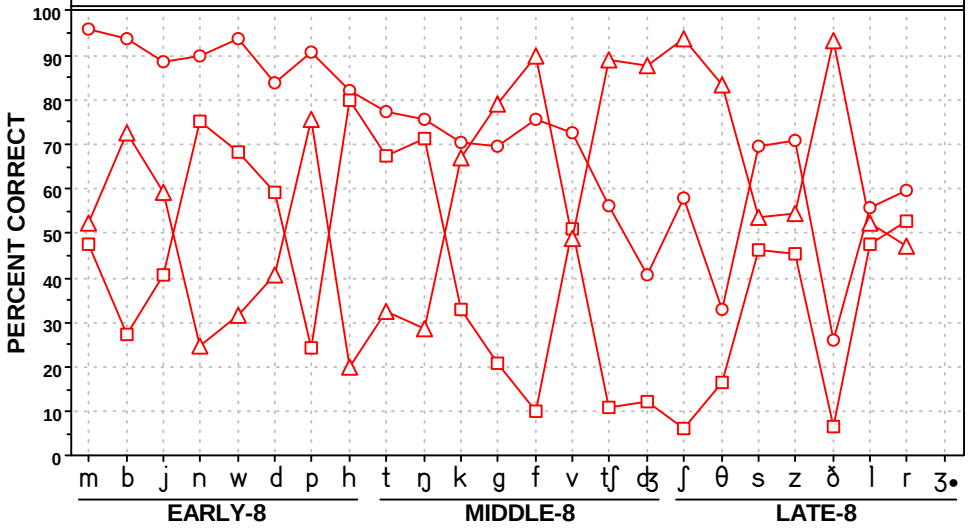
	EARLY-8			MIDDLE-8			LATE-8			TOTAL		
	S	C	T	S	C	T	S	C	T	S	C	T
○ PCC-A	90.2	85.3	89.6	72.7	70.1	72.0	54.9	59.4	56.2	77.1	70.6	75.7
□ ROI-A	50.3	59.8	51.9	34.0	42.0	38.0	19.3	55.5	29.6	29.4	52.5	35.5
△ RSI-A	32.0	33.4	32.3	61.2	52.5	57.5	76.0	39.8	65.9	63.9	43.0	58.2
◇ RDI-A	17.7	6.8	15.8	4.8	5.4	4.5	4.7	4.7	4.5	6.7	4.5	6.3



• = insufficient data

Ⓒ PERCENTAGE OF CONSONANTS CORRECT--REVISED RELATIVE ERRORS Source: CS

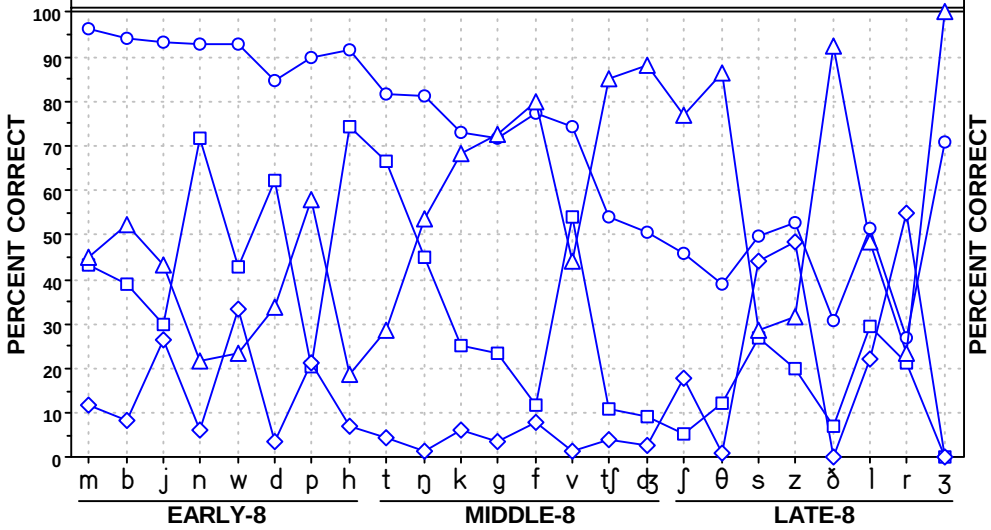
	EARLY-8			MIDDLE-8			LATE-8			TOTAL		
	S	C	T	S	C	T	S	C	T	S	C	T
○ PCC-R	91.4	86.8	90.9	73.6	71.3	73.0	56.8	60.9	57.9	78.4	72.0	77.0
□ ROI-R	62.0	64.8	63.3	35.6	45.1	40.0	20.4	57.6	30.9	31.6	54.9	37.9
△ RSI-R	38.0	35.2	36.7	64.4	54.9	60.0	79.6	42.4	69.1	68.4	45.1	62.1



• = insufficient data

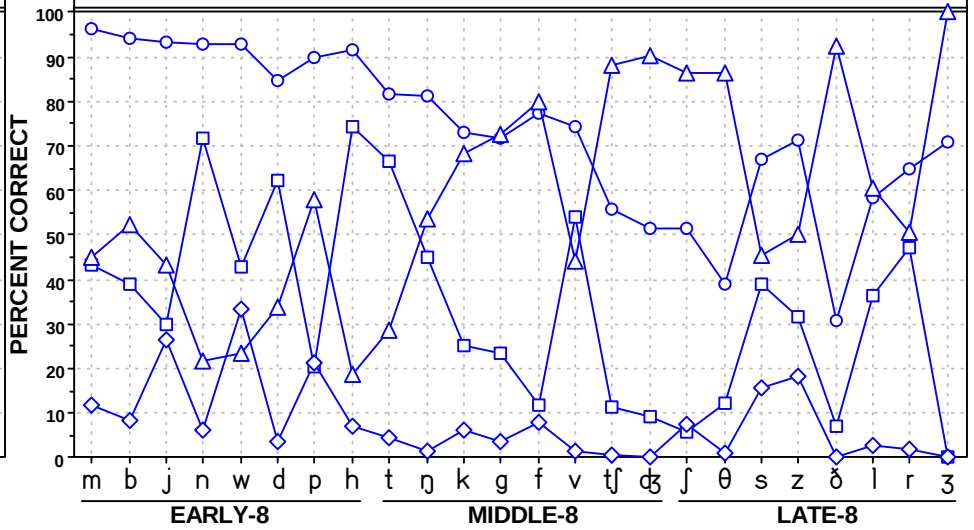
Ⓐ PERCENTAGE OF CONSONANTS CORRECT RELATIVE ERRORS Source: CS

	EARLY-8			MIDDLE-8			LATE-8			TOTAL		
	S	C	T	S	C	T	S	C	T	S	C	T
○PCC	93.8	87.6	92.8	78.4	74.5	77.5	43.0	42.4	42.8	76.9	66.3	74.5
□ROI	53.4	65.3	57.1	35.8	46.8	39.8	10.6	34.7	17.9	20.5	39.3	26.0
△RSI	33.1	28.9	31.9	59.8	48.0	55.5	57.5	25.9	48.1	55.2	30.5	47.9
◇RDI	13.5	5.8	11.0	4.4	5.2	4.7	31.8	39.5	34.0	24.3	30.2	26.1



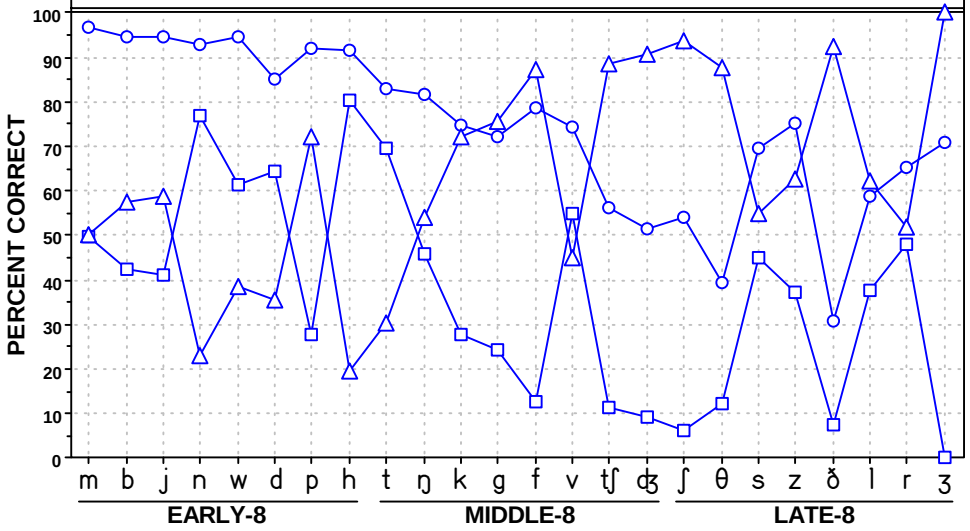
Ⓑ PERCENTAGE OF CONSONANTS CORRECT--ADJUSTED RELATIVE ERRORS Source: CS

	EARLY-8			MIDDLE-8			LATE-8			TOTAL		
	S	C	T	S	C	T	S	C	T	S	C	T
○PCC-A	93.8	87.6	92.8	78.5	74.6	77.6	57.9	61.7	59.1	80.8	73.9	79.3
□ROI-A	53.4	65.3	57.1	36.0	46.8	40.0	14.6	52.3	25.2	25.3	53.2	33.0
△RSI-A	33.1	28.9	31.9	60.3	48.3	56.0	80.7	42.5	70.3	69.1	42.2	61.8
◇RDI-A	13.5	5.8	11.0	3.7	4.9	4.0	4.7	5.1	4.6	5.6	4.6	5.3



Ⓒ PERCENTAGE OF CONSONANTS CORRECT--REVISED RELATIVE ERRORS Source: CS

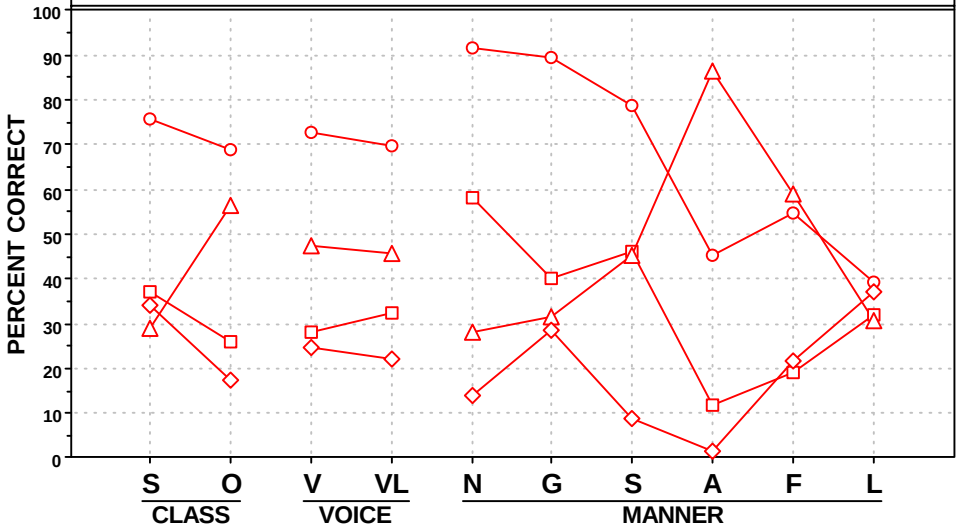
	EARLY-8			MIDDLE-8			LATE-8			TOTAL		
	S	C	T	S	C	T	S	C	T	S	C	T
○PCC-R	94.5	88.4	93.5	79.4	75.6	78.6	59.5	63.2	60.6	81.8	75.0	80.4
□ROI-R	61.6	68.9	64.0	37.7	49.4	41.9	15.2	54.7	26.3	27.1	55.7	34.9
△RSI-R	38.4	31.1	36.0	62.3	50.6	58.1	84.8	45.3	73.7	72.9	44.3	65.1



A

CONSONANT FEATURES CORRECT RELATIVE ERRORS Source: CS

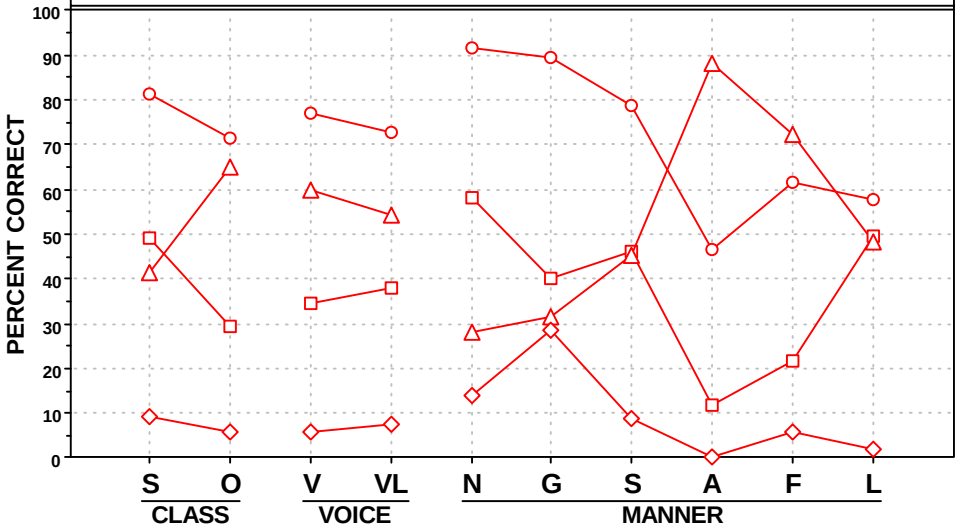
	CLASS		VOICE		MANNER					
	S	O	V	VL	N	G	S	A	F	L
○ PCC	75.9	68.7	72.7	69.9	91.5	89.6	78.7	45.2	54.6	39.2
□ ROI	37.0	26.1	27.9	32.2	57.9	40.0	46.1	11.8	19.2	32.1
△ RSI	28.9	56.5	47.2	45.6	28.3	31.6	45.1	86.6	58.9	30.6
◇ RDI	34.1	17.4	24.8	22.2	13.8	28.4	8.8	1.6	21.9	37.2



B

CONSONANT FEATURES CORRECT--ADJUSTED RELATIVE ERRORS Source: CS

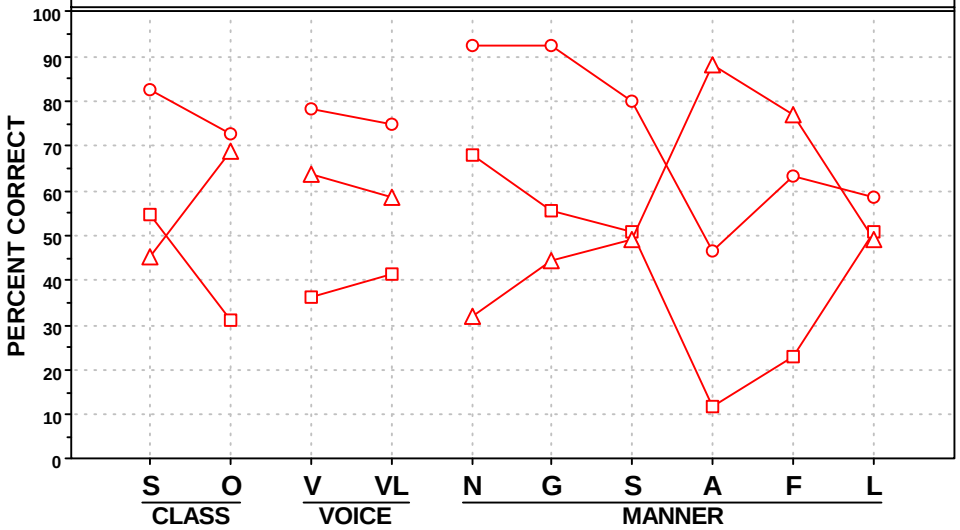
	CLASS		VOICE		MANNER					
	S	O	V	VL	N	G	S	A	F	L
○ PCC-A	81.4	71.5	77.1	73.0	91.5	89.6	78.7	46.5	61.7	57.7
□ ROI-A	49.3	29.4	34.6	38.0	57.9	40.0	46.1	11.8	21.7	49.8
△ RSI-A	41.3	64.9	59.8	54.3	28.3	31.6	45.1	88.2	72.5	48.2
◇ RDI-A	9.3	5.7	5.6	7.7	13.8	28.4	8.8	0.0	5.8	2.0



C

CONSONANT FEATURES CORRECT--REVISED RELATIVE ERRORS Source: CS

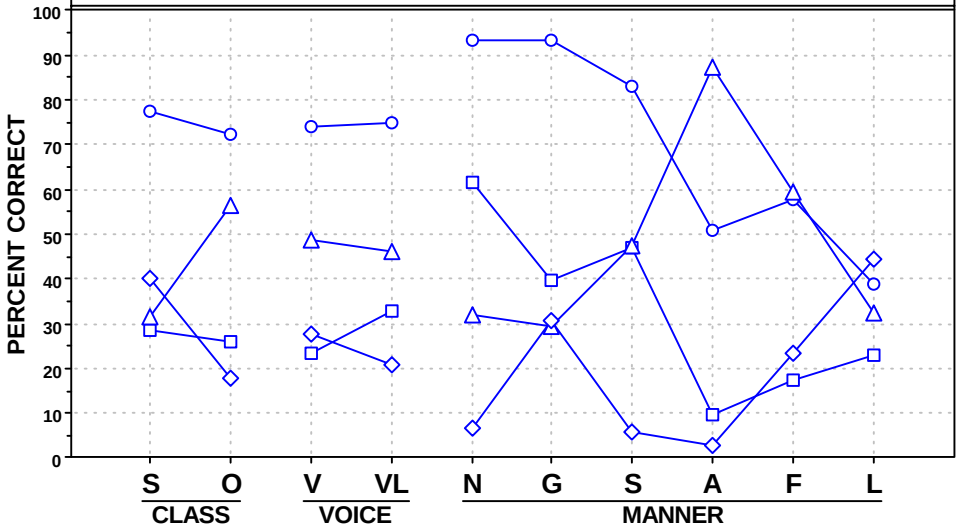
	CLASS		VOICE		MANNER					
	S	O	V	VL	N	G	S	A	F	L
○ PCC-R	82.6	73.0	78.2	74.8	92.3	92.7	80.0	46.5	63.4	58.5
□ ROI-R	54.5	31.3	36.5	41.3	68.2	55.6	50.8	11.8	22.9	50.9
△ RSI-R	45.5	68.7	63.5	58.7	31.8	44.4	49.2	88.2	77.1	49.1



A

CONSONANT FEATURES CORRECT RELATIVE ERRORS Source: CS

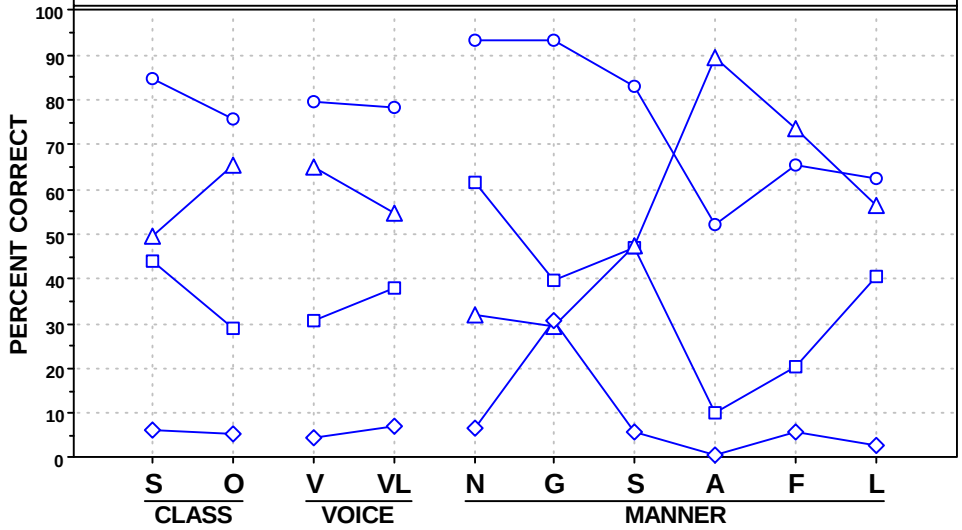
	CLASS		VOICE		MANNER					
	S	O	V	VL	N	G	S	A	F	L
○ PCC	77.6	72.3	74.2	74.9	93.6	93.3	83.1	50.9	57.6	38.9
□ ROI	28.5	25.8	23.2	32.8	61.7	39.7	46.8	9.8	17.3	23.1
△ RSI	31.5	56.6	48.9	46.2	31.8	29.5	47.5	87.3	59.4	32.4
◇ RDI	40.0	17.6	27.8	21.0	6.5	30.9	5.7	2.9	23.3	44.6



B

CONSONANT FEATURES CORRECT--ADJUSTED RELATIVE ERRORS Source: CS

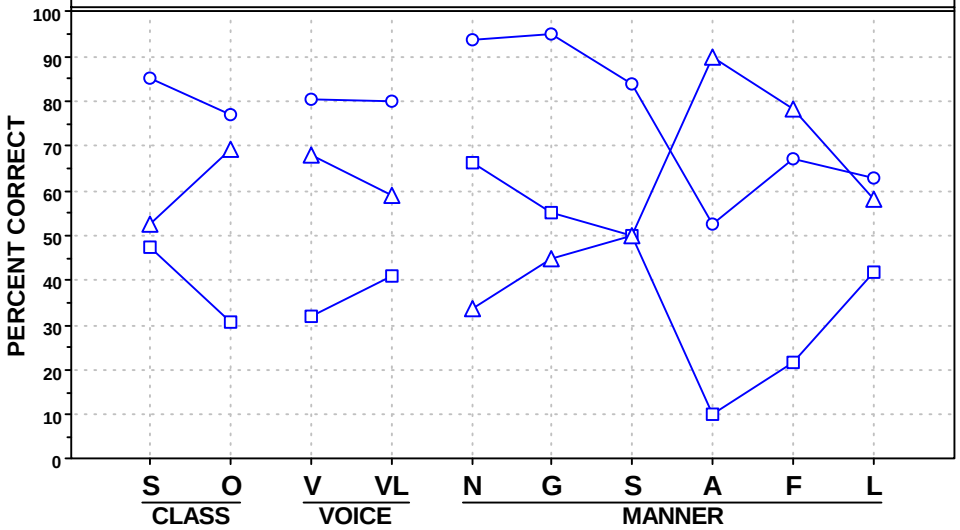
	CLASS		VOICE		MANNER					
	S	O	V	VL	N	G	S	A	F	L
○ PCC-A	84.7	75.6	79.8	78.4	93.6	93.3	83.1	52.3	65.5	62.3
□ ROI-A	44.1	29.1	30.5	38.0	61.7	39.7	46.8	9.9	20.6	40.6
△ RSI-A	49.8	65.6	65.1	54.8	31.8	29.5	47.5	89.7	73.6	56.5
◇ RDI-A	6.1	5.3	4.3	7.2	6.5	30.9	5.7	0.4	5.8	2.9

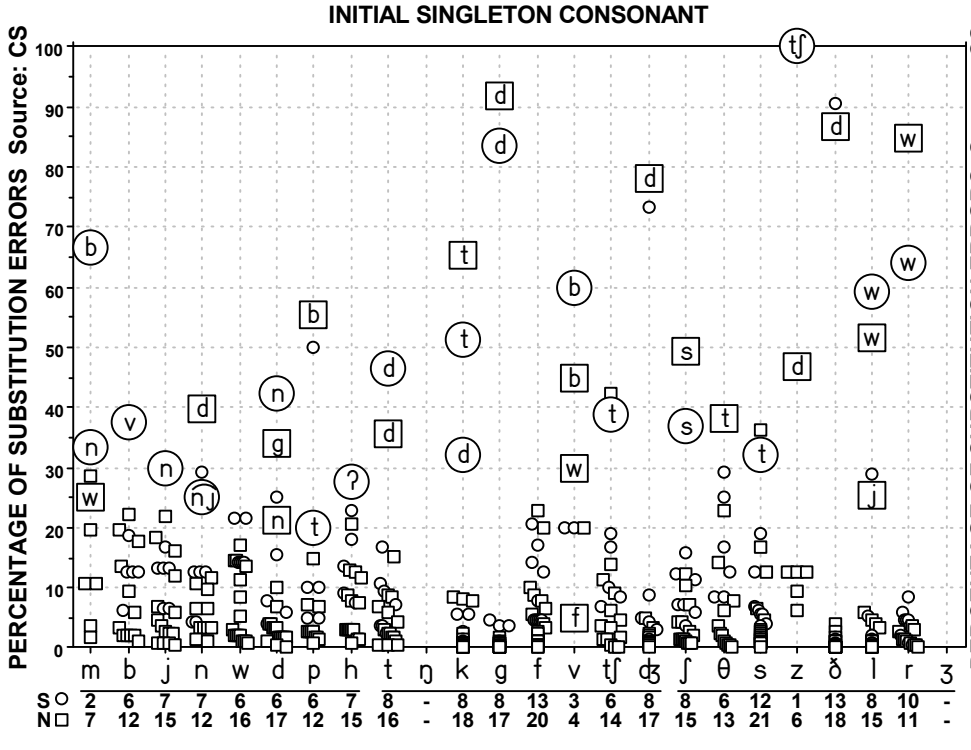


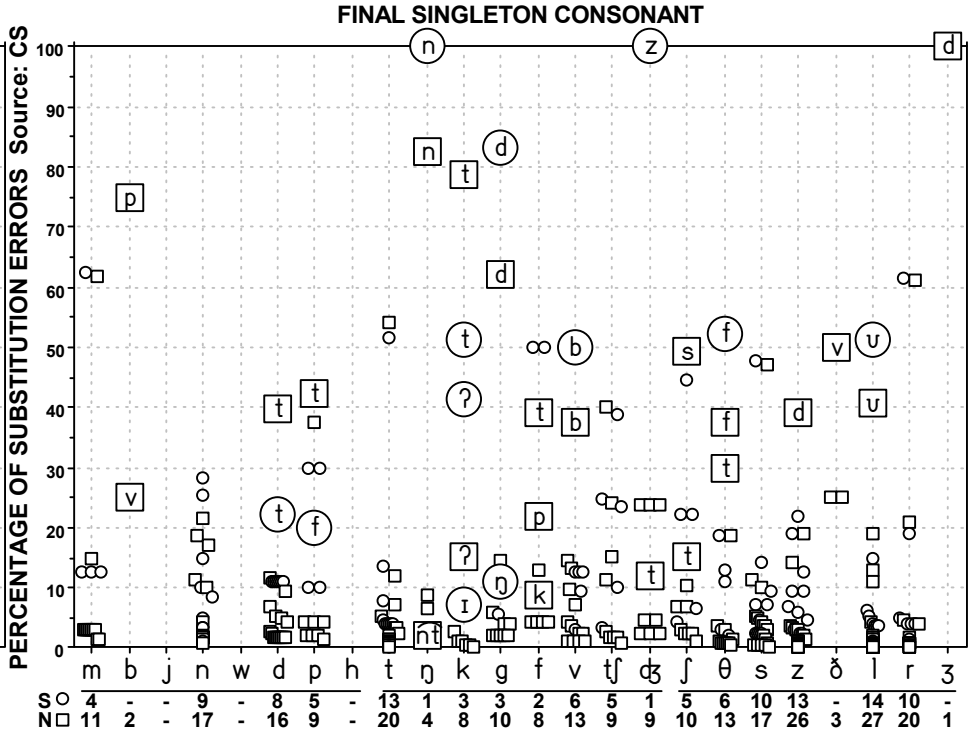
C

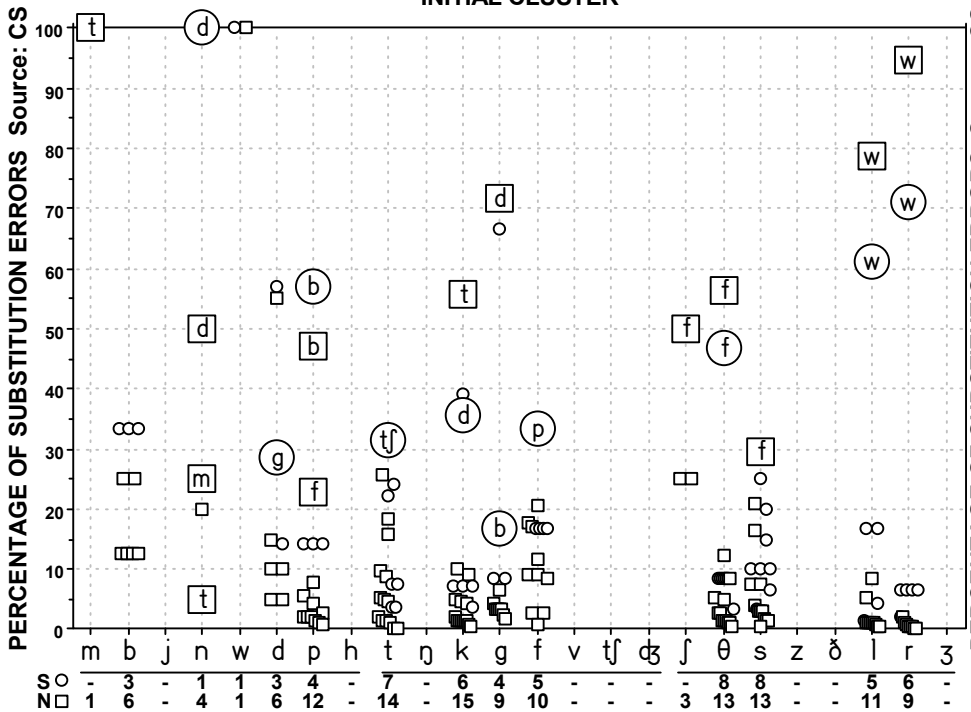
CONSONANT FEATURES CORRECT--REVISED RELATIVE ERRORS Source: CS

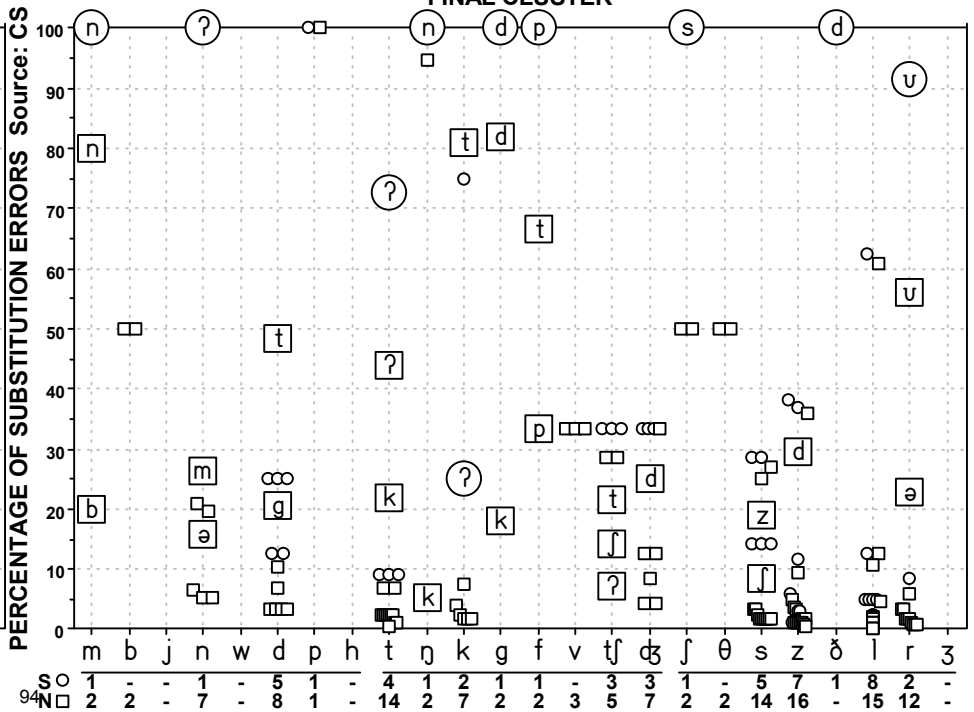
	CLASS		VOICE		MANNER					
	S	O	V	VL	N	G	S	A	F	L
○ PCC-R	85.3	76.9	80.5	79.9	93.9	95.2	84.1	52.5	67.2	62.7
□ ROI-R	47.3	30.8	31.9	41.0	66.3	55.1	49.8	9.9	21.7	41.9
△ RSI-R	52.7	69.2	68.1	59.0	33.7	44.9	50.2	90.1	78.3	58.1

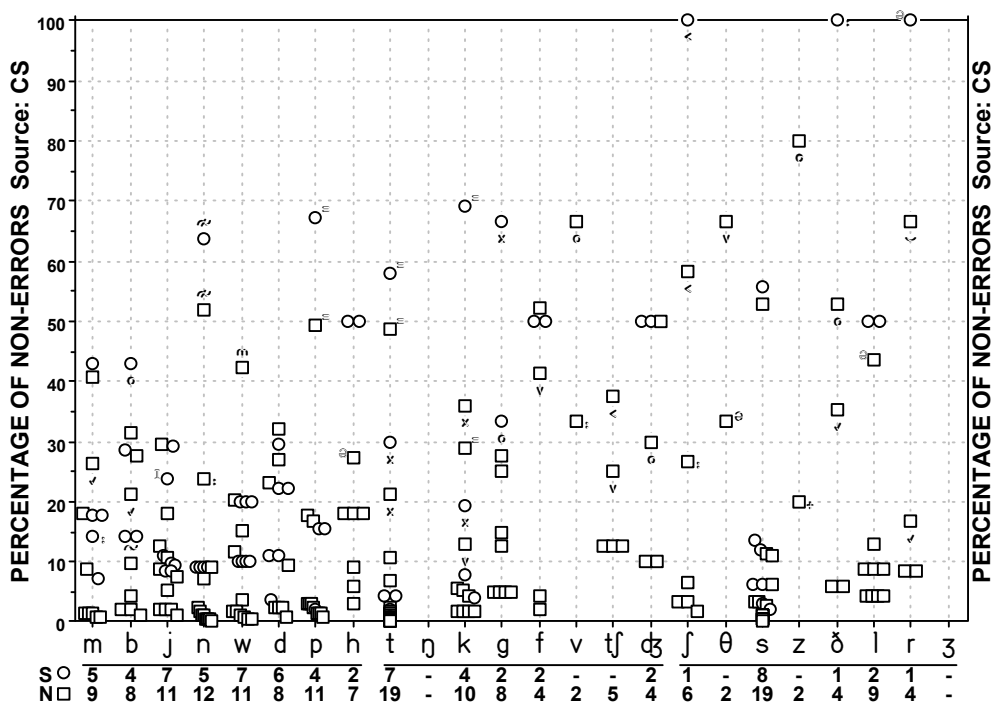


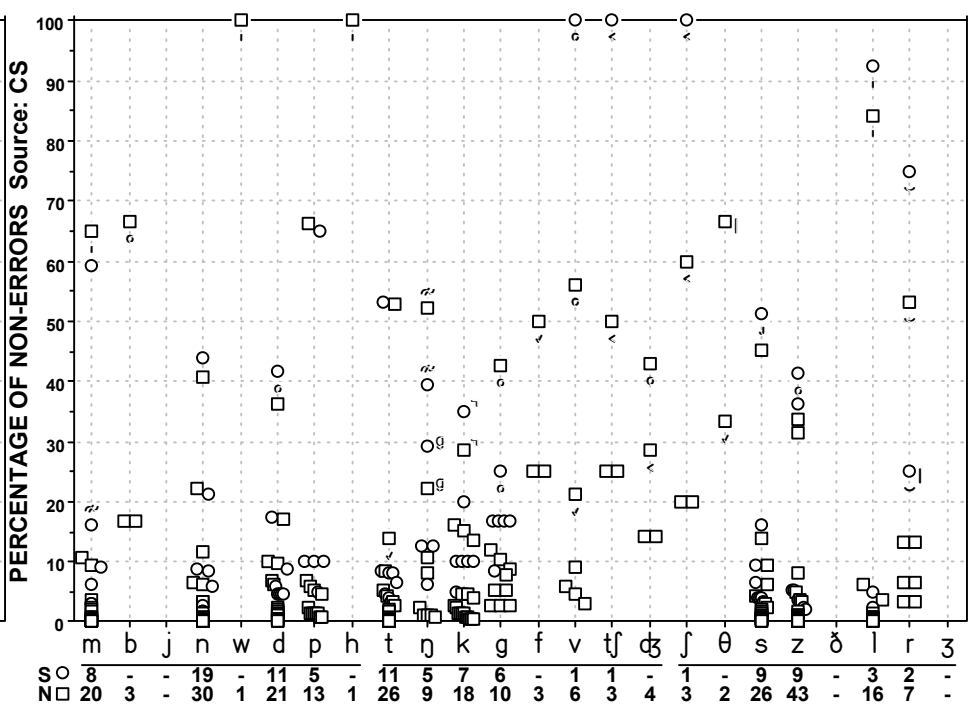

INITIAL SINGLETON CONSONANT
PERCENTAGE OF SUBSTITUTION ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S 2 6 7 7 6 6 6 7 8 - 8 8 13 3 6 8 8 6 12 1 13 8 10 -
N 7 12 15 12 16 17 12 15 16 - 18 17 20 4 14 17 15 13 21 6 18 15 11 -

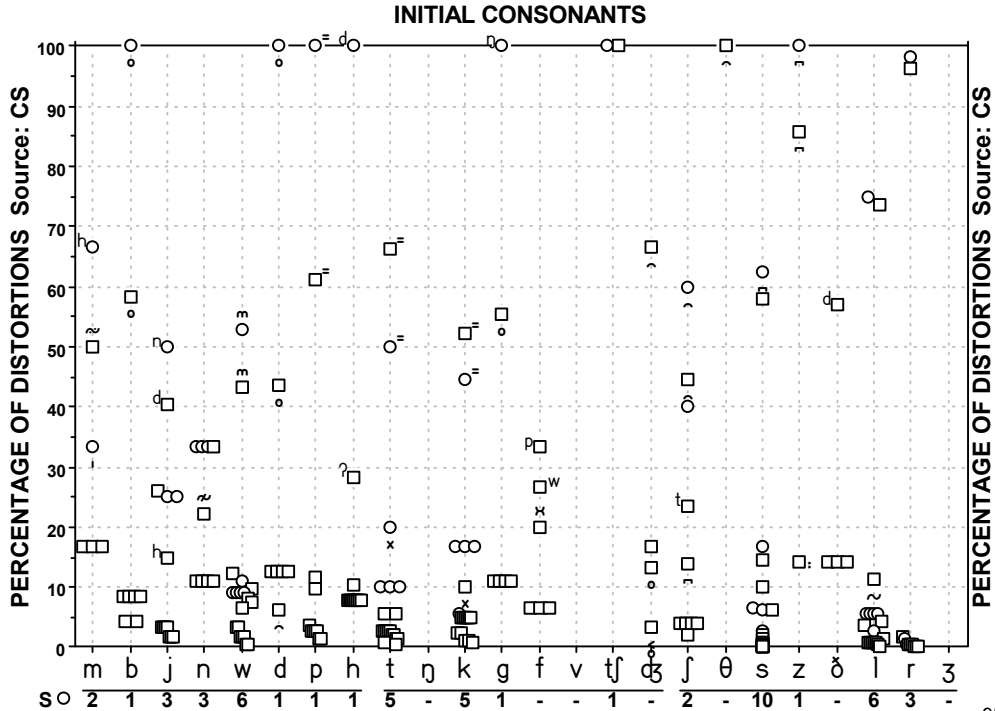

FINAL SINGLETON CONSONANT
PERCENTAGE OF SUBSTITUTION ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S 4 - - 9 - 8 5 - 13 1 3 3 2 6 5 1 5 6 10 13 - 14 10 -
N 11 2 - 17 - 16 9 - 20 4 8 10 8 13 9 9 10 13 17 26 3 27 20 1

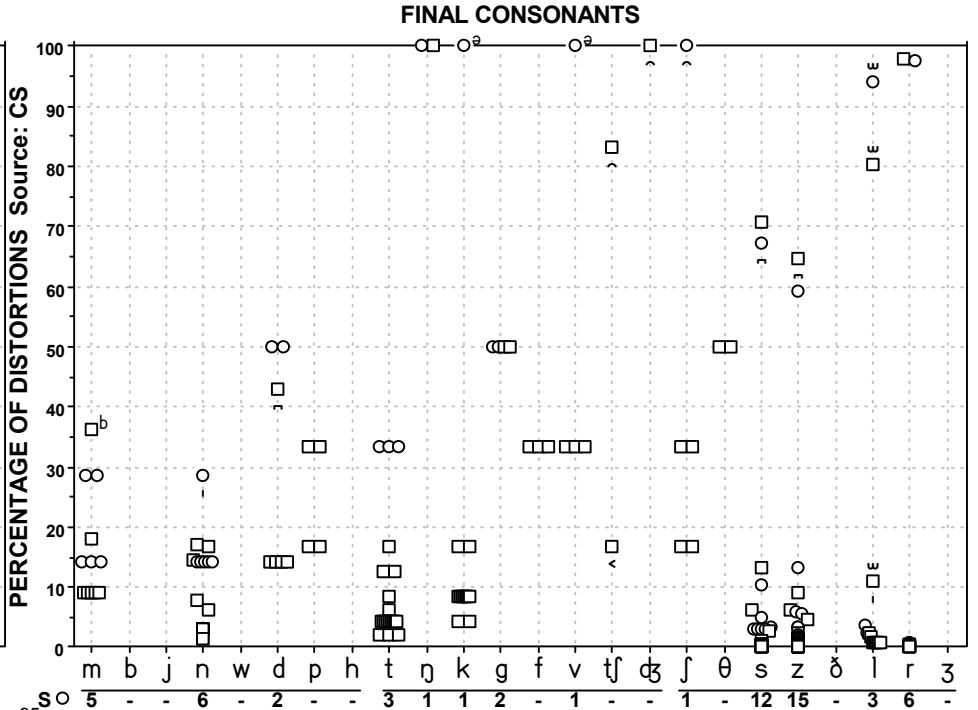

INITIAL CLUSTER
PERCENTAGE OF SUBSTITUTION ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S - 3 - 1 1 3 4 - 7 - 6 4 5 - - - - 8 8 - - 5 6 -
N 1 6 - 4 1 6 12 - 14 - 15 9 10 - - - 3 13 13 - - 11 9 -

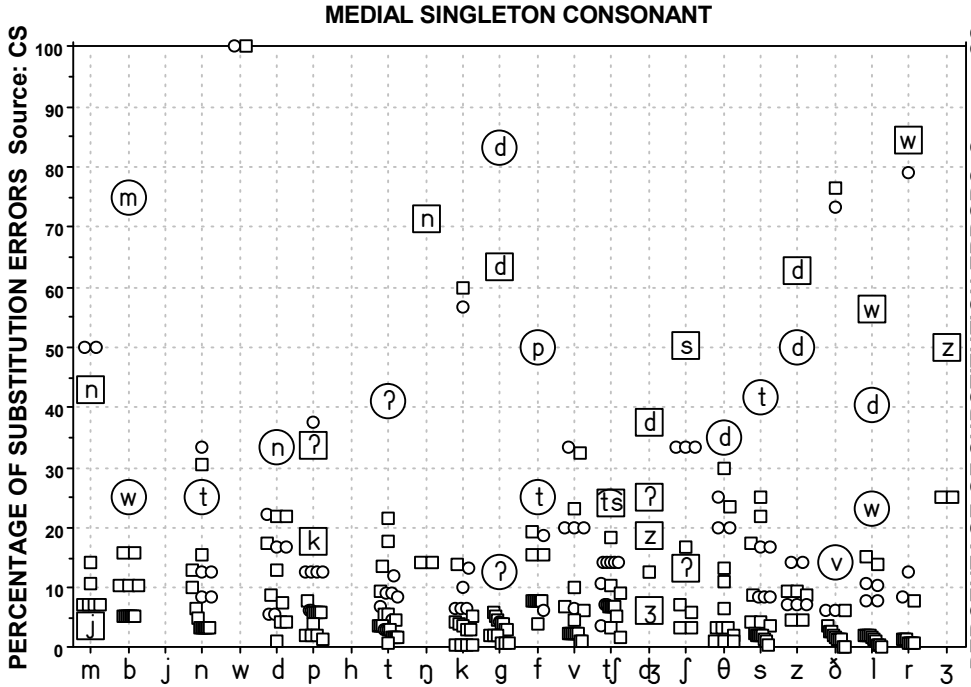

FINAL CLUSTER
PERCENTAGE OF SUBSTITUTION ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S 1 - - 1 - 5 1 - 4 1 2 1 1 - 3 3 1 - 5 7 1 8 2 -
N 2 2 - 7 - 8 1 - 14 2 7 2 2 3 5 7 2 2 14 16 - 15 12 -

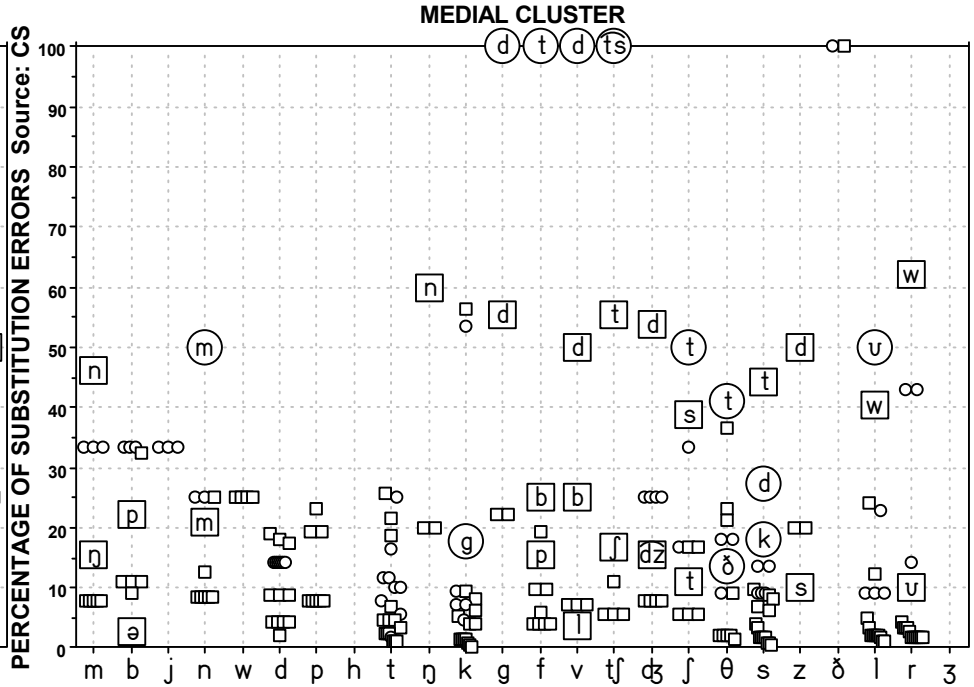

INITIAL CONSONANTS
PERCENTAGE OF NON-ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ
S 5 4 7 5 7 6 4 2 7 - 4 2 2 - - 2 1 - 8 - 1 2 1 -
N 9 8 11 12 11 8 11 7 19 - 10 8 4 2 5 4 6 2 19 2 4 9 4 -

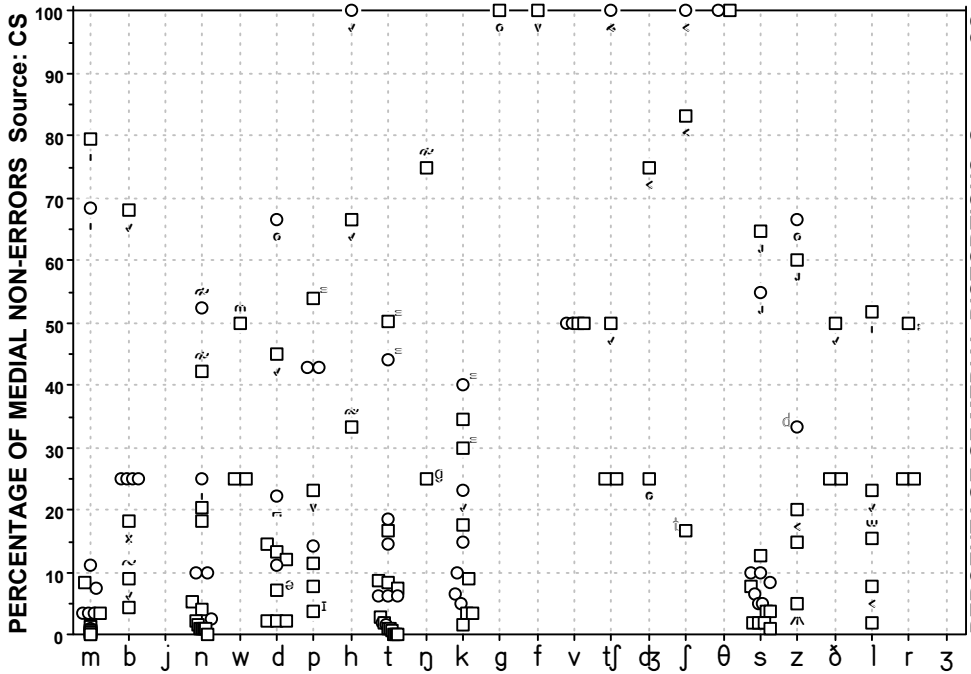

FINAL CONSONANTS
PERCENTAGE OF NON-ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ
S 8 - - 19 - 11 5 - 11 5 7 6 - 1 1 - 1 - 9 9 - 3 2 -
N 20 3 - 30 1 21 13 1 26 9 18 10 3 6 3 4 3 2 26 43 - 16 7 -

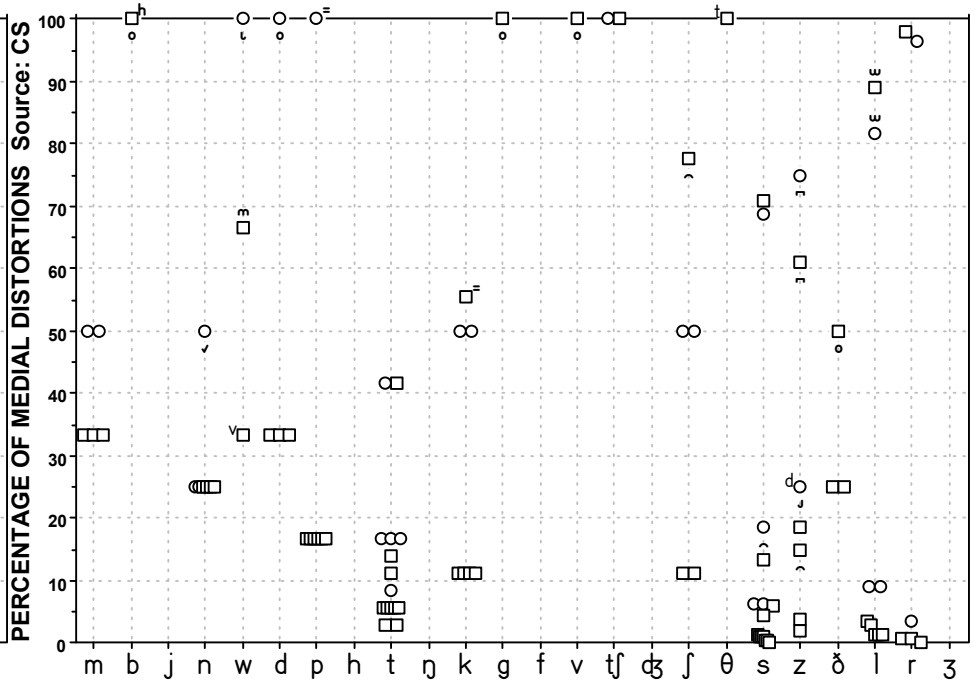

INITIAL CONSONANTS
PERCENTAGE OF DISTORTIONS Source: CS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ
S 2 1 3 3 6 1 1 1 5 - 5 1 - - 1 - 2 - 10 1 - 6 3 -
N 4 7 10 6 13 6 10 10 14 - 13 5 6 - 1 4 8 1 28 2 4 12 8 -


FINAL CONSONANTS
PERCENTAGE OF DISTORTIONS Source: CS
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ
S 5 - - 6 - 2 - - 3 1 1 2 - 1 - - 1 - 12 15 - 3 6 -
N 7 - - 18 - 5 4 - 17 1 11 2 3 3 2 1 4 2 33 45 - 9 18 -


MEDIAL SINGLETON CONSONANT
PERCENTAGE OF SUBSTITUTION ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S 2 2 - 6 1 6 7 - 10 - 6 3 4 5 9 - 3 4 6 6 4 6 3 -
N 8 12 - 12 1 9 13 - 16 3 12 14 10 14 11 5 7 12 15 6 12 13 9 3

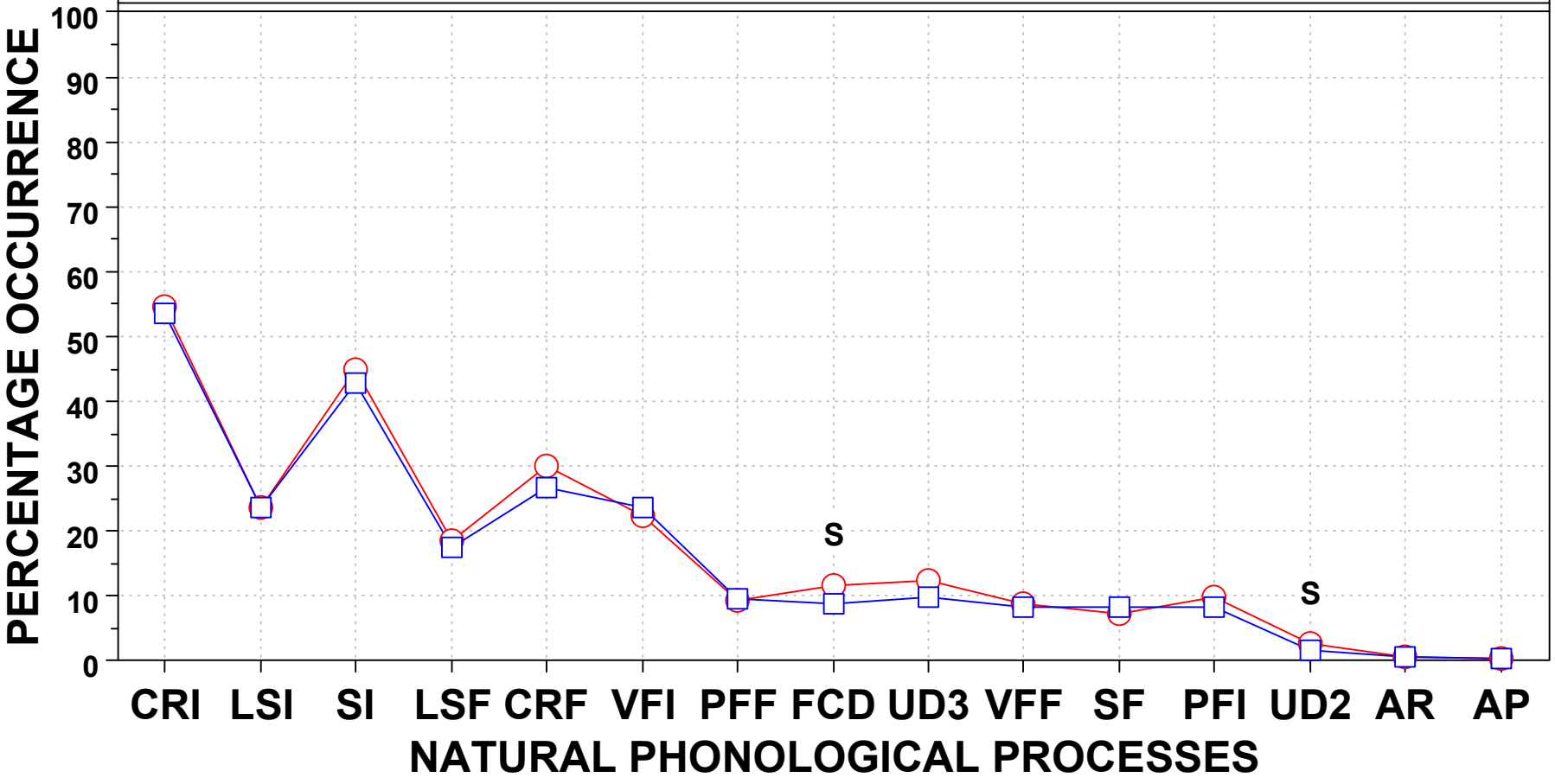

MEDIAL CLUSTER
PERCENTAGE OF SUBSTITUTION ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S 3 3 3 3 - 7 - - 9 - 6 1 1 1 4 3 7 5 7 - 1 5 3 -
N 7 7 - 8 4 11 8 - 14 3 14 3 10 6 6 6 7 9 15 4 1 13 14 -


PERCENTAGE OF MEDIAL NON-ERRORS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S 8 4 - 5 - 3 3 1 8 - 6 - - 2 1 2 1 - 1 1 7 2 - - - -
N 14 4 - 12 3 8 5 2 13 2 7 1 1 2 3 2 2 1 9 4 3 5 3 -


PERCENTAGE OF MEDIAL DISTORTIONS Source: CS
m b j n w d p h t ŋ k g f v tʃ ʤ ʃ θ s z ð l r ʒ
S 2 - - 3 1 1 1 - 5 - 2 - - - 1 - 2 - 4 2 - 3 2 -
N 3 1 - 4 2 3 6 - 10 - 5 1 - 1 1 - 3 1 11 5 3 6 4 -

NATURAL PHONOLOGICAL PROCESSES Source: CS

		Assimilat		Clus Reduc		Final	Liq Simp		Palat Front		Stopping		Unstress Del		Velar Front	
		Regr	Progr	Init	Final	SCon Del	Init	Final	Init	Final	Init	Final	S2 syl	3+ syl	Init	Final
○ S	*M*	0.6	0.4	54.6	29.9	11.7	23.7	18.5	9.8	9.4	45.0	7.2	2.8	12.4	22.5	8.7
	SD	0.9	0.7	39.7	21.8	11.6	32.8	25.0	27.2	26.8	23.9	12.8	7.7	21.5	32.7	22.1
□ N	*M*	0.7	0.4	53.6	26.6	8.8	23.8	17.6	8.3	9.6	42.9	8.2	1.5	10.0	23.7	8.3
	SD	1.3	0.9	37.5	24.1	11.3	31.8	24.8	21.1	27.4	25.7	14.5	3.4	19.0	36.0	19.2

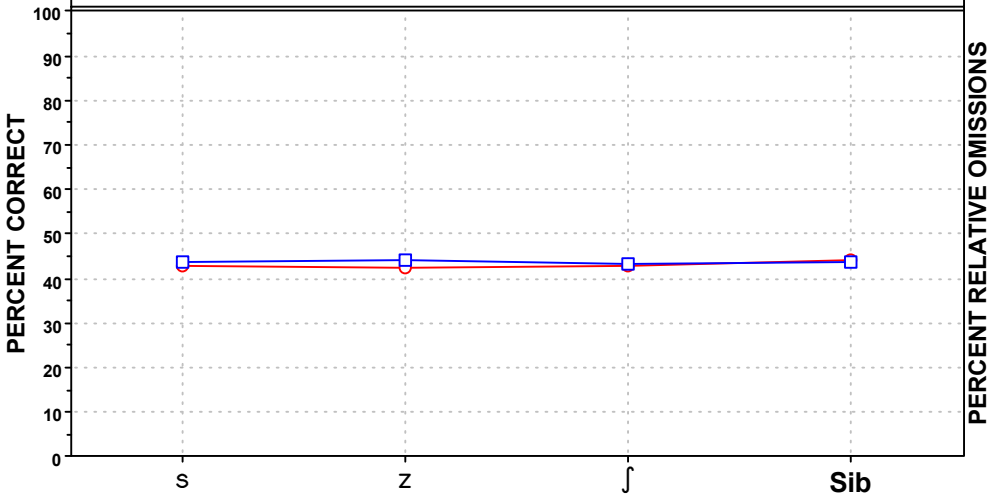


*p < .05, †p < .01, ‡p < .001, Øno test Effect:[97]S≥.2,M≥.5,L≥.8,V≥1,E≥2

Consonant Profile 13, S and N

A — PERCENTAGE OF SIBILANTS CORRECT Source: CS

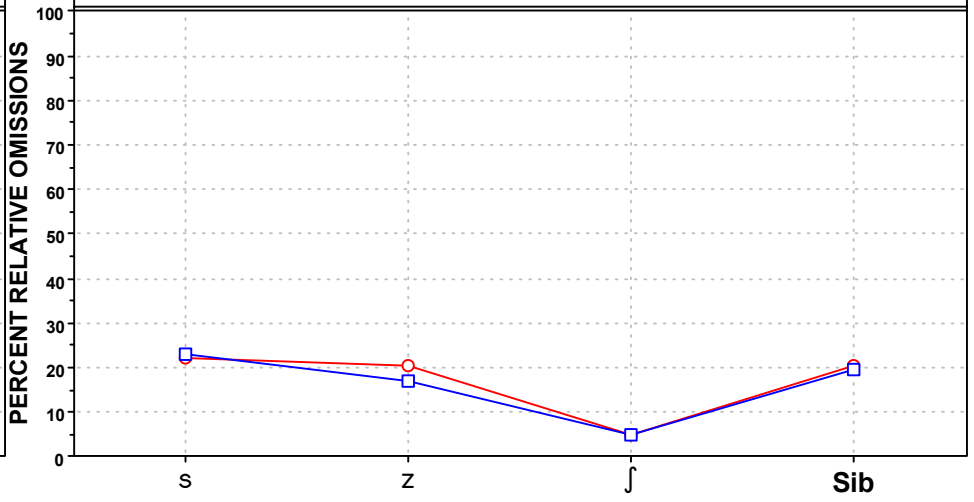
		s	z	ʃ	Sib
S	*M*	42.9	42.6	42.8	44.1
	SD	31.8	31.5	44.3	28.9
N	*M*	43.6	44.3	43.2	43.8
	SD	34.4	34.4	43.4	32.5



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

B — PERCENTAGE OF ABSOLUTE AND RELATIVE OMISSIONS Source: CS

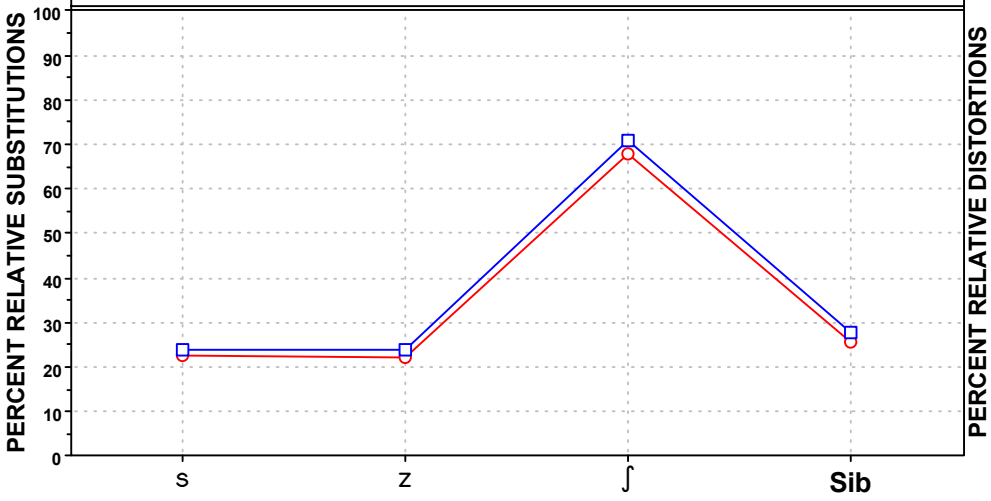
		s		z		ʃ		TOTAL	
		A	R	A	R	A	R	A	R
S	*M*	15.5	22.3	13.9	20.6	3.6	5.2	13.4	20.4
	SD	19.2	24.3	23.1	27.1	17.1	20.4	15.6	19.1
N	*M*	15.3	23.2	11.1	17.1	3.2	5.0	13.2	19.4
	SD	21.5	26.5	21.7	28.0	15.9	20.4	19.1	22.8



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

C — PERCENTAGE OF ABSOLUTE AND RELATIVE SUBSTITUTIONS Source: CS

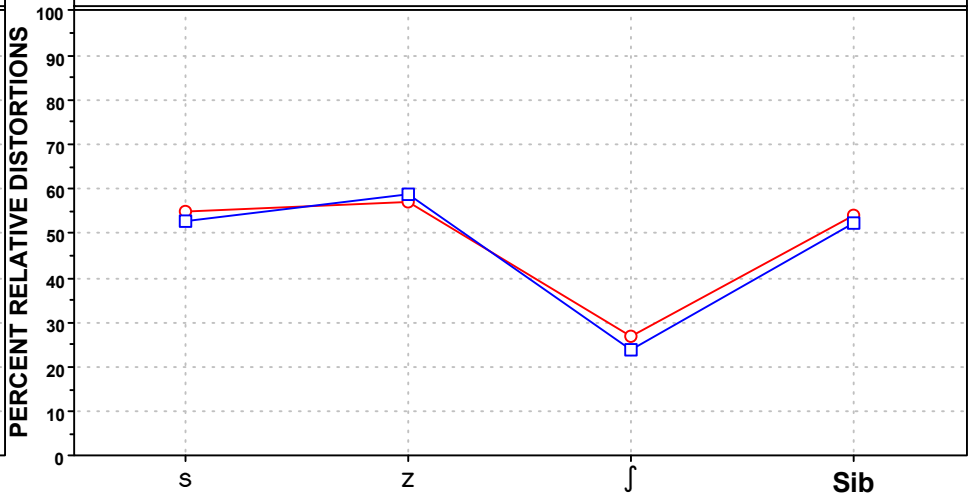
		s		z		ʃ		TOTAL	
		A	R	A	R	A	R	A	R
S	*M*	14.8	22.8	14.8	22.2	38.4	67.8	16.4	25.6
	SD	16.8	21.6	18.9	25.3	42.4	40.9	15.0	19.1
N	*M*	14.8	24.1	13.7	23.8	42.2	71.0	16.2	28.0
	SD	18.7	24.4	19.6	27.8	43.8	41.5	17.4	22.0



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

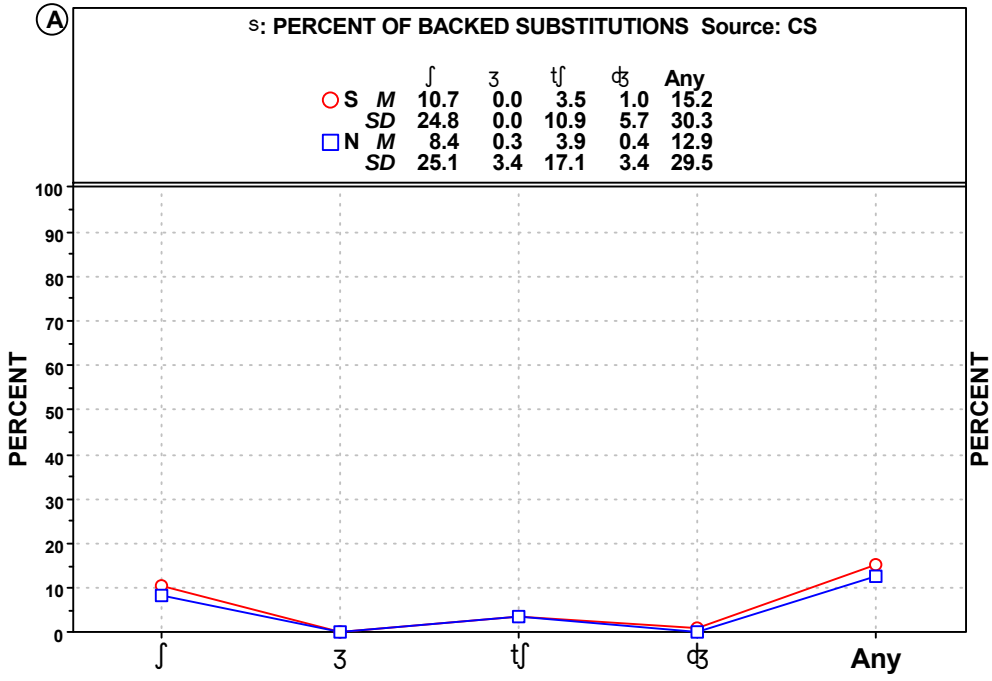
D — PERCENTAGE OF ABSOLUTE AND RELATIVE DISTORTIONS Source: CS

		s		z		ʃ		TOTAL	
		A	R	A	R	A	R	A	R
S	*M*	26.9	54.9	28.7	57.2	15.2	27.1	26.2	54.0
	SD	24.0	34.2	26.2	36.2	30.8	39.3	21.6	30.7
N	*M*	26.3	52.6	30.9	59.0	11.4	24.0	26.8	52.6
	SD	27.4	36.6	30.1	37.5	25.9	39.1	25.9	32.9



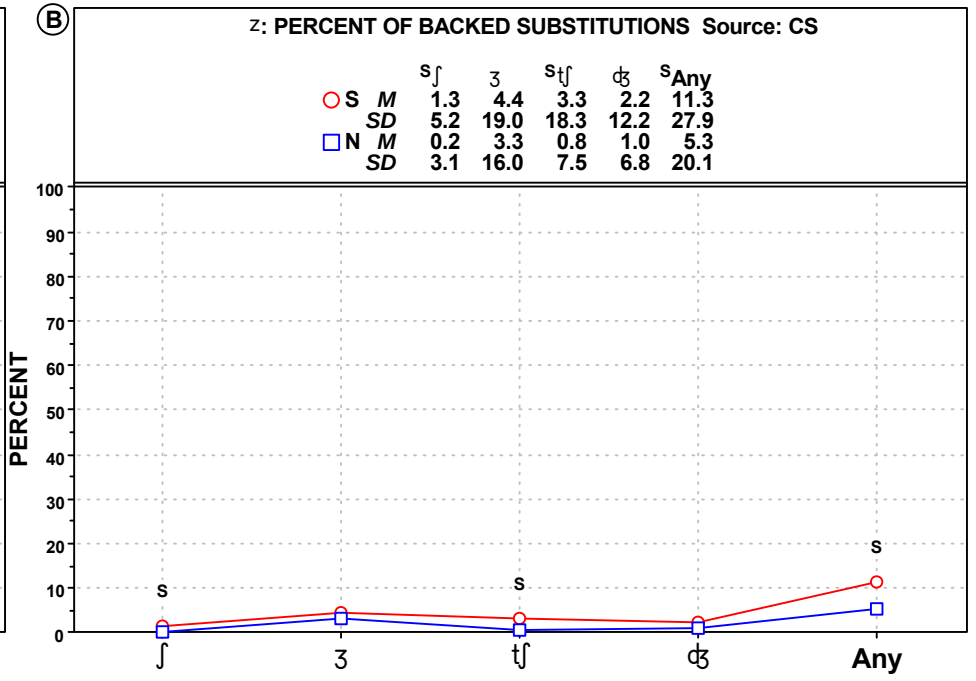
*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Ⓐ



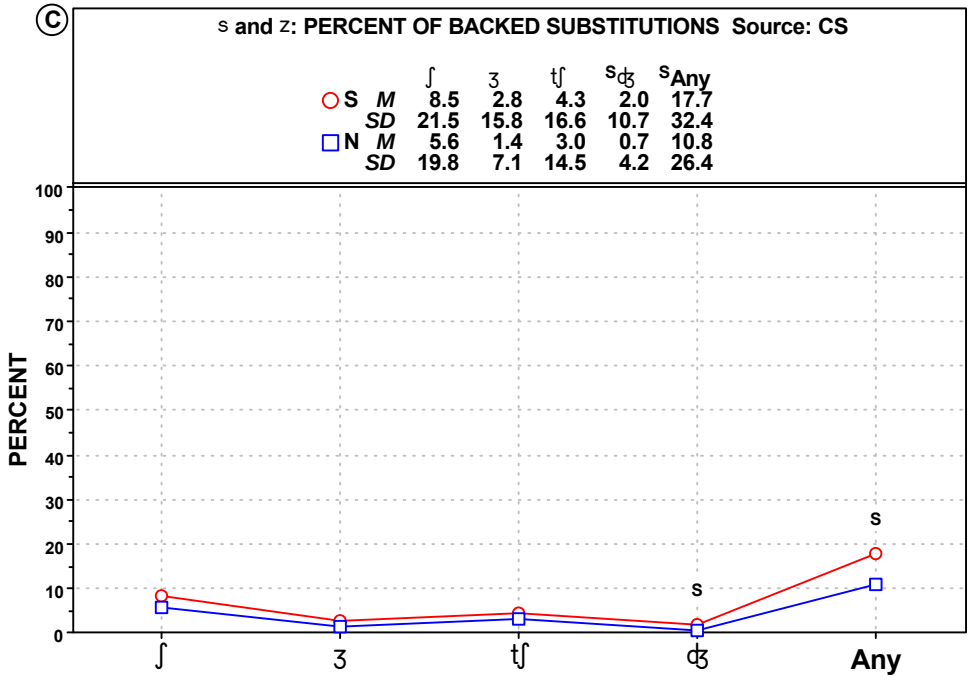
*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Ⓑ



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

Ⓒ

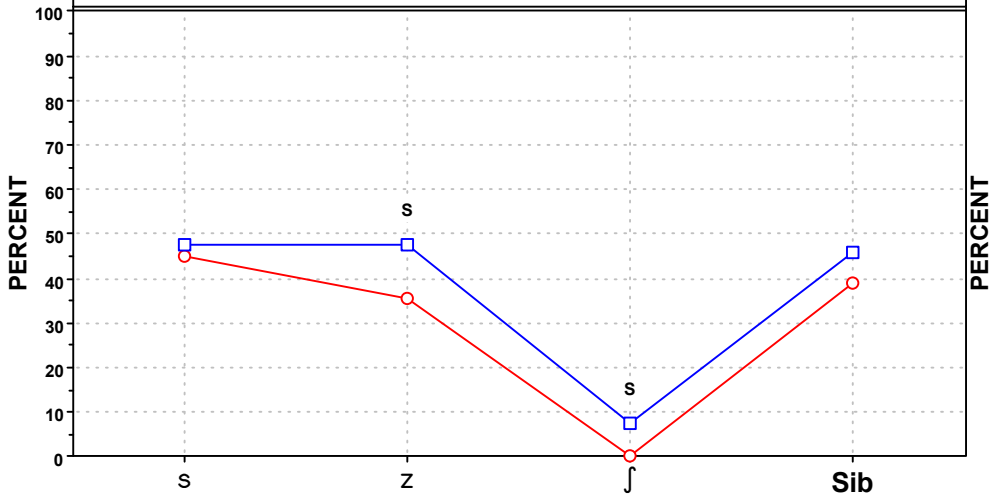


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A

PERCENT DENTALIZED OF DISTORTED Source: CS

		s	sz	s∫	Sib
S	*M*	45.0	35.5	0.0	39.1
	SD	38.9	41.1	0.0	36.4
N	*M*	47.7	47.6	7.6	45.8
	SD	40.6	41.4	25.0	37.5

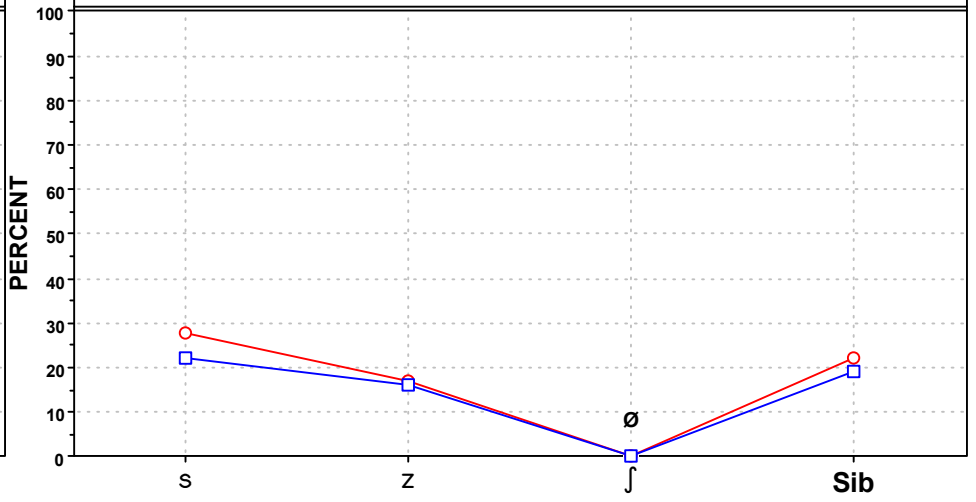


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

PERCENT PALATALIZED OF DISTORTED Source: CS

		s	z	Ø∫	Sib
S	*M*	27.6	16.8	0.0	22.4
	SD	36.5	27.8	0.0	31.5
N	*M*	22.0	16.3	0.0	19.2
	SD	32.4	29.7	0.0	29.1

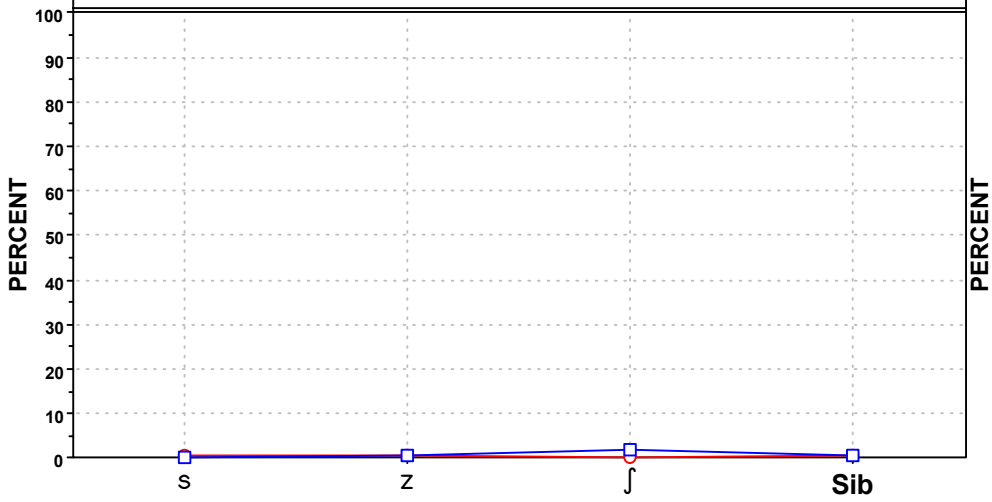


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

PERCENT RETROFLEXED OF DISTORTED Source: CS

		s	z	∫	Sib
S	*M*	0.8	0.7	0.0	0.7
	SD	3.8	4.4	0.0	3.7
N	*M*	0.4	0.6	1.8	0.5
	SD	4.4	4.3	13.5	3.6

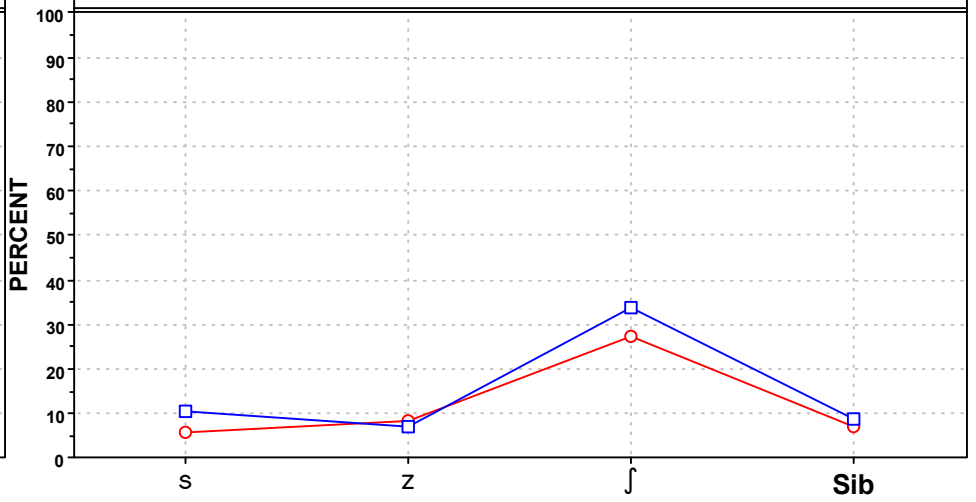


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D

PERCENT LATERALIZED OF DISTORTED Source: CS

		s	z	∫	Sib
S	*M*	5.8	8.4	27.3	7.2
	SD	18.4	24.8	46.7	19.8
N	*M*	10.6	7.0	33.9	8.9
	SD	25.9	22.4	46.4	22.3

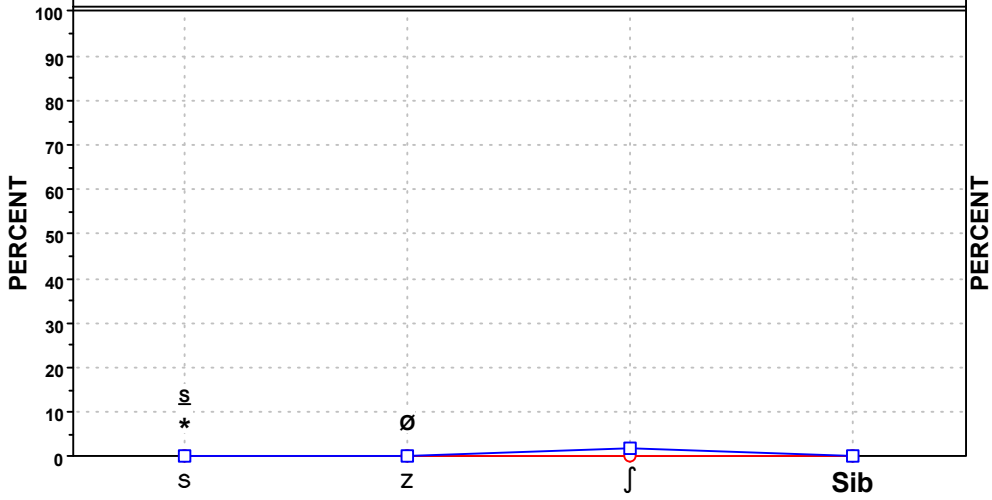


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

E

PERCENT BACKED OF DISTORTED Source: CS

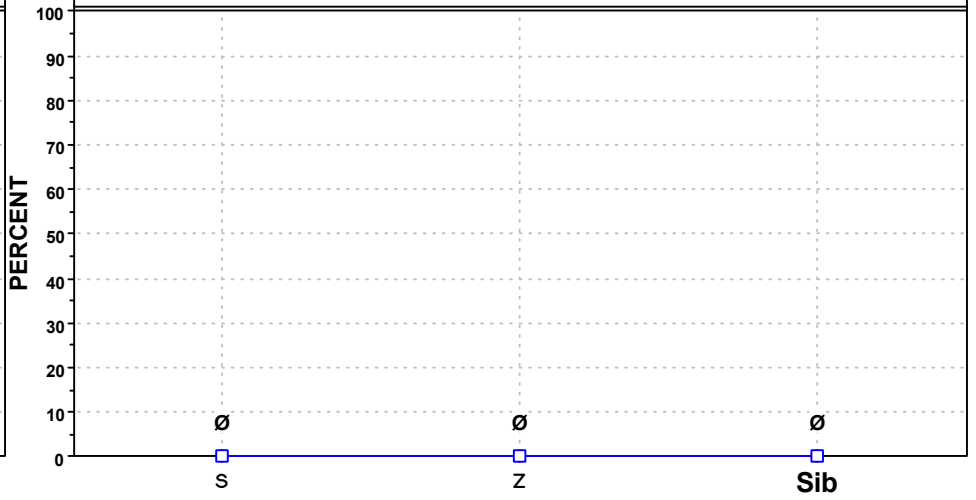
		S*S	Ø Z	∫	Sib
○ S	*M*	0.4	0.0	0.0	0.2
	SD	2.5	0.0	0.0	1.3
□ N	*M*	0.0	0.0	1.8	0.1
	SD	0.0	0.0	13.5	1.9



F

PERCENT BACKED ON-GLIDE OF DISTORTED Source: CS

		Ø S	Ø Z	Ø Sib
○ S	*M*	0.0	0.0	0.0
	SD	0.0	0.0	0.0
□ N	*M*	0.0	0.0	0.0
	SD	0.0	0.0	0.0

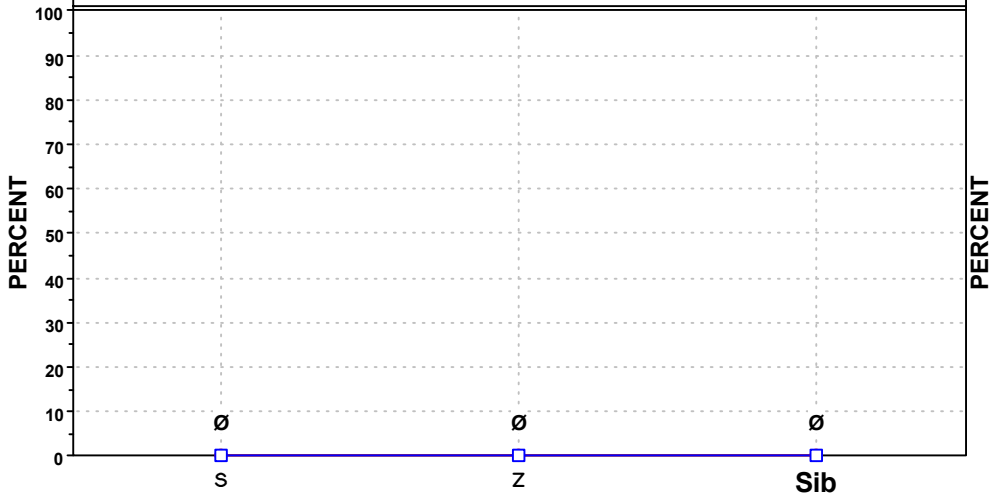


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

G

PERCENT BACKED OFF-GLIDE OF DISTORTED Source: CS

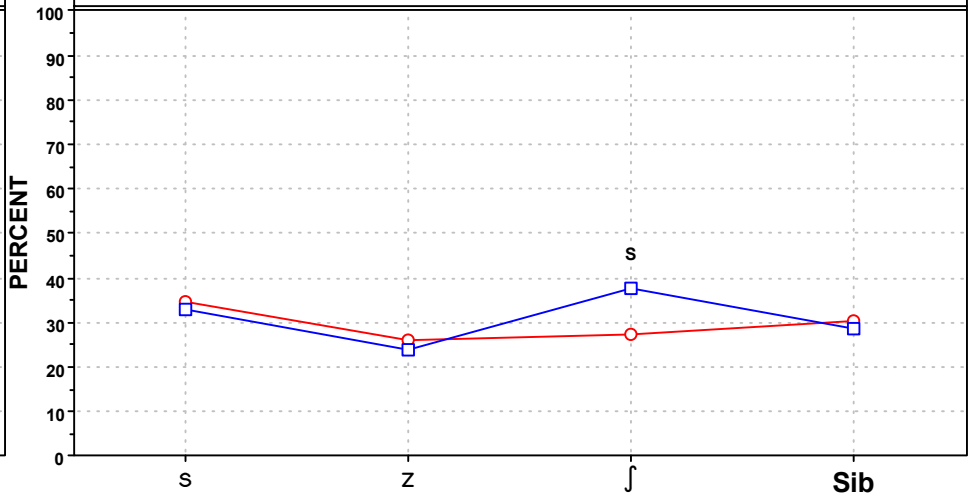
		Ø S	Ø Z	Ø Sib
○ S	*M*	0.0	0.0	0.0
	SD	0.0	0.0	0.0
□ N	*M*	0.0	0.0	0.0
	SD	0.0	0.0	0.0



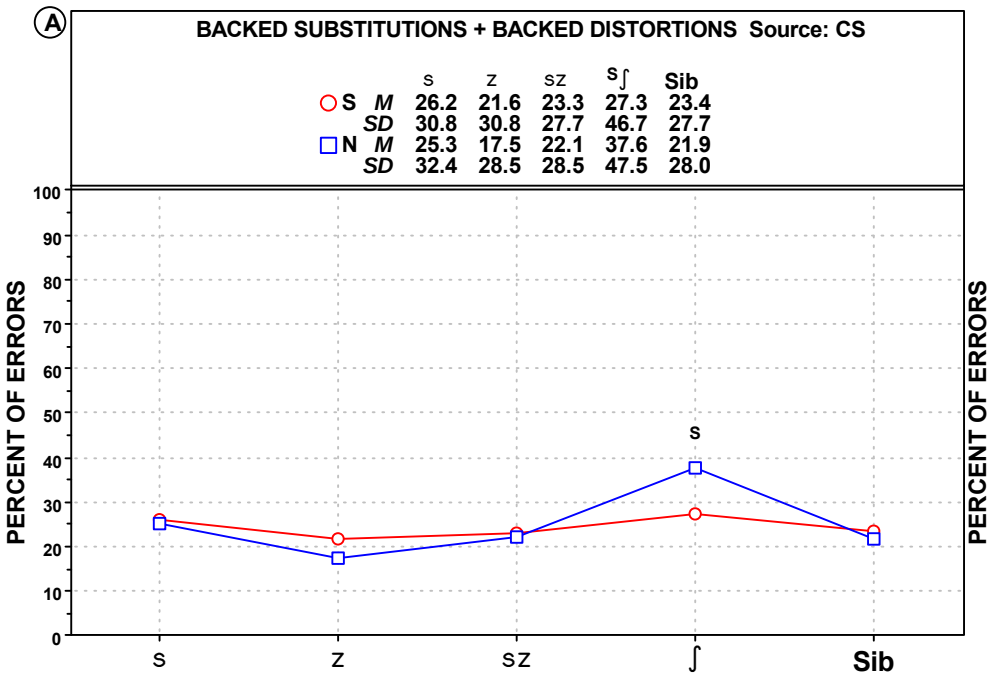
H

PERCENT BACKED DISTORTION [excludes dentalized] OF DISTORTED Source: CS

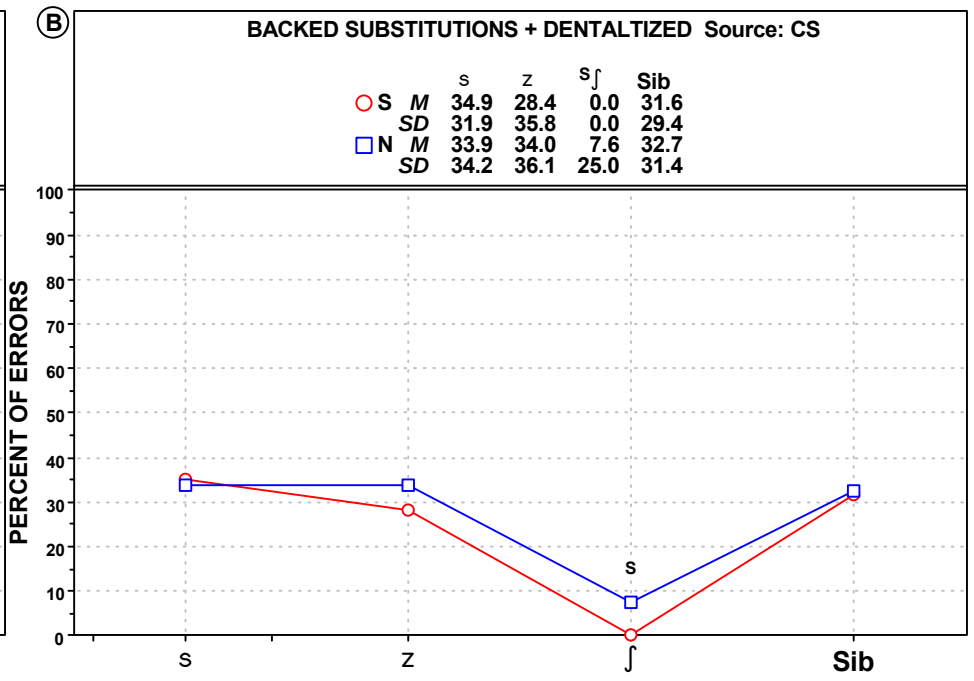
		S	Z	S∫	Sib
○ S	*M*	34.6	25.9	27.3	30.5
	SD	38.8	34.0	46.7	35.1
□ N	*M*	33.0	24.0	37.6	28.8
	SD	37.9	34.6	47.5	33.7



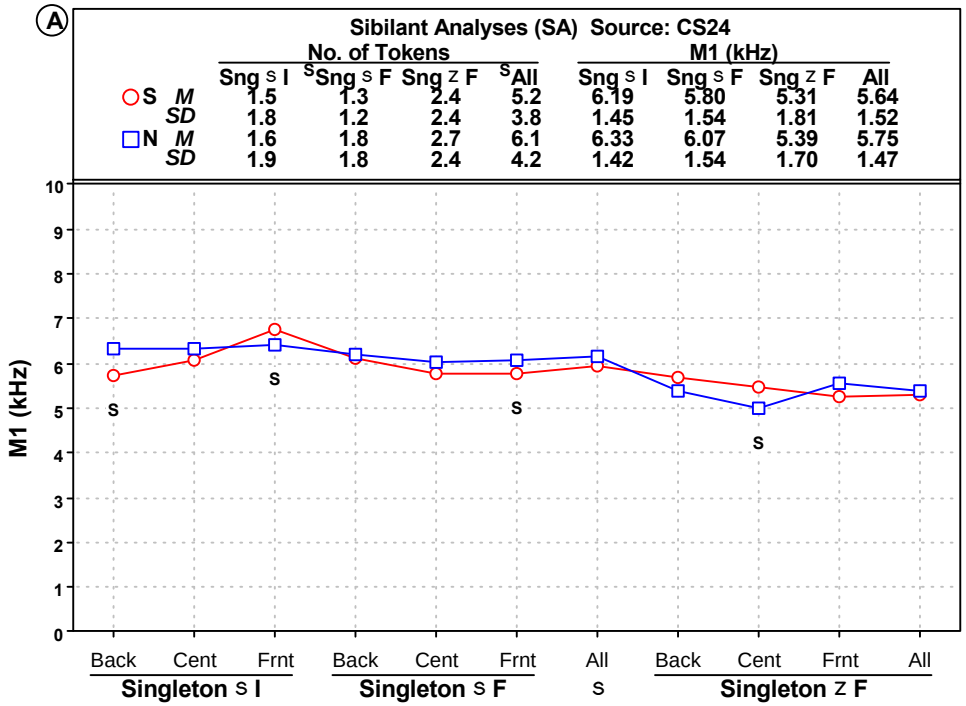
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



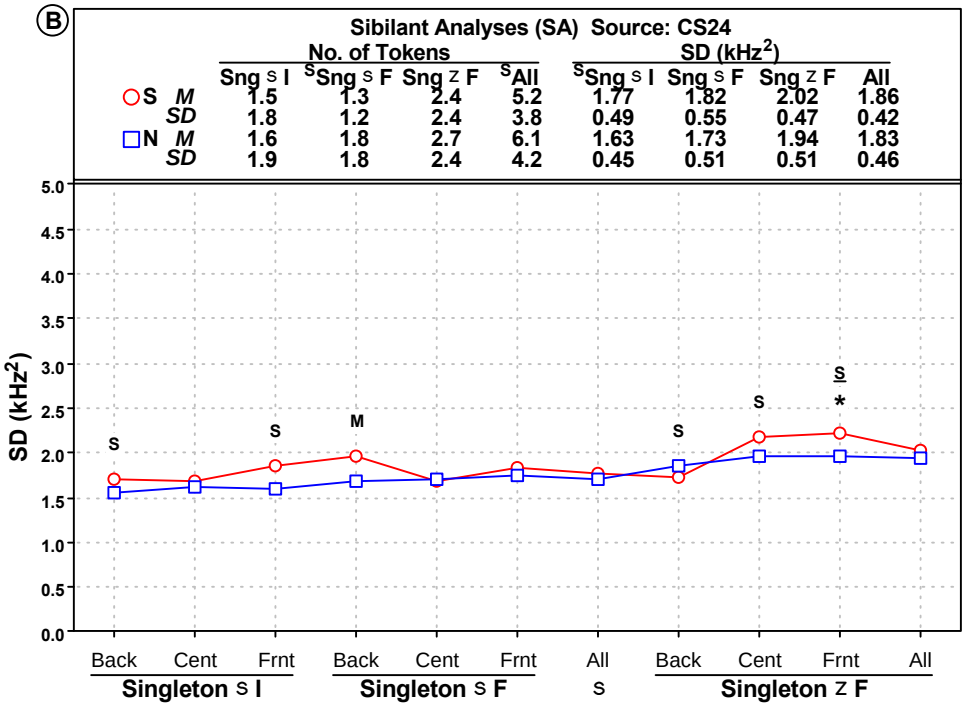
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



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



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

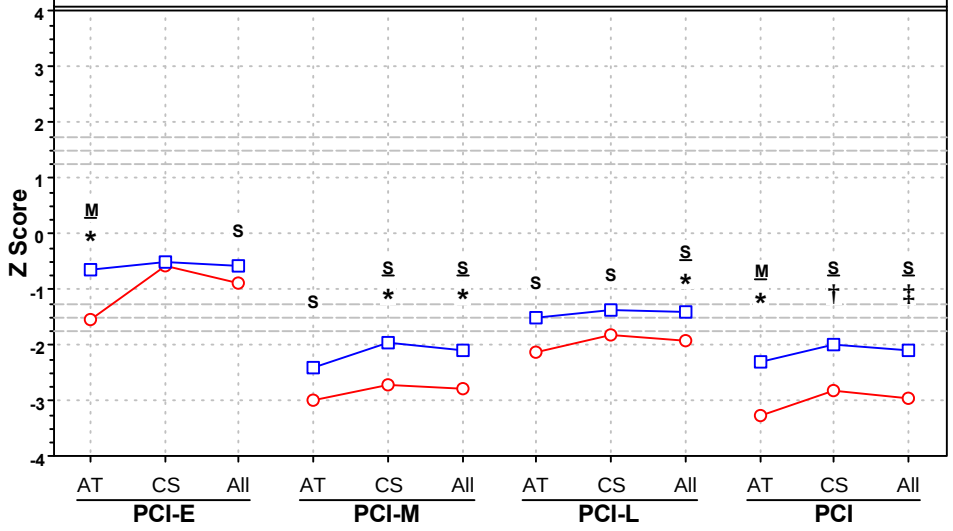


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A

Percent Consonants in Inventory Z Scores

		PCI-E			PCI-M			PCI-L			PCI		
		M*AT	CS	SAll	SAT	S*CS	S*All	SAT	SCS	S*All	M*AT	S†CS	S†All
S	*M*	-1.53	-0.57	-0.88	-2.97	-2.70	-2.79	-2.14	-1.81	-1.92	-3.27	-2.81	-2.96
	SD	2.09	1.66	1.85	2.47	2.02	2.16	1.82	1.94	1.89	1.90	1.88	1.89
N	*M*	-0.64	-0.51	-0.55	-2.40	-1.96	-2.09	-1.48	-1.38	-1.41	-2.28	-1.98	-2.07
	SD	1.54	1.61	1.59	2.30	2.14	2.20	1.66	1.92	1.85	1.93	1.93	1.94

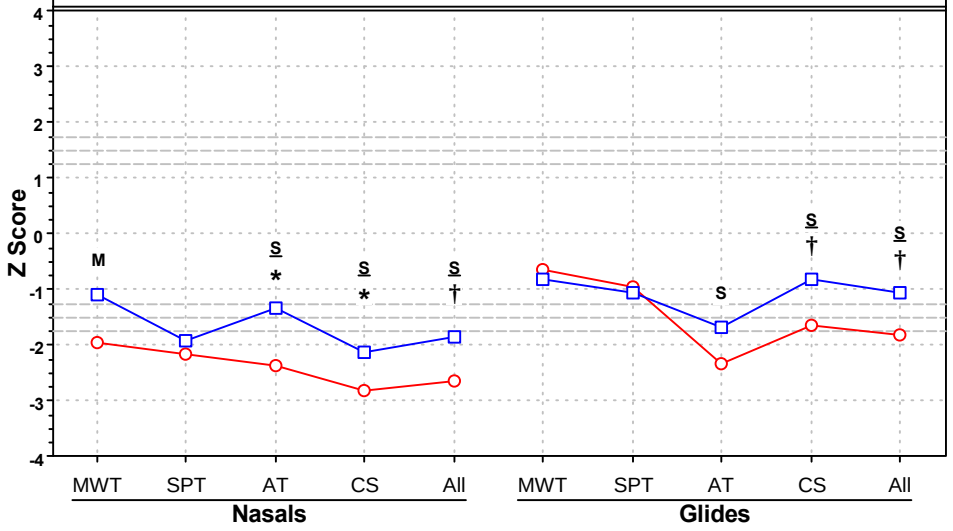


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

Percent Features Correct Z Scores

		Nasals					Glides				
		MMWT	SPT	S*AT	S*CS	S†All	MWT	SPT	SAT	S†CS	S†All
S	*M*	-1.96	-2.16	-2.36	-2.80	-2.62	-0.65	-0.94	-2.34	-1.64	-1.80
	SD	0.86	2.33	2.24	2.15	2.13	0.50	1.89	2.32	2.02	2.10
N	*M*	-1.07	-1.91	-1.34	-2.13	-1.86	-0.82	-1.06	-1.68	-0.80	-1.05
	SD	1.23	1.92	2.07	2.20	2.16	1.47	1.63	2.08	1.90	1.98

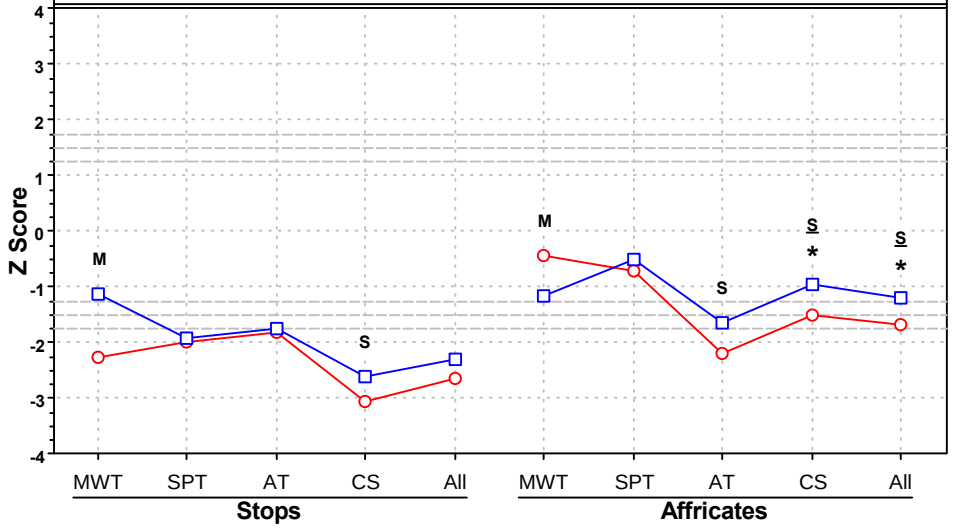


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

Percent Features Correct Z Scores

		Stops					Affricates				
		MMWT	SPT	AT	SCS	All	MMWT	SPT	SAT	S*CS	S*All
S	*M*	-2.26	-1.97	-1.81	-3.04	-2.62	-0.42	-0.70	-2.19	-1.50	-1.66
	SD	2.13	1.93	2.10	1.97	2.07	1.14	1.15	2.11	1.74	1.87
N	*M*	-1.13	-1.92	-1.75	-2.59	-2.29	-1.17	-0.51	-1.63	-0.97	-1.18
	SD	1.46	1.54	2.15	2.02	2.08	1.29	1.05	1.76	1.61	1.67

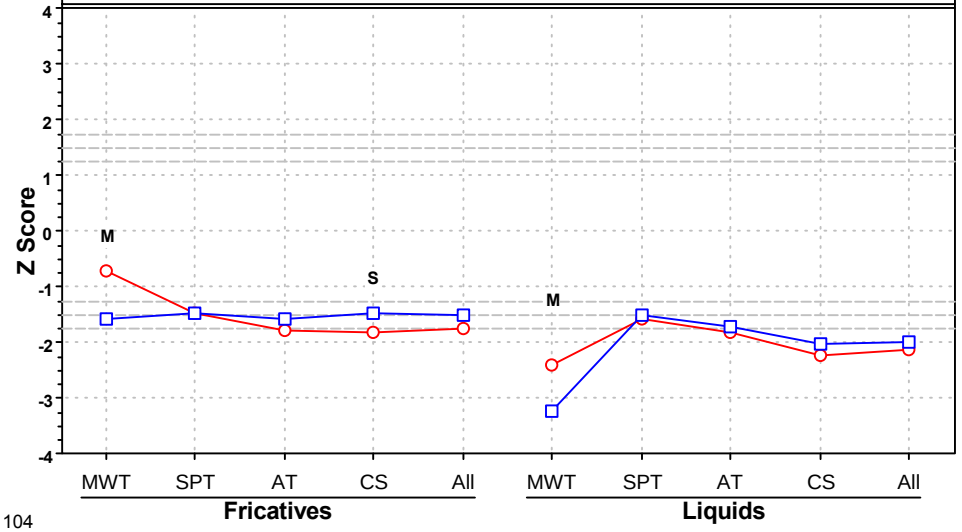


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D

Percent Features Correct Z Scores

		Fricatives					Liquids				
		MMWT	SPT	AT	SCS	All	MMWT	SPT	AT	CS	All
S	*M*	-0.71	-1.47	-1.76	-1.80	-1.73	-2.38	-1.55	-1.80	-2.23	-2.11
	SD	1.12	1.92	1.94	1.51	1.64	1.92	0.97	1.63	1.38	1.48
N	*M*	-1.58	-1.47	-1.57	-1.45	-1.49	-3.21	-1.49	-1.72	-2.00	-1.97
	SD	1.61	1.80	1.83	1.48	1.59	1.46	1.02	1.24	1.29	1.31

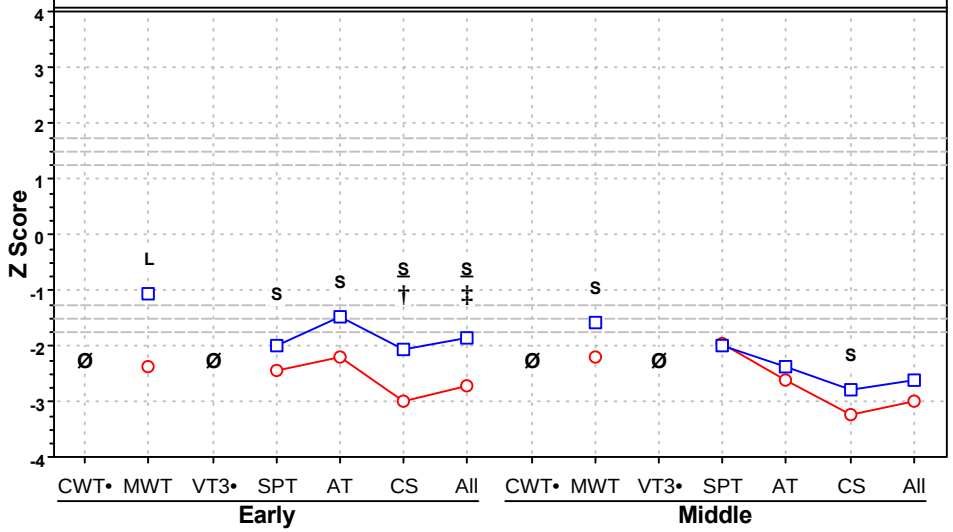


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

E

Percent Consonants Correct Z Scores

		Early						Middle						
		Ø CWT	L MWT	Ø VT3	S SPT	S AT	S† CS	S‡ All	Ø CWT	S MWT	Ø VT3	SPT	AT	S CS	All
○ S	*M*	-2.36			-2.42	-2.20	-2.98	-2.71		-2.19		-1.96	-2.61	-3.24	-2.99
	SD	1.87			2.06	1.84	2.01	1.96		1.77		1.88	2.27	1.87	2.00
□ N	*M*	-1.05			-1.98	-1.48	-2.04	-1.84		-1.56		-1.99	-2.35	-2.79	-2.61
	SD	1.30			1.74	1.99	2.11	2.07		1.41		1.59	2.06	2.00	2.01

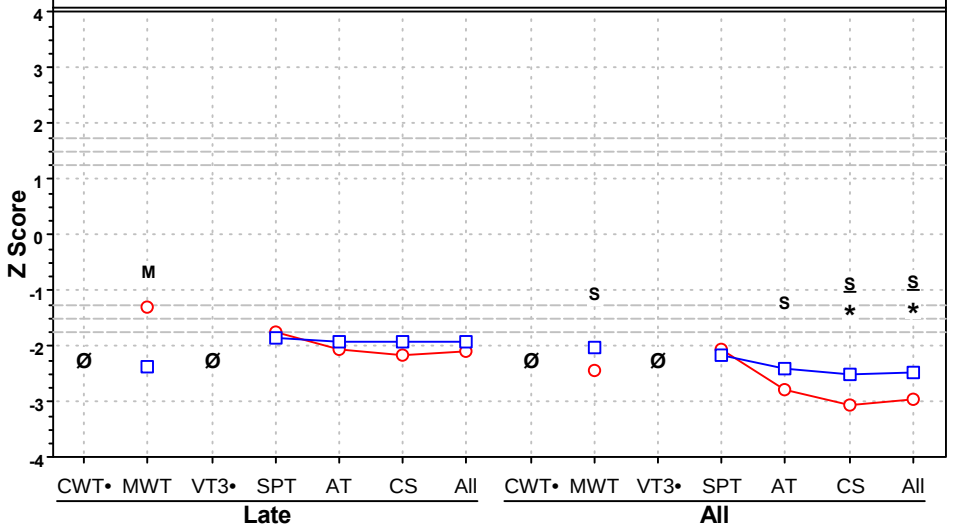


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

F

Percent Consonants Correct Z Scores

		Late						All						
		Ø CWT	M MWT	Ø VT3	SPT	AT	CS	All	Ø CWT	S MWT	Ø VT3	SPT	S AT	S* CS	S* All
○ S	*M*	-1.31			-1.76	-2.04	-2.17	-2.09		-2.41		-2.06	-2.77	-3.06	-2.94
	SD	1.60			1.50	1.61	1.30	1.41		2.12		1.81	1.86	1.42	1.58
□ N	*M*	-2.35			-1.85	-1.91	-1.90	-1.92		-2.03		-2.17	-2.40	-2.51	-2.46
	SD	1.57			1.52	1.47	1.41	1.43		1.20		1.49	1.65	1.51	1.54

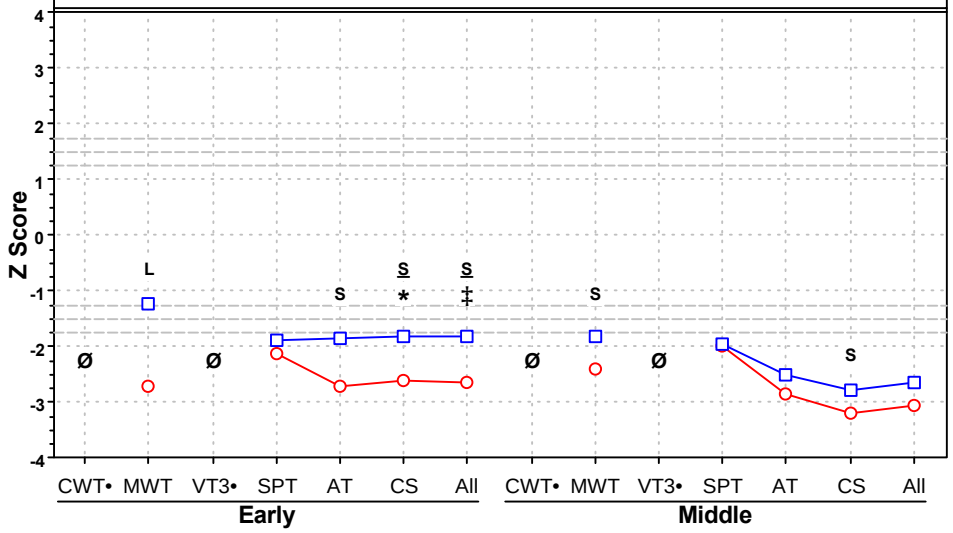


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

G

Percent Cononants Correct-Revised Z Scores

		Early						Middle						
		Ø CWT	L MWT	Ø VT3	SPT	S AT	S* CS	S‡ All	Ø CWT	S MWT	Ø VT3	SPT	AT	S CS	All
○ S	*M*	-2.69			-2.11	-2.71	-2.60	-2.64		-2.41		-1.99	-2.86	-3.19	-3.05
	SD	1.75			2.19	2.02	2.16	2.08		1.89		1.88	2.47	1.93	2.09
□ N	*M*	-1.24			-1.88	-1.86	-1.80	-1.79		-1.80		-1.95	-2.48	-2.78	-2.65
	SD	1.42			1.75	2.14	2.04	2.05		1.51		1.58	2.11	2.02	2.03

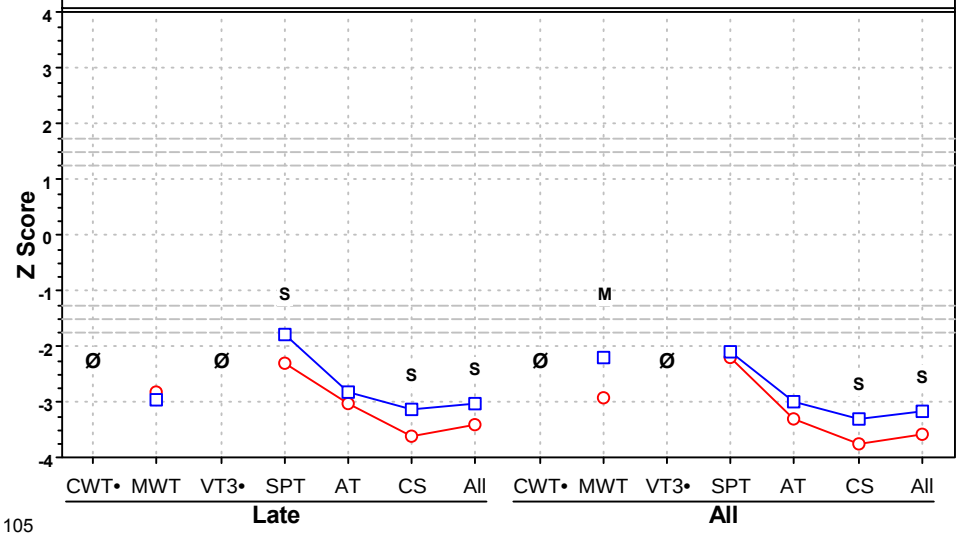


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

H

Percent Consonants Correct-Revised Z Scores

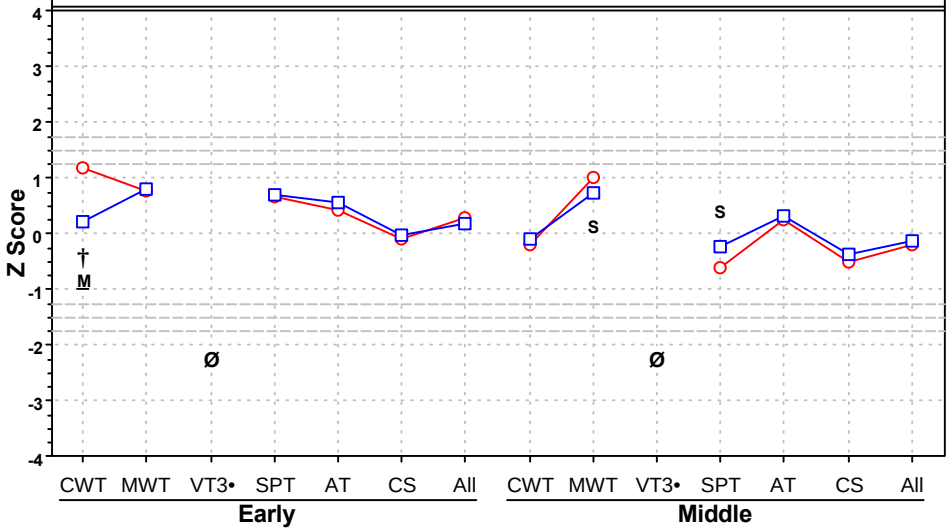
		Late						All						
		Ø CWT	MWT	Ø VT3	S SPT	AT	S CS	S All	Ø CWT	M MWT	Ø VT3	SPT	AT	S CS	S All
○ S	*M*	-2.82			-2.28	-3.00	-3.62	-3.39		-2.92		-2.19	-3.31	-3.74	-3.57
	SD	2.07			1.98	2.02	1.59	1.76		1.88		2.13	1.98	1.64	1.75
□ N	*M*	-2.94			-1.78	-2.80	-3.11	-3.02		-2.19		-2.08	-2.97	-3.29	-3.15
	SD	1.49			1.69	1.92	1.75	1.79		1.31		1.70	1.91	1.72	1.78



*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

I Relative Omission Index Z Scores

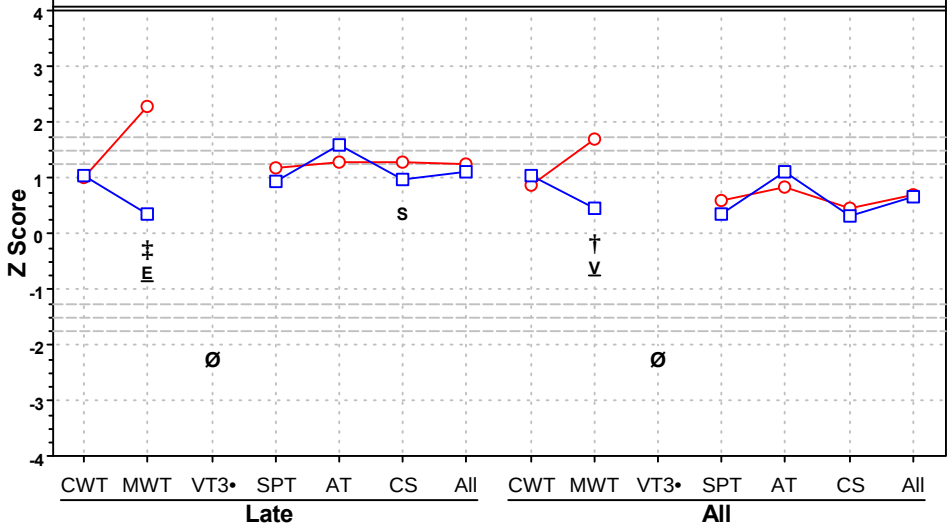
		Early							Middle						
		CWT	MWT	VT3	SPT	AT	CS	All	CWT	MWT	VT3	SPT	AT	CS	All
		M†		Ø						S	Ø	S			
S	*M*	1.18	0.76		0.68	0.44	-0.10	0.30	-0.19	1.00		-0.59	0.24	-0.50	-0.20
	SD	2.01	0.87		1.30	0.74	0.85	1.21	0.59	0.85		1.31	1.13	0.87	0.96
N	*M*	0.22	0.80		0.70	0.55	-0.02	0.18	-0.08	0.74		-0.22	0.32	-0.36	-0.12
	SD	1.10	0.95		0.83	0.89	0.84	0.94	0.98	1.13		0.92	1.42	0.80	1.06



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

J Relative Omission Index Z Scores

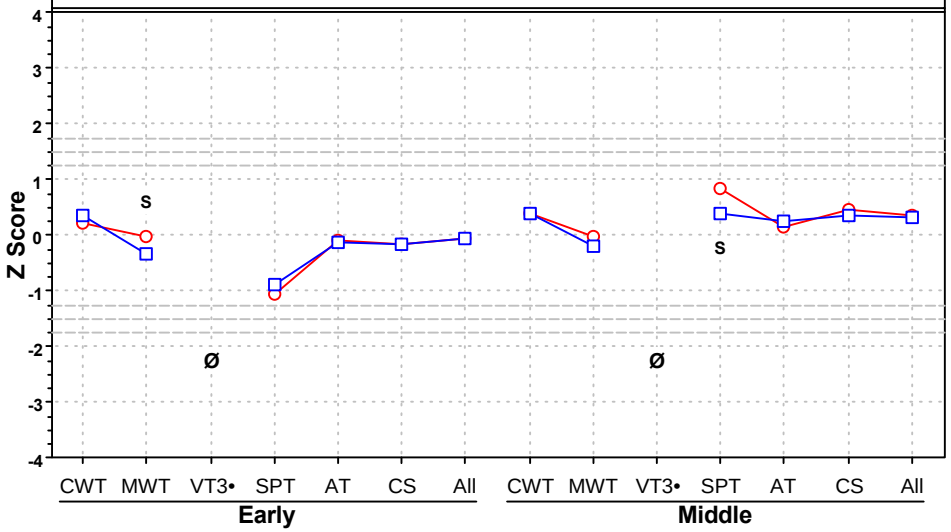
		Late							All						
		CWT	MWT	VT3	SPT	AT	CS	All	CWT	MWT	VT3	SPT	AT	CS	All
			E‡	Ø			S			V†	Ø				
S	*M*	1.03	2.29		1.20	1.30	1.28	1.27	0.86	1.72		0.59	0.84	0.47	0.69
	SD	1.77	1.09		1.94	1.71	1.54	1.62	1.26	0.73		1.75	1.24	1.11	1.18
N	*M*	1.07	0.36		0.94	1.59	1.00	1.12	1.04	0.46		0.35	1.12	0.32	0.66
	SD	1.54	0.87		1.91	1.96	1.43	1.60	1.44	0.71		1.07	1.52	0.97	1.27



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

K Relative Substitution Index Z Scores

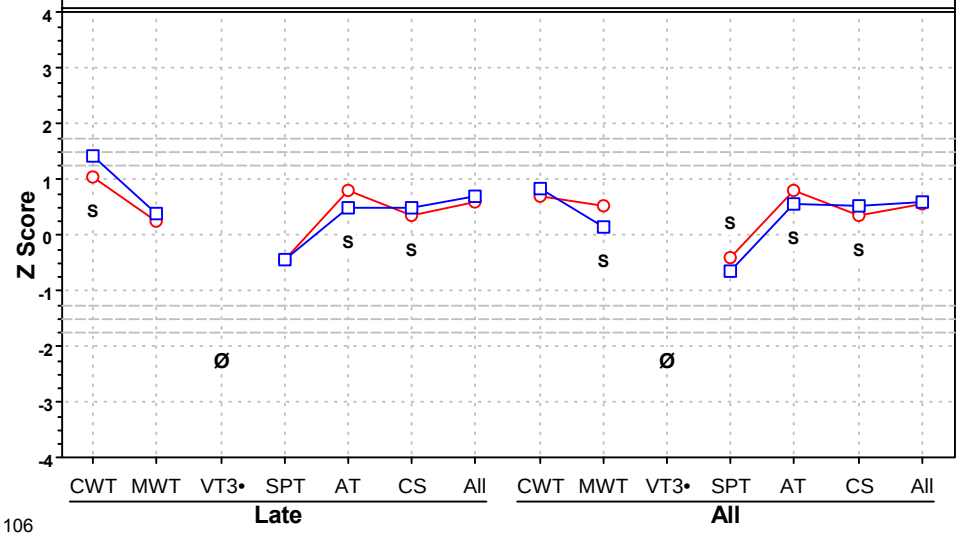
		Early							Middle						
		CWT	MWT	VT3	SPT	AT	CS	All	CWT	MWT	VT3	SPT	AT	CS	All
			S	Ø							Ø	S			
S	*M*	0.21	-0.03		-1.05	-0.07	-0.16	-0.06	0.39	-0.03		0.83	0.14	0.47	0.36
	SD	1.94	0.77		1.51	0.75	0.94	1.13	0.90	0.63		1.37	0.85	0.87	0.87
N	*M*	0.37	-0.31		-0.87	-0.13	-0.16	-0.06	0.38	-0.18		0.39	0.27	0.35	0.32
	SD	1.84	0.94		1.01	0.84	0.82	1.11	0.80	1.13		0.96	0.95	0.84	0.87



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

L Relative Substitution Index Z Scores

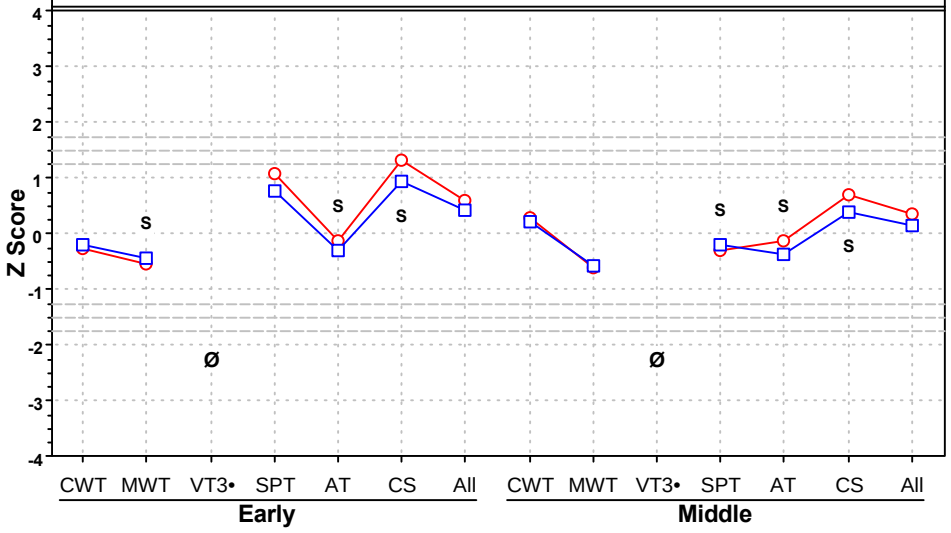
		Late							All						
		CWT	MWT	VT3	SPT	AT	CS	All	CWT	MWT	VT3	SPT	AT	CS	All
		S		Ø		S	S			S	Ø	S	S	S	
S	*M*	1.06	0.27		-0.42	0.81	0.35	0.61	0.72	0.54		-0.39	0.80	0.37	0.56
	SD	1.27	0.35		0.46	1.03	0.60	0.93	0.56	0.77		0.88	0.86	0.64	0.70
N	*M*	1.43	0.39		-0.44	0.50	0.49	0.70	0.84	0.14		-0.64	0.58	0.54	0.60
	SD	1.48	0.96		0.66	0.82	0.75	1.05	0.89	0.90		0.99	0.82	0.83	0.85



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

M — Relative Distortion Index Z Scores

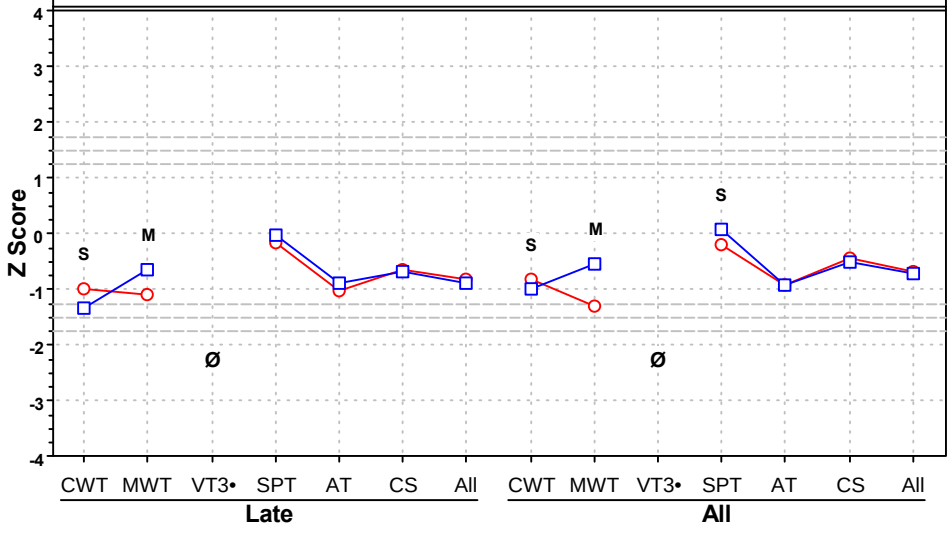
		Early							Middle						
		CWT	S_{MWT}	$Ø_{VT3}$	SPT	S_{AT}	S_{CS}	All	CWT	MWT	$Ø_{VT3}$	S_{SPT}	S_{AT}	S_{CS}	All
○ S	*M*	-0.27	-0.55		1.10	-0.13	1.33	0.59	0.29	-0.59		-0.30	-0.13	0.70	0.36
	SD	0.53	0.10		2.16	1.18	2.08	1.81	1.64	0.12		0.25	0.86	1.93	1.65
□ N	*M*	-0.18	-0.44		0.78	-0.29	0.94	0.42	0.21	-0.57		-0.17	-0.37	0.38	0.15
	SD	0.84	0.57		2.00	0.71	1.89	1.62	1.55	0.46		0.47	0.59	1.54	1.40



*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

N — Relative Distortion Index Z Scores

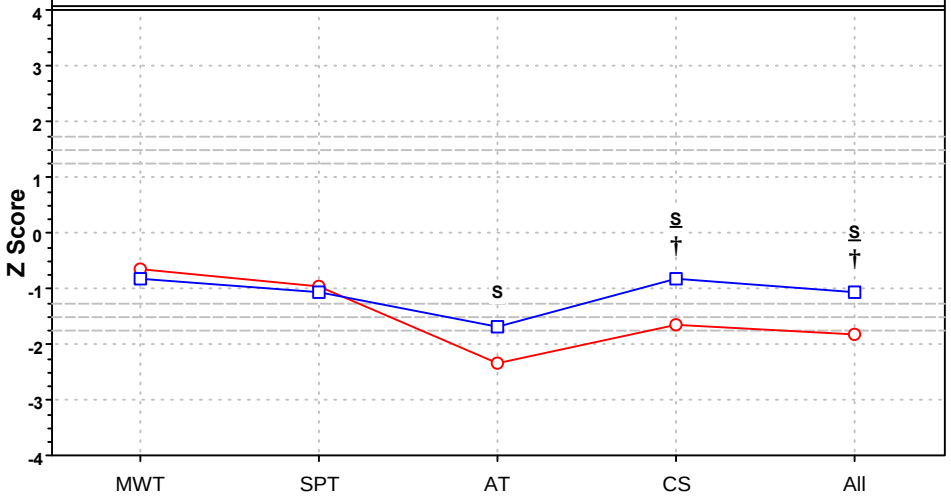
		Late							All						
		S_{CWT}	M_{MWT}	$Ø_{VT3}$	SPT	AT	CS	All	S_{CWT}	M_{MWT}	$Ø_{VT3}$	S_{SPT}	AT	CS	All
○ S	*M*	-0.99	-1.10		-0.15	-1.02	-0.64	-0.83	-0.80	-1.30		-0.20	-0.91	-0.42	-0.66
	SD	1.04	0.33		1.05	0.92	0.76	0.87	0.71	0.20		0.87	0.92	0.91	0.88
□ N	*M*	-1.34	-0.63		-0.01	-0.87	-0.68	-0.87	-0.99	-0.54		0.07	-0.91	-0.49	-0.70
	SD	1.10	0.92		1.13	0.82	0.89	0.96	0.84	1.25		1.20	0.85	0.91	0.92



*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

O — Percent of Glides Correct

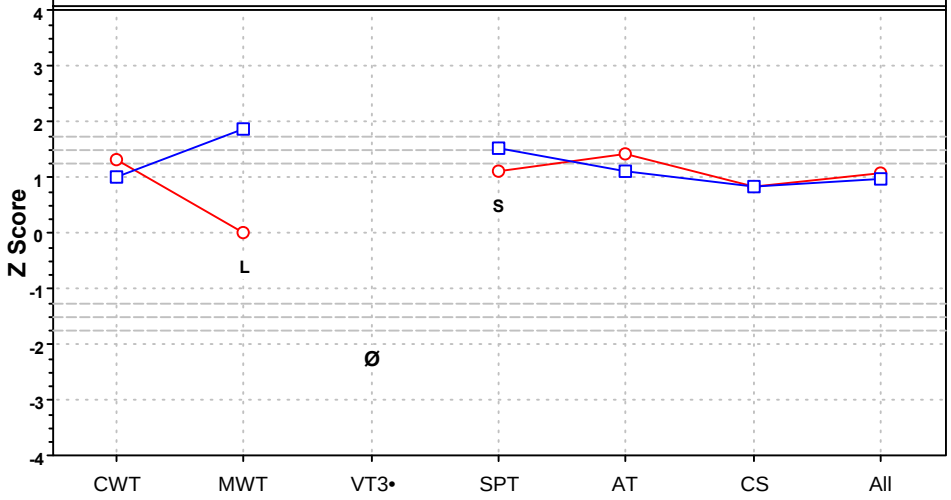
		Percent Correct					Z Scores				
		M_{MWT}	S_{SPT}	S_{AT}	S^{*}_{CS}	S^{*}_{All}	MWT	SPT	S_{AT}	$S^{†}_{CS}$	$S^{†}_{All}$
○ S	*M*	12.5	69.9	75.5	89.6	81.3	-0.65	-0.94	-2.34	-1.64	-1.80
	SD	25.0	26.9	25.9	14.2	25.6	0.50	1.89	2.32	2.02	2.10
□ N	*M*	38.1	62.9	80.5	93.3	87.3	-0.82	-1.06	-1.68	-0.80	-1.05
	SD	38.4	25.6	20.2	11.1	19.9	1.47	1.63	2.08	1.90	1.98



*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

P — Percent of Consonant Place Modifications

		Percent Correct							Z Scores						
		CWT	S_{MWT}	$Ø_{VT3}$	M_{SPT}	AT	CS	All	CWT	L_{MWT}	$Ø_{VT3}$	S_{SPT}	AT	CS	All
○ S	*M*	7.97	6.93		8.08	7.21	5.25	6.42	1.34	0.03		1.12	1.44	0.85	1.08
	SD	5.10	6.11		4.52	4.17	3.02	4.10	1.93	1.20		1.56	1.94	1.57	1.75
□ N	*M*	7.40	7.96		10.8	7.01	5.70	6.45	1.02	1.88		1.55	1.12	0.84	0.98
	SD	4.54	4.28		4.69	3.72	3.53	3.92	1.91	2.16		1.75	1.77	1.57	1.73

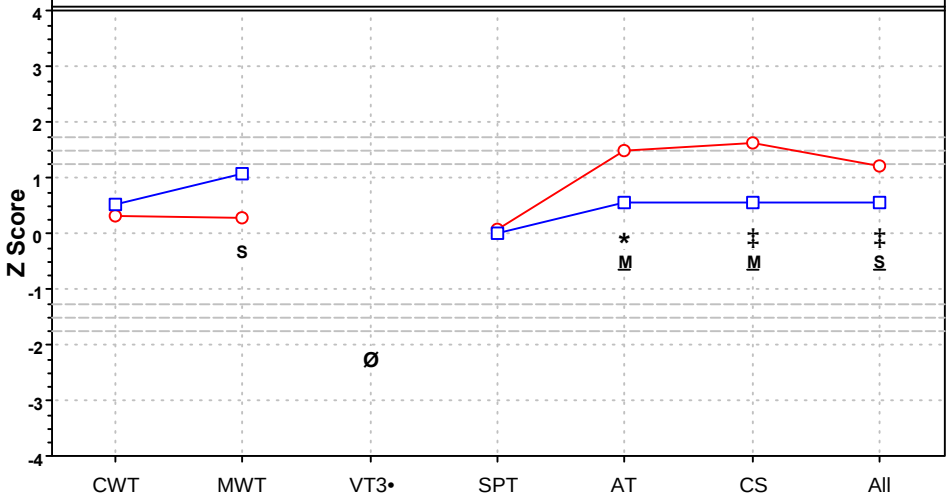


*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

Q

Percent of Consonant Duration Modifications

		Percent Correct						Z Scores					
		CWT	MWT	Ø VT3	SPT	S* AT	M‡ CS	S‡ All	CWT	S MWT	Ø VT3	SPT	M* AT	M‡ CS	S‡ All
S	*M*	0.51	0.62		0.25	1.41	1.71	1.31	0.34	0.31		0.10	1.49	1.63	1.24
	SD	1.01	0.90		0.51	2.24	1.52	1.67	1.63	1.82		1.40	2.11	2.22	2.10
N	*M*	0.51	0.74		0.27	0.75	1.08	0.87	0.53	1.09		0.01	0.57	0.55	0.57
	SD	0.86	0.69		0.51	1.27	1.11	1.11	1.74	1.81		1.16	1.79	1.65	1.70



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

R

Percent of Consonant Addition Modifications

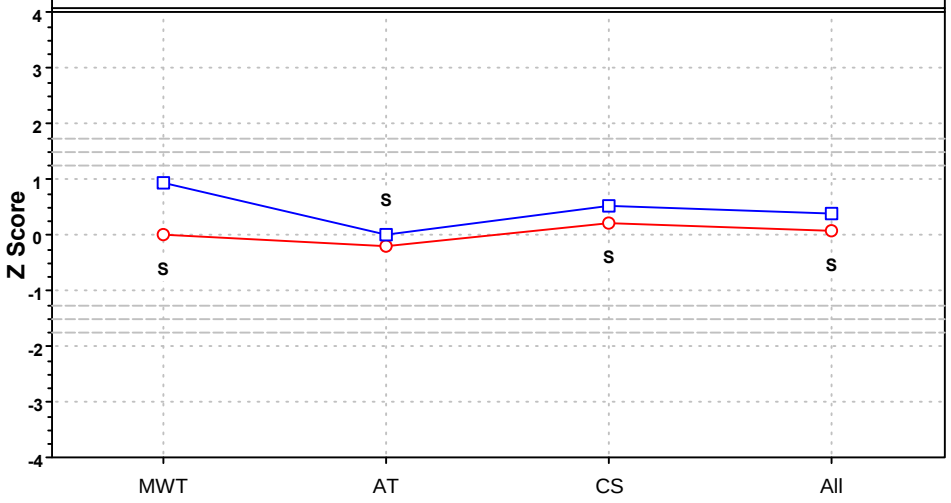
		Percent Correct							Z Scores						
		S CWT	MWT	Ø VT3	SPT	S AT	M‡ CS	S‡ All	S CWT	S MWT	Ø VT3	S SPT	M† AT	M‡ CS	M‡ All
S	*M*	2.06	4.62		2.37	2.82	1.79	2.21	2.23	0.75		0.75	2.59	2.19	2.23
	SD	3.13	2.01		1.62	3.45	1.50	2.56	2.40	1.11		1.74	2.19	2.10	2.17
N	*M*	1.36	4.70		2.42	1.92	1.21	1.51	1.70	0.29		0.25	1.41	1.01	1.23
	SD	1.58	2.17		1.59	1.80	1.08	1.56	2.31	1.19		1.22	1.88	1.78	1.94

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

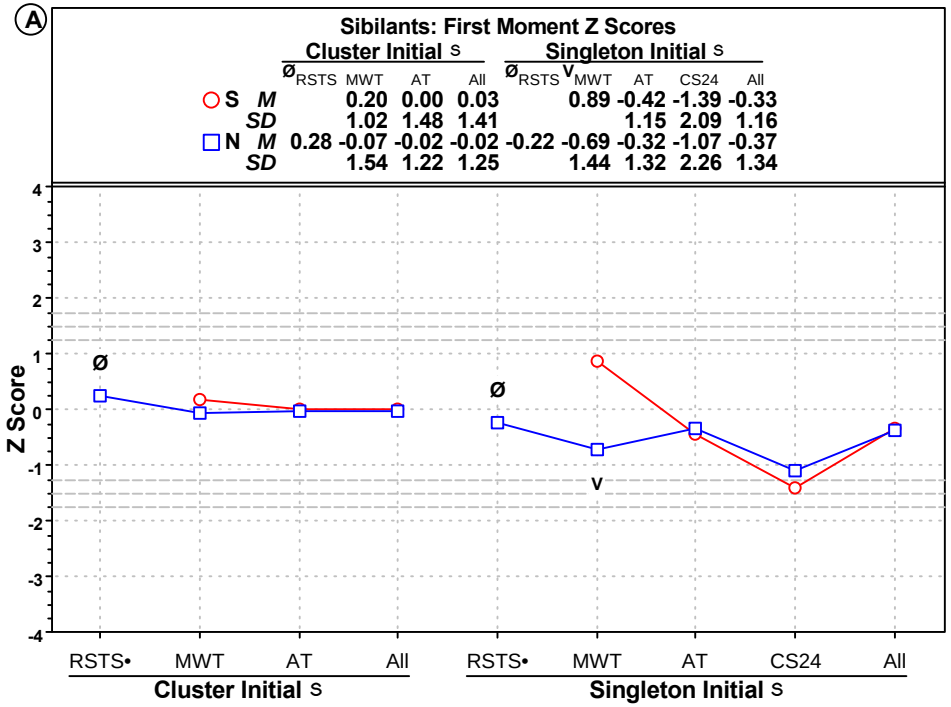
S

Nasal Emission

		Nasal Emission				Z Scores			
		S MWT	AT	CS	All	S MWT	S AT	S CS	S All
S	*M*	0.00	0.00	0.01	0.01	0.00	-0.20	0.21	0.07
	SD	0.00	0.00	0.04	0.03	0.00	0.16	1.09	0.89
N	*M*	0.40	0.03	0.04	0.05	0.95	0.00	0.54	0.40
	SD	1.23	0.15	0.18	0.31	2.01	0.89	1.60	1.48



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



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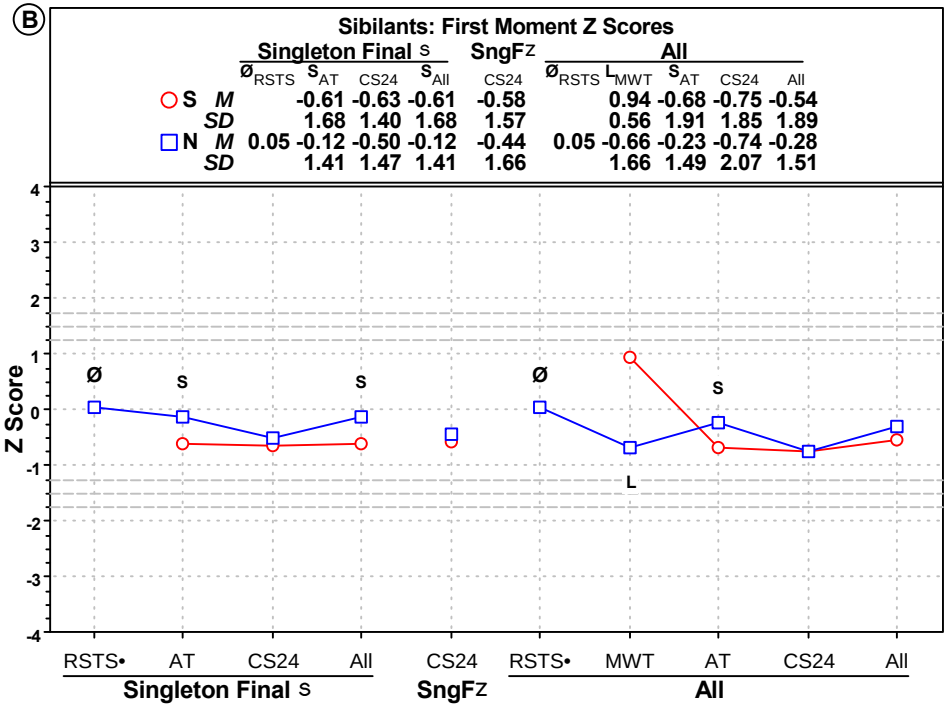

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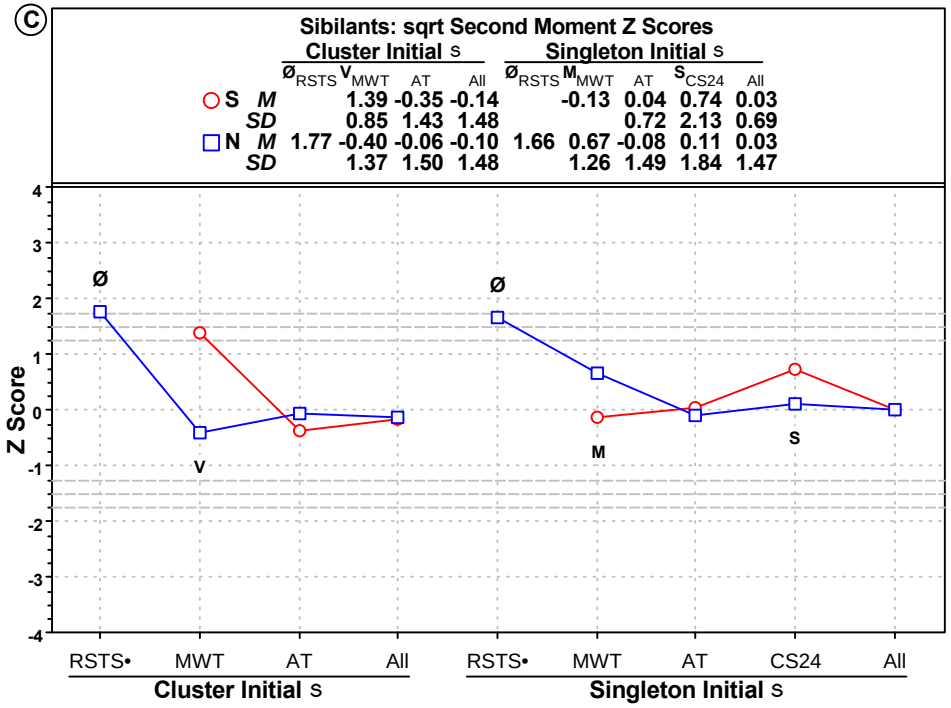
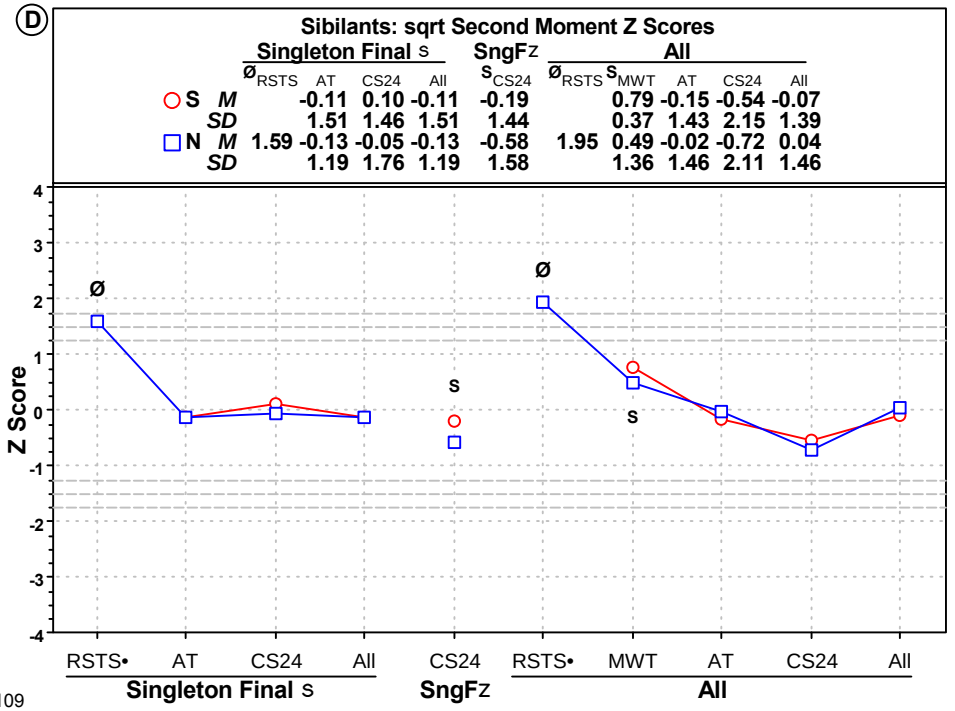


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

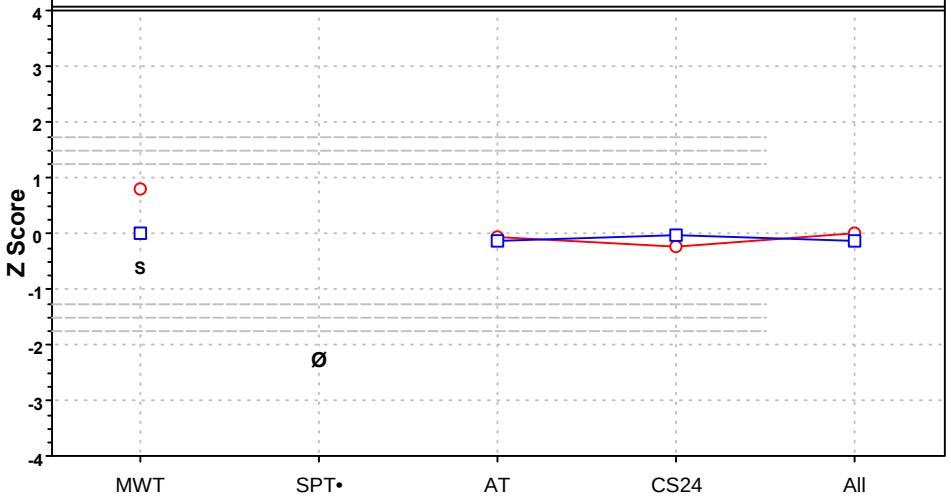


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

E

Average Duration of Consonant Clusters

		Relative Duration					Z Scores				
		MWT	ØSPT	AT	CS24	All	SMWT	ØSPT	AT	CS24	All
○ S	*M*	926		751	787	768	0.81		-0.06	-0.21	0.03
	SD	193		284	206	278	1.13		1.85	1.40	1.79
□ N	*M*	900		749	822	765	0.03		-0.14	-0.01	-0.12
	SD	320		237	287	250	1.77		1.77	1.89	1.77

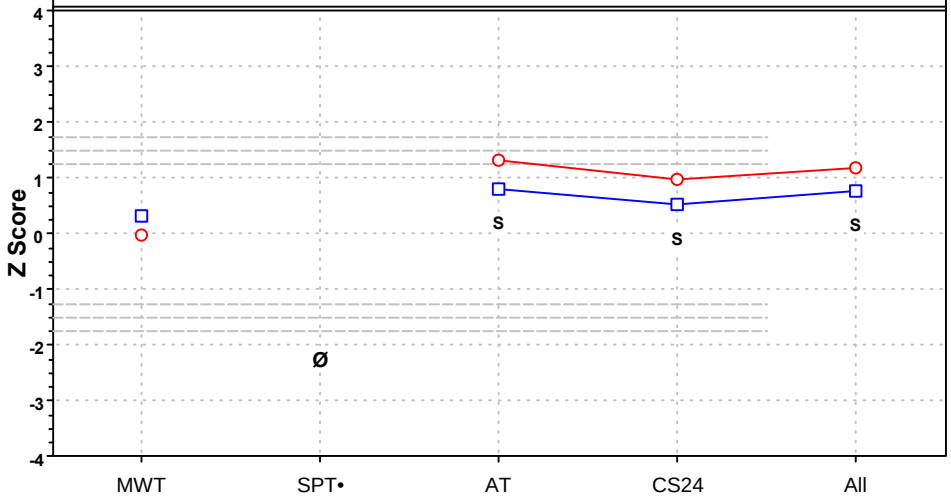


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

F

Average Intra-Cluster Durations

		Relative Duration					Z Scores				
		SMWT	ØSPT	AT	SCS24	All	MWT	ØSPT	SAT	SCS24	SAll
○ S	*M*	15		23	29	22	-0.01		1.32	1.00	1.20
	SD	3		34	58	32	0.24		1.99	2.14	1.93
□ N	*M*	76		23	20	29	0.33		0.82	0.52	0.77
	SD	181		40	35	71	1.83		1.79	1.88	1.79

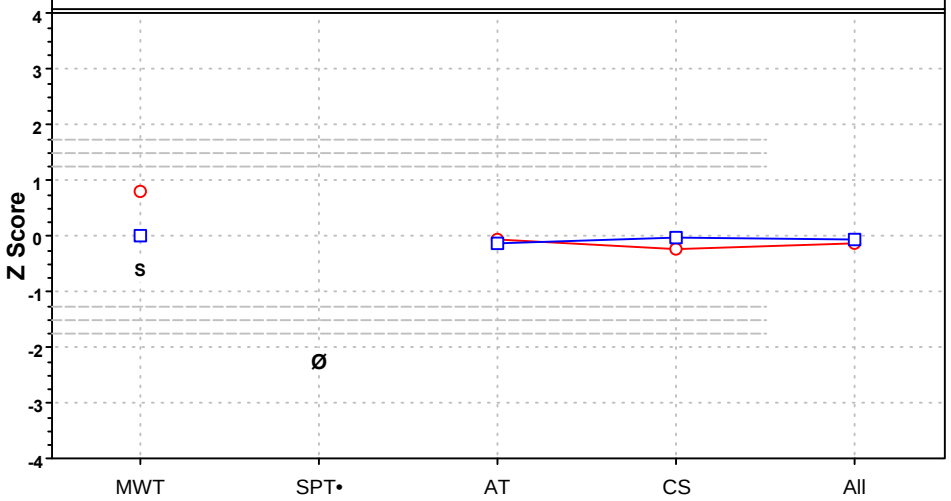


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

G

Transition Relative Duration Z Scores

		Total Cluster				
		SMWT	ØSPT	AT	CS	All
○ S	*M*	0.81		-0.06	-0.21	-0.11
	SD	1.13		1.85	1.40	1.56
□ N	*M*	0.03		-0.14	-0.01	-0.05
	SD	1.77		1.77	1.89	1.84

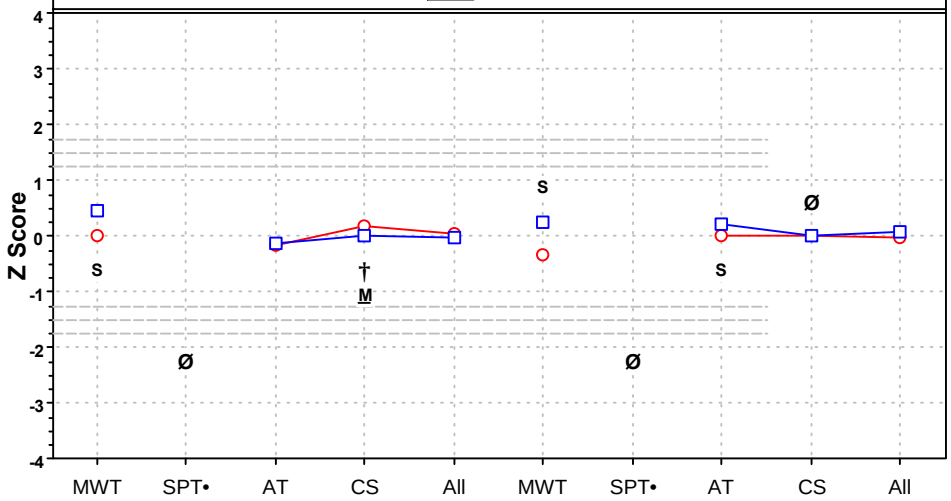


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

H

Transition Relative Duration Z Scores

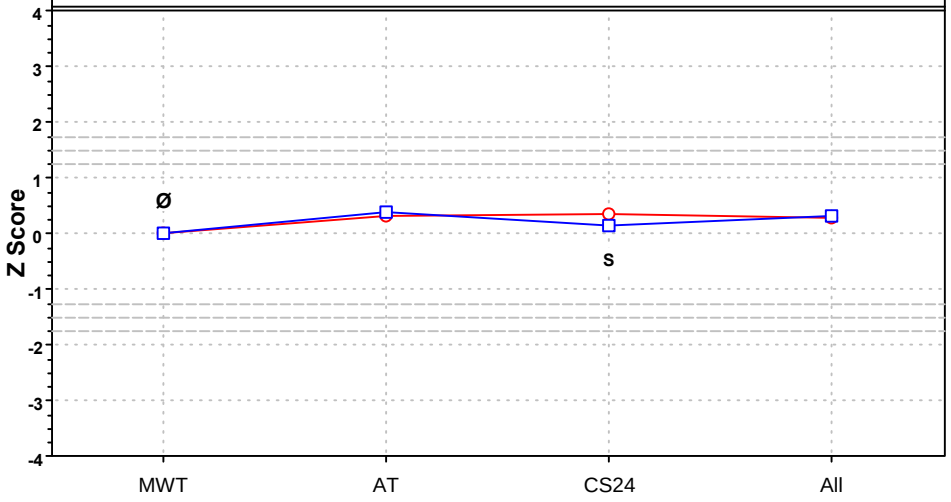
		Pause						Disruption					
		SMWT	ØSPT	AT	M†CS	All		SMWT	ØSPT	SAT	ØCS	All	
○ S	*M*	0.00		-0.16	0.17	0.04		-0.32		0.00	0.00	-0.01	
	SD	0.00		0.16	0.93	0.72		0.00		0.00	0.00	0.06	
□ N	*M*	0.47		-0.13	0.00	-0.02		0.25		0.23	0.00	0.09	
	SD	1.78		0.48	0.00	0.46		1.40		1.22	0.00	0.77	



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

I Percentage S-F/F-S Cluster Disruptions

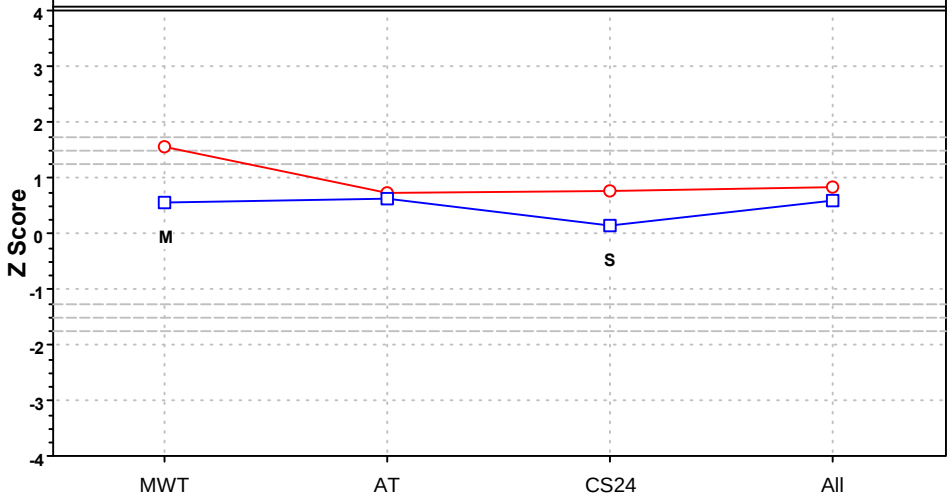
		Percent Disruptions				Z Scores			
		Ø MWT	AT	CS24	All	Ø MWT	AT	S CS24	All
○ S	*M*	0.0	4.8	1.5	4.2	0.00	0.33	0.34	0.29
	SD	0.0	17.8	6.4	16.7	0.00	1.35	1.29	1.26
□ N	*M*	0.0	6.2	1.0	5.4	0.00	0.39	0.16	0.34
	SD	0.0	22.4	7.4	21.0	0.00	1.43	0.89	1.34



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

J Mean S-F/FS Cluster Duration (unadjusted for rate)

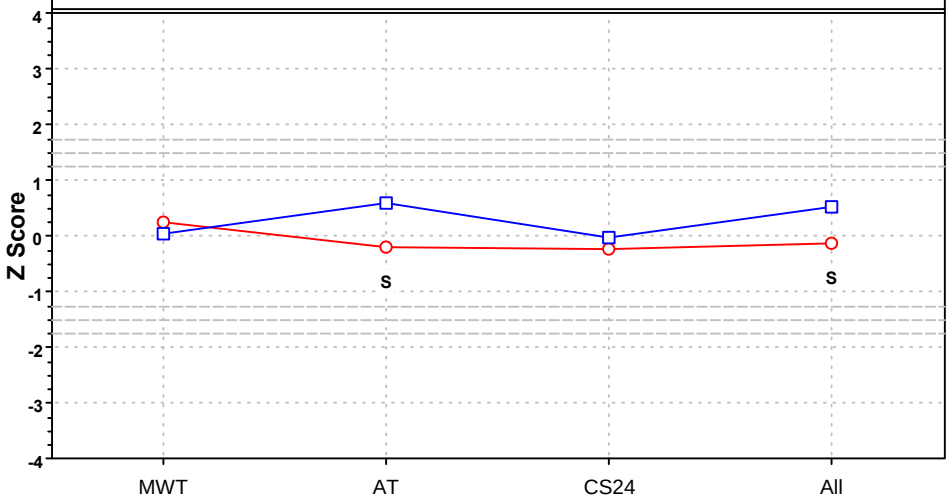
		Cluster Milliseconds				Z Scores			
		M MWT	AT	S CS24	All	M MWT	AT	S CS24	All
○ S	*M*	337	295	250	301	1.56	0.73	0.78	0.84
	SD	121	80	72	82	2.45	1.68	1.41	1.71
□ N	*M*	282	285	232	285	0.58	0.62	0.15	0.62
	SD	63	84	91	81	1.23	1.49	1.80	1.45



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

K Mean S-F/FS Cluster Durations (adjusted for rate)

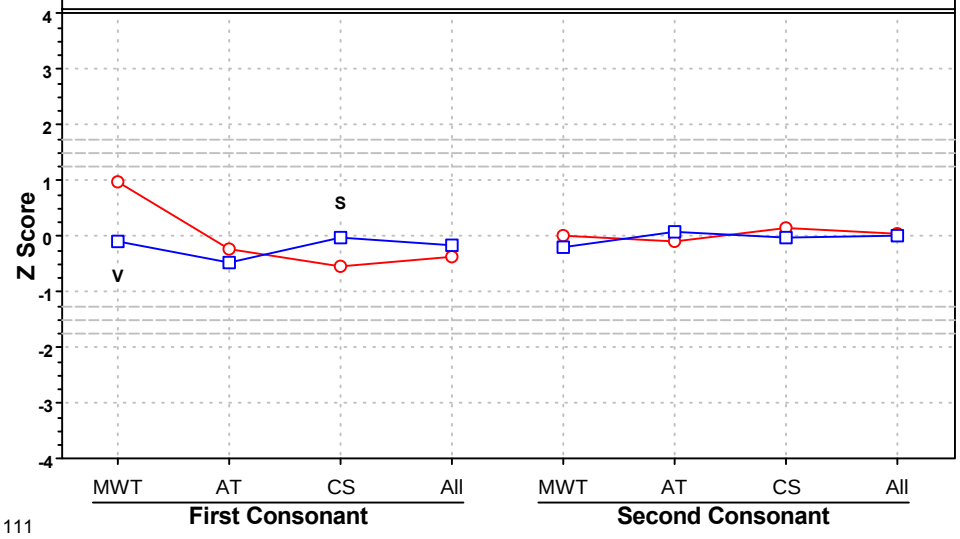
		Relative Duration				Z Scores			
		S MWT	S AT	CS24	S All	MWT	S AT	CS24	S All
○ S	*M*	934	911	787	913	0.27	-0.19	-0.21	-0.13
	SD	183	197	206	190	0.97	2.16	1.40	2.03
□ N	*M*	987	1024	822	1020	0.06	0.61	-0.01	0.54
	SD	258	328	287	319	1.01	2.28	1.89	2.16



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

L Transition Relative Duration Z Scores

		First Consonant				Second Consonant			
		V MWT	AT	S CS	All	MWT	AT	CS	All
○ S	*M*	0.98	-0.21	-0.54	-0.35	0.03	-0.10	0.14	0.05
	SD	0.64	1.77	1.36	1.52	3.82	1.98	1.48	1.73
□ N	*M*	-0.10	-0.46	-0.01	-0.17	-0.21	0.09	-0.01	0.02
	SD	0.97	1.88	1.75	1.78	1.60	1.81	1.96	1.90



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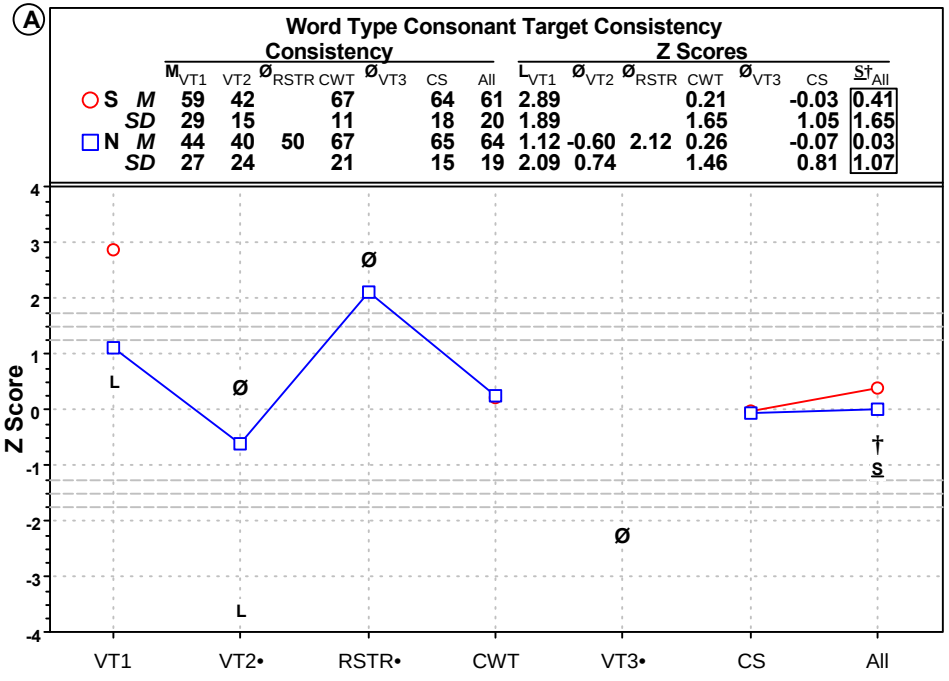
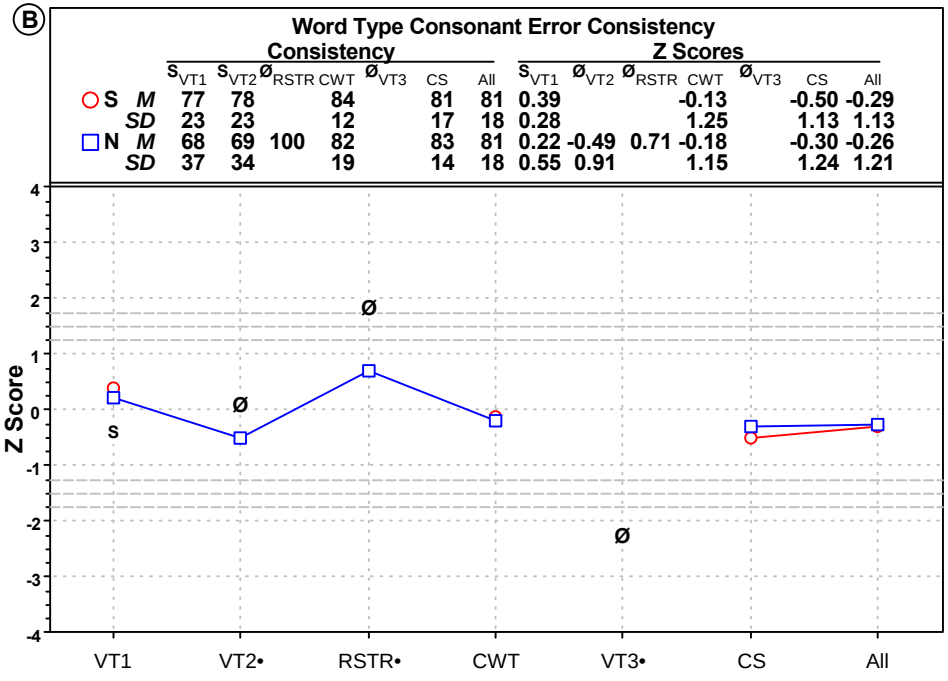


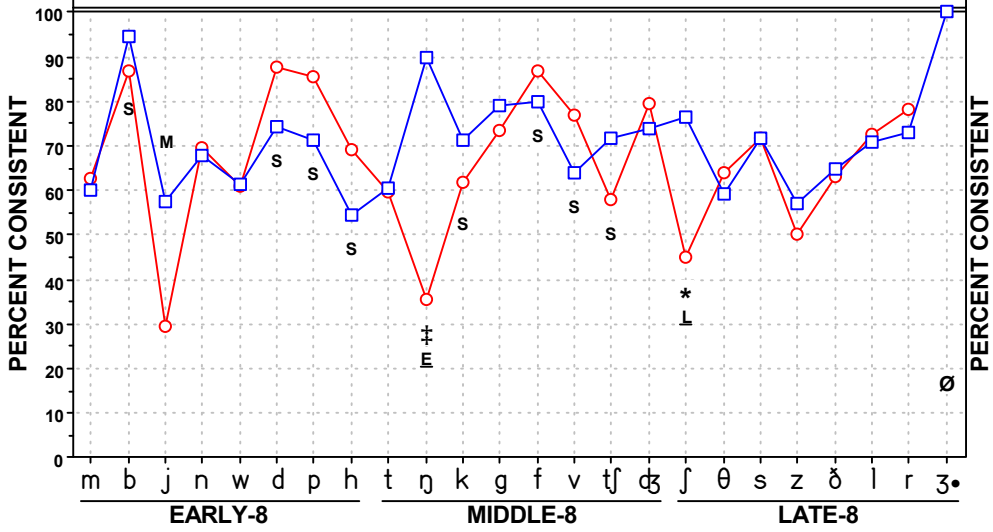
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data



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

A — CONSONANT TARGET CONSISTENCY: PHONEME Source: CS

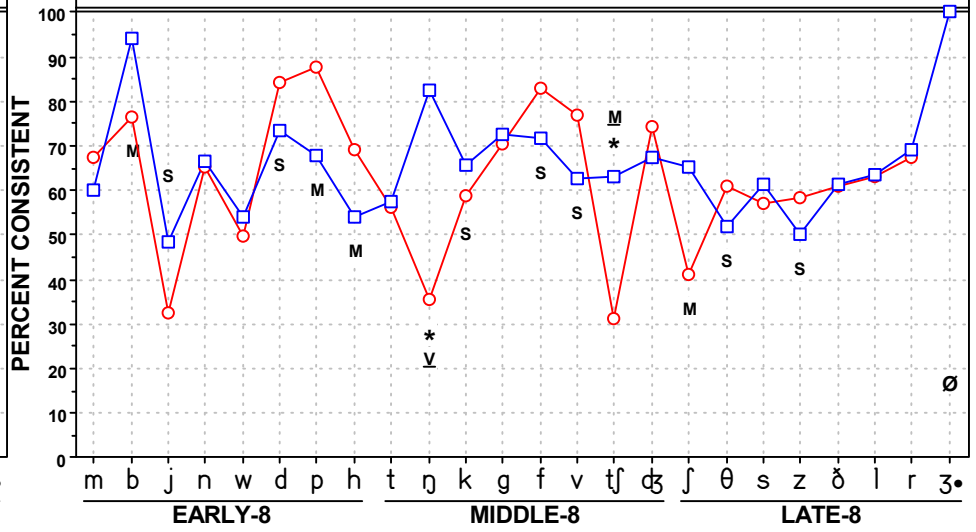
		EARLY-8 TYP	EARLY-8 TOK	EARLY-8 %C	MIDDLE-8 TYP	MIDDLE-8 TOK	MIDDLE-8 %C	LATE-8 TYP	LATE-8 TOK	LATE-8 %C	TOTAL TYP	TOTAL TOK	TOTAL %C
S	*M*	2.4	8.3	69.9	5.2	20.3	59.4	8.1	30.1	65.9	15.7	58.7	63.5
	SD	2.9	9.9	25.1	5.7	24.6	23.0	5.8	24.3	19.0	12.6	50.9	17.9
N	*M*	1.4	5.5	66.5	3.5	12.7	67.5	7.2	28.1	64.7	12.2	46.3	64.6
	SD	2.4	10.8	29.9	3.6	14.8	23.7	4.8	24.6	18.6	8.9	41.8	15.3



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

B — CONSONANT TARGET CONSISTENCY: PHONEME & DIACRITIC Source: CS

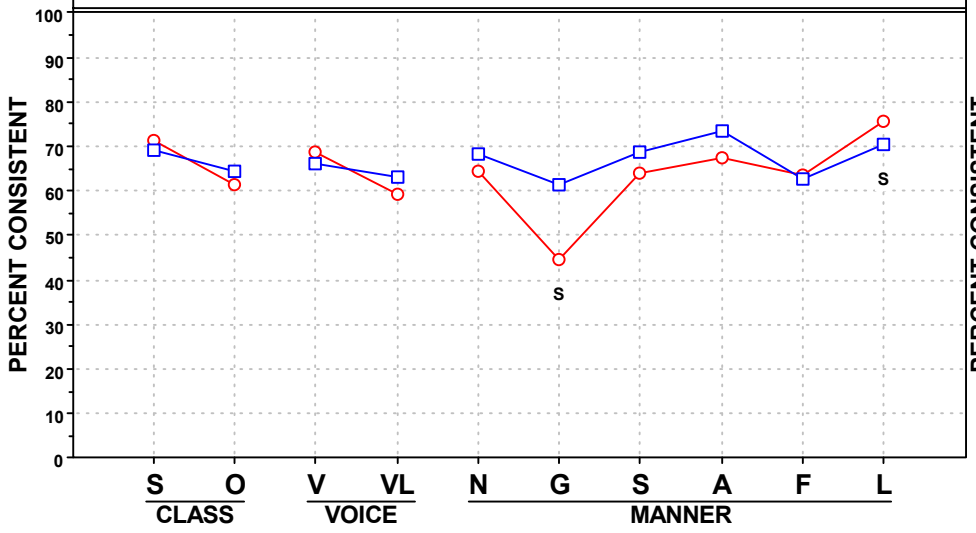
		EARLY-8 TYP	EARLY-8 TOK	EARLY-8 %C	MIDDLE-8 TYP	MIDDLE-8 TOK	MIDDLE-8 %C	LATE-8 TYP	LATE-8 TOK	LATE-8 %C	TOTAL TYP	TOTAL TOK	TOTAL %C
S	*M*	2.7	9.6	65.0	5.3	21.3	55.7	10.8	38.7	60.9	18.9	69.6	59.9
	SD	3.0	10.6	26.9	5.9	26.1	22.3	6.6	26.8	17.5	13.5	55.1	17.1
N	*M*	1.5	6.1	63.9	3.7	13.2	62.6	10.8	39.0	61.7	16.1	58.3	61.5
	SD	2.4	11.1	29.5	3.7	15.0	24.2	6.0	28.6	17.9	10.0	45.1	14.8



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

C — FEATURE TARGET CONSISTENCY: PHONEME Source: CS

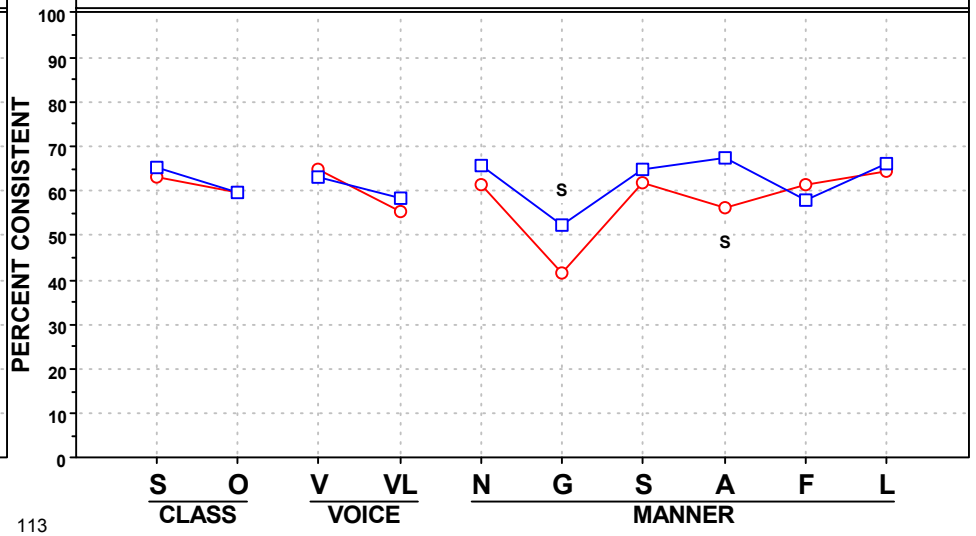
		CLASS S	CLASS O	VOICE V	VOICE VL	MANNER N	MANNER G	MANNER S	MANNER A	MANNER F	MANNER L
S	*M*	71.4	61.5	68.8	59.2	64.5	44.5	64.1	67.7	63.4	75.7
	SD	20.7	18.7	18.1	23.6	28.9	41.9	24.2	39.9	18.5	24.4
N	*M*	69.1	64.4	66.0	63.2	68.3	61.3	68.7	73.7	62.8	70.5
	SD	24.2	17.9	17.6	23.0	30.7	33.1	23.5	35.7	21.4	25.7



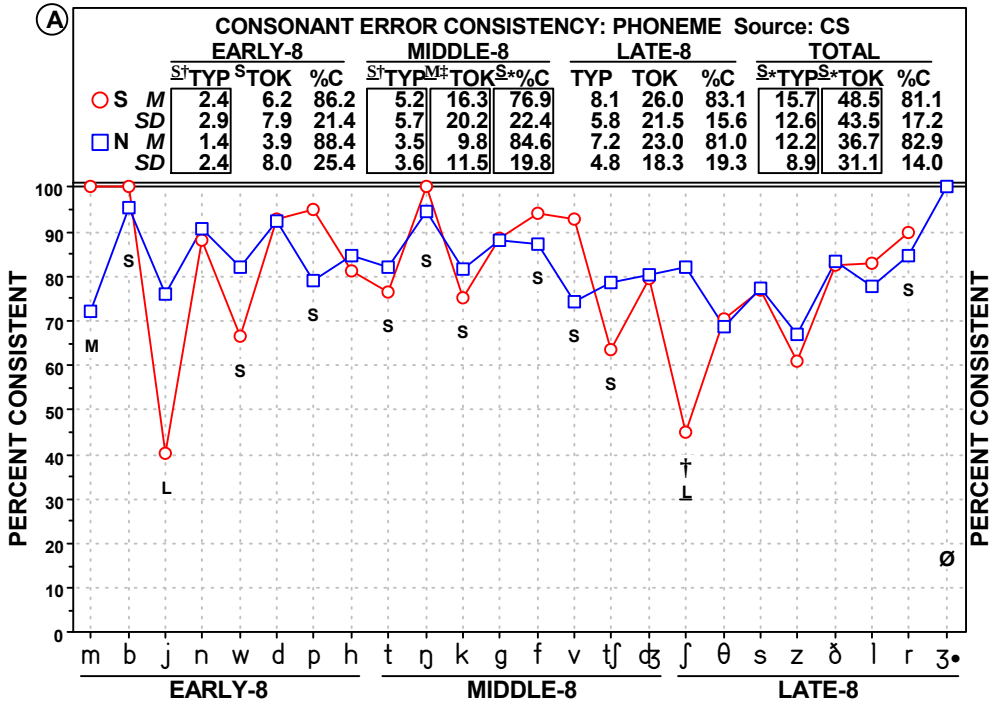
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

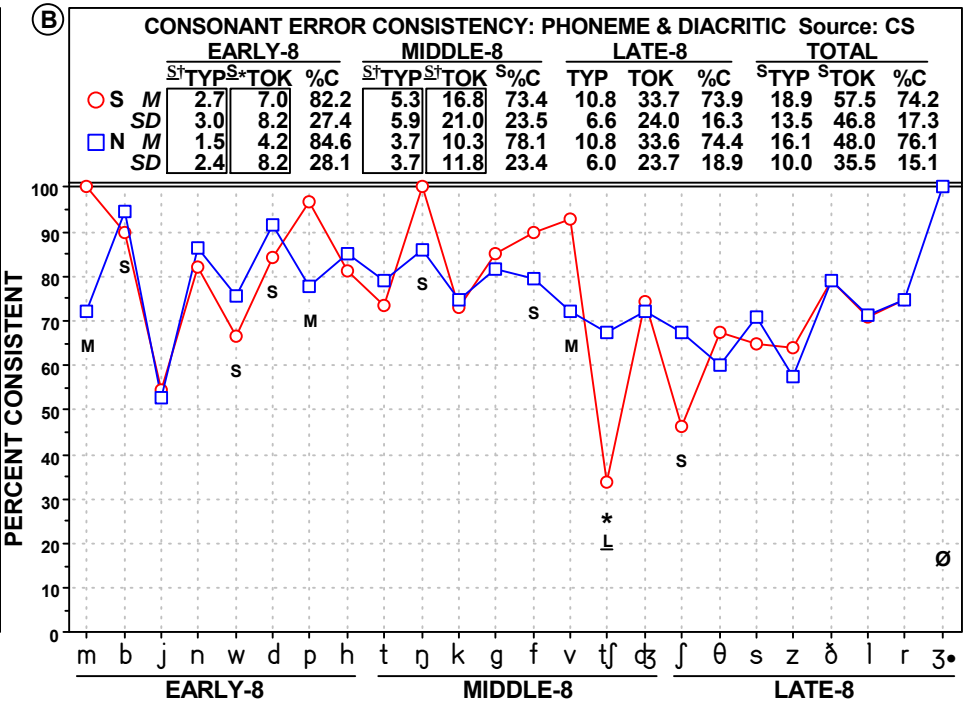
D — FEATURE TARGET CONSISTENCY: PHONEME & DIACRITIC Source: CS

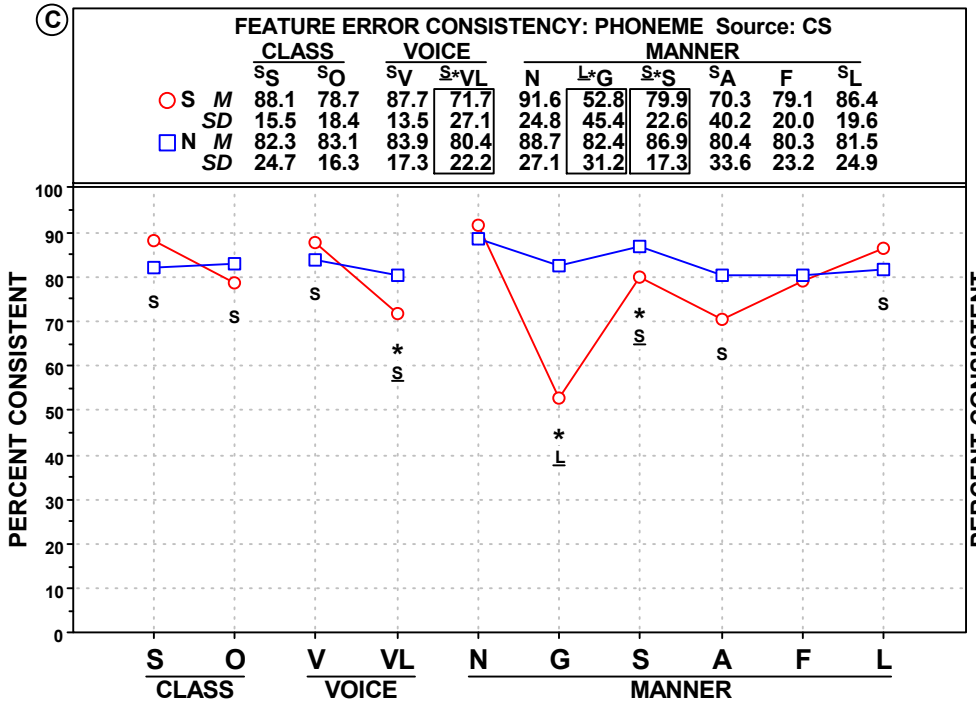
		CLASS S	CLASS O	VOICE V	VOICE VL	MANNER N	MANNER G	MANNER S	MANNER A	MANNER F	MANNER L
S	*M*	63.0	59.5	64.7	55.6	61.4	41.6	61.6	56.3	61.3	64.6
	SD	20.0	18.2	17.0	23.4	31.5	35.5	23.2	42.1	19.0	21.8
N	*M*	65.2	59.7	63.0	58.5	65.9	52.5	64.7	67.4	58.1	66.1
	SD	23.2	17.6	17.3	22.5	31.6	32.1	24.0	38.8	21.6	24.7

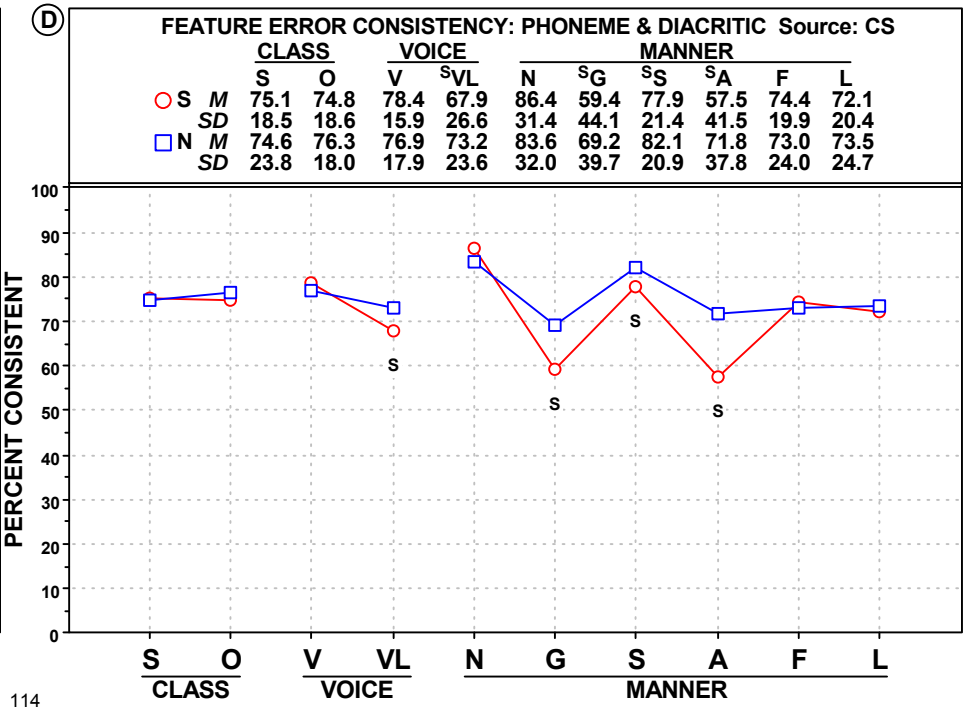


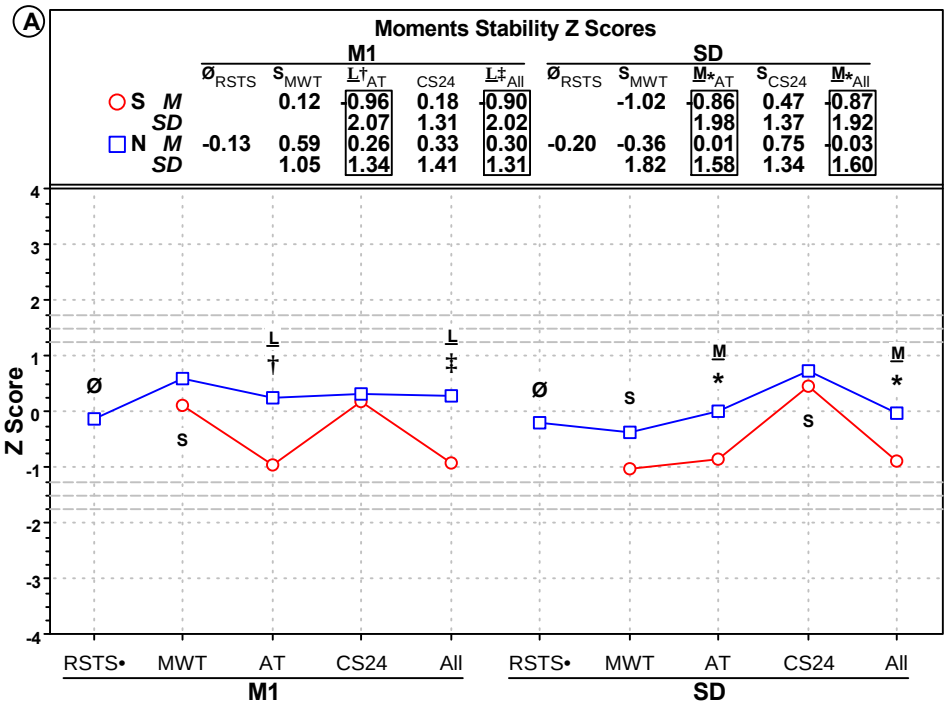
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


A
CONSONANT ERROR CONSISTENCY: PHONEME Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 2.4 6.2 86.2 5.2 16.3 76.9 8.1 26.0 83.1 15.7 48.5 81.1
SD 2.9 7.9 21.4 5.7 20.2 22.4 5.8 21.5 15.6 12.6 43.5 17.2
N M 1.4 3.9 88.4 3.5 9.8 84.6 7.2 23.0 81.0 12.2 36.7 82.9
SD 2.4 8.0 25.4 3.6 11.5 19.8 4.8 18.3 19.3 8.9 31.1 14.0
PERCENT CONSISTENT
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

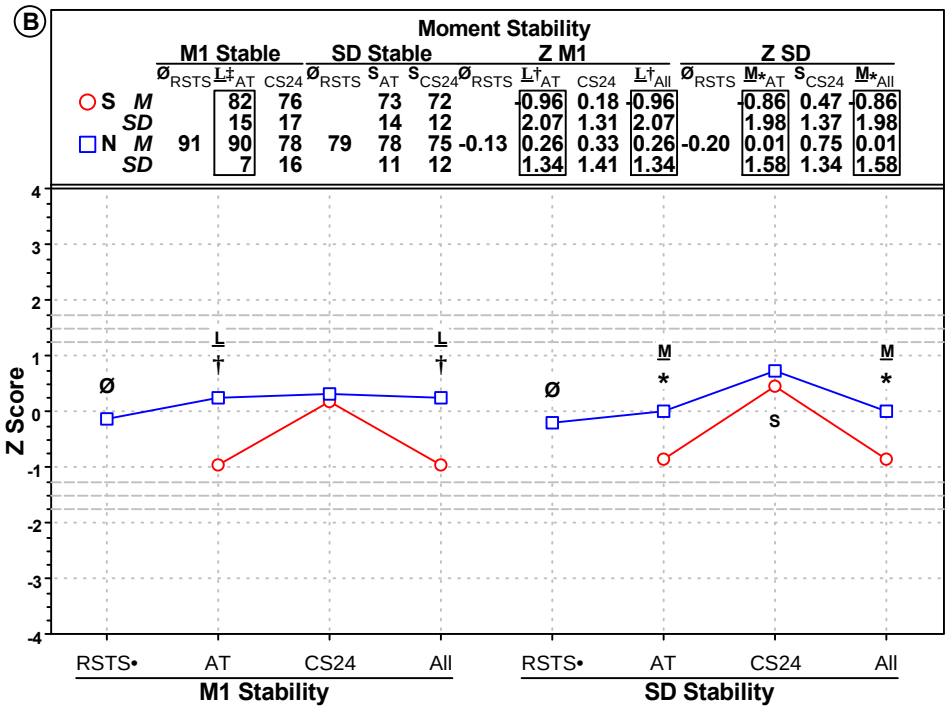

B
CONSONANT ERROR CONSISTENCY: PHONEME & DIACRITIC Source: CS
EARLY-8 MIDDLE-8 LATE-8 TOTAL
S M 2.7 7.0 82.2 5.3 16.8 73.4 10.8 33.7 73.9 18.9 57.5 74.2
SD 3.0 8.2 27.4 5.9 21.0 23.5 6.6 24.0 16.3 13.5 46.8 17.3
N M 1.5 4.2 84.6 3.7 10.3 78.1 10.8 33.6 74.4 16.1 48.0 76.1
SD 2.4 8.2 28.1 3.7 11.8 23.4 6.0 23.7 18.9 10.0 35.5 15.1
PERCENT CONSISTENT
m b j n w d p h t ŋ k g f v tʃ dʒ ʃ θ s z ð l r ʒ•
EARLY-8 MIDDLE-8 LATE-8
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


C
FEATURE ERROR CONSISTENCY: PHONEME Source: CS
CLASS VOICE MANNER
S M 88.1 78.7 87.7 71.7 91.6 52.8 79.9 70.3 79.1 86.4
SD 15.5 18.4 13.5 27.1 24.8 45.4 22.6 40.2 20.0 19.6
N M 82.3 83.1 83.9 80.4 88.7 82.4 86.9 80.4 80.3 81.5
SD 24.7 16.3 17.3 22.2 27.1 31.2 17.3 33.6 23.2 24.9
PERCENT CONSISTENT
S O V VL N G S A F L
CLASS VOICE MANNER
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


D
FEATURE ERROR CONSISTENCY: PHONEME & DIACRITIC Source: CS
CLASS VOICE MANNER
S M 75.1 74.8 78.4 67.9 86.4 59.4 77.9 57.5 74.4 72.1
SD 18.5 18.6 15.9 26.6 31.4 44.1 21.4 41.5 19.9 20.4
N M 74.6 76.3 76.9 73.2 83.6 69.2 82.1 71.8 73.0 73.5
SD 23.8 18.0 17.9 23.6 32.0 39.7 20.9 37.8 24.0 24.7
PERCENT CONSISTENT
S O V VL N G S A F L
CLASS VOICE MANNER
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



*p < .05, †p < .01, ‡p < .001, Ønone Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

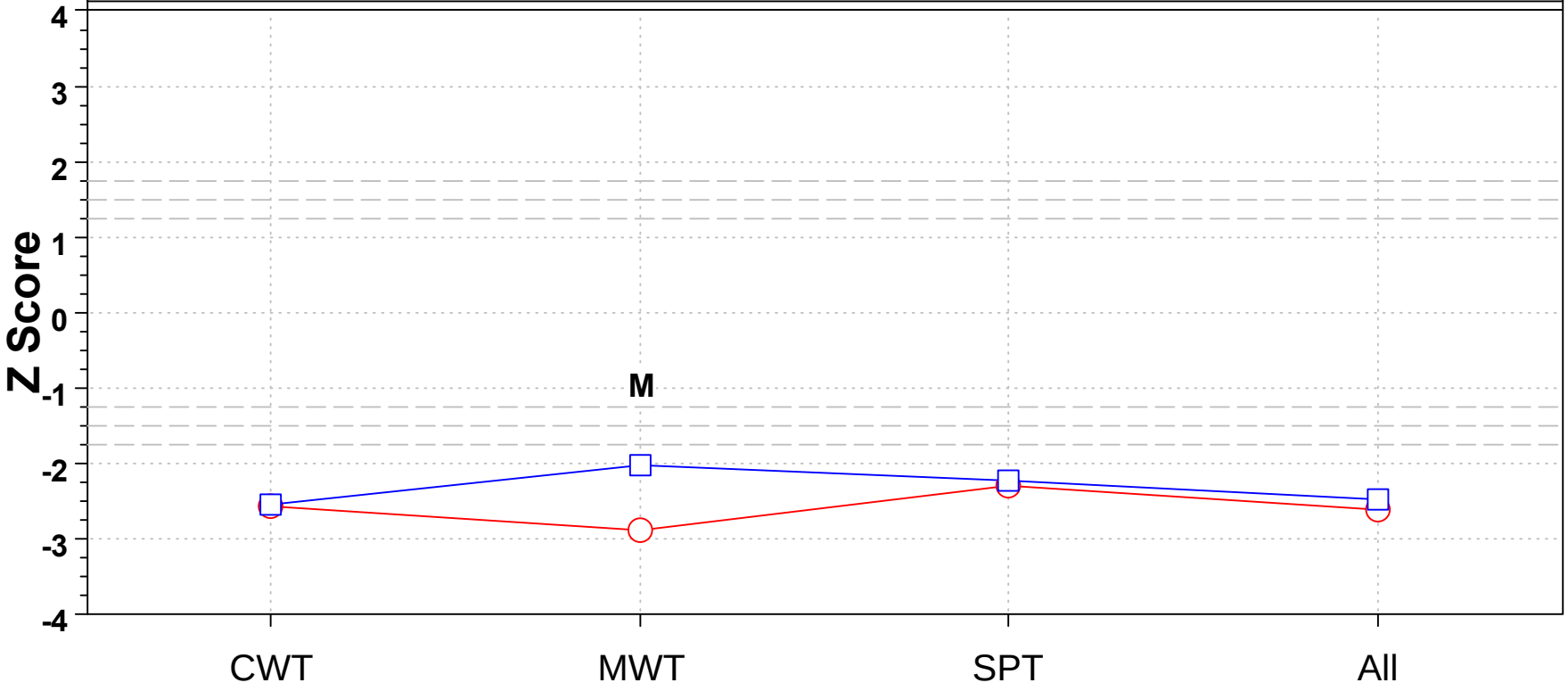


*p < .05, †p < .01, ‡p < .001, Ønone Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

VOWEL & CONSONANT PROFILES

Percent of Phonemes Correct in Complex Words

		% Phonemes Correct				Z Scores			
		CWT	MMWT	SPT	All	CWT	MMWT	SPT	All
○ S	*M*	71.8	45.2	66.2	68.0	-2.57	-2.88	-2.29	-2.61
	SD	20.1	22.5	23.0	22.2	1.85	2.32	1.82	1.88
□ N	*M*	70.4	56.3	65.9	68.6	-2.55	-2.03	-2.22	-2.48
	SD	15.2	13.3	14.2	15.7	1.55	1.18	1.52	1.52

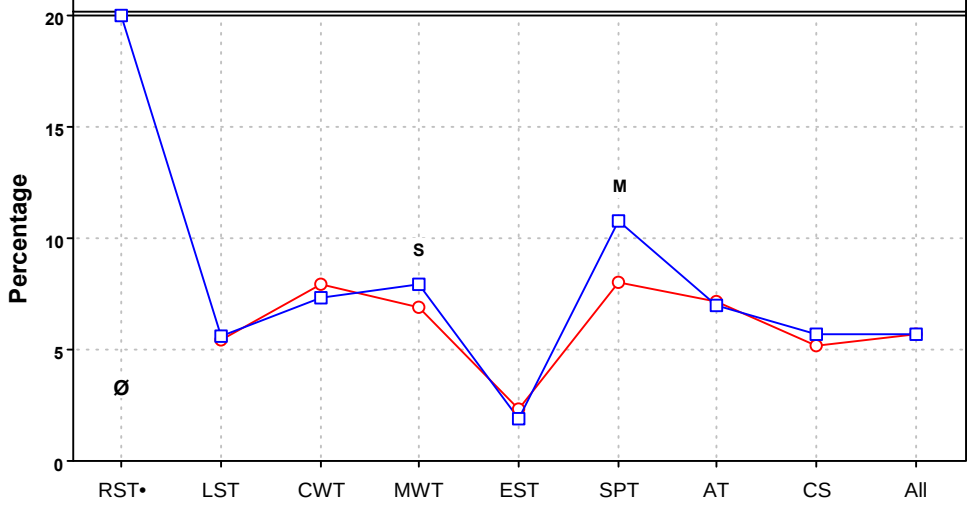


*$p < .05$, †$p < .01$, ‡$p < .001$, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A

Phoneme Distortions: Place Values
Percent

		Ø RST	LST	CWT	S MWT	EST	M SPT	AT	CS	All
○ S	*M*		5.45	7.97	6.93	2.35	8.08	7.21	5.25	5.73
	SD		4.25	5.10	6.11	2.61	4.52	4.17	3.02	4.17
□ N	*M*	20.00	5.64	7.40	7.96	1.93	10.85	7.01	5.70	5.73
	SD		3.12	4.54	4.28	3.50	4.69	3.72	3.53	4.05

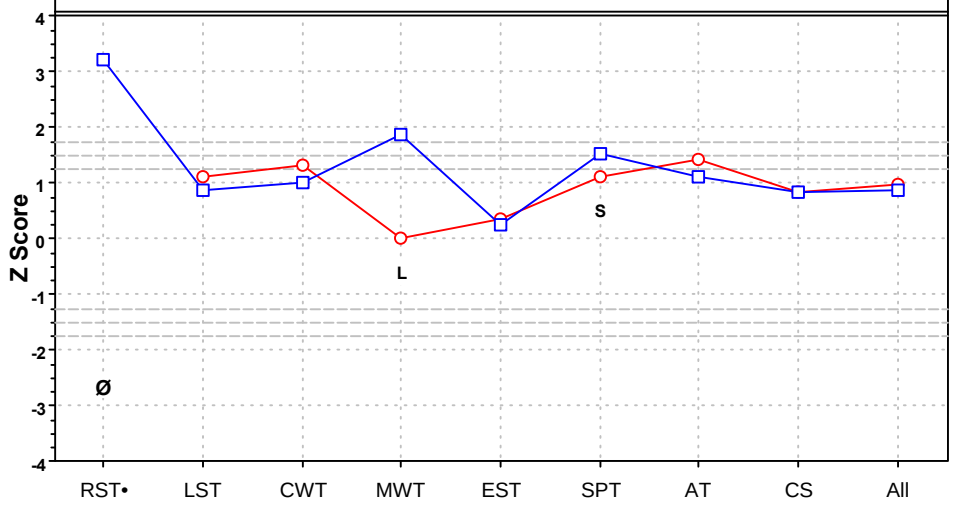


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

B

Phoneme Distortions: Place Z Scores
Z Scores

		Ø RST	LST	CWT	L MWT	EST	S SPT	AT	CS	All
○ S	*M*		1.11	1.34	0.03	0.38	1.12	1.44	0.85	0.99
	SD		1.73	1.93	1.20	1.29	1.56	1.94	1.57	1.70
□ N	*M*	3.24	0.87	1.02	1.88	0.24	1.55	1.12	0.84	0.86
	SD		1.45	1.91	2.16	1.76	1.75	1.77	1.57	1.71

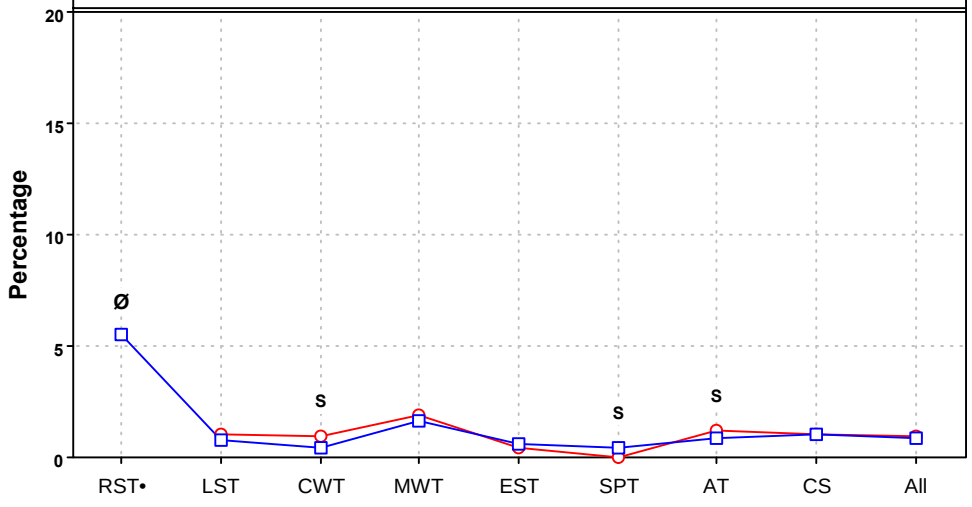


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

C

Phoneme Distortions: Manner Values
Percent

		Ø RST	LST	S CWT	MWT	EST	S SPT	S AT	CS	All
○ S	*M*		1.10	0.97	1.93	0.49	0.06	1.28	1.04	1.03
	SD		2.00	1.50	0.94	1.46	0.16	1.61	1.36	1.53
□ N	*M*	5.60	0.82	0.51	1.69	0.64	0.47	0.88	1.06	0.87
	SD		1.48	0.99	2.05	1.66	2.03	1.81	1.79	1.65

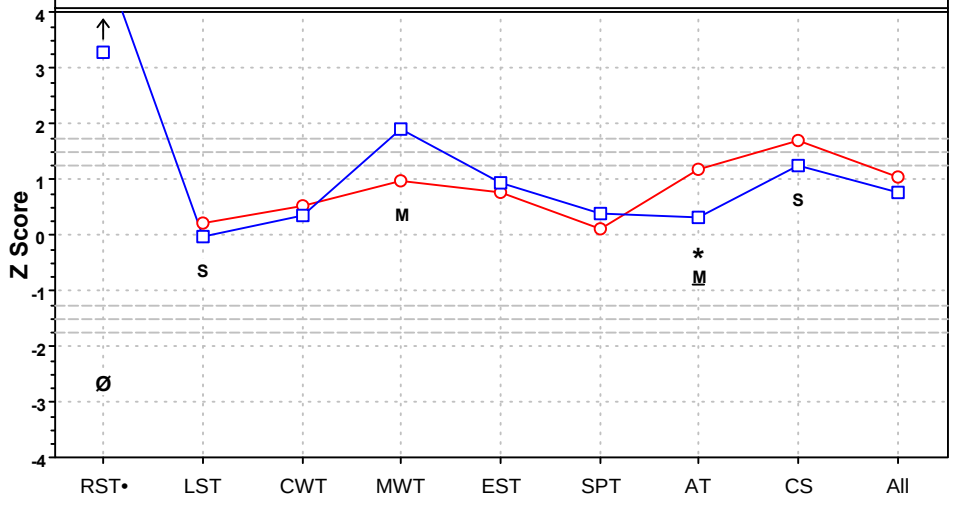


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

D

Phoneme Distortions: Manner Z Scores
Z Scores

		Ø RST	S LST	CWT	M MWT	EST	SPT	M* AT	S CS	All
○ S	*M*		0.24	0.54	0.99	0.77	0.12	1.21	1.69	1.06
	SD		1.36	1.65	0.78	1.88	1.43	2.08	2.28	2.00
□ N	*M*	5.00	-0.01	0.38	1.92	0.94	0.41	0.33	1.27	0.76
	SD		1.07	1.51	1.91	1.95	1.63	1.48	2.01	1.80

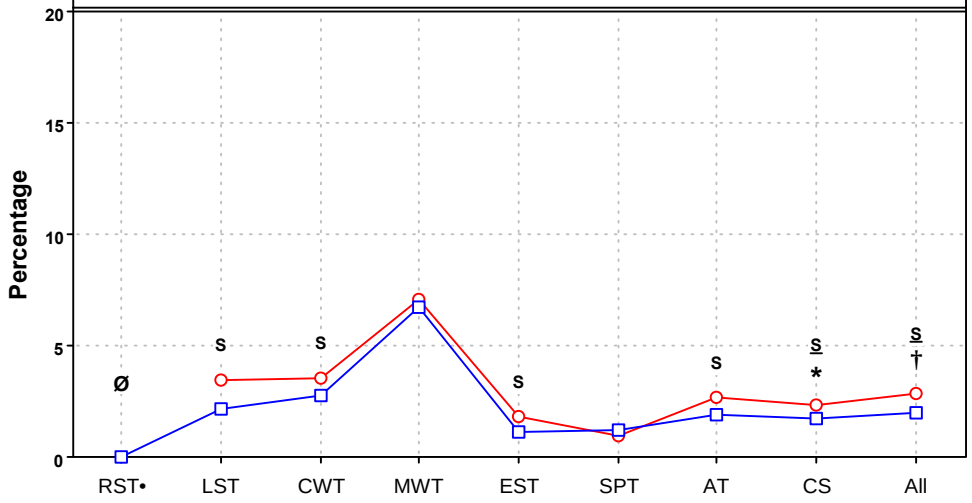


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

E

Phoneme Distortions: Voicing Values
Percent

		$Ø_{RST}$	S_{LST}	S_{CWT}	MWT	S_{EST}	SPT	S_{AT}	$S*_{CS}$	$S†_{All}$
○ S	*M*		3.52	3.56	7.12	1.85	0.97	2.73	2.41	2.87
	SD		4.33	4.54	2.90	2.48	1.19	3.15	1.79	3.25
□ N	*M*	0.00	2.23	2.83	6.80	1.13	1.21	1.91	1.75	2.06
	SD		3.60	3.20	4.79	2.93	1.77	2.30	2.20	2.93

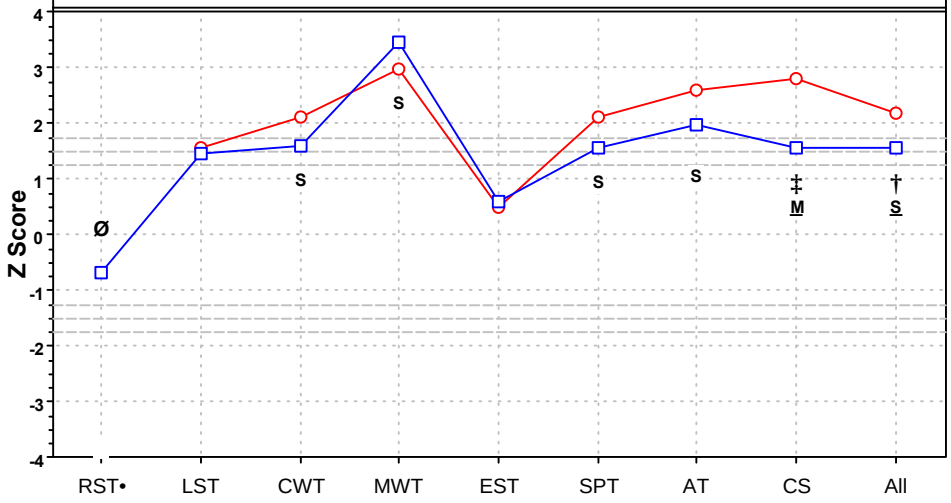


*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

F

Phoneme Distortions: Voicing Z Scores
Z Scores

		$Ø_{RST}$	LST	S_{CWT}	S_{MWT}	EST	S_{SPT}	S_{AT}	$M‡_{CS}$	$S†_{All}$
○ S	*M*		1.56	2.13	2.99	0.48	2.11	2.61	2.81	2.18
	SD		2.15	2.50	1.53	1.61	2.45	2.39	2.25	2.32
□ N	*M*	-0.67	1.48	1.61	3.46	0.60	1.58	1.99	1.59	1.55
	SD		2.23	2.02	1.89	1.94	2.19	2.22	2.16	2.17

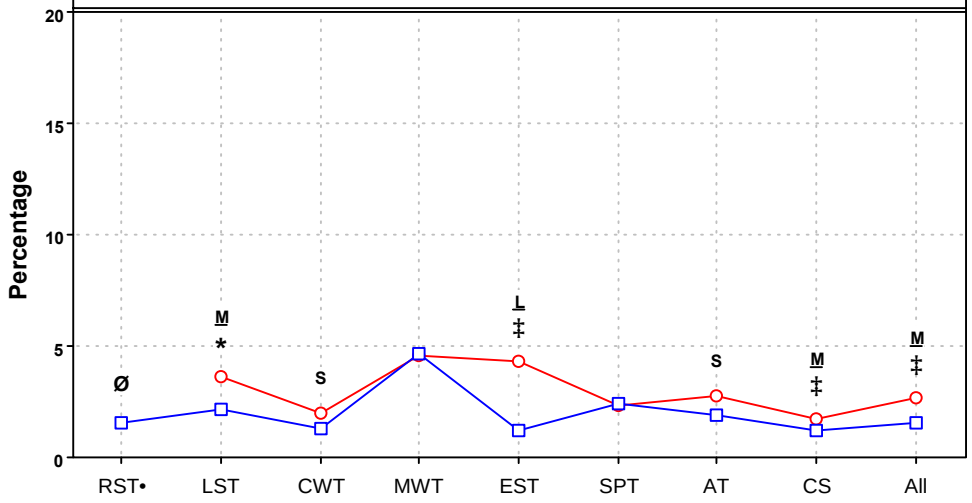


*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

G

Phoneme Distortions: Addition Values
Percent

		$Ø_{RST}$	$M*_{LST}$	S_{CWT}	MWT	$L‡_{EST}$	SPT	S_{AT}	$M‡_{CS}$	$M‡_{All}$
○ S	*M*		3.64	2.06	4.62	4.32	2.37	2.82	1.79	2.70
	SD		3.96	3.13	2.01	6.38	1.62	3.45	1.50	3.57
□ N	*M*	1.60	2.21	1.36	4.70	1.28	2.42	1.92	1.21	1.59
	SD		1.98	1.58	2.17	2.57	1.59	1.80	1.08	1.81

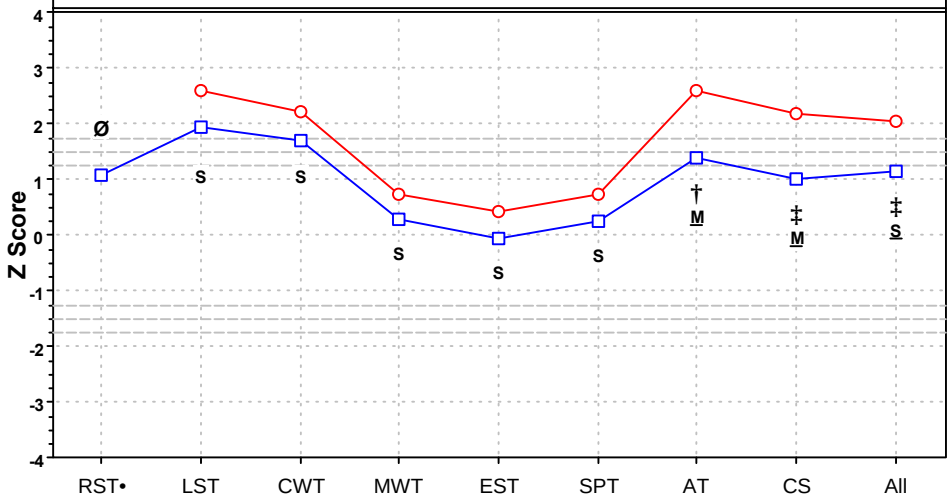


*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

H

Phoneme Distortions: Addition Z Scores
Z Scores

		$Ø_{RST}$	S_{LST}	S_{CWT}	S_{MWT}	S_{EST}	S_{SPT}	$M†_{AT}$	$M‡_{CS}$	$S‡_{All}$
○ S	*M*		2.60	2.23	0.75	0.42	0.75	2.59	2.19	2.04
	SD		2.40	2.40	1.11	1.33	1.74	2.19	2.10	2.20
□ N	*M*	1.10	1.96	1.70	0.29	-0.06	0.25	1.41	1.01	1.16
	SD		2.03	2.31	1.19	1.32	1.22	1.88	1.78	1.96

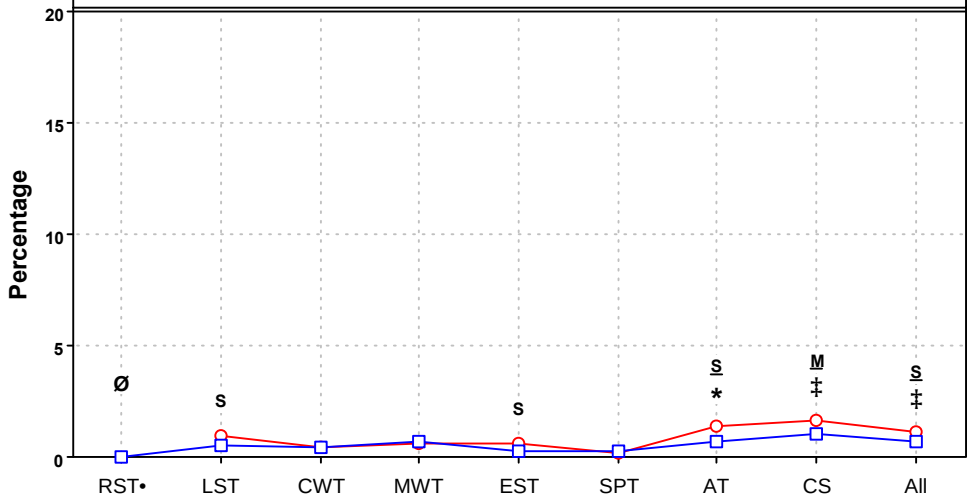


*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

I Phoneme Distortions: Duration Values

Percent

		$Ø_{RST}$	S_{LST}	CWT	MWT	S_{EST}	SPT	$S*_{AT}$	$M‡_{CS}$	$S‡_{All}$
○ S	*M*		0.96	0.51	0.62	0.63	0.25	1.41	1.71	1.17
	SD		2.23	1.01	0.90	0.85	0.51	2.24	1.52	1.68
□ N	*M*	0.00	0.55	0.51	0.74	0.29	0.27	0.75	1.08	0.74
	SD		1.21	0.86	0.69	1.13	0.51	1.27	1.11	1.14

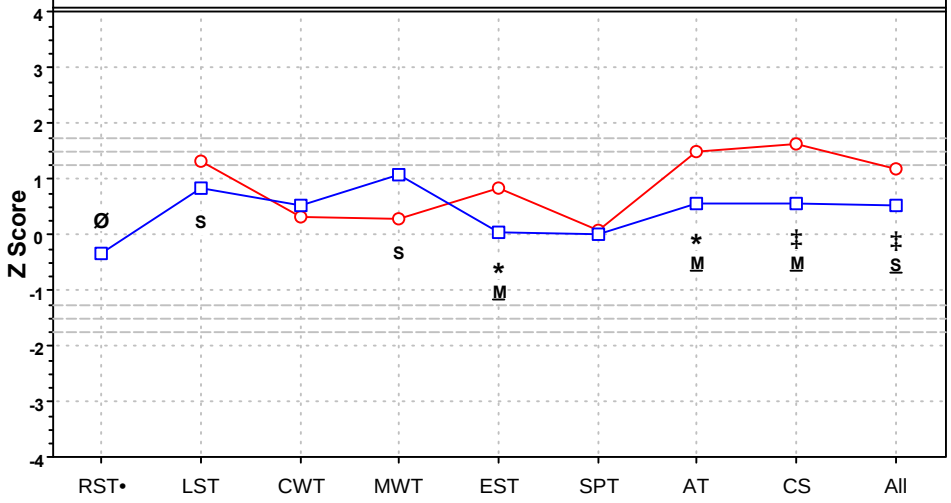


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

J Phoneme Distortions: Duration Z Scores

Z Scores

		$Ø_{RST}$	S_{LST}	CWT	S_{MWT}	$M*_{EST}$	SPT	$M*_{AT}$	$M‡_{CS}$	$S‡_{All}$
○ S	*M*		1.32	0.34	0.31	0.86	0.10	1.49	1.63	1.20
	SD		2.40	1.63	1.82	1.50	1.40	2.11	2.22	2.07
□ N	*M*	-0.33	0.83	0.53	1.09	0.06	0.01	0.57	0.55	0.54
	SD		1.89	1.74	1.81	1.29	1.16	1.79	1.65	1.69

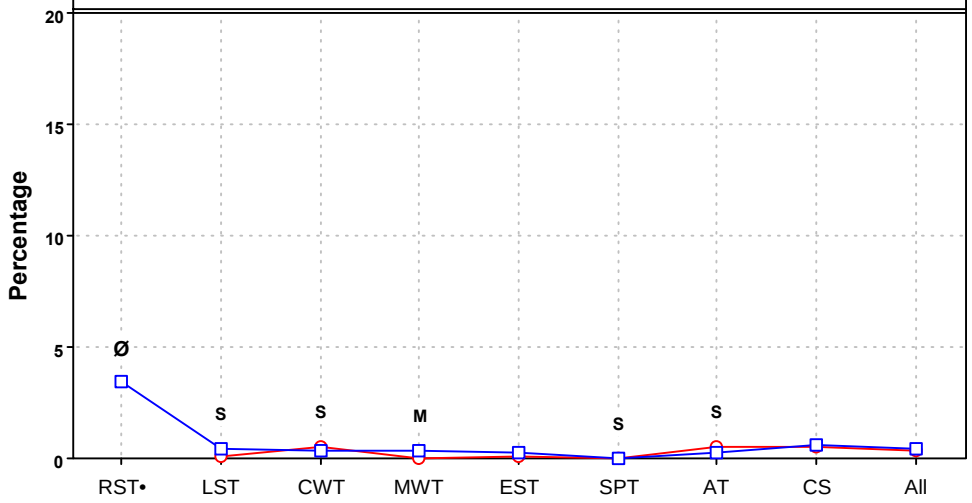


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

K Phoneme Distortions: Force Values

Percent

		$Ø_{RST}$	S_{LST}	S_{CWT}	M_{MWT}	EST	S_{SPT}	S_{AT}	CS	All
○ S	*M*		0.15	0.54	0.00	0.14	0.00	0.59	0.53	0.42
	SD		0.46	0.81	0.00	0.60	0.00	0.87	1.16	0.91
□ N	*M*	3.53	0.45	0.35	0.38	0.33	0.08	0.31	0.63	0.46
	SD		1.08	0.68	0.67	1.31	0.31	0.72	1.18	1.05

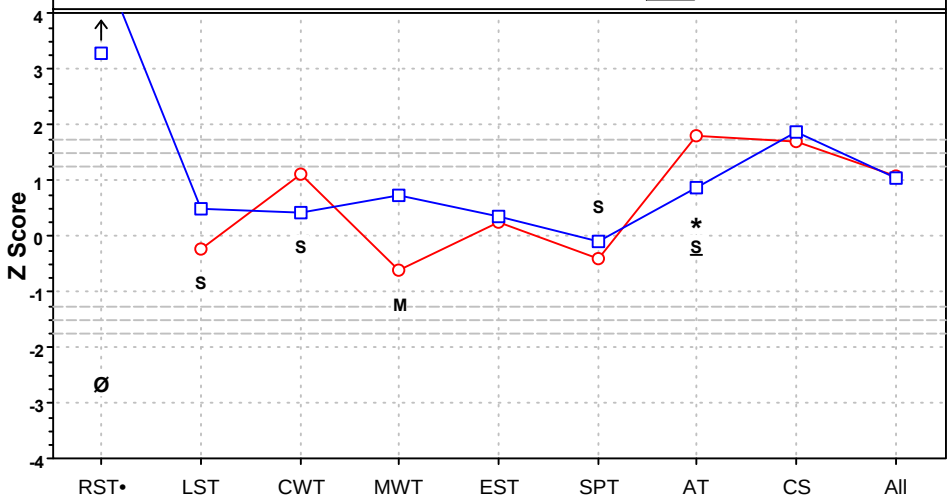


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

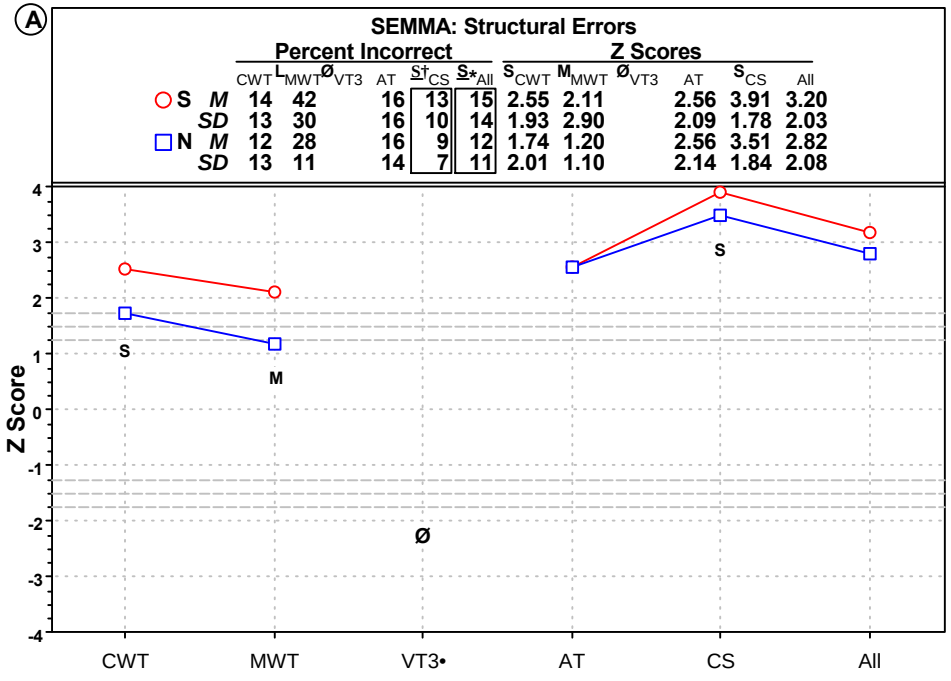
L Phoneme Distortions: Force Z Scores

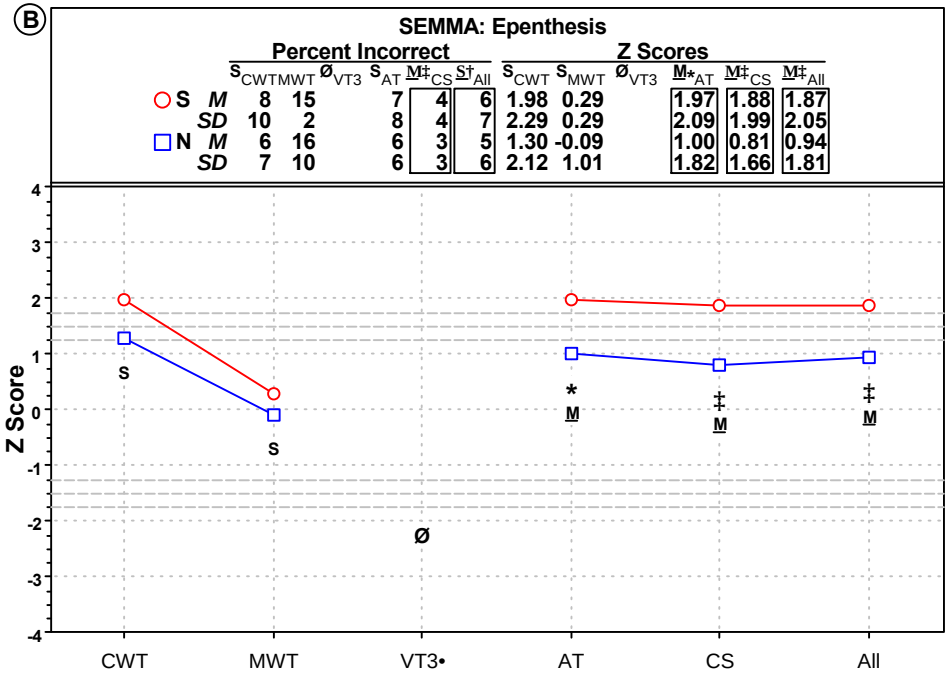
Z Scores

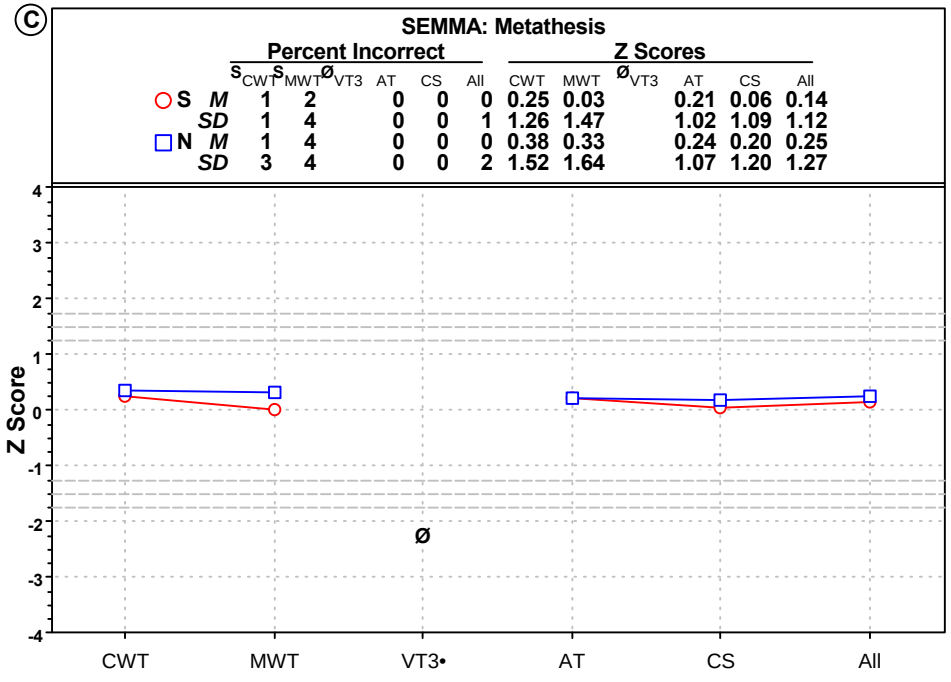
		$Ø_{RST}$	S_{LST}	S_{CWT}	M_{MWT}	EST	S_{SPT}	$S*_{AT}$	CS	All
○ S	*M*		-0.21	1.12	-0.61	0.26	-0.41	1.81	1.70	1.09
	SD		0.52	2.24	0.00	1.15	0.16	2.39	2.42	2.16
□ N	*M*	5.00	0.50	0.45	0.73	0.38	-0.10	0.90	1.86	1.06
	SD		1.72	1.71	1.96	1.32	1.04	2.03	2.38	2.10

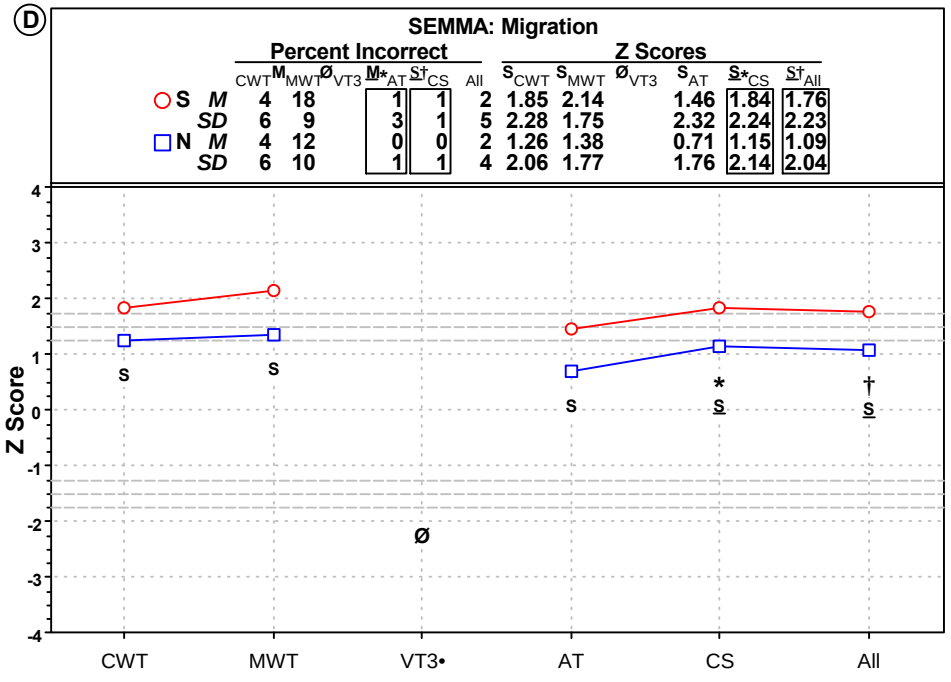


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


A
SEMMA: Structural Errors
Percent Incorrect
Z Scores
S M 14 42 16 13 15 2.55 2.11 2.56 3.91 3.20
SD 13 30 16 10 14 1.93 2.90 2.09 1.78 2.03
N M 12 28 16 9 12 1.74 1.20 2.56 3.51 2.82
SD 13 11 14 7 11 2.01 1.10 2.14 1.84 2.08
Z Score
CWT MWT VT3• AT CS All
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


B
SEMMA: Epenthesis
Percent Incorrect
Z Scores
S M 8 15 7 4 6 1.98 0.29 1.97 1.88 1.87
SD 10 2 8 4 7 2.29 0.29 2.09 1.99 2.05
N M 6 16 6 3 5 1.30 -0.09 1.00 0.81 0.94
SD 7 10 6 3 6 2.12 1.01 1.82 1.66 1.81
Z Score
CWT MWT VT3• AT CS All
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

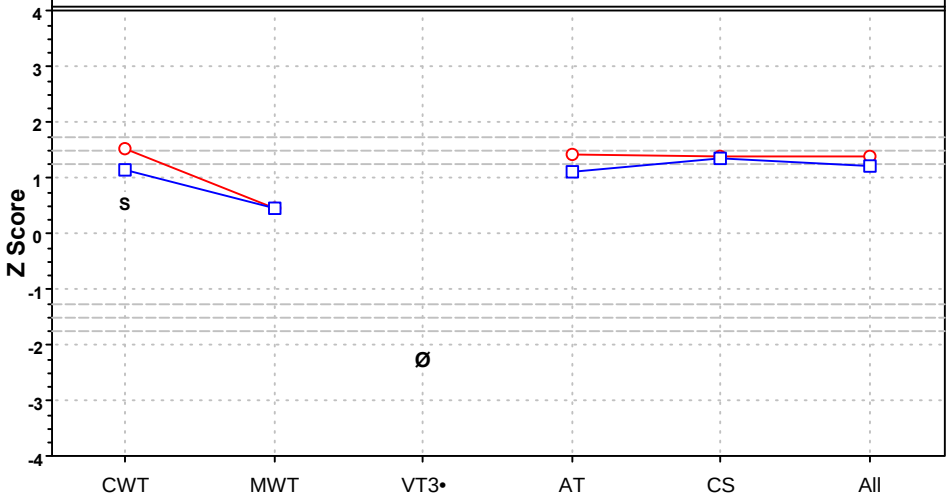

C
SEMMA: Metathesis
Percent Incorrect
Z Scores
S M 1 2 0 0 0 0.25 0.03 0.21 0.06 0.14
SD 1 4 0 0 1 1.26 1.47 1.02 1.09 1.12
N M 1 4 0 0 0 0.38 0.33 0.24 0.20 0.25
SD 3 4 0 0 2 1.52 1.64 1.07 1.20 1.27
Z Score
CWT MWT VT3• AT CS All
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


D
SEMMA: Migration
Percent Incorrect
Z Scores
S M 4 18 1 1 2 1.85 2.14 1.46 1.84 1.76
SD 6 9 3 1 5 2.28 1.75 2.32 2.24 2.23
N M 4 12 0 0 2 1.26 1.38 0.71 1.15 1.09
SD 6 10 1 1 4 2.06 1.77 1.76 2.14 2.04
Z Score
CWT MWT VT3• AT CS All
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

Ⓔ

SEMMA: Assimilation

		Percent Incorrect						Z Scores					
		S_{CWT}	S_{MWT}	$Ø_{VT3}$	AT	CS	All	S_{CWT}	MWT	$Ø_{VT3}$	AT	CS	All
○ S	*M*	15	26		3	2	6	1.53	0.47		1.42	1.40	1.40
	SD	11	8		3	2	9	1.76	0.60		2.03	1.80	1.81
□ N	*M*	19	23		3	2	7	1.16	0.45		1.11	1.36	1.23
	SD	15	7		3	2	10	1.46	1.02		1.63	1.85	1.70



*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

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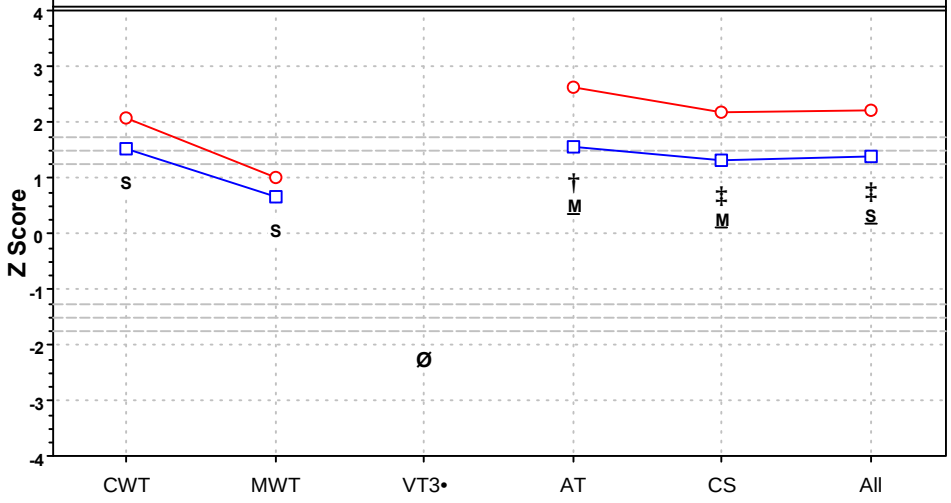
EMMA

		Percent Incorrect						Z Scores					
		CWT	MWT	$Ø_{VT3}$	S_{AT}	S†CS	All	S_{CWT}	S_{MWT}	$Ø_{VT3}$	M†AT	M‡CS	S‡All
○ S	*M*	25	47		11	8	14	2.10	1.02		2.62	2.18	2.22
	SD	17	11		9	5	14	1.61	0.83		2.22	1.78	1.83
□ N	*M*	27	45		9	6	13	1.54	0.68		1.56	1.34	1.41
	SD	18	12		7	4	14	1.56	0.91		1.78	1.58	1.61

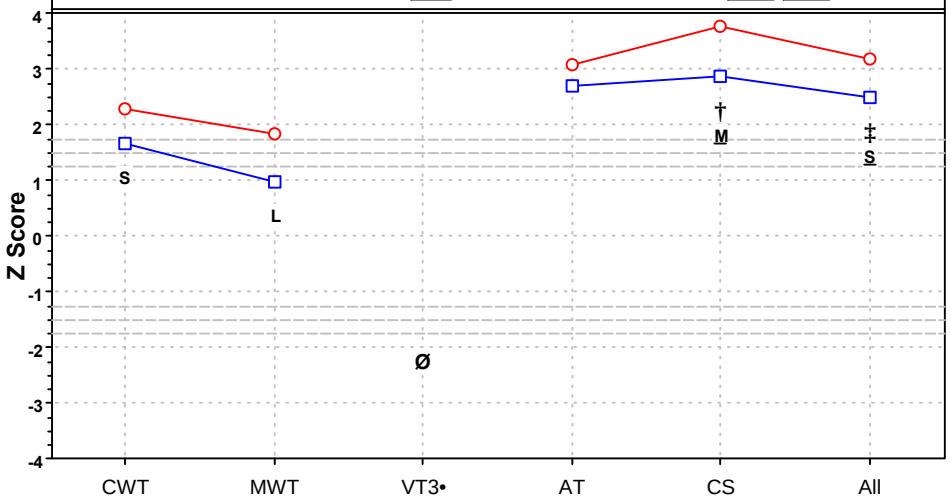


*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

Ⓖ

SEMMA

		Percent Incorrect						Z Scores					
		CWT	M$_{MWT}$	$Ø_{VT3}$	AT	S†CS	All	S_{CWT}	L$_{MWT}$	$Ø_{VT3}$	AT	M†CS	S‡All
○ S	*M*	33	68		24	18	25	2.30	1.83		3.10	3.78	3.20
	SD	23	22		19	12	20	1.57	1.54		2.14	1.80	1.92
□ N	*M*	35	58		24	14	23	1.67	0.99		2.72	2.86	2.50
	SD	21	16		16	9	18	1.47	0.91		2.05	1.85	1.88

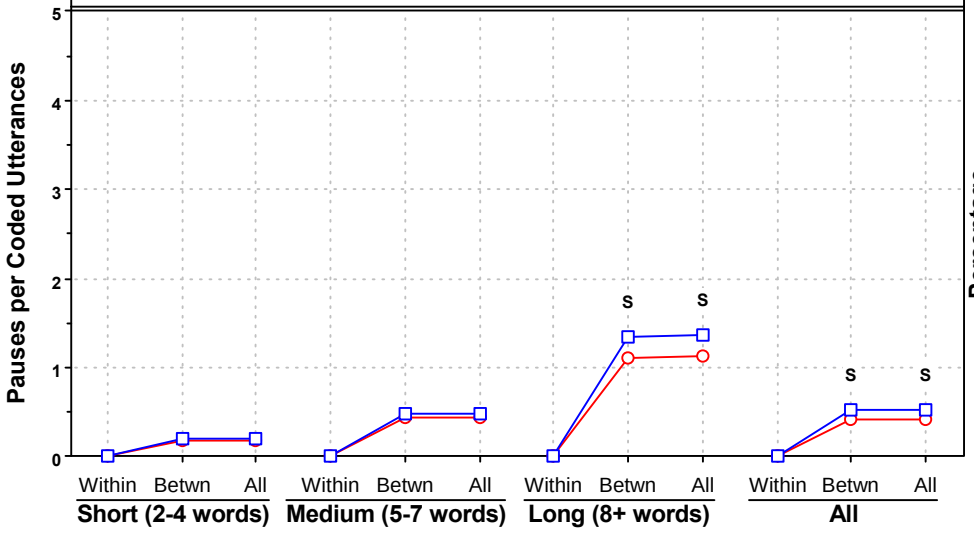


*p < .05, †p < .01, ‡p < .001, ^{Ø}no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

A

TA: Syllable Segregation Pauses Source: CS24

		Short Utts			Medium Utts			Long Utts			All Utts		
		Within	Betwn	All	Within	Betwn	All	Within	Betwn	All	Within	Betwn	All
○ S	*M*	0.01	0.18	0.19	0.00	0.44	0.45	0.00	1.12	1.12	0.01	0.42	0.43
	SD	0.02	0.15	0.15	0.03	0.41	0.41	0.00	0.74	0.74	0.01	0.34	0.34
□ N	*M*	0.00	0.20	0.20	0.00	0.48	0.49	0.00	1.35	1.36	0.00	0.53	0.53
	SD	0.06	0.19	0.21	0.02	0.38	0.38	0.02	1.02	1.03	0.01	0.40	0.40

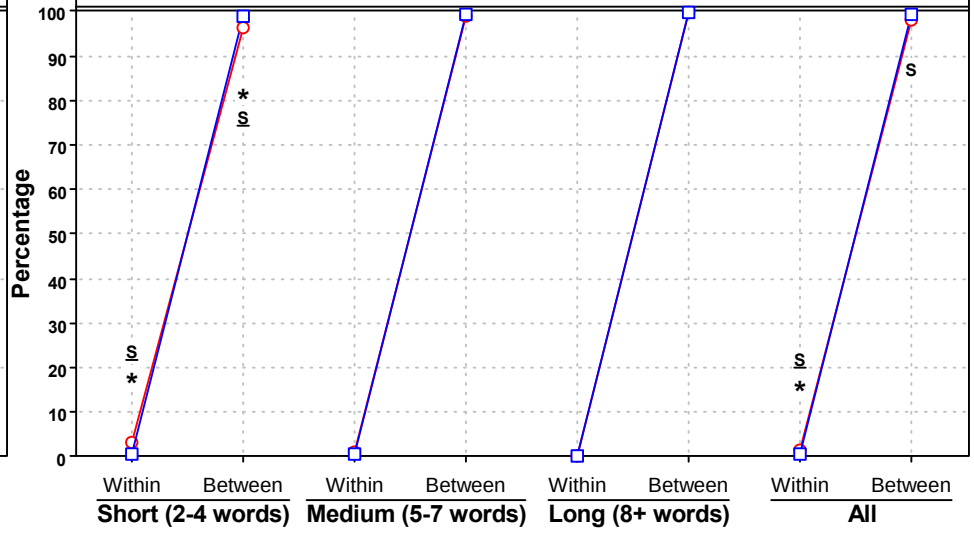


*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

TA: Syllable Segregation Pauses Source: CS24

		S Within		S Betwn		M Within		M Betwn		L Within		L Betwn		Within		Between	
		S*No.	S*%	No.	S*%	No.	%	No.	%	No.	%	SNo.	%	SNo.	S*%	SNo.	S%
○ S	*M*	0.1	3	2.2	96	0.0	1	3.1	99	0.0	0	4.2	100	0.1	1	9.5	98
	SD	0.3	10	2.0	11	0.2	5	3.0	5	0.0	0	6.0	2	0.3	5	7.7	5
□ N	*M*	0.0	1	2.0	99	0.0	1	3.5	99	0.0	0	6.3	100	0.1	1	11.8	99
	SD	0.2	5	2.0	5	0.2	5	2.9	5	0.1	1	7.0	3	0.3	3	8.2	3

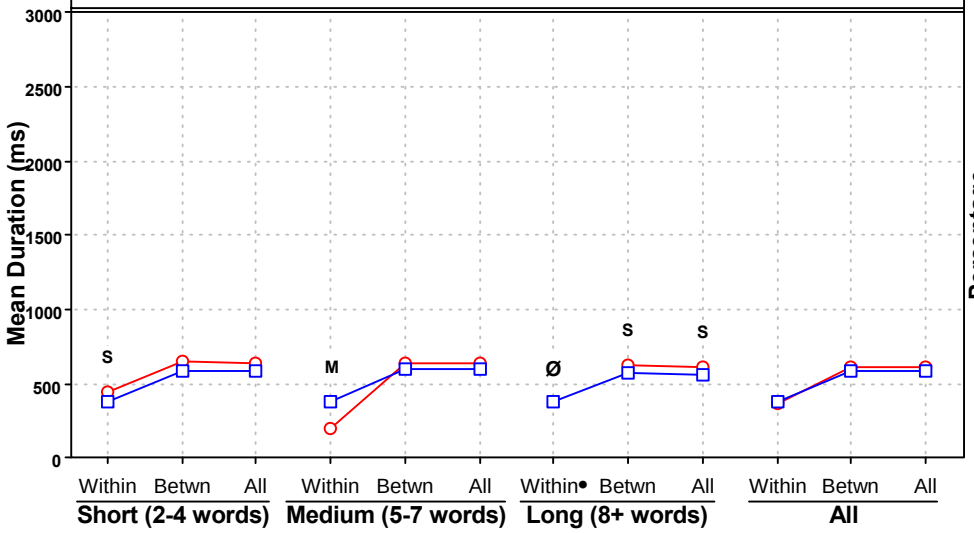


*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

TA: Syllable Segregation Pauses Source: CS24

		Short Utts			Medium Utts			Long Utts			All Utts		
		SWithin	Betwn	All	MWithin	Betwn	All	ØWithin	SBetwn	SAll	Within	Betwn	All
○ S	*M*	448	654	643	201	642	640		621	620	365	620	615
	SD	335	334	327	98	288	291		300	300	292	191	190
□ N	*M*	387	593	592	378	598	598	385	570	568	383	589	587
	SD	233	362	360	220	320	321	240	226	223	220	207	206

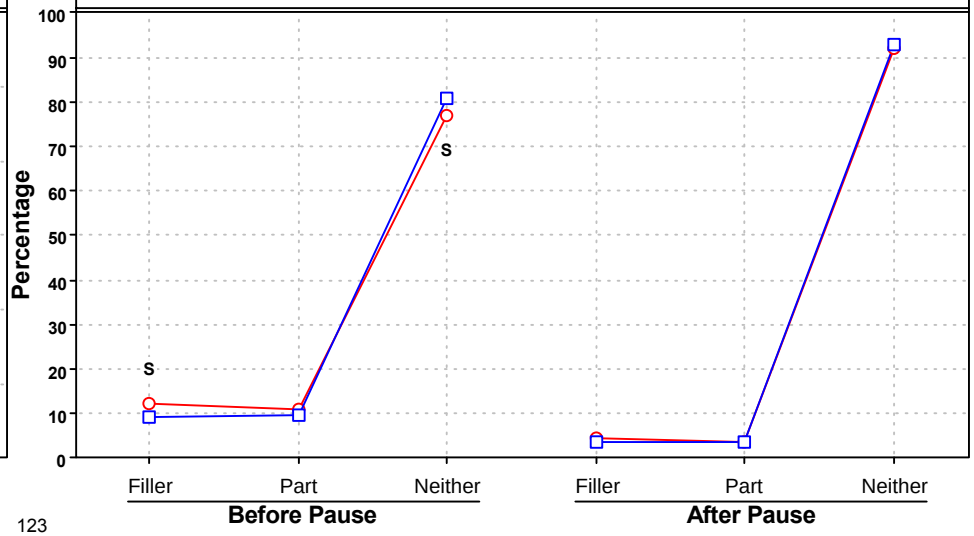


*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

D

TA: Syllable Segregation Pauses Source: CS24

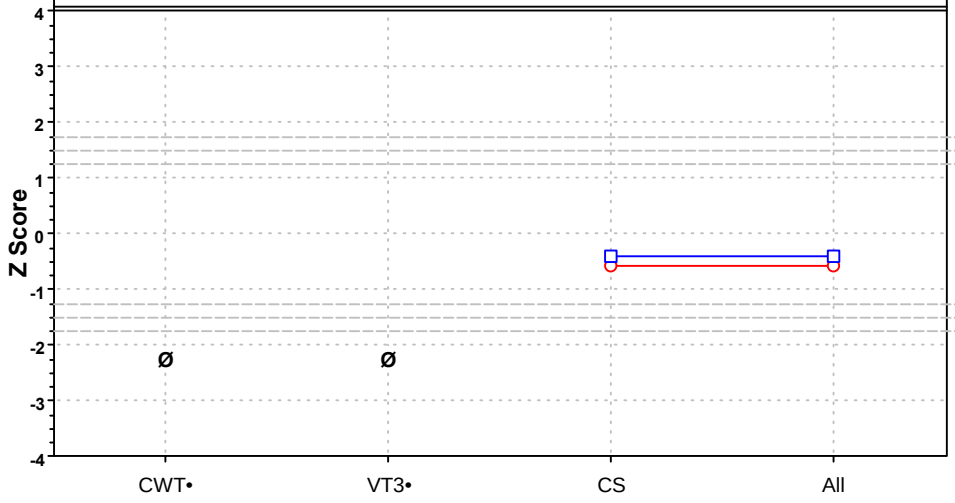
		Fill Before		Part Before		Neither		Fill After		Part After		Neither	
		No.	S%	No.	%	SNo.	S%	No.	%	No.	%	SNo.	%
○ S	*M*	1.0	12	1.0	11	7.4	77	0.4	4	0.4	4	8.7	92
	SD	1.4	17	1.7	17	6.7	21	1.0	9	0.8	7	7.1	12
□ N	*M*	1.2	9	1.2	10	9.4	81	0.6	4	0.5	3	10.8	93
	SD	1.6	11	1.7	12	6.7	17	1.1	7	1.0	7	7.2	10



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

A **Percent of Phonemes Correct in Complex Words Stability**

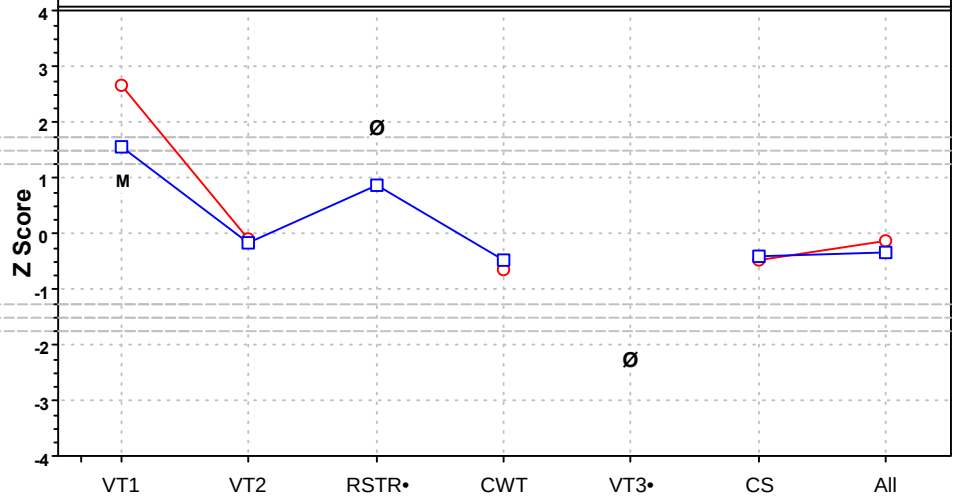
		Percent				Z Scores			
		CWT	Ø$_{VT3}$	S$_{CS}$	All	Ø$_{CWT}$	Ø$_{VT3}$	CS	All
○ S	*M*	73		69	70			-0.57	-0.57
	SD	13		19	17			1.47	1.47
□ N	*M*	70		72	72			-0.40	-0.40
	SD	17		15	16			1.13	1.13



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

B **Whole Word Type Target Consistency**

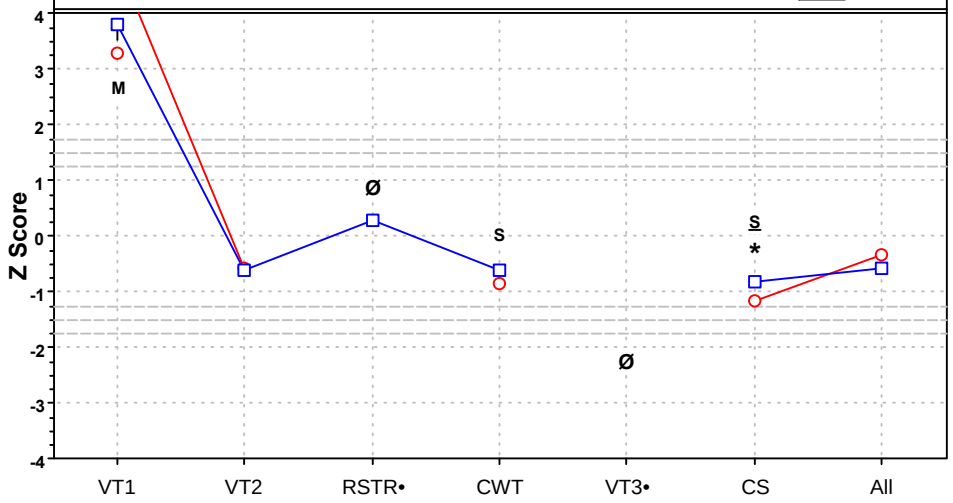
		Consistency						Z Scores					
		S$_{VT1}$	S$_{VT2}$	Ø$_{RSTR}$	S$_{CWT}$	Ø$_{VT3}$	CS	All	M$_{VT1}$	VT2	Ø$_{RSTR}$	CWT	Ø$_{VT3}$	CS	All
○ S	*M*	45	37		31		49	43	2.67	-0.08		-0.65		-0.46	-0.11
	SD	29	21		20		17	21	1.67	1.25		0.82		1.06	1.48
□ N	*M*	39	43	33	36		51	46	1.58	-0.14	0.87	-0.45		-0.40	-0.33
	SD	25	26		22		16	21	1.58	1.87		1.05		0.80	1.11



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

C **Whole Word Type Error Consistency**

		Consistency							Z Scores						
		S$_{VT1}$	VT2	Ø$_{RSTR}$	CWT	Ø$_{VT3}$	S$_{CS}$	All	M$_{VT1}$	VT2	Ø$_{RSTR}$	S$_{CWT}$	Ø$_{VT3}$	S*$_{CS}$	All
○ S	*M*	57	60		40		59	54	5.00	-0.57		-0.84		-1.17	-0.34
	SD	30	32		28		19	26	0.00	1.57		1.59		0.95	2.21
□ N	*M*	65	61	67	41		63	57	3.80	-0.61	0.29	-0.61		-0.81	-0.58
	SD	37	33		25		20	26	2.34	1.58		0.98		1.14	1.46

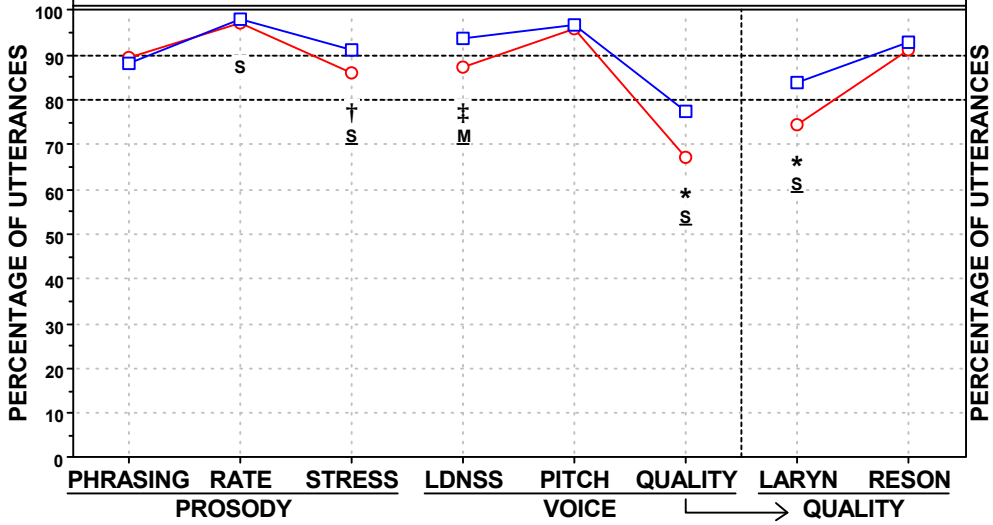


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

PROSODY-VOICE SCREENING PROFILE

A — PROSODY-VOICE SUMMARY Source: CS

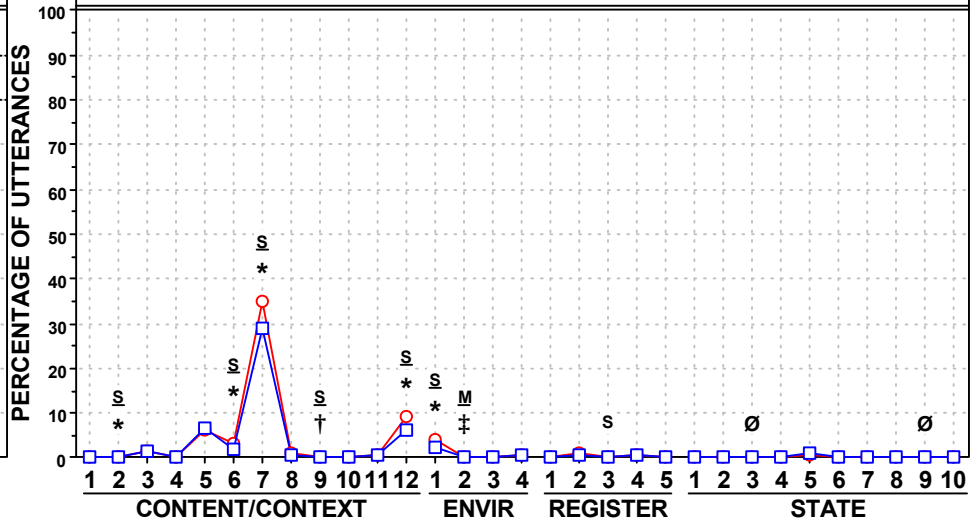
		APPROP PROSODY			APPROPRIATE VOICE					APPR
		PHRAS	S RATE	S† STRESS	M‡ LDNSS	PITCH	S* QUAL	S* LARYN	RESON	S† UTTS
S	*M*	89.6	97.0	86.2	87.5	96.1	67.0	74.6	91.2	44.6
	SD	9.7	6.9	13.8	17.0	7.8	30.5	28.1	20.0	25.7
N	*M*	88.1	97.9	91.2	93.7	96.9	77.6	83.9	92.9	56.7
	SD	10.4	4.3	9.6	10.8	8.6	27.0	24.2	16.5	24.9



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

B — SAMPLE INFORMATION AND EXCLUSION CODES Source: CS

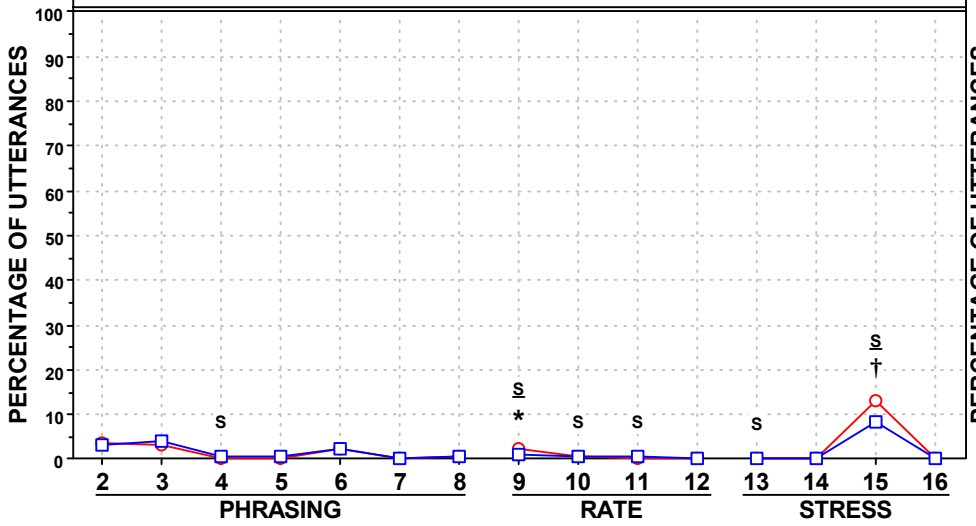
		NO. OF UTTS		%RESP	%DIFF	% EXCLUSION CODES				
		M‡ EXCLD	CODED	INVOLV	S* JUDGE	S* CONT	S* ENVIR	RGSTR	STATE	S† TOTAL
S	*M*	57.7	23.5	22.0	51.0	57.5	4.9	2.4	1.2	59.3
	SD	48.7	1.6	-	-	25.8	7.1	5.2	2.8	25.1
N	*M*	34.9	23.7	15.3	33.3	47.3	2.9	1.6	1.5	47.9
	SD	30.3	1.6	-	-	26.9	5.4	4.9	3.5	26.7



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

C — INAPPROPRIATE PROSODY Source: CS

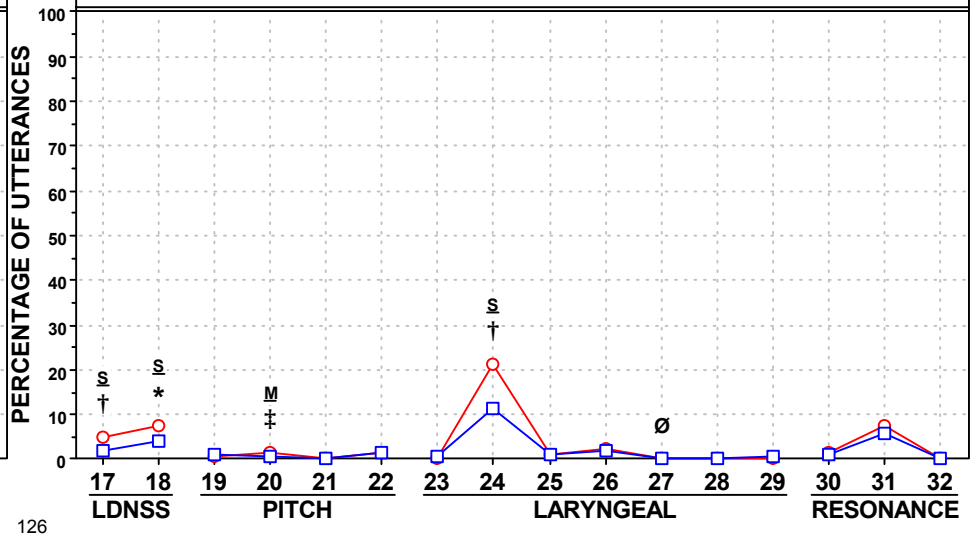
		PHRASING			RATE			STRESS			TOTAL		
		Q	N	T	Q	S N	T	S† Q	S† N	M‡ T	S† Q	S N	S* T
S	*M*	0.0	10.4	10.4	0.0	3.0	3.0	5.0	13.8	18.7	5.0	24.5	28.4
	SD	0.0	9.7	9.7	0.0	6.9	6.9	5.8	13.8	16.1	5.8	15.7	17.4
N	*M*	0.0	11.9	11.9	0.0	2.1	2.1	2.7	8.8	11.5	2.8	20.8	23.1
	SD	0.2	10.4	10.4	0.4	4.3	4.3	5.0	9.6	11.2	5.0	13.3	14.2



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

D — INAPPROPRIATE VOICE Source: CS

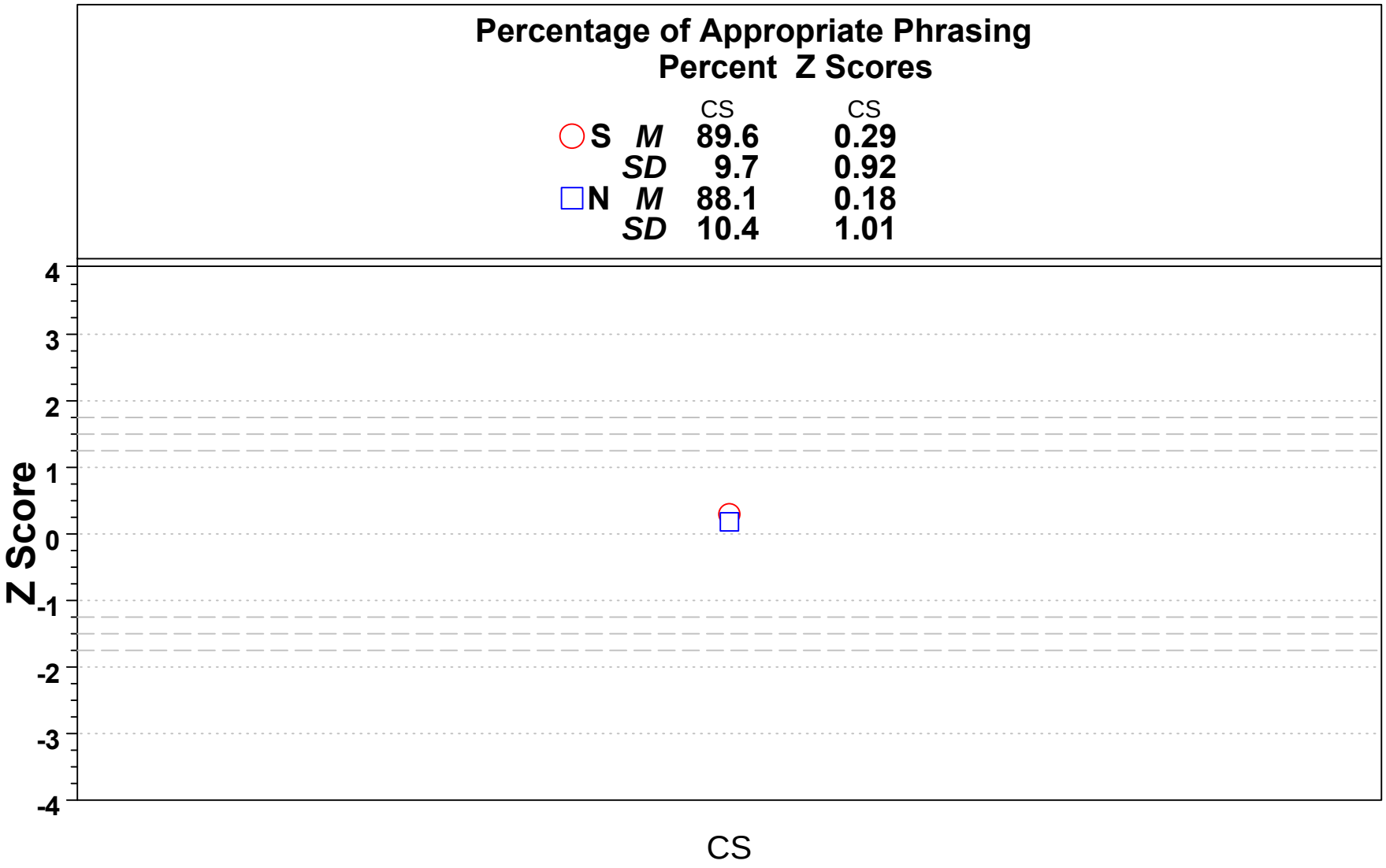
		LDNSS			PITCH			LARYN			RESON			TOTAL		
		S† Q	M‡ N	M‡ T	S† Q	N	T	Q	S* N	S* T	Q	N	T	S* Q	M† N	M‡ T
S	*M*	2.2	12.5	14.7	1.1	3.9	5.0	3.4	25.4	28.8	2.2	8.8	11.0	8.5	42.9	48.8
	SD	4.3	17.0	17.5	2.8	7.8	8.2	6.0	28.1	28.8	6.8	20.0	22.5	12.8	29.5	30.4
N	*M*	0.9	6.3	7.2	0.3	3.1	3.4	2.6	16.1	18.7	1.4	7.1	8.5	5.0	29.0	33.2
	SD	2.9	10.8	11.6	1.4	8.6	8.9	5.8	24.1	25.5	3.9	16.5	18.0	8.7	27.9	28.8



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

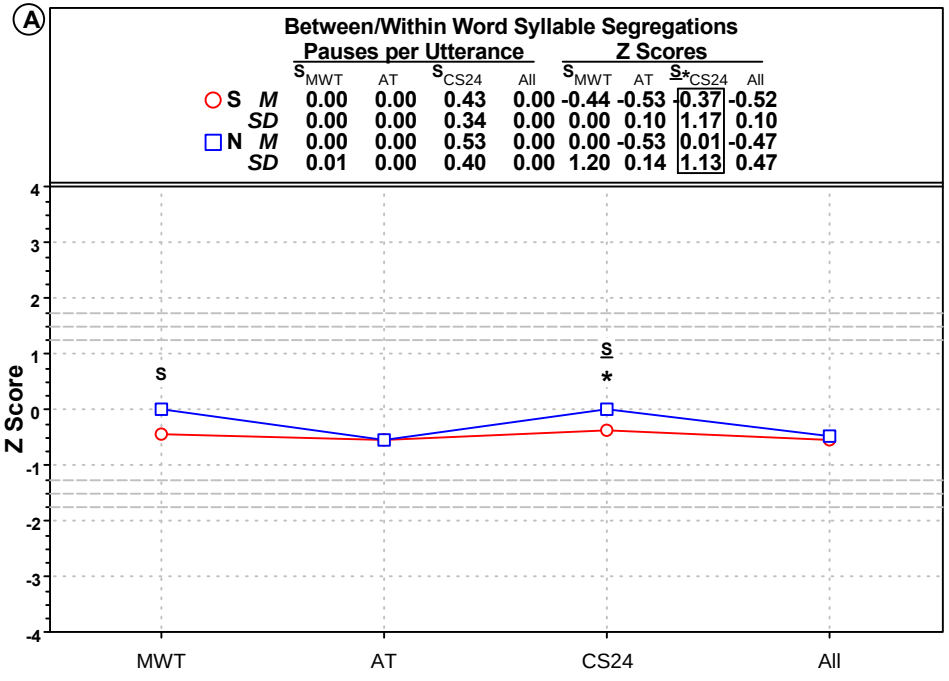
PVSP Profile 1, S and N

PHRASING PROFILES

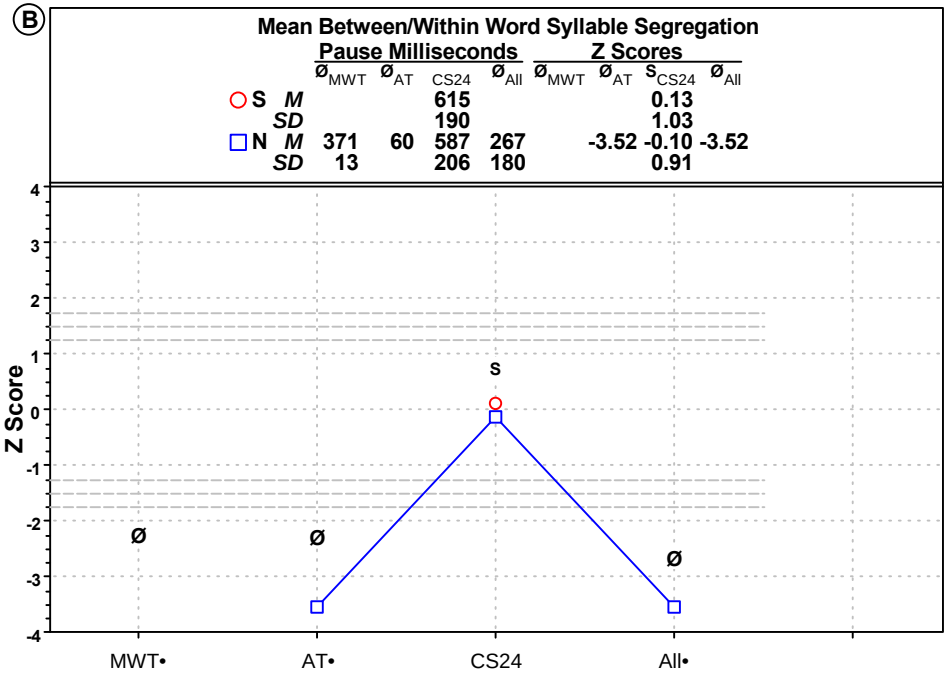


*$p < .05$, †$p < .01$, ‡$p < .001$, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Phrasing Profile 1, S and N

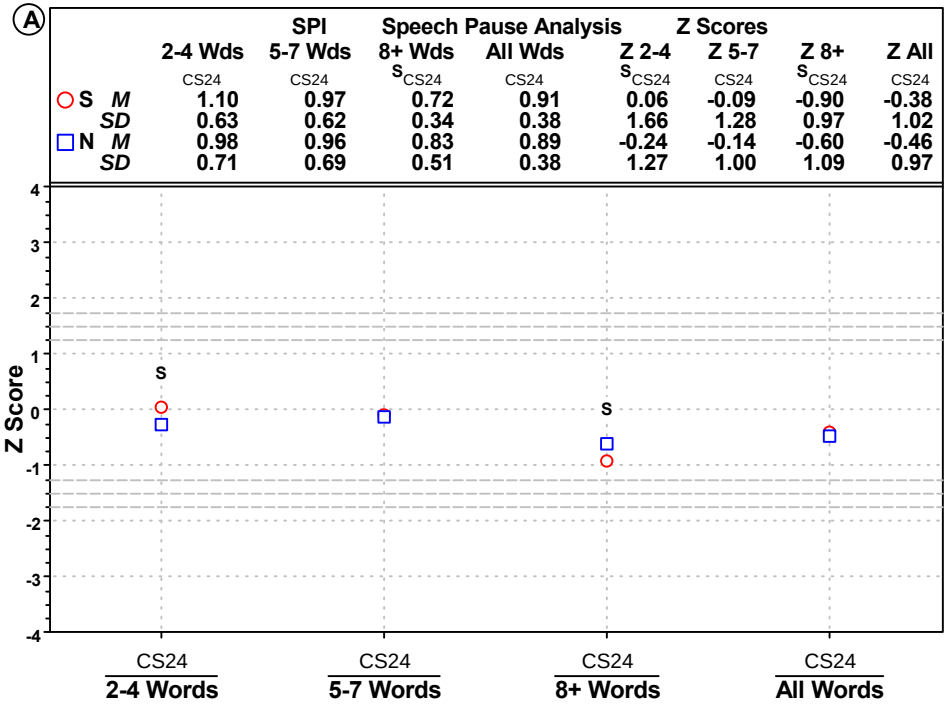


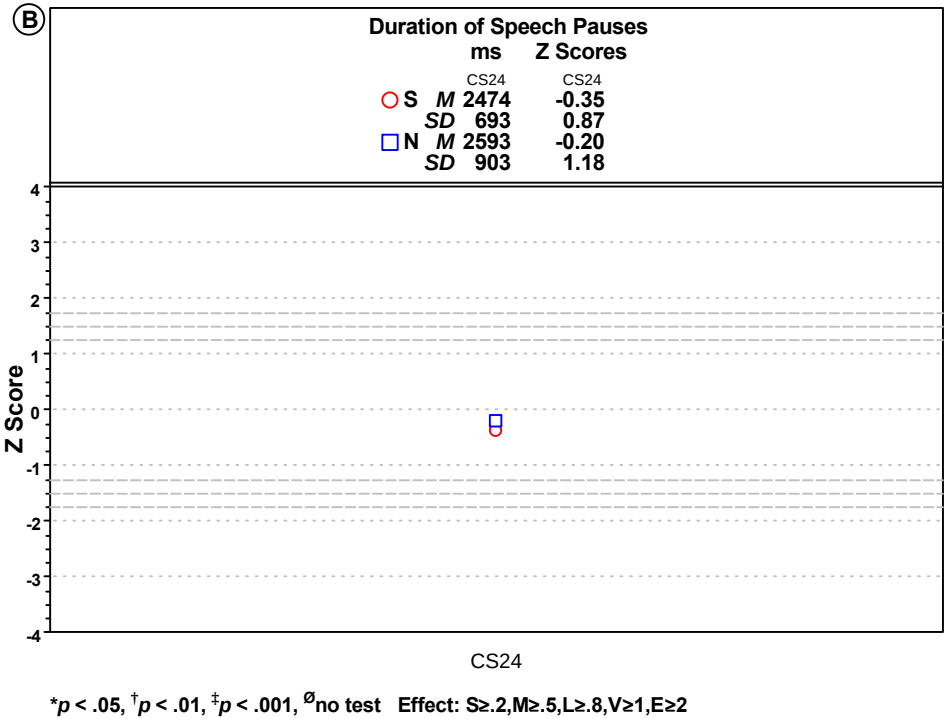
*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

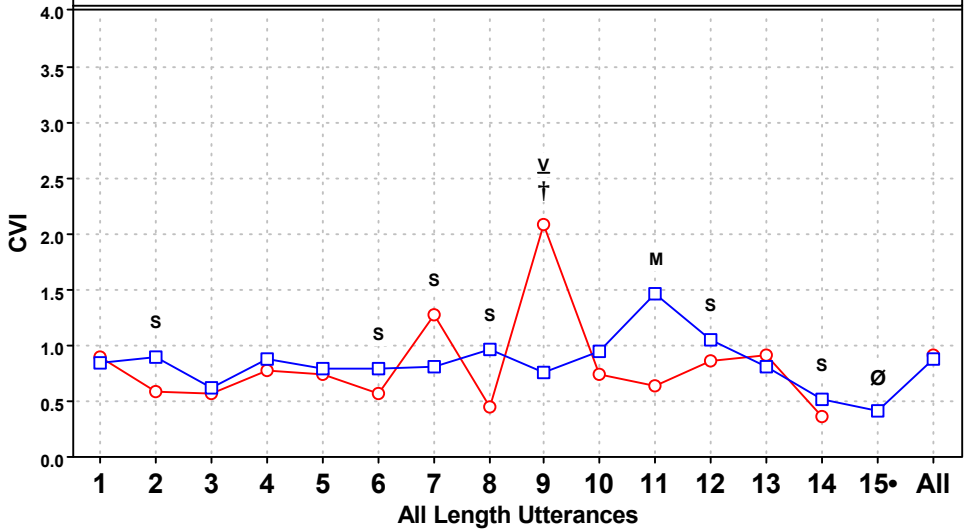
Phrasing Profile 2, S and N


A
SPI Speech Pause Analysis Z Scores
2-4 Wds 5-7 Wds 8+ Wds All Wds Z 2-4 Z 5-7 Z 8+ Z All
CS24 CS24 S CS24 CS24 S CS24 CS24 S CS24 CS24
S M 1.10 0.97 0.72 0.91 0.06 -0.09 -0.90 -0.38
SD 0.63 0.62 0.34 0.38 1.66 1.28 0.97 1.02
N M 0.98 0.96 0.83 0.89 -0.24 -0.14 -0.60 -0.46
SD 0.71 0.69 0.51 0.38 1.27 1.00 1.09 0.97
Z Score
4
3
2
1
0
-1
-2
-3
-4
S
S
CS24 CS24 CS24 CS24
2-4 Words 5-7 Words 8+ Words All Words
*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


B
Duration of Speech Pauses
ms Z Scores
CS24 CS24
S M 2474 -0.35
SD 693 0.87
N M 2593 -0.20
SD 903 1.18
Z Score
4
3
2
1
0
-1
-2
-3
-4
CS24
*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A — Phrasing Analysis: All Utts. Source: CS24

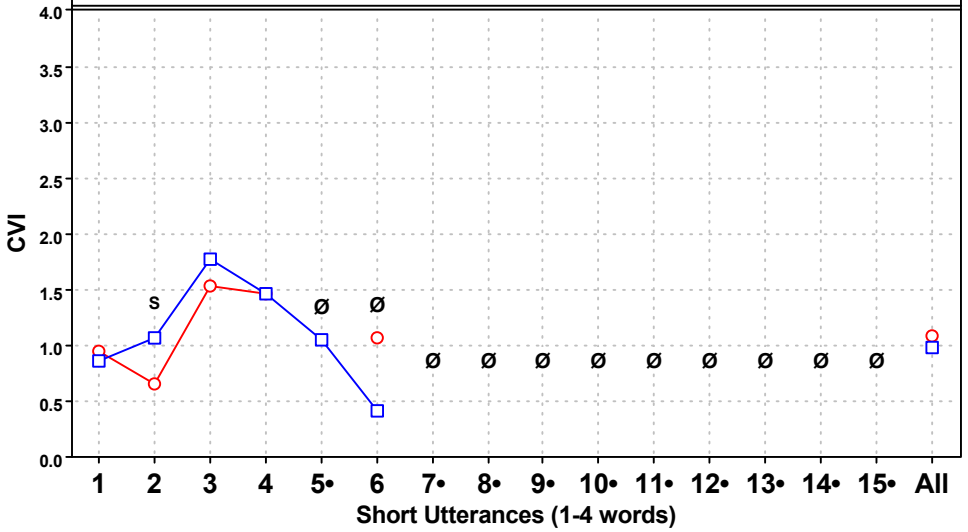
		No. Utts	Events Pause	Events Speech	Percent Pause	Percent Speech	Duration Pause	Duration Speech	CV Pause	CV Speech	CVI
S	*M*	6.62	1.39	2.39	24.77	75.23	830	2474	0.571	0.653	0.912
	SD	3.89	0.36	0.36	5.69	5.69	261	693	0.220	0.165	0.381
N	*M*	7.35	1.53	2.53	24.97	75.03	904	2593	0.580	0.676	0.885
	SD	3.75	0.47	0.47	7.22	7.22	421	903	0.219	0.163	0.379



*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

B — Phrasing Analysis: Short Utts. Source: CS24

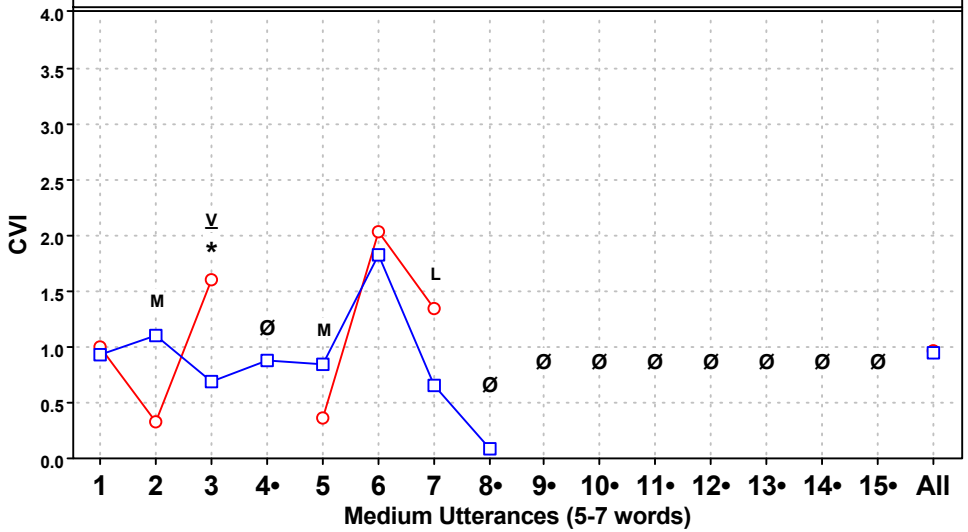
		No. Utts	Events Pause	Events Speech	Percent Pause	Percent Speech	Duration Pause	Duration Speech	CV Pause	CV Speech	CVI
S	*M*	2.08	1.12	2.12	30.28	69.72	720	1491	0.535	0.536	1.098
	SD	1.84	0.27	0.27	9.68	9.68	464	351	0.291	0.192	0.632
N	*M*	1.82	1.10	2.10	30.18	69.82	664	1400	0.509	0.555	0.979
	SD	1.70	0.25	0.25	11.43	11.43	448	494	0.270	0.246	0.710



*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

C — Phrasing Analysis: Medium Utts. Source: CS24

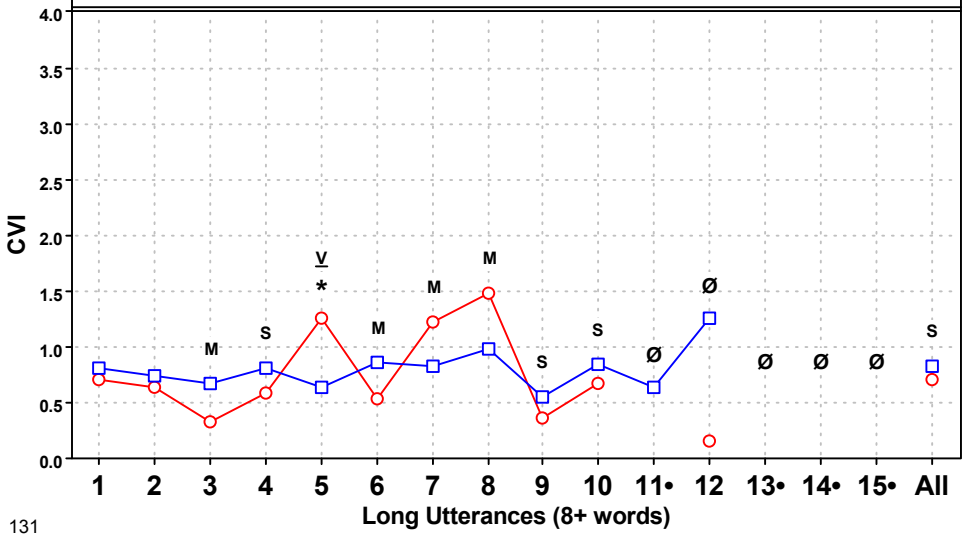
		No. Utts	Events Pause	Events Speech	Percent Pause	Percent Speech	Duration Pause	Duration Speech	CV Pause	CV Speech	CVI
S	*M*	2.32	1.34	2.34	23.75	76.25	841	2432	0.476	0.553	0.968
	SD	1.98	0.48	0.48	7.89	7.89	439	436	0.245	0.221	0.621
N	*M*	2.60	1.36	2.36	24.89	75.11	836	2176	0.507	0.581	0.955
	SD	1.94	0.53	0.53	9.89	9.89	601	562	0.265	0.217	0.687



*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

D — Phrasing Analysis: Long Utts. Source: CS24

		No. Utts	Events Pause	Events Speech	Percent Pause	Percent Speech	Duration Pause	Duration Speech	CV Pause	CV Speech	CVI
S	*M*	2.22	1.83	2.83	22.07	77.93	1071	3639	0.482	0.682	0.717
	SD	2.80	0.53	0.53	7.78	7.78	480	742	0.207	0.228	0.341
N	*M*	2.93	2.07	3.07	22.14	77.86	1201	3727	0.514	0.665	0.833
	SD	2.72	0.98	0.98	9.16	9.16	854	1036	0.215	0.243	0.512

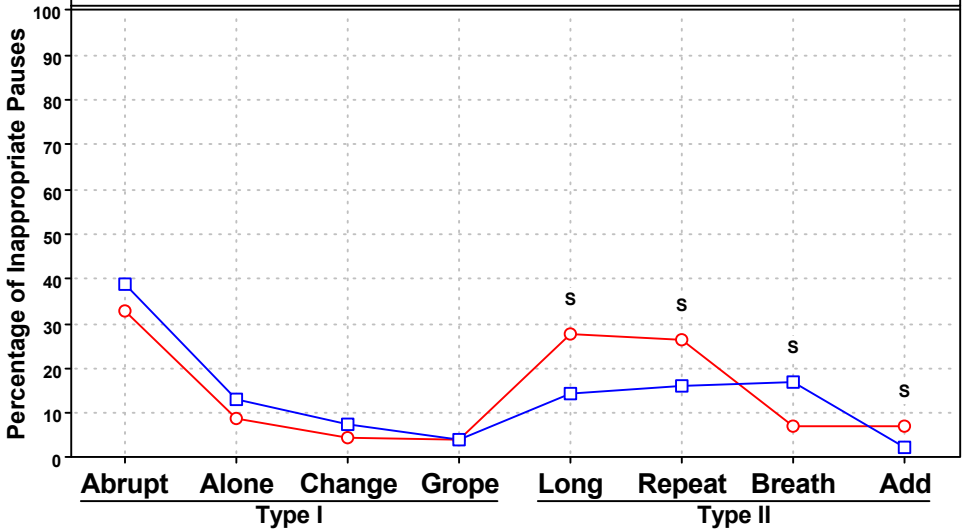


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

A

Inapp. Pause: All Utts. Source: CS

		Type I				Type II			
		Abrupt	Alone	Change	Grope	Long	Repeat	Breath	Add
S	*M*	33.00	9.00	4.67	4.00	27.67	26.33	7.00	7.00
	SD	44.91	27.84	16.33	20.00	40.16	41.16	22.27	22.27
N	*M*	38.97	12.91	7.38	4.12	14.30	16.22	17.12	2.46
	SD	41.04	27.39	21.50	15.17	30.28	30.30	32.56	13.23

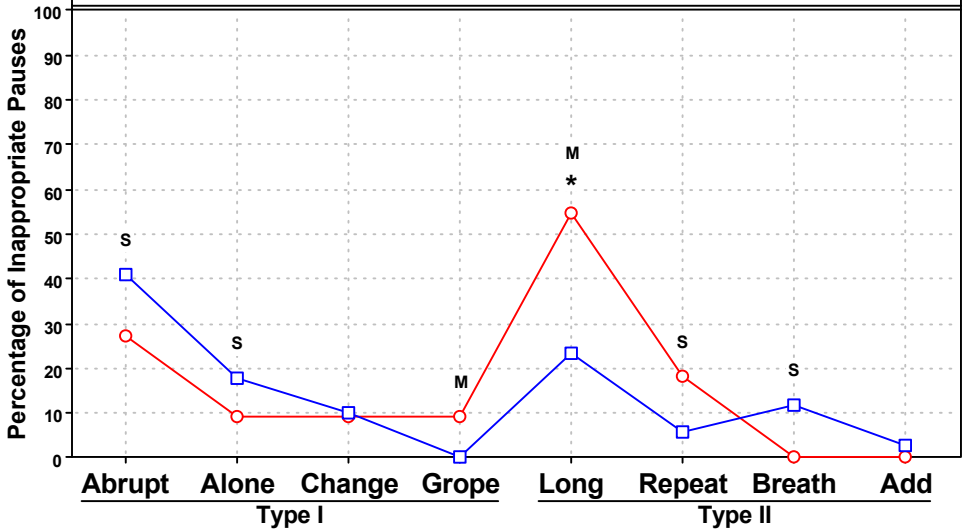


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

Inapp. Pause: Short 1-4 Words Utts. Source: CS

		Type I				Type II			
		Abrupt	Alone	Change	Grope	Long	Repeat	Breath	Add
S	*M*	27.27	9.09	9.09	9.09	54.55	18.18	0.00	0.00
	SD	46.71	30.15	30.15	30.15	52.22	40.45	0.00	0.00
N	*M*	41.18	17.65	10.29	0.00	23.53	5.88	11.76	2.94
	SD	46.82	36.69	29.59	0.00	41.26	23.88	32.70	17.15

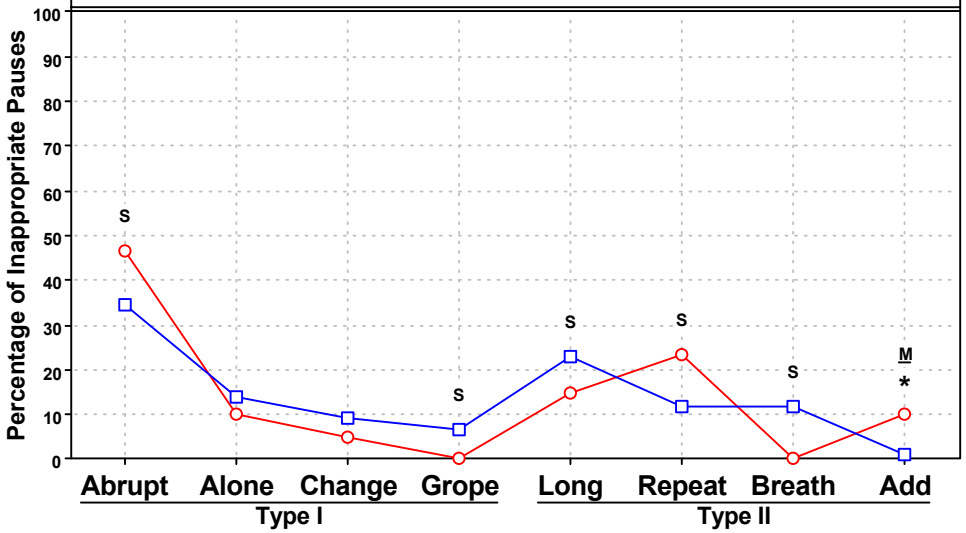


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

Inapp. Pause: Medium 5-7 Words Utts. Source: CS

		Type I				Type II			
		Abrupt	Alone	Change	Grope	Long	Repeat	Breath	Add
S	*M*	46.67	10.00	5.00	0.00	15.00	23.33	0.00	10.00
	SD	50.18	31.62	15.81	0.00	33.75	41.72	0.00	31.62
N	*M*	34.47	13.76	9.22	6.57	22.85	11.87	11.87	1.01
	SD	44.48	32.04	27.35	22.62	39.72	29.78	31.46	5.76

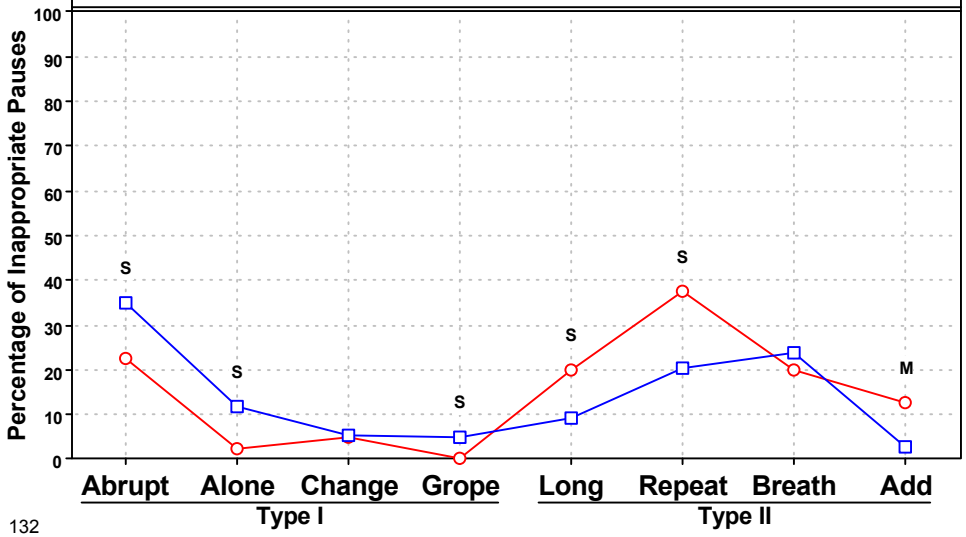


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D

Inapp. Pause: Long 8+ Words Utts. Source: CS

		Type I				Type II			
		Abrupt	Alone	Change	Grope	Long	Repeat	Breath	Add
S	*M*	22.50	2.50	5.00	0.00	20.00	37.50	20.00	12.50
	SD	41.58	7.91	15.81	0.00	42.16	46.02	34.96	31.73
N	*M*	34.90	11.71	5.56	4.83	9.31	20.55	23.91	2.86
	SD	41.05	25.87	20.99	18.87	25.76	33.67	39.64	15.25

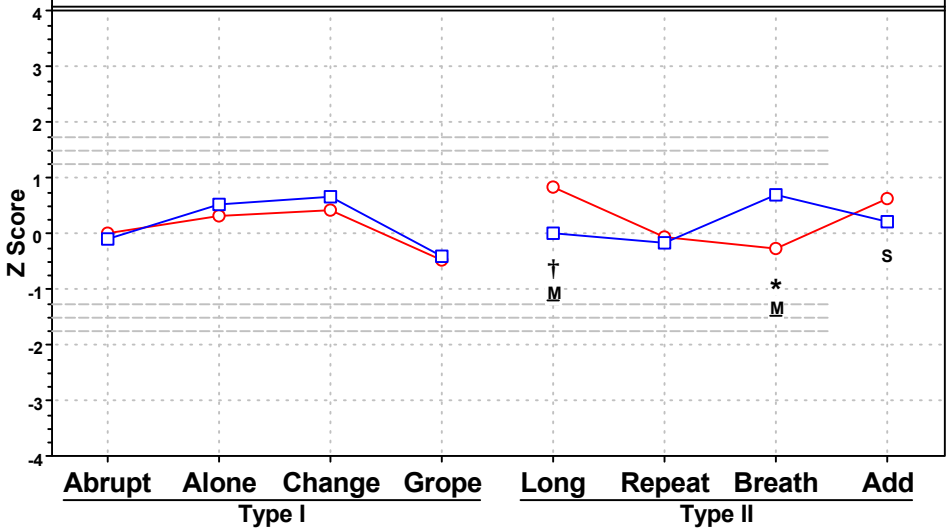


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

A

Inapp. Pause: All Utts. Source: CS

		Type I				Type II			
		Abrupt	Alone	Change	Grope	M†Long	Repeat	M*Breath	SAdd
S	*M*	0.02	0.33	0.43	-0.48	0.85	-0.05	-0.25	0.65
	SD	0.91	1.50	1.44	0.36	2.08	0.94	0.43	1.72
N	*M*	-0.09	0.53	0.67	-0.41	0.02	-0.17	0.69	0.22
	SD	1.25	1.67	1.71	0.63	1.22	1.09	1.96	1.03

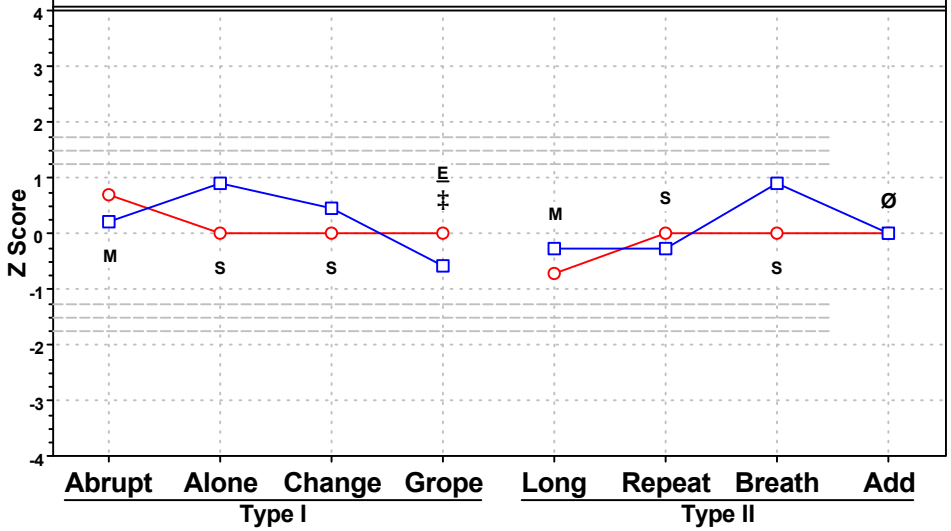


*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

Inapp. Pause: Short 1-4 Words Utts. Source: CS

		Type I				Type II			
		MAbrupt	SAlone	SChange	E‡Grope	MLong	SRepeat	SBreath	ØAdd
S	*M*	0.71	0.00	0.00	0.00	-0.71	0.00	0.00	0.00
	SD								
N	*M*	0.21	0.91	0.45	-0.58	-0.26	-0.26	0.91	0.00
	SD	0.82	2.02	1.51	0.00	0.70	0.70	2.02	0.00

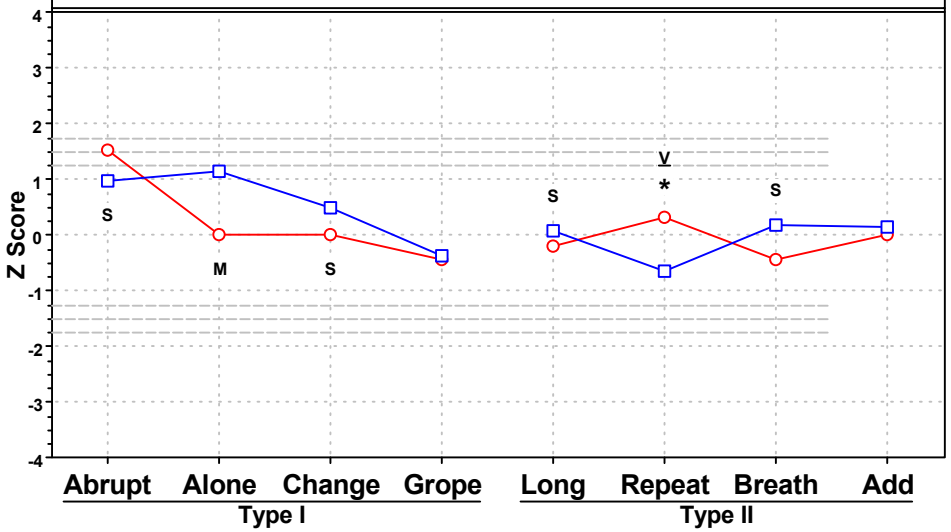


*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

Inapp. Pause: Medium 5-7 Words Utts. Source: CS

		Type I				Type II			
		SAbrupt	MAlone	SChange	Grope	SLong	V*Repeat	SBreath	Add
S	*M*	1.54	0.00	0.00	-0.43	-0.18	0.32	-0.43	0.00
	SD	2.42	0.00	0.00	0.29	0.35	0.76	0.29	0.00
N	*M*	0.98	1.17	0.50	-0.37	0.09	-0.63	0.20	0.17
	SD	2.10	2.15	1.53	0.49	1.09	0.66	1.35	0.91

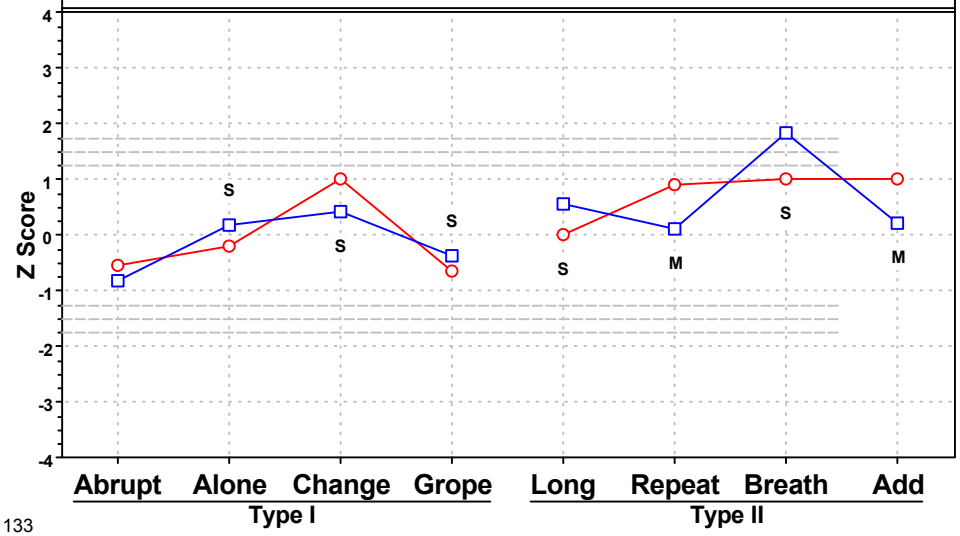


*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D

Inapp. Pause: Long 8+ Words Utts. Source: CS

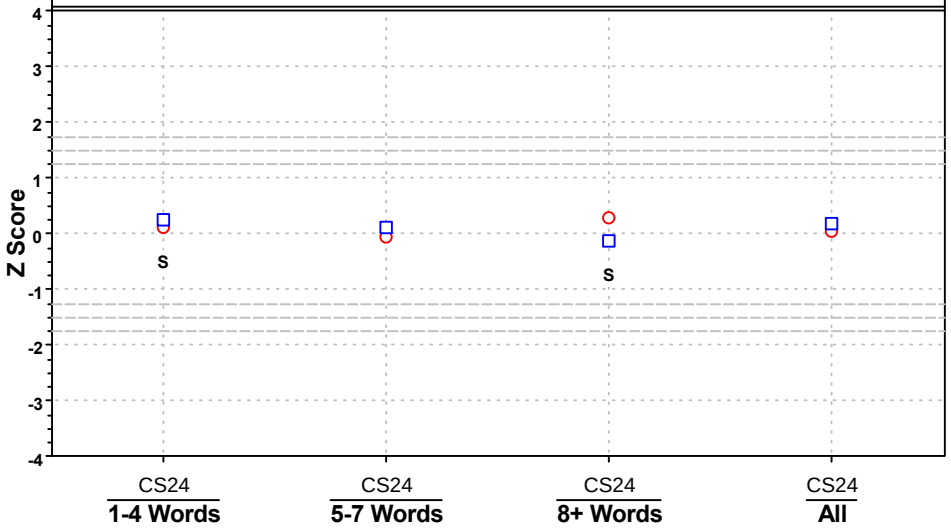
		Type I				Type II			
		Abrupt	SAlone	SChange	SGrope	SLong	MRepeat	SBreath	MAdd
S	*M*	-0.54	-0.17	1.00	-0.63	0.00	0.93	1.00	1.00
	SD	1.03	0.39	2.24	0.07	0.71	1.83	2.24	2.24
N	*M*	-0.82	0.20	0.43	-0.38	0.58	0.12	1.86	0.21
	SD	1.48	1.57	1.41	0.84	1.73	1.31	2.43	1.02



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

A Mean Syll Duration w/ Pauses Stability

		1-4 Wrd CS24	5-7 Wrd s_{CS24}	8+ Wrd CS24	All CS24	Z 1-4 s_{CS24}	Z 5-7 CS24	Z 8+ s_{CS24}	Z All CS24
○ S	*M*	65.37	68.26	75.25	64.80	0.12	-0.04	0.28	0.07
	SD	16.09	14.40	8.75	12.50	0.77	1.01	1.03	1.17
□ N	*M*	67.97	72.12	75.69	65.93	0.27	0.13	-0.12	0.20
	SD	16.19	16.85	14.57	13.31	0.69	1.16	1.63	1.17



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

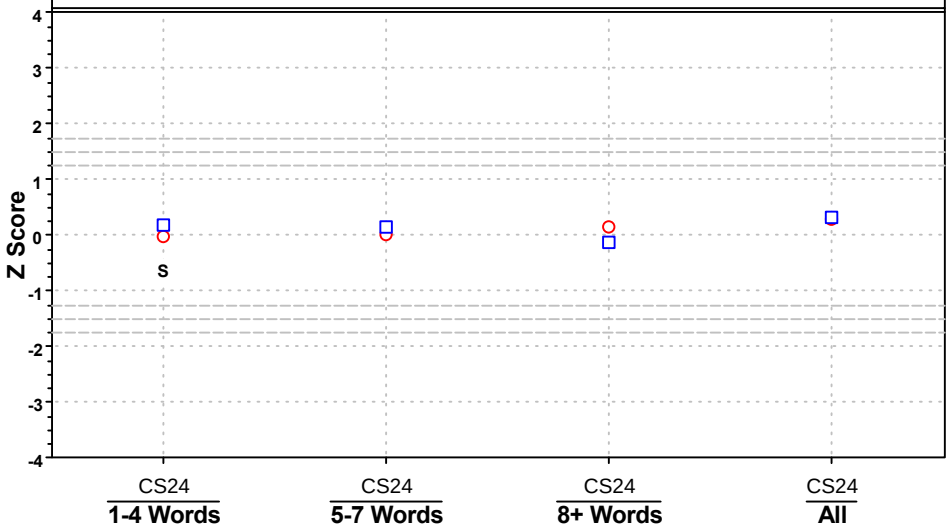
B Mean Syll Duration w/o Pauses Stability

		1-4 Wrd CS24	5-7 Wrd CS24	8+ Wrd CS24	All CS24	Z 1-4 s_{CS24}	Z 5-7 CS24	Z 8+ CS24	Z All s*$_{CS24}$
○ S	*M*	71.75	78.46	82.74	71.94	-0.29	0.21	0.23	-0.58
	SD	13.28	12.13	8.21	10.10	1.13	1.21	0.98	1.52
□ N	*M*	73.02	79.17	83.93	73.82	-0.04	0.22	0.29	-0.15
	SD	12.21	12.39	8.96	9.92	1.07	1.14	1.09	1.32

*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C Speaking Rate Syllables/Sec Stability

		1-4 Wrd CS24	5-7 Wrd s_{CS24}	8+ Wrd CS24	All CS24	Z 1-4 s_{CS24}	Z 5-7 CS24	Z 8+ CS24	Z All CS24
○ S	*M*	68.51	71.06	75.21	69.73	-0.00	0.02	0.15	0.29
	SD	11.04	12.59	8.22	7.07	0.77	0.95	1.10	0.76
□ N	*M*	70.58	73.96	76.62	70.27	0.19	0.15	-0.11	0.32
	SD	12.49	13.63	13.40	8.02	0.71	1.08	1.63	0.95



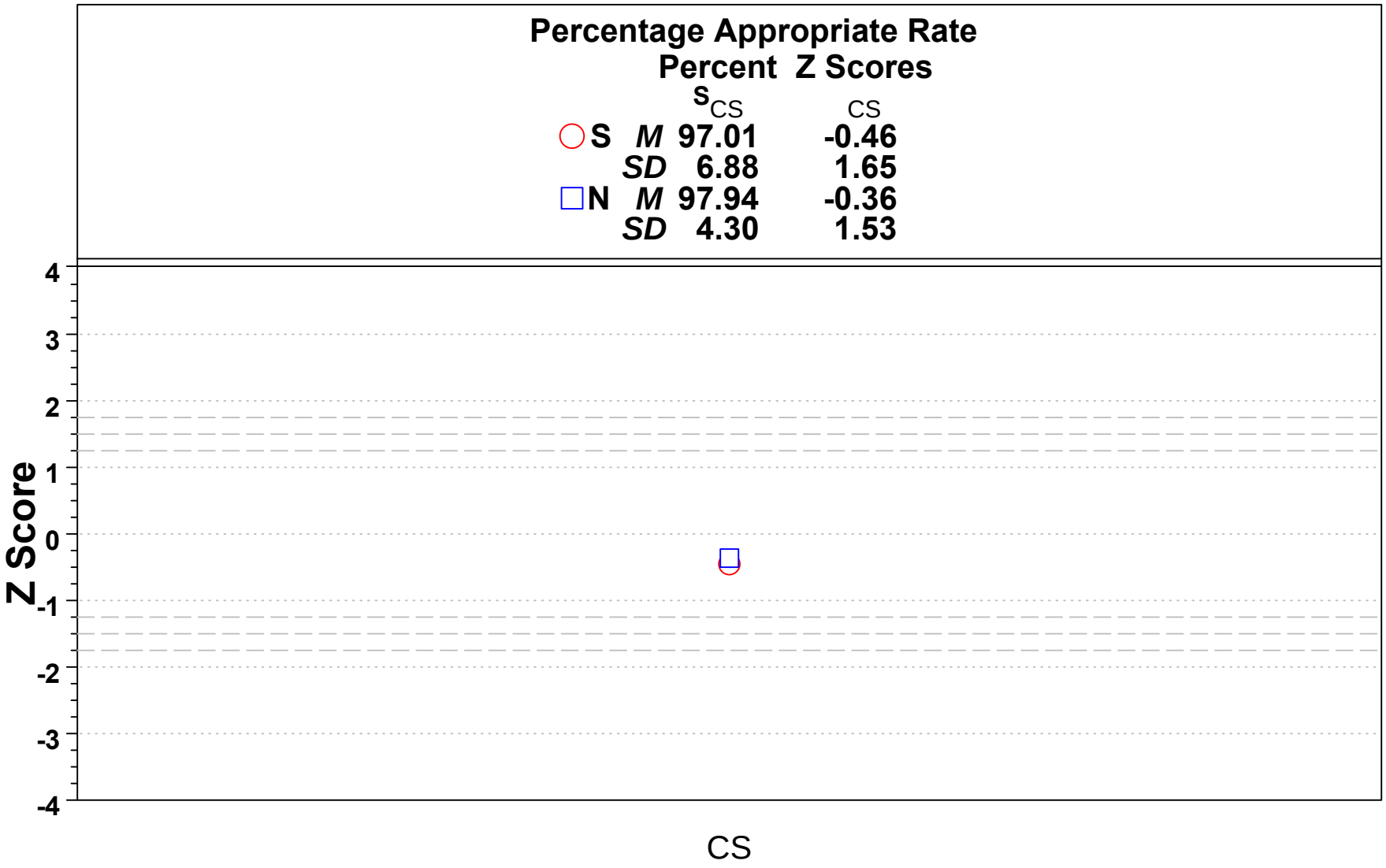
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D Speaking Rate Phonemes/Sec Stability

		1-4 Wrd s*$_{CS24}$	5-7 Wrd s_{CS24}	8+ Wrd s_{CS24}	All s_{CS24}	Z 1-4 s*$_{CS24}$	Z 5-7 s_{CS24}	Z 8+ CS24	Z All s_{CS24}
○ S	*M*	67.38	70.10	73.76	68.70	-0.02	-0.20	0.04	0.02
	SD	11.47	9.89	11.90	6.70	0.77	0.69	1.17	0.93
□ N	*M*	71.15	73.95	76.78	70.68	0.26	0.02	-0.08	0.23
	SD	12.21	13.53	13.73	8.26	0.78	1.04	1.54	1.10

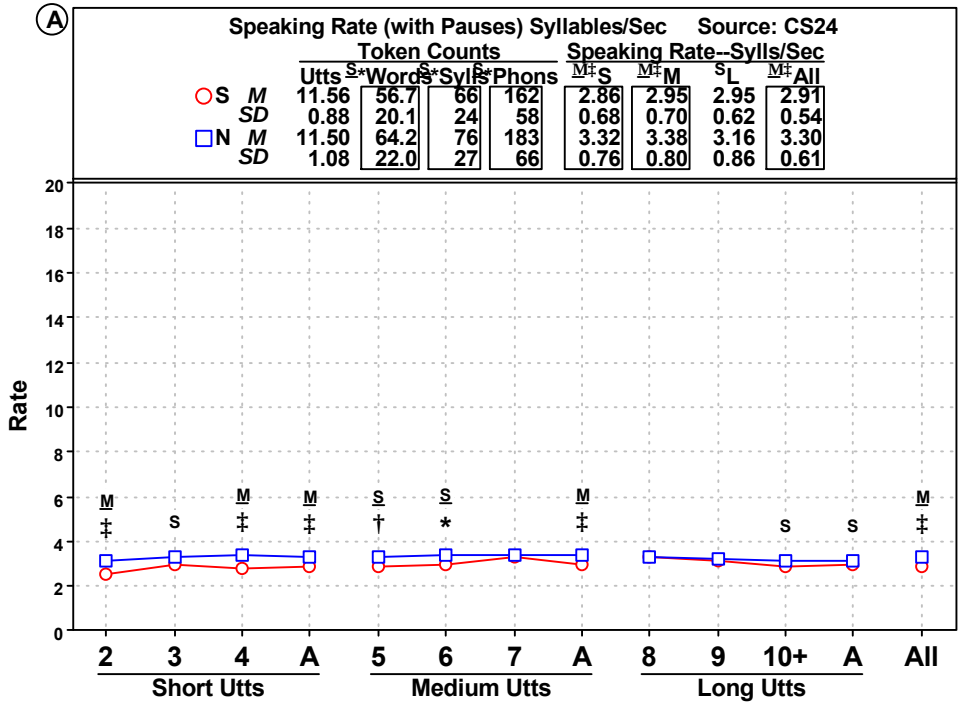
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

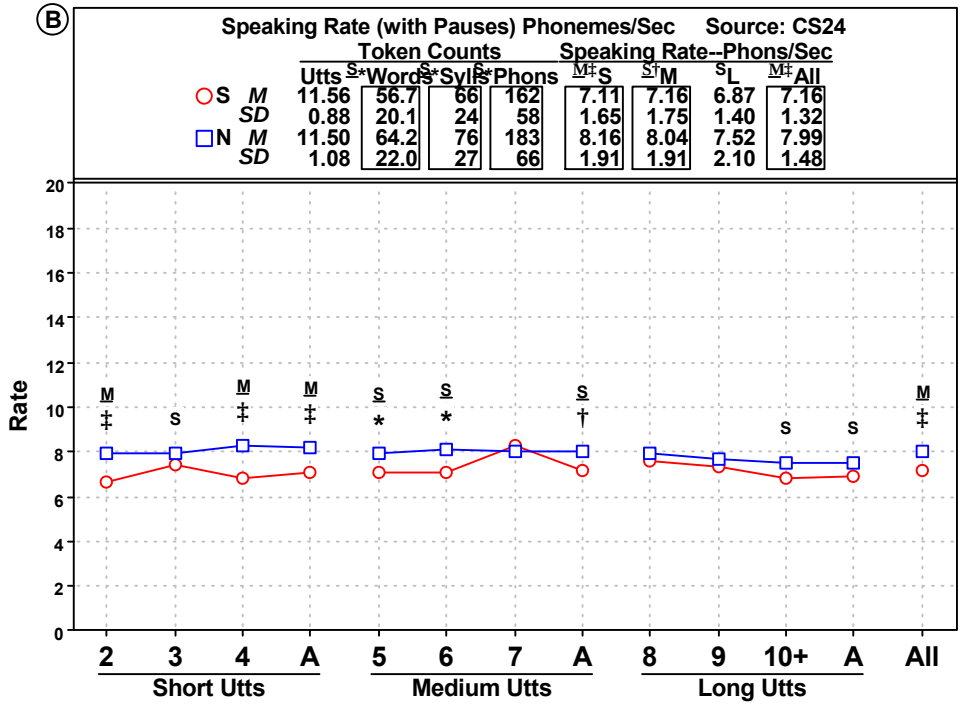
RATE PROFILES

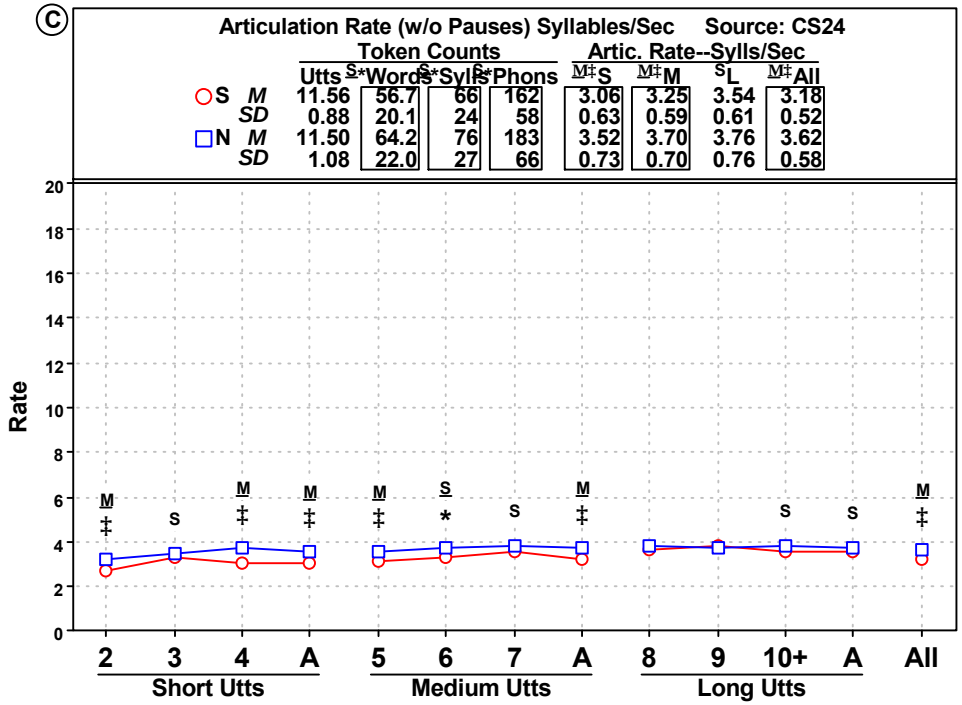


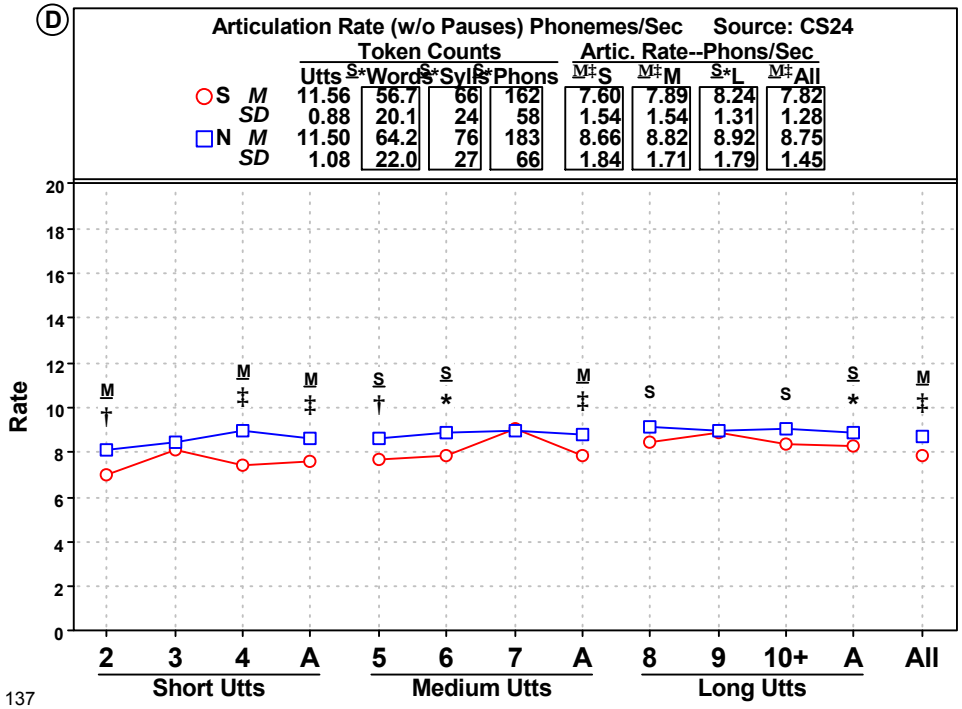
*$p < .05$, †$p < .01$, ‡$p < .001$, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

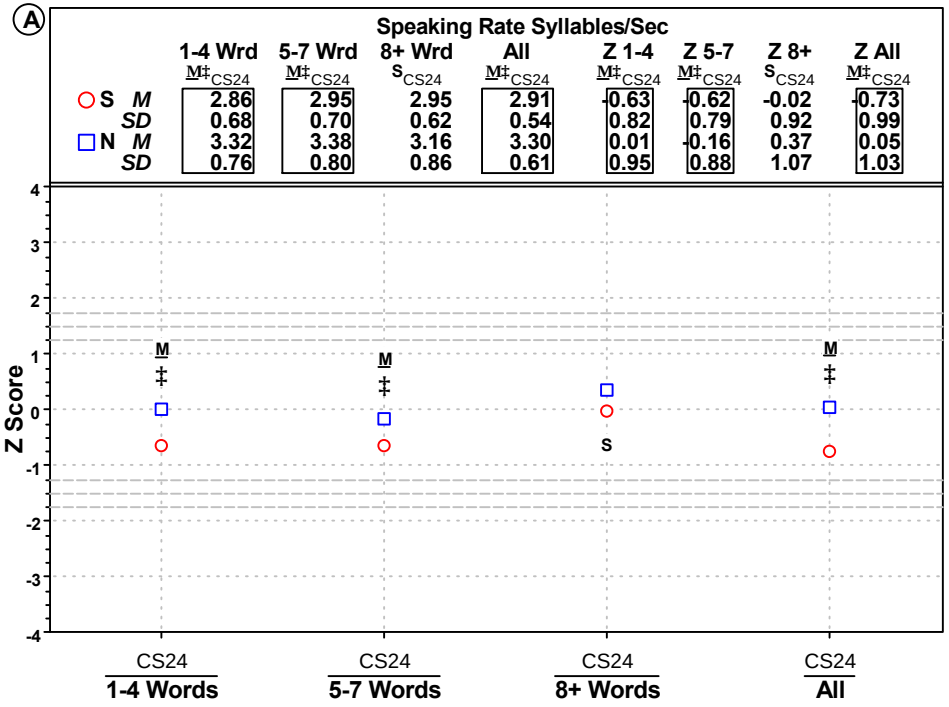
Rate Profile 1, S and N


A
Speaking Rate (with Pauses) Syllables/Sec Source: CS24
Token Counts
Speaking Rate--Syll/Sec
Utts S* Words S* Sylls S* Phons M‡ S M‡ M S L M‡ All
S M 11.56 56.7 66 162 2.86 2.95 2.95 2.91
SD 0.88 20.1 24 58 0.68 0.70 0.62 0.54
N M 11.50 64.2 76 183 3.32 3.38 3.16 3.30
SD 1.08 22.0 27 66 0.76 0.80 0.86 0.61
Rate
2 3 4 A 5 6 7 A 8 9 10+ A All
Short Utts
Medium Utts
Long Utts
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

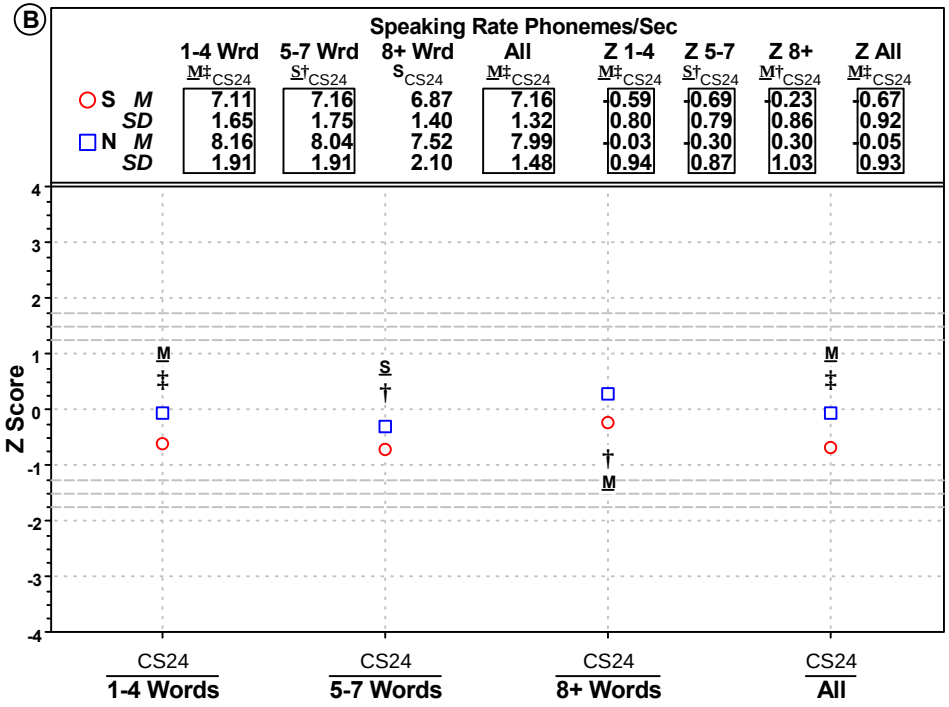

B
Speaking Rate (with Pauses) Phonemes/Sec Source: CS24
Token Counts
Speaking Rate--Phons/Sec
Utts S* Words S* Sylls S* Phons M‡ S S† M S L M‡ All
S M 11.56 56.7 66 162 7.11 7.16 6.87 7.16
SD 0.88 20.1 24 58 1.65 1.75 1.40 1.32
N M 11.50 64.2 76 183 8.16 8.04 7.52 7.99
SD 1.08 22.0 27 66 1.91 1.91 2.10 1.48
Rate
2 3 4 A 5 6 7 A 8 9 10+ A All
Short Utts
Medium Utts
Long Utts
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


C
Articulation Rate (w/o Pauses) Syllables/Sec Source: CS24
Token Counts
Artic. Rate--Syll/Sec
Utts S* Words S* Sylls S* Phons M‡ S M‡ M S L M‡ All
S M 11.56 56.7 66 162 3.06 3.25 3.54 3.18
SD 0.88 20.1 24 58 0.63 0.59 0.61 0.52
N M 11.50 64.2 76 183 3.52 3.70 3.76 3.62
SD 1.08 22.0 27 66 0.73 0.70 0.76 0.58
Rate
2 3 4 A 5 6 7 A 8 9 10+ A All
Short Utts
Medium Utts
Long Utts
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

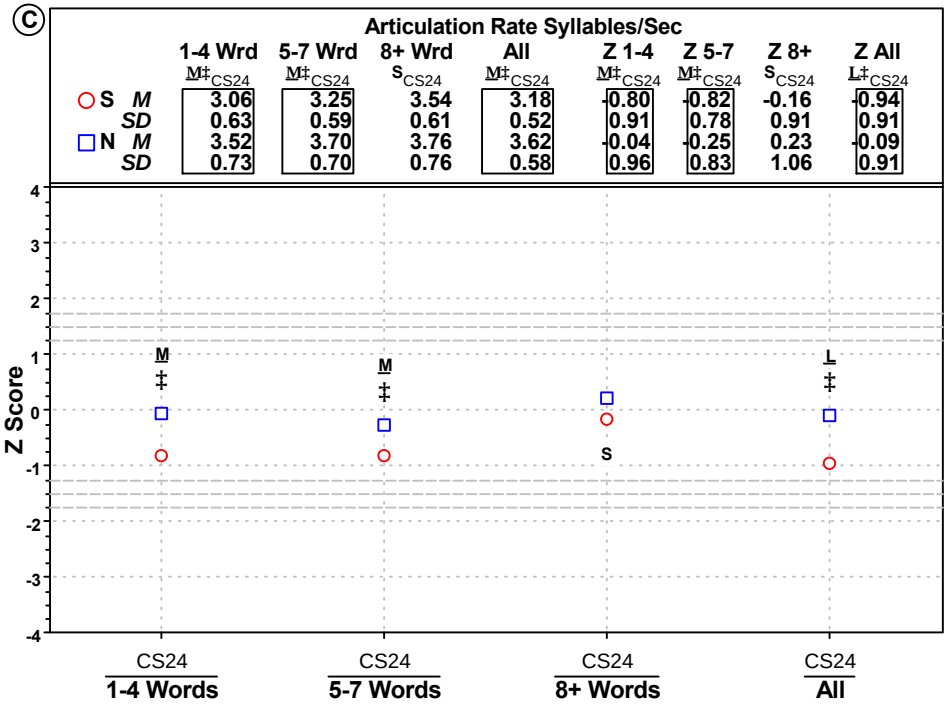

D
Articulation Rate (w/o Pauses) Phonemes/Sec Source: CS24
Token Counts
Artic. Rate--Phons/Sec
Utts S* Words S* Sylls S* Phons M‡ S M‡ M S L M‡ All
S M 11.56 56.7 66 162 7.60 7.89 8.24 7.82
SD 0.88 20.1 24 58 1.54 1.54 1.31 1.28
N M 11.50 64.2 76 183 8.66 8.82 8.92 8.75
SD 1.08 22.0 27 66 1.84 1.71 1.79 1.45
Rate
2 3 4 A 5 6 7 A 8 9 10+ A All
Short Utts
Medium Utts
Long Utts
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



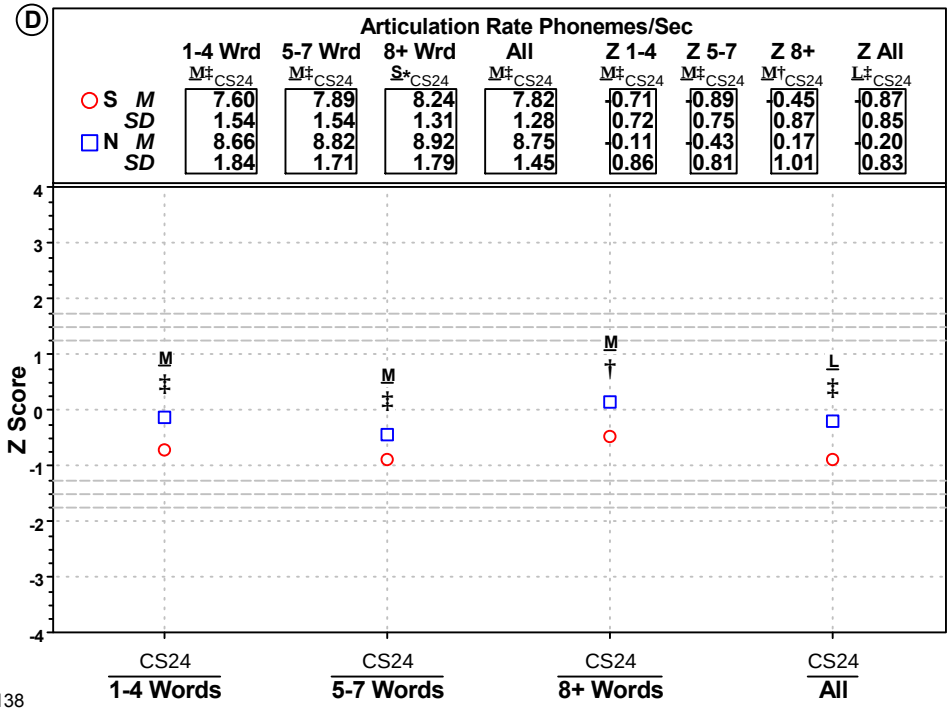
*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



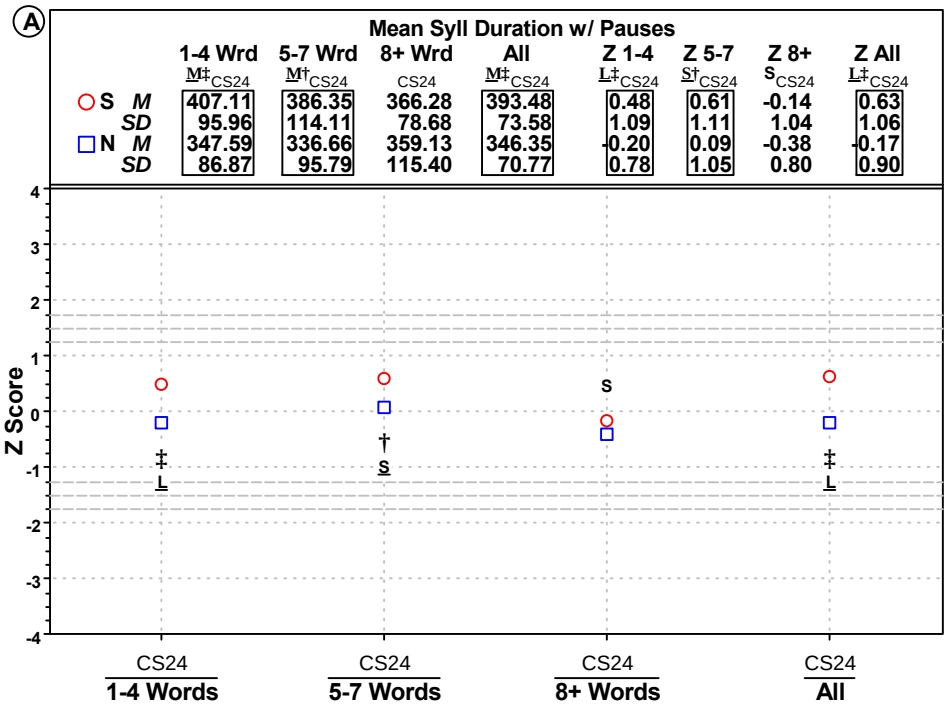
*p < .05, †p < .01, ‡p < .001, Ønone test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



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



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



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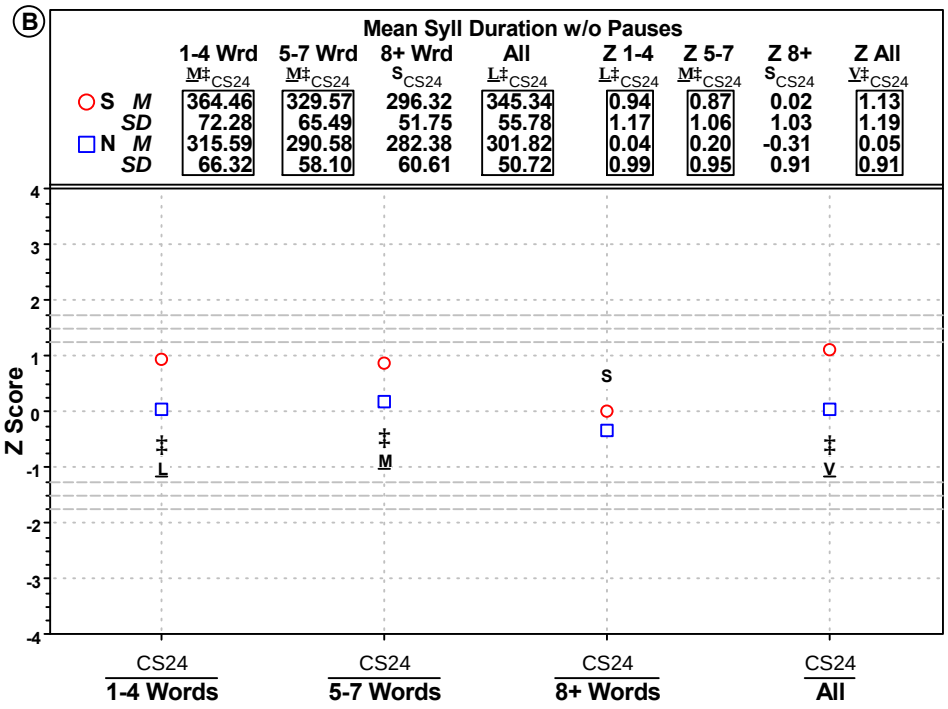


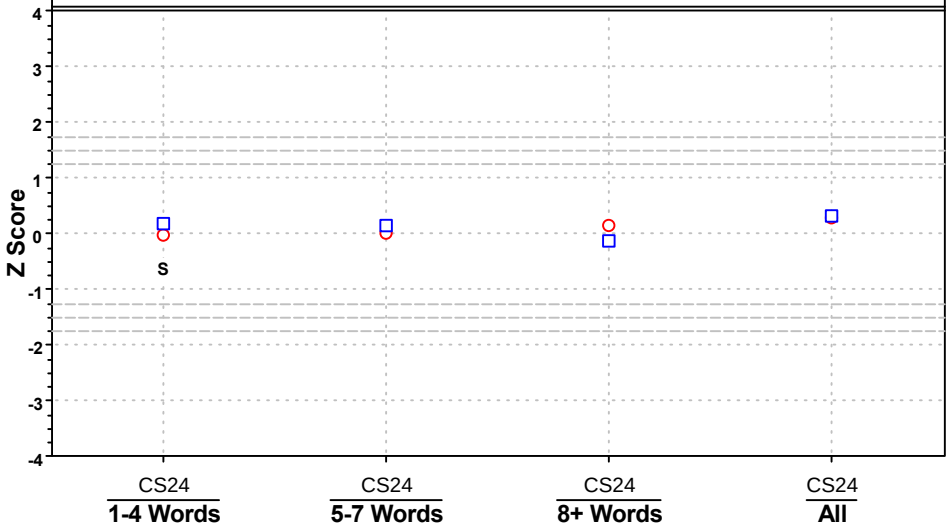
*p < .05, †p < .01, ‡p < .001, ⌀no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Rate Profile 4, S and N

A

Speaking Rate Syllables/Sec Stability

		1-4 Wrd	5-7 Wrd	8+ Wrd	All	Z 1-4	Z 5-7	Z 8+	Z All
		CS24	S_{CS24}	CS24	CS24	S_{CS24}	CS24	CS24	CS24
○ S	*M*	68.51	71.06	75.21	69.73	-0.00	0.02	0.15	0.29
	SD	11.04	12.59	8.22	7.07	0.77	0.95	1.10	0.76
□ N	*M*	70.58	73.96	76.62	70.27	0.19	0.15	-0.11	0.32
	SD	12.49	13.63	13.40	8.02	0.71	1.08	1.63	0.95

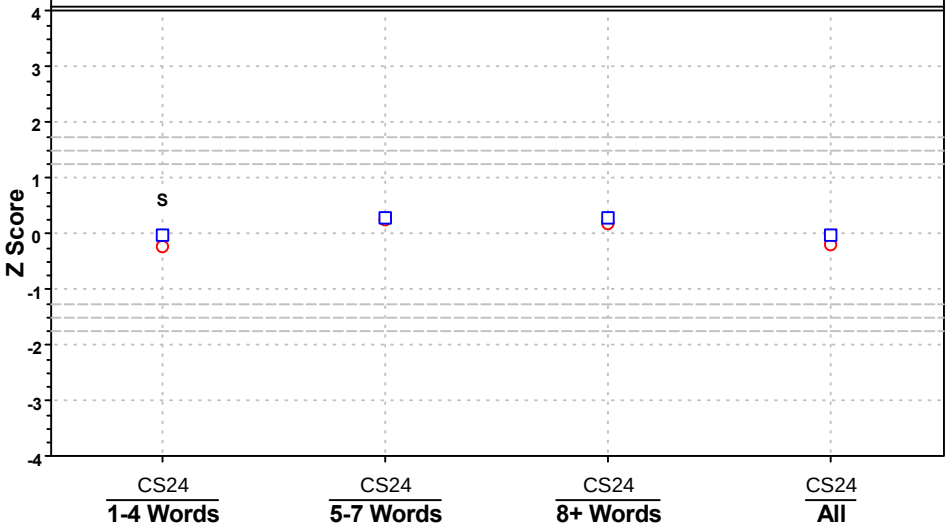


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

Articulation Rate Syllables/Sec Stability

		1-4 Wrd	5-7 Wrd	8+ Wrd	All	Z 1-4	Z 5-7	Z 8+	Z All
		CS24	CS24	CS24	CS24	S_{CS24}	CS24	CS24	CS24
○ S	*M*	73.60	78.80	82.67	74.80	-0.23	0.25	0.20	-0.17
	SD	10.83	11.86	8.00	6.83	1.00	1.09	1.03	1.06
□ N	*M*	73.84	79.80	84.12	75.65	-0.03	0.28	0.29	-0.02
	SD	10.76	10.82	8.32	7.24	0.97	1.04	1.06	1.10

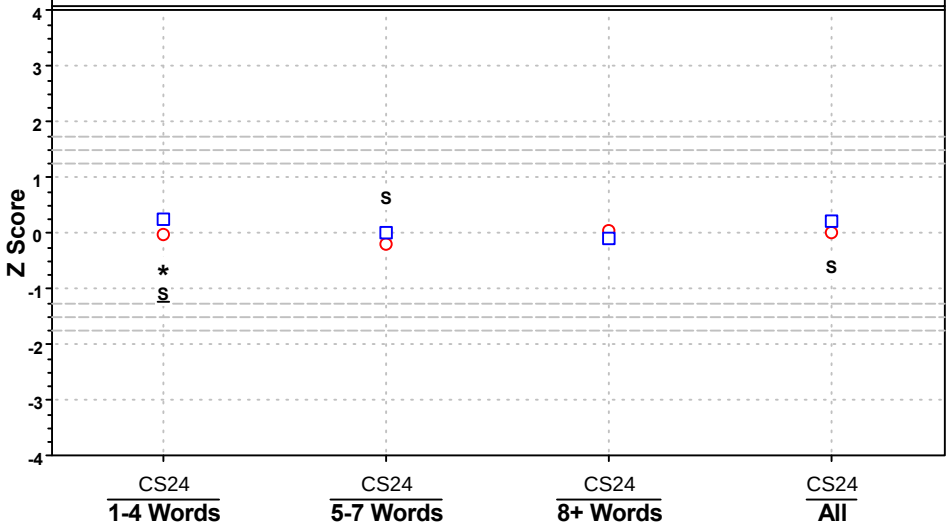


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

Speaking Rate Phonemes/Sec Stability

		1-4 Wrd	5-7 Wrd	8+ Wrd	All	Z 1-4	Z 5-7	Z 8+	Z All
		S*$_{CS24}$	S_{CS24}	S_{CS24}	S_{CS24}	S*$_{CS24}$	S_{CS24}	CS24	S_{CS24}
○ S	*M*	67.38	70.10	73.76	68.70	-0.02	-0.20	0.04	0.02
	SD	11.47	9.89	11.90	6.70	0.77	0.69	1.17	0.93
□ N	*M*	71.15	73.95	76.78	70.68	0.26	0.02	-0.08	0.23
	SD	12.21	13.53	13.73	8.26	0.78	1.04	1.54	1.10

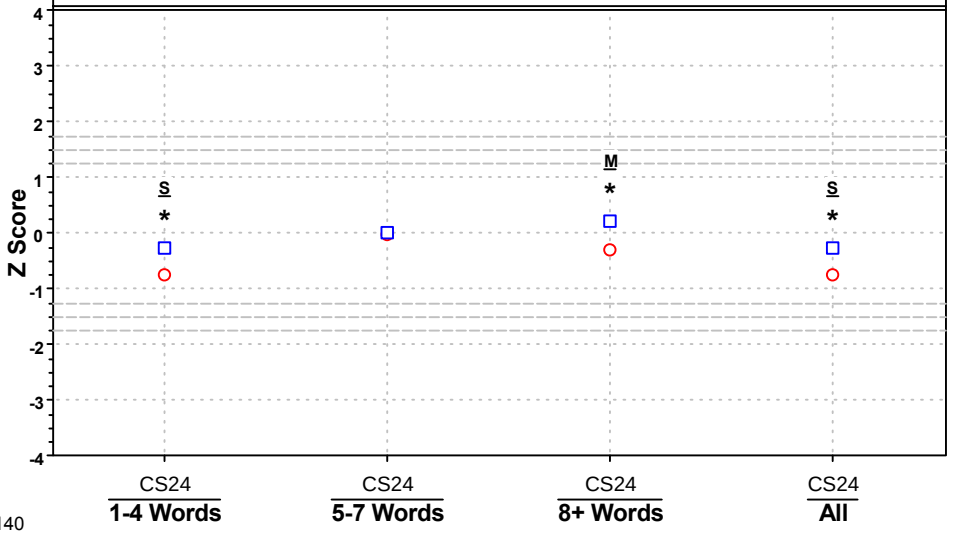


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

D

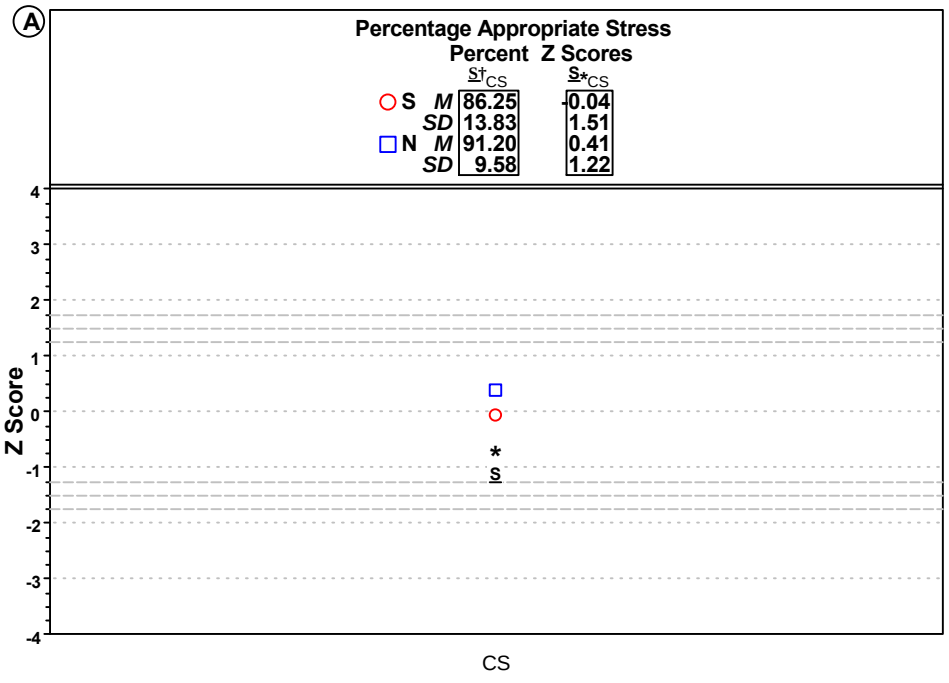
Articulation Rate Phonemes/Sec Stability

		1-4 Wrd	5-7 Wrd	8+ Wrd	All	Z 1-4	Z 5-7	Z 8+	Z All
		S_{CS24}	CS24	M†$_{CS24}$	S*$_{CS24}$	S*$_{CS24}$	CS24	M*$_{CS24}$	S*$_{CS24}$
○ S	*M*	71.78	78.79	79.29	74.11	-0.74	-0.02	-0.29	-0.75
	SD	10.40	9.99	8.95	6.79	1.79	1.08	1.17	1.40
□ N	*M*	74.80	79.92	84.50	76.40	-0.26	0.03	0.23	-0.25
	SD	10.66	10.50	8.33	6.55	1.51	1.21	0.92	1.28



*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

STRESS PROFILES



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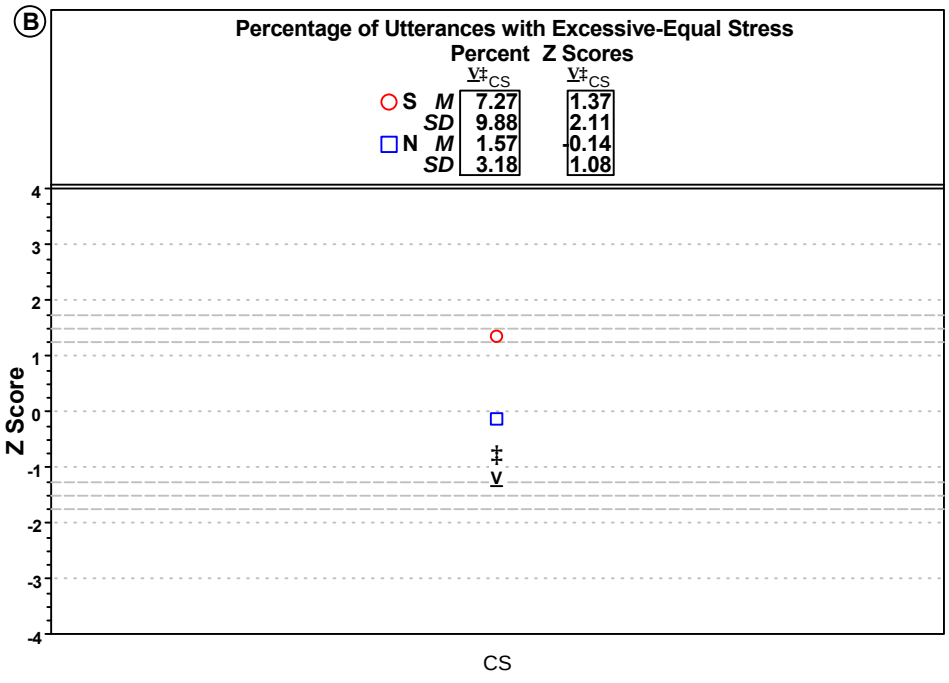

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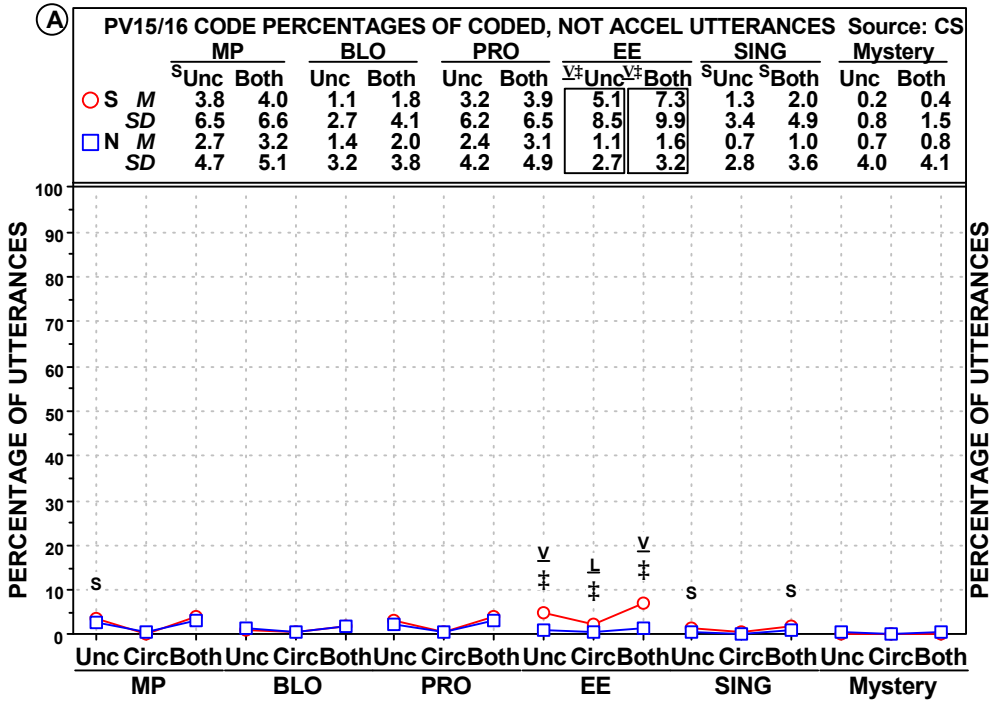

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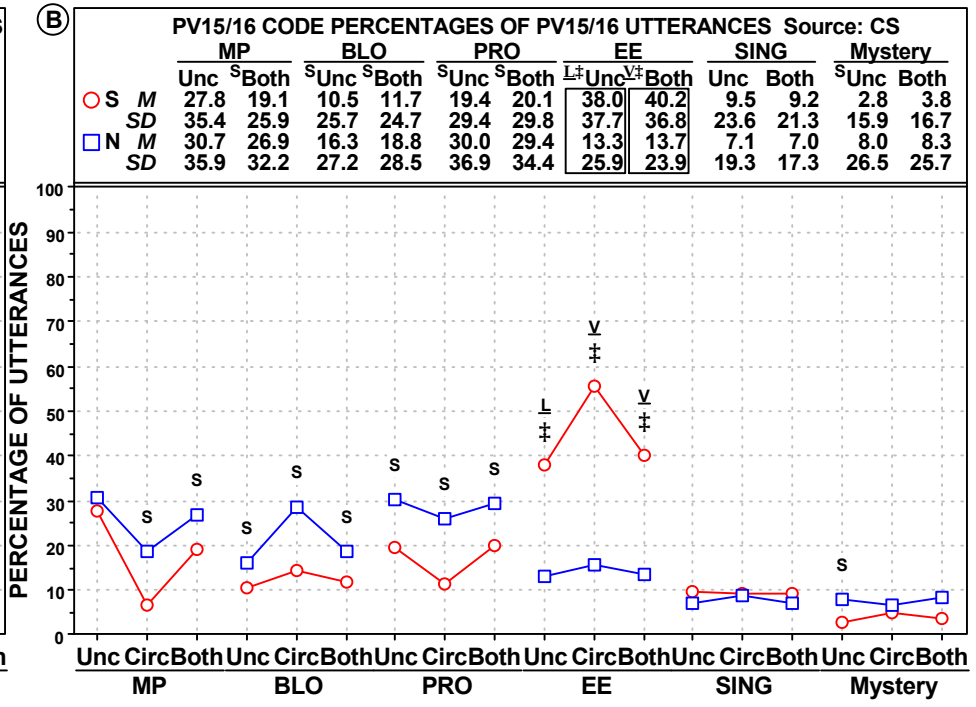

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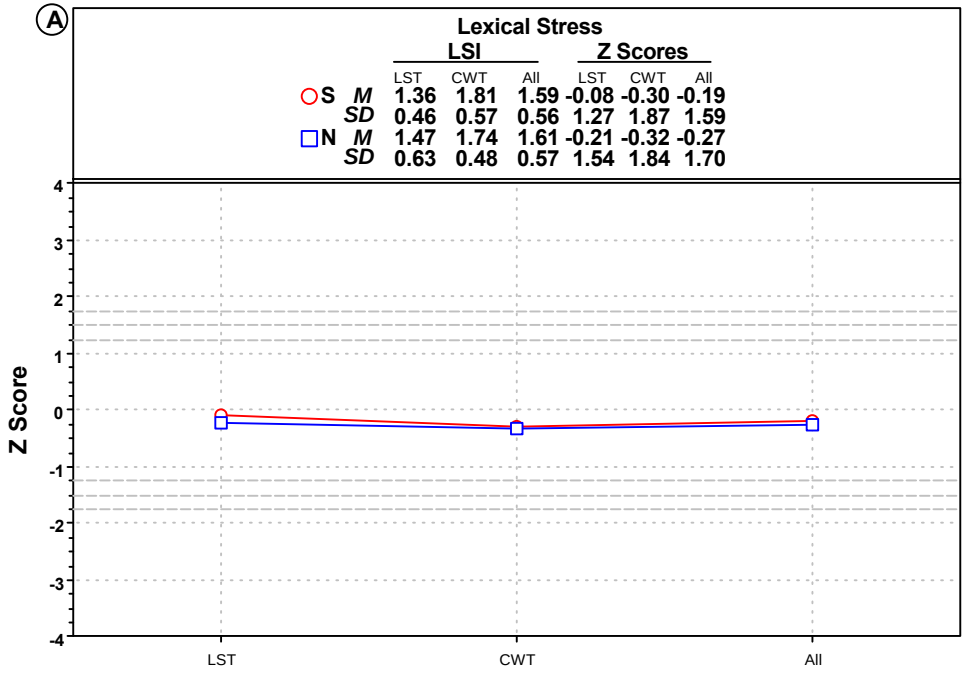

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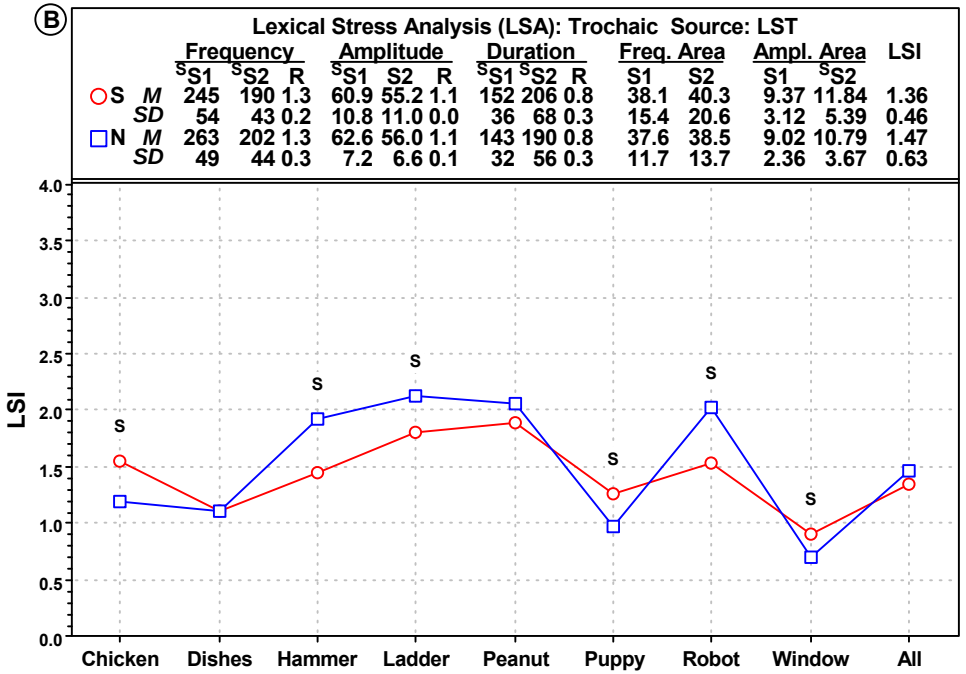

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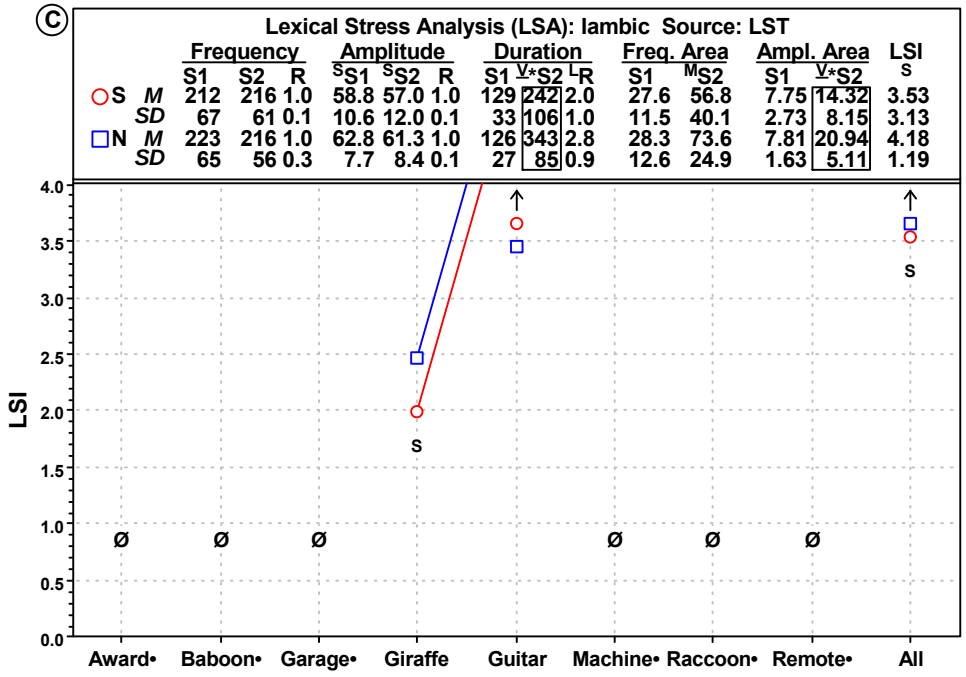
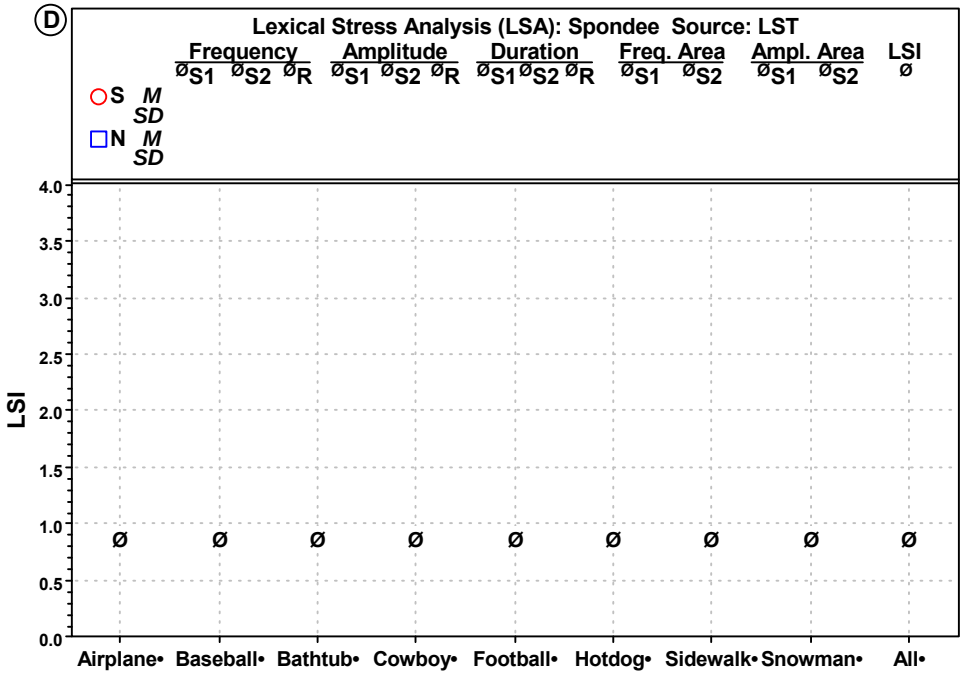
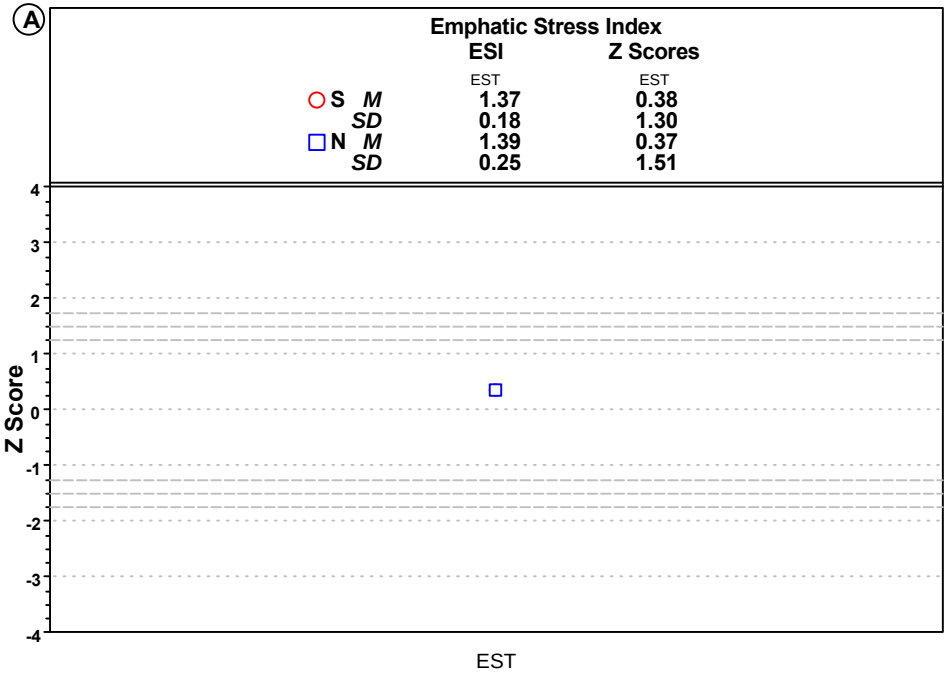


*p < .05, †p < .01, ‡p < .001, ⁰no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data



• = insufficient data

Stress Profile 3, S and N



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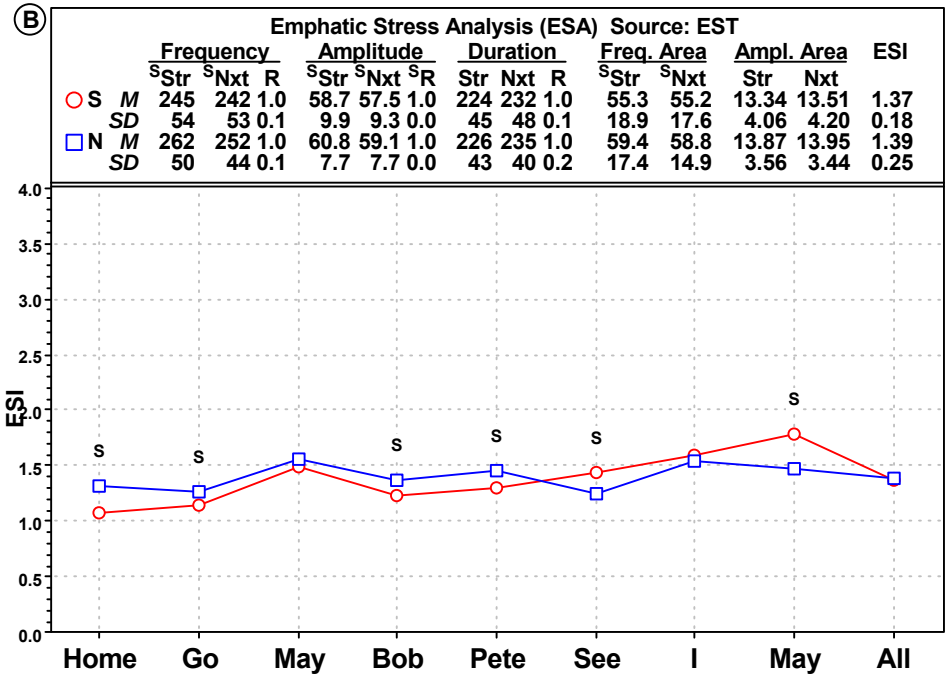
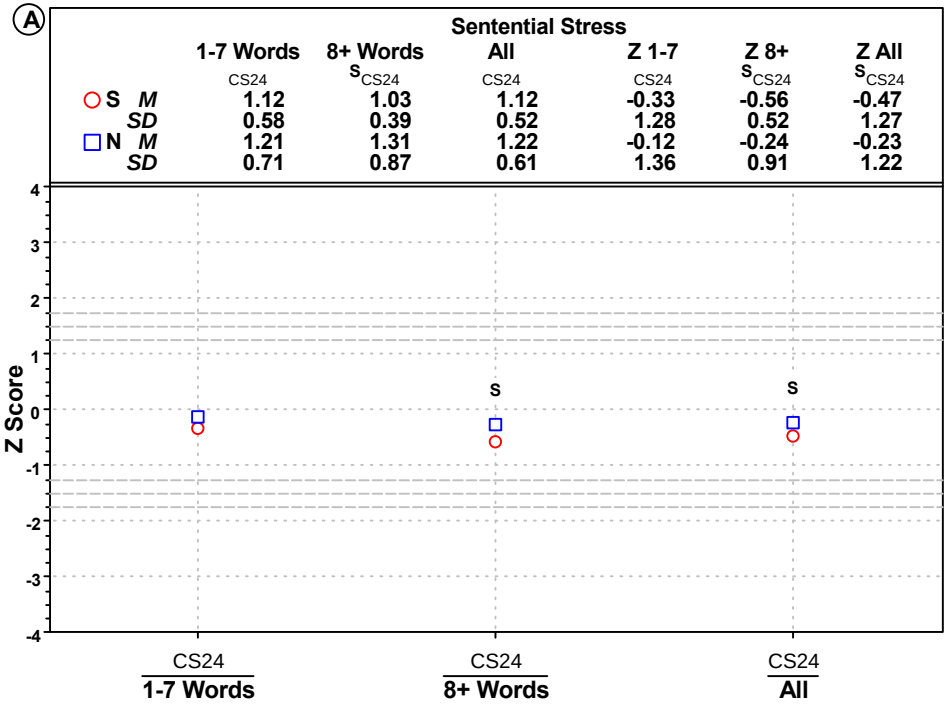


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Stress Profile 4, S and N



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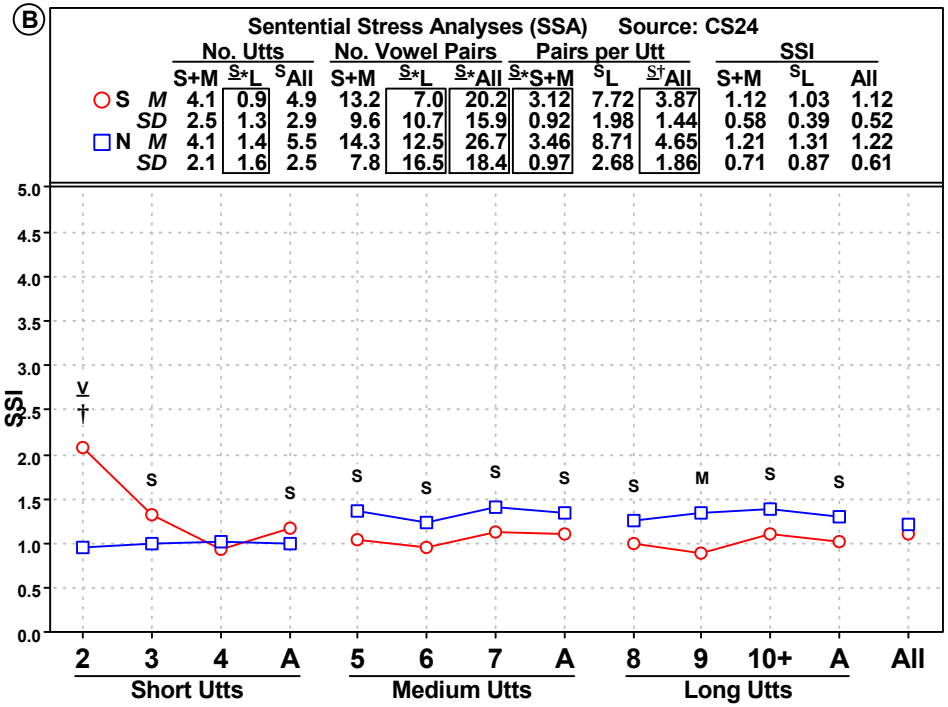


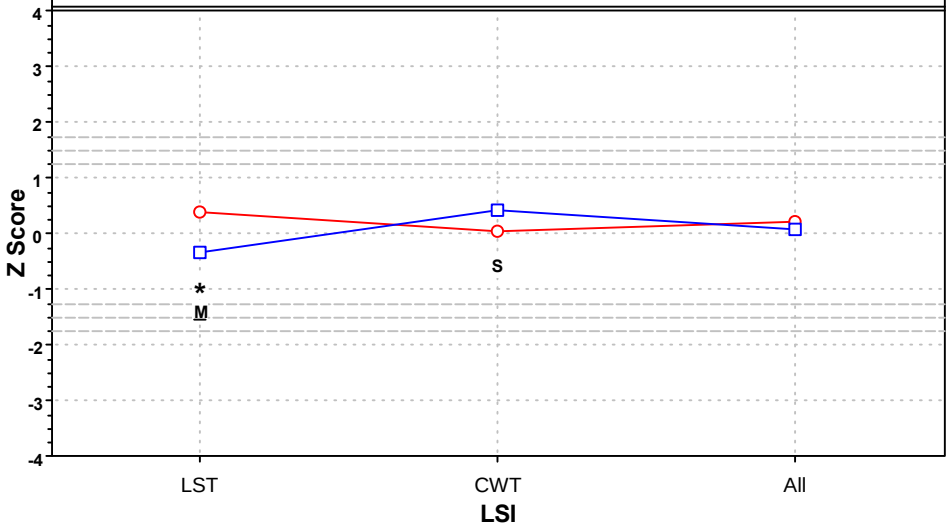
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Stress Profile 5, S and N

A

Lexical Stress Stability

	LSI Stability			LSI Z Scores		
	M†LST	SCWT	SAll	M*LST	SCWT	All
S M	57.3	52.8	54.9	0.38	0.05	0.21
SD	15.5	17.8	16.7	1.05	1.12	1.09
N M	41.4	58.4	50.1	-0.32	0.44	0.07
SD	21.9	15.8	20.8	1.25	1.20	1.28

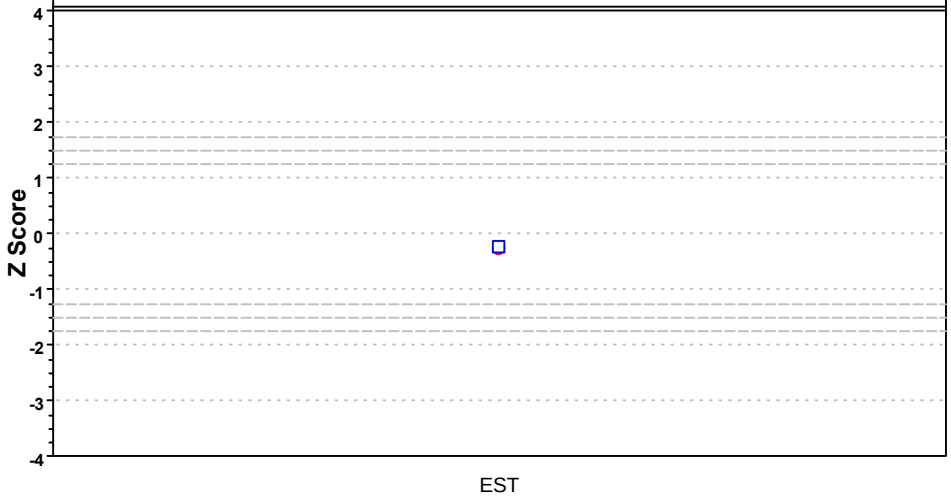


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

Emphatic Stress Stability

	Stability	Z Scores
	EST	EST
S M	61.9	-0.26
SD	13.4	1.22
N M	60.4	-0.23
SD	15.8	1.20

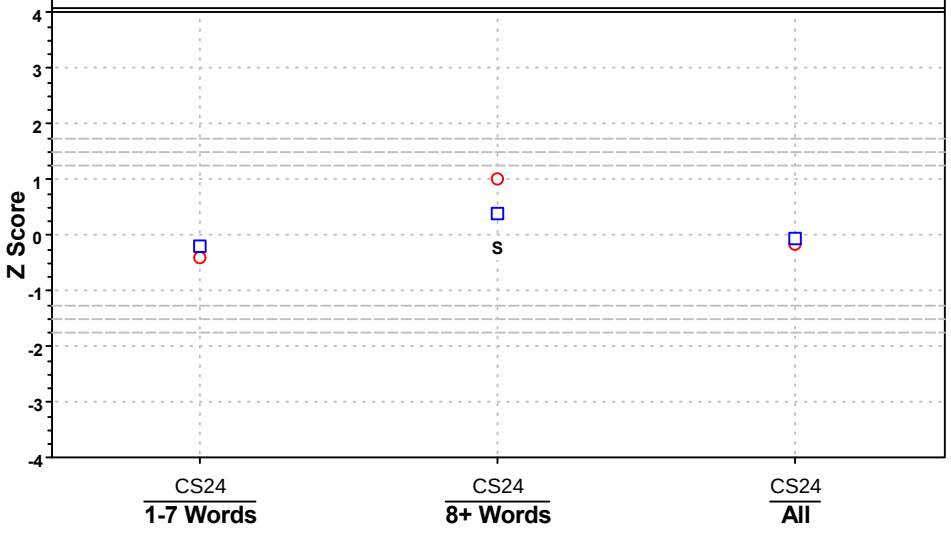


*p < .05, †p < .01, ‡p < .001, Ømo test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

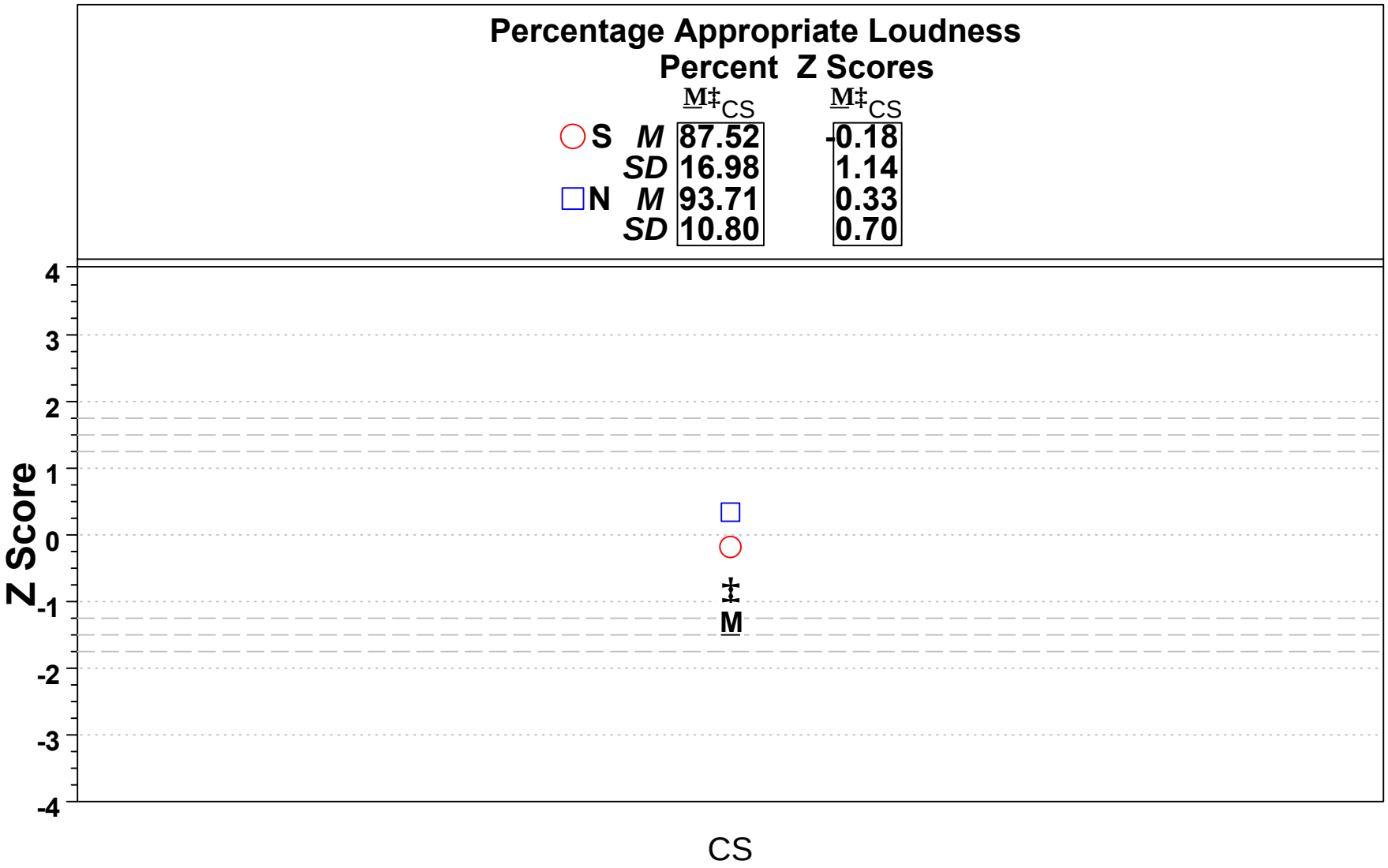
Sentential Stress Stability

	1-7 Words	8+ Words	All	Z 1-7	Z 8+	Z All
	CS24	SCS24	CS24	CS24	SCS24	CS24
S M	27.24	72.20	29.98	-0.38	1.01	-0.17
SD	32.79	24.38	32.07	1.41	1.62	1.42
N M	31.28	61.75	33.68	-0.19	0.39	-0.04
SD	32.57	24.99	30.61	1.33	1.24	1.36



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

LOUDNESS PROFILES



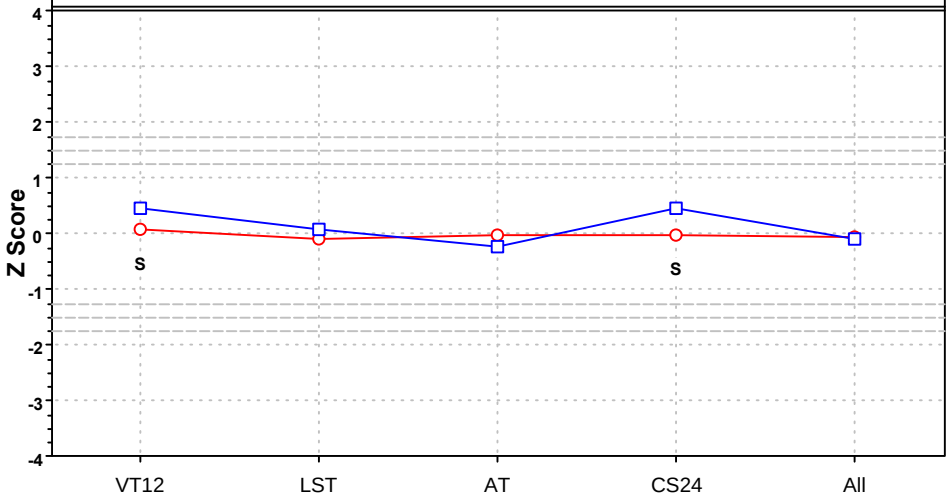
*$p < .05$, †$p < .01$, ‡$p < .001$, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Loudness Profile 1, S and N

A

Speech Intensity Index (SII)

		SII					Z Scores				
		s_{VT12}	s_{LST}	AT	s_{CS24}	All	s_{VT12}	LST	AT	s_{CS24}	All
○ S	*M*	7.95	10.56	10.19	11.50	10.36	0.07	-0.09	-0.01	-0.02	-0.05
	SD	3.13	5.26	4.80	4.90	4.96	1.45	1.60	1.61	2.16	1.59
□ N	*M*	8.57	11.64	10.24	12.67	10.90	0.46	0.09	-0.23	0.47	-0.07
	SD	2.76	5.11	5.00	3.96	5.09	1.56	1.59	1.44	1.63	1.52

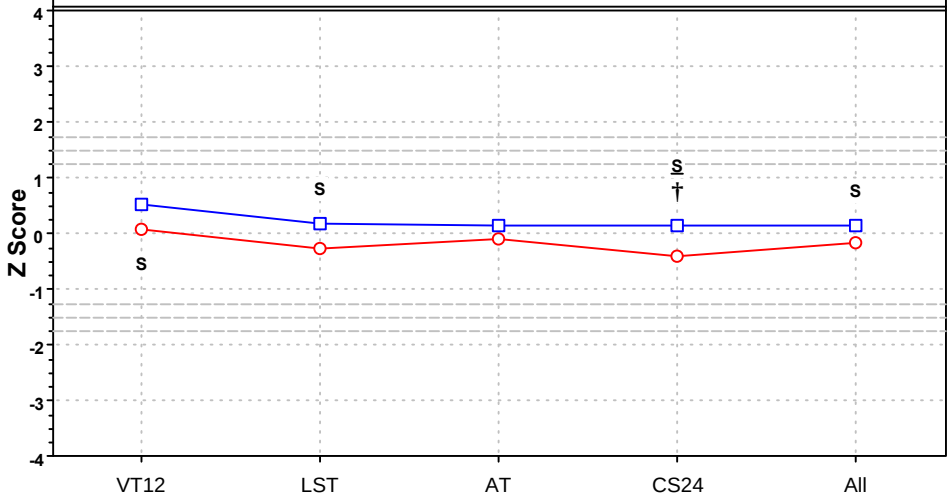


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

SII Vowels Stops Differences

		dB					Z Scores				
		s_{VT12}	s_{LST}	s_{AT}	$s†_{CS24}$	s_{All}	s_{VT12}	s_{LST}	AT	$s†_{CS24}$	s_{All}
○ S	*M*	8.20	10.86	8.02	10.13	9.34	0.10	-0.24	-0.10	-0.39	-0.16
	SD	3.00	4.89	5.04	4.75	5.11	1.36	1.74	1.70	1.38	1.70
□ N	*M*	8.89	12.66	9.13	11.90	10.80	0.52	0.18	0.15	0.14	0.16
	SD	2.81	4.70	5.20	4.14	5.27	1.58	1.52	1.62	1.24	1.57

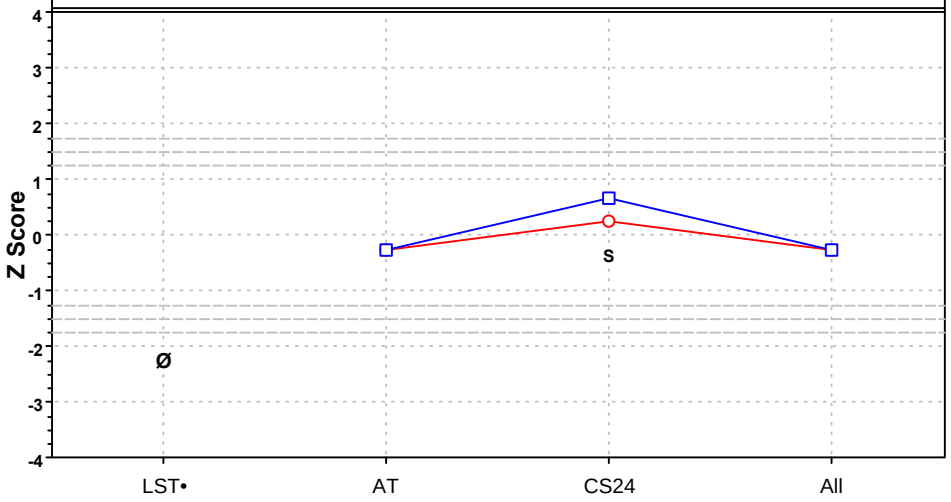


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

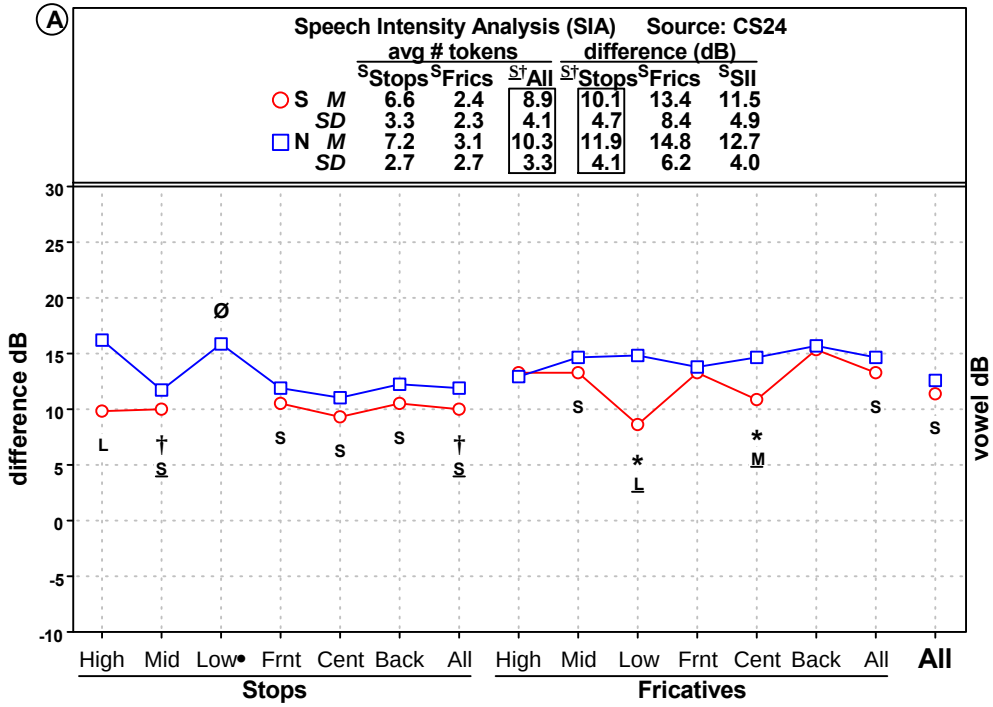
C

SII Vowels Fricative Differences

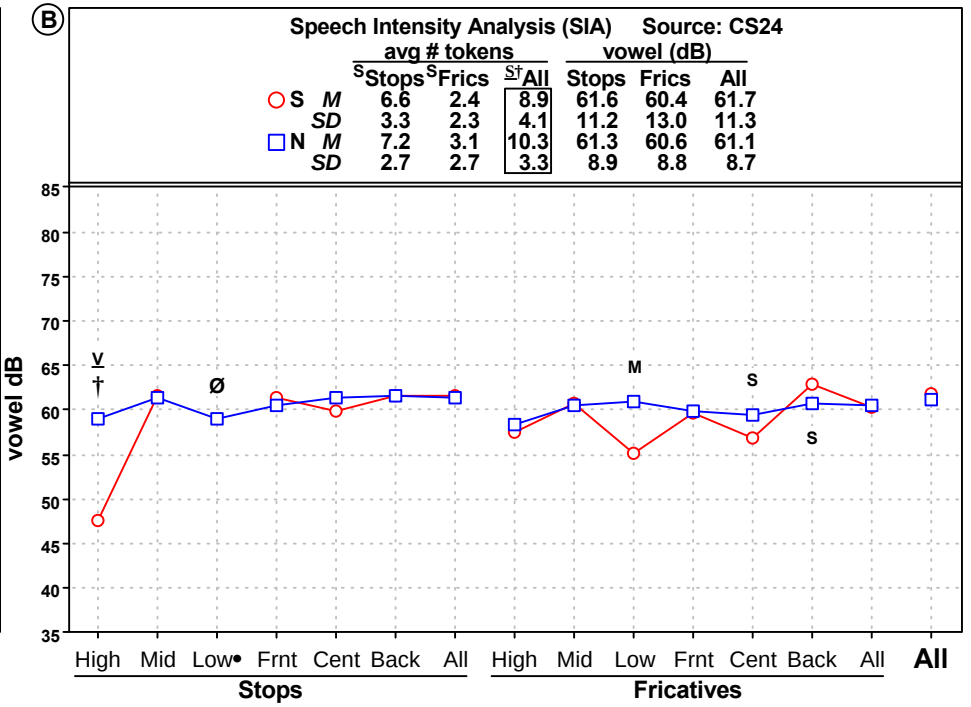
		dB				Z Scores			
		Ø$_{LST}$	AT	s_{CS24}	All	Ø$_{LST}$	AT	s_{CS24}	All
○ S	*M*		10.65	13.37	10.65		-0.27	0.27	-0.27
	SD		5.58	8.45	5.58		1.31	2.17	1.31
□ N	*M*		11.13	14.81	11.13		-0.27	0.66	-0.27
	SD		6.37	6.24	6.37		1.31	1.66	1.31



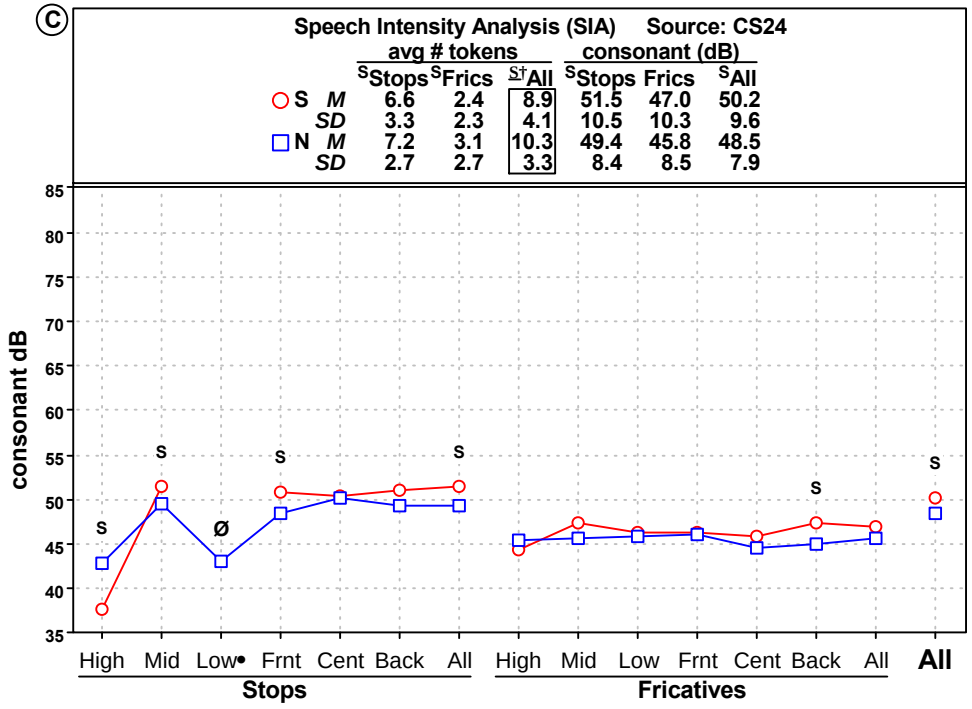
*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data



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



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

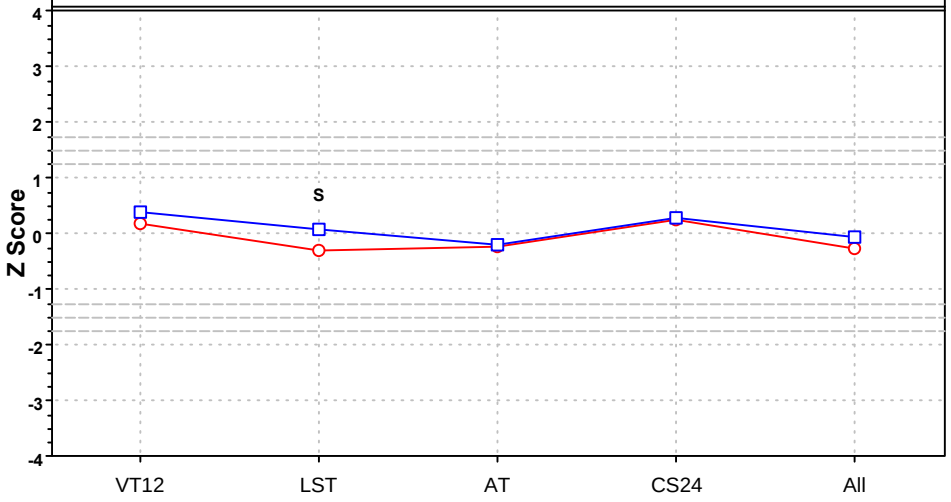


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

A

Speech Intensity Index (SII) Stability

		Stability					Z Scores				
		s_{VT12}	s_{LST}	AT	CS24	All	VT12	s_{LST}	AT	CS24	All
○ S	*M*	20.1	44.4	33.9	41.3	38.5	0.18	-0.30	-0.23	0.27	-0.26
	SD	55.6	50.4	55.9	27.2	53.1	1.48	1.61	1.46	1.56	1.51
□ N	*M*	30.2	54.7	12.8	42.8	31.6	0.41	0.09	-0.17	0.31	-0.06
	SD	30.5	49.0	206.2	21.5	157.7	1.45	1.13	1.31	1.29	1.24

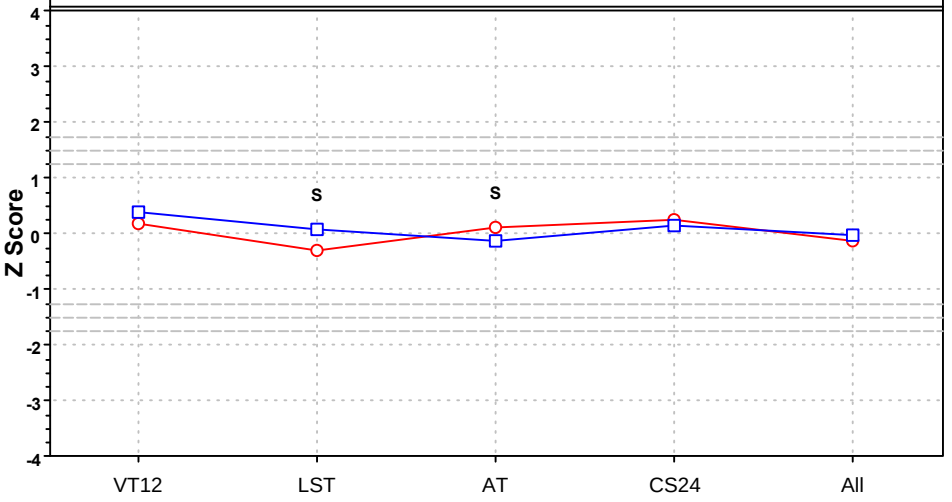


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

SII Vowels Stops Differences Stability

		Stability					Z Scores				
		s_{VT12}	s_{LST}	s_{AT}	CS24	All	VT12	s_{LST}	s_{AT}	CS24	All
○ S	*M*	20.1	44.4	47.0	42.2	45.5	0.18	-0.30	0.11	0.26	-0.12
	SD	55.6	50.4	50.5	28.8	49.5	1.48	1.61	1.04	1.24	1.38
□ N	*M*	30.2	54.7	26.7	40.8	41.6	0.41	0.09	-0.12	0.16	-0.01
	SD	30.5	49.0	70.0	30.0	61.2	1.45	1.13	1.18	1.19	1.16

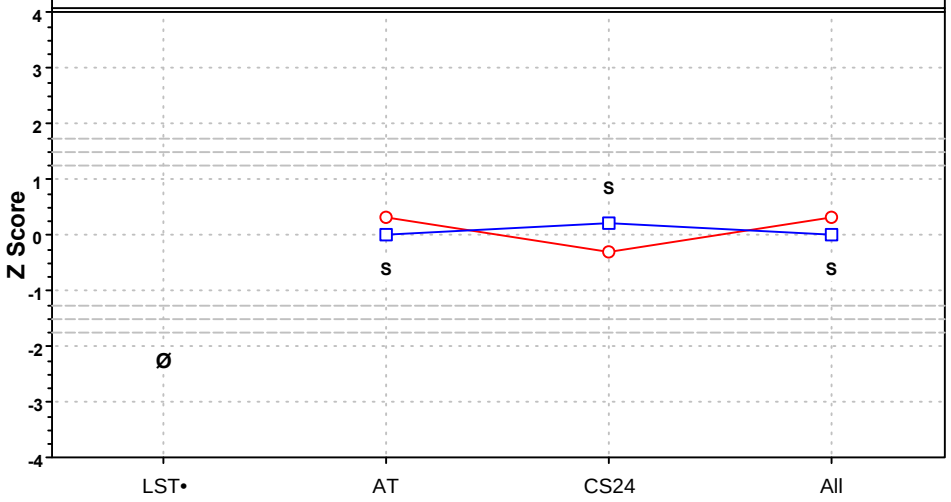


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

C

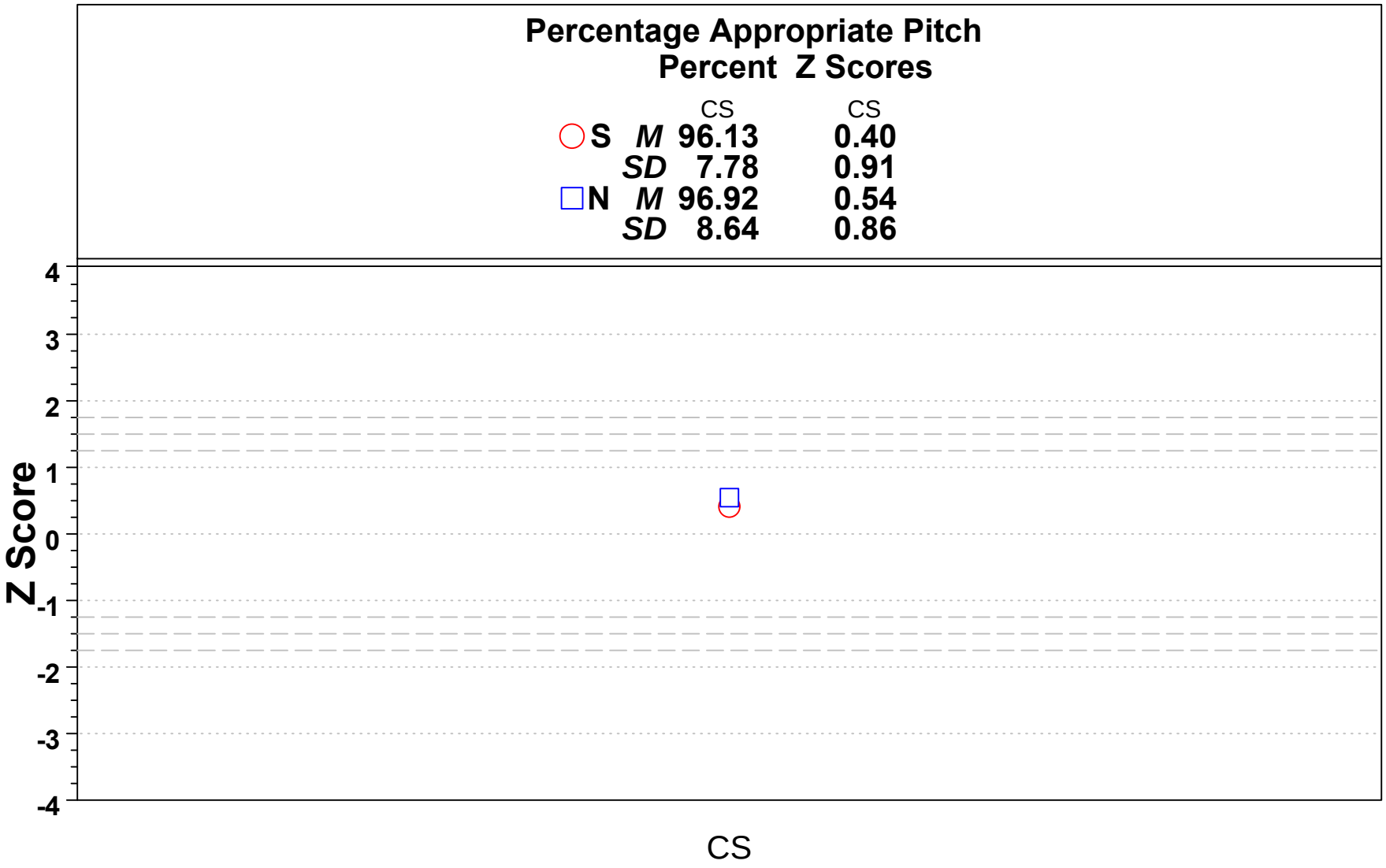
SII Vowels Fricative Differences Stability

		Stability				Z Scores			
		Ø$_{LST}$	AT	CS24	All	Ø$_{LST}$	s_{AT}	s_{CS24}	s_{All}
○ S	*M*		58.6	34.3	58.6		0.34	-0.28	0.34
	SD		35.4	60.4	35.4		0.77	1.96	0.77
□ N	*M*		-33.8	48.4	-33.8		0.01	0.23	0.01
	SD		753.4	76.5	753.4		1.33	1.17	1.33



*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

PITCH PROFILES



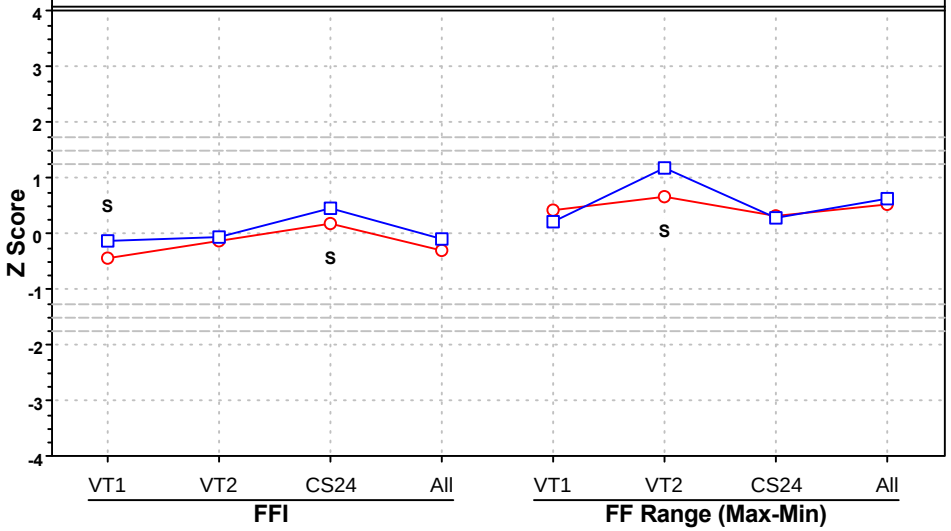
*$p < .05$, †$p < .01$, ‡$p < .001$, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Pitch Profile 1, S and N

A

Fundamental Frequency Index, Range

		FFI			FF Range			Z FFI			Z FF Range		
		S_{VT1}	VT2	S_{CS24}	VT1	S_{VT2}	CS24	S_{VT1}	VT2	S_{CS24}	VT1	S_{VT2}	CS24
○ S	*M*	236	227	264	103	152	354	-0.43	-0.12	0.18	0.43	0.68	0.33
	SD	43	44	59	52	94	166	1.71	2.02	1.73	1.44	1.48	1.43
□ N	*M*	244	231	275	106	200	350	-0.12	-0.06	0.48	0.22	1.18	0.30
	SD	37	36	47	67	135	146	1.47	1.67	1.23	1.22	1.72	1.40

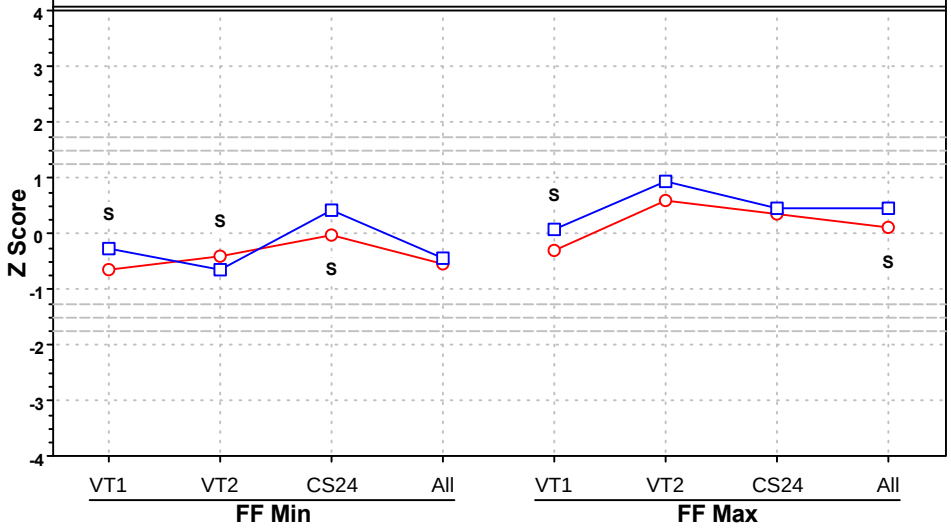


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

Fundamental Frequency Min, Max

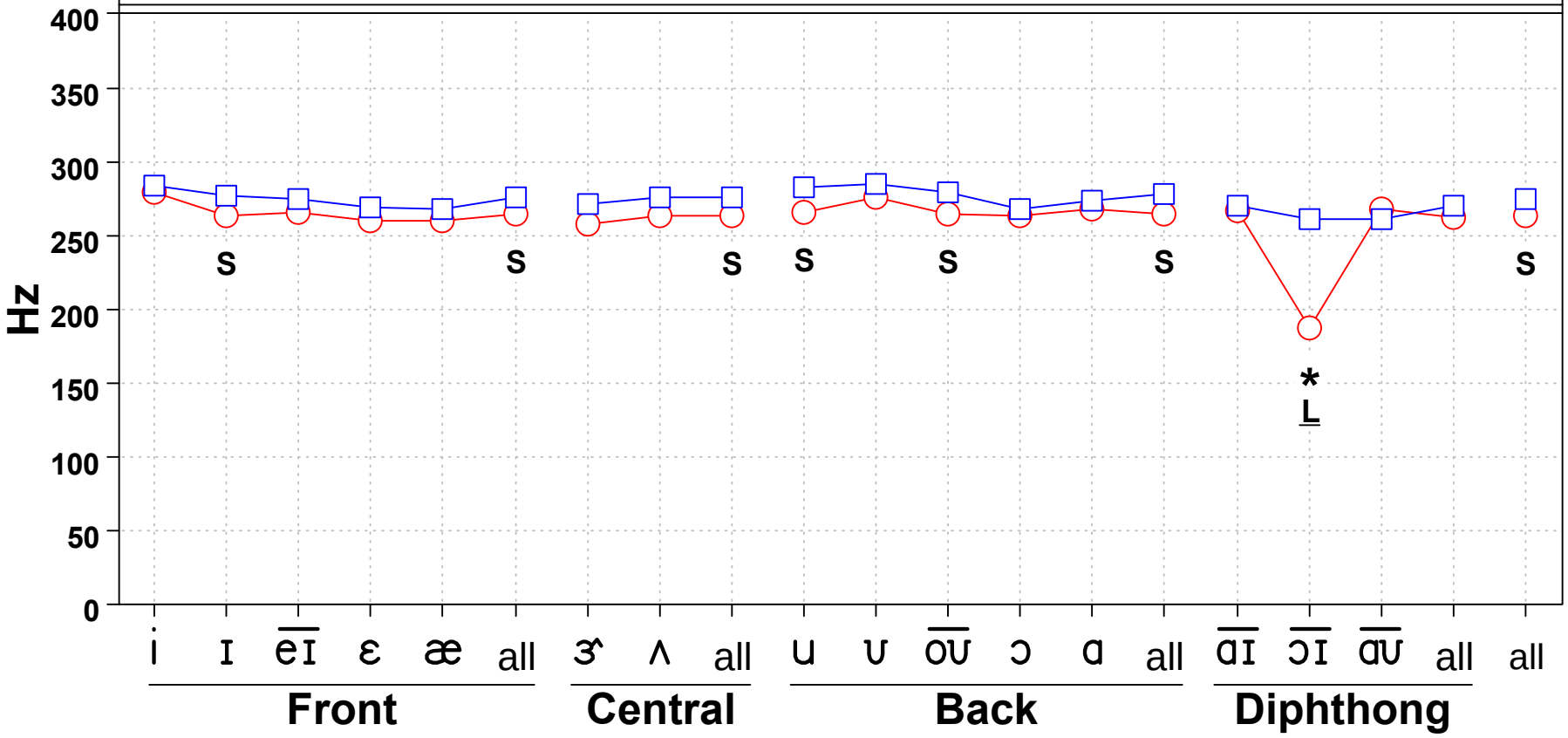
		FF Min			FF Max			Z FF Min			Z FF Max		
		S_{VT1}	S_{VT2}	S_{CS24}	S_{VT1}	S_{VT2}	CS24	S_{VT1}	S_{VT2}	S_{CS24}	S_{VT1}	VT2	CS24
○ S	*M*	173	145	106	276	296	460	-0.63	-0.39	-0.01	-0.31	0.61	0.36
	SD	70	70	58	50	84	160	2.16	1.39	1.57	1.39	2.07	1.36
□ N	*M*	188	124	118	294	324	468	-0.25	-0.65	0.44	0.08	0.94	0.46
	SD	55	61	58	58	109	140	1.50	1.18	1.59	1.36	1.98	1.34



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

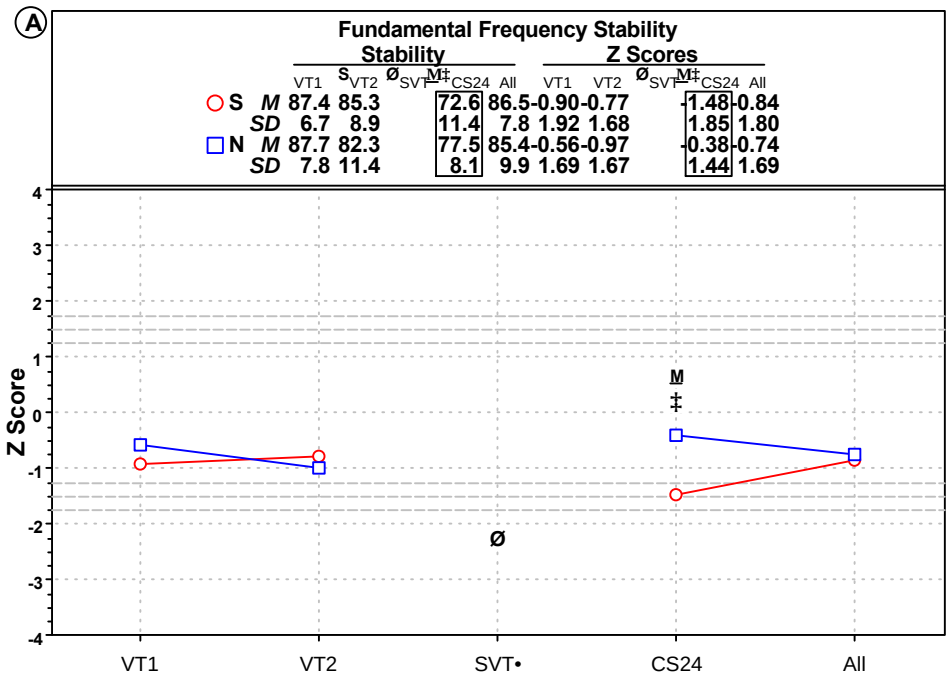
Fundamental Frequency Analyses (FFA) Source: CS24

		avg # tokens					F0 (Hz)				All			
		S† frnt	S* cent	S back	diph	S† all	S frnt	S cent	S back	diph	S mean	S min	max	rng
○ S	*M*	28.0	6.6	16.9	8.6	60.1	264	264	265	263	264	106	460	354
	SD	10.0	3.8	5.1	3.4	17.4	61	87	58	68	59	58	160	166
□ N	*M*	33.3	7.7	18.3	9.3	68.7	275	276	278	270	275	118	468	350
	SD	11.1	3.5	5.4	4.3	19.1	47	57	51	53	47	58	140	146

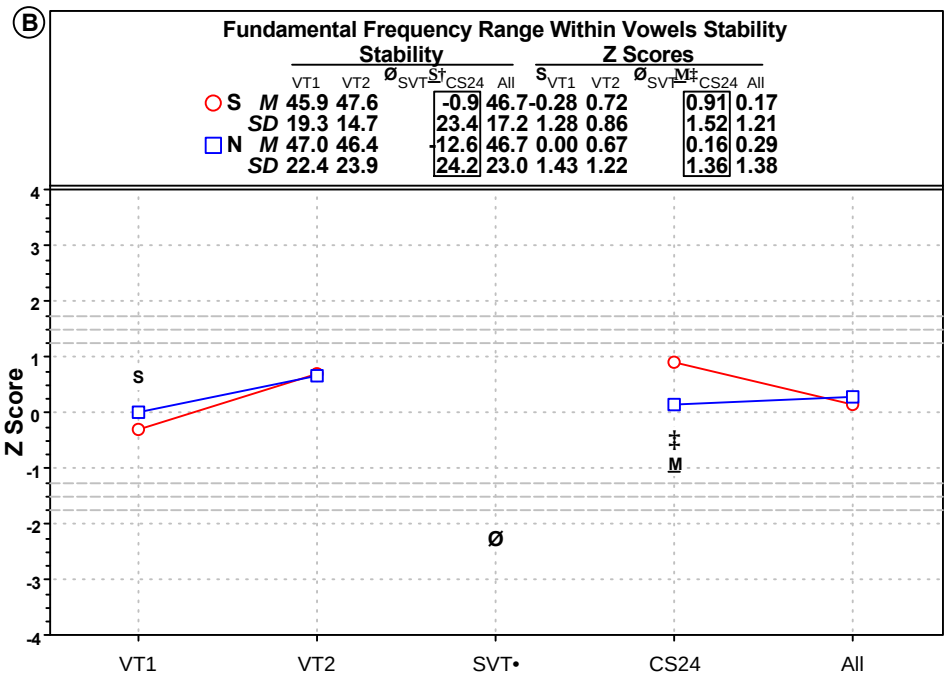


*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

Pitch Profile 3, S and N



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



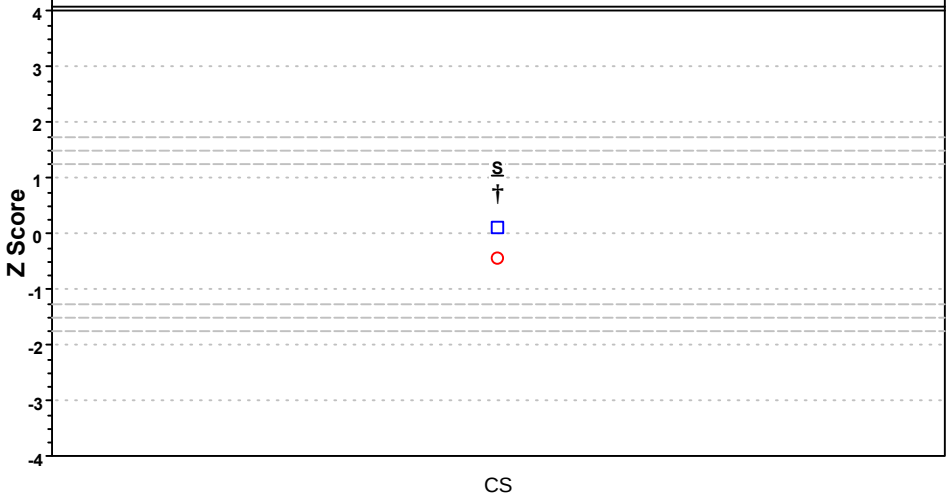
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

LARYNGEAL QUALITY PROFILES

A

Percentage Appropriate Laryngeal Quality
Percent Z Scores

		S^{*}_{CS}	$S^{\dagger}_{CS}$
S	*M*	74.59	-0.44
	SD	28.07	1.46
N	*M*	83.85	0.12
	SD	24.17	1.29

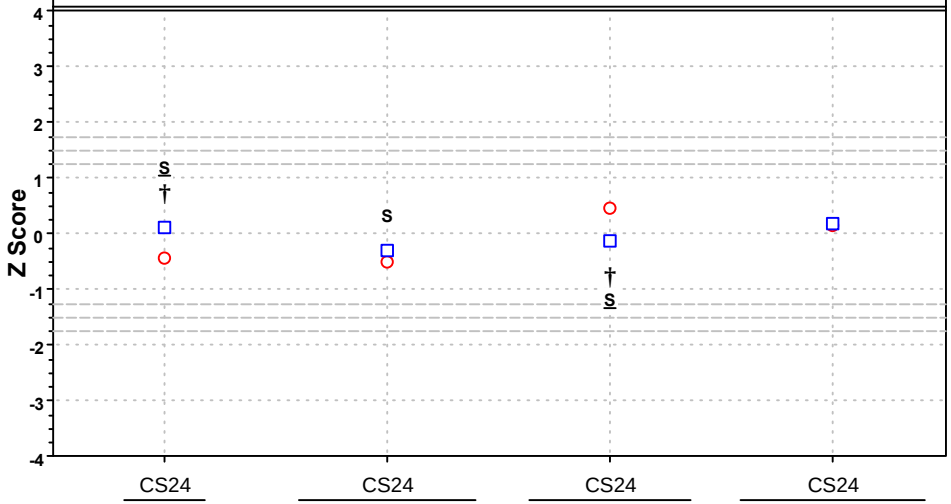


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

B

PVSP Laryngeal Quality Part 1

		% Appr S^{*}_{CS24}	% PV23 CS24	% PV24 $S^{\dagger}_{CS24}$	% PV25 CS24	ZAppr $S^{\dagger}_{CS24}$	ZPV23 S_{CS24}	ZPV24 $S^{\dagger}_{CS24}$	ZPV25 CS24
S	*M*	74.59	0.33	21.03	1.25	-0.44	-0.50	0.48	0.15
	SD	28.07	1.85	27.83	6.03	1.46	0.35	1.61	1.09
N	*M*	83.85	0.79	11.50	1.07	0.12	-0.30	-0.12	0.20
	SD	24.17	2.78	21.29	6.98	1.29	0.89	1.26	1.18

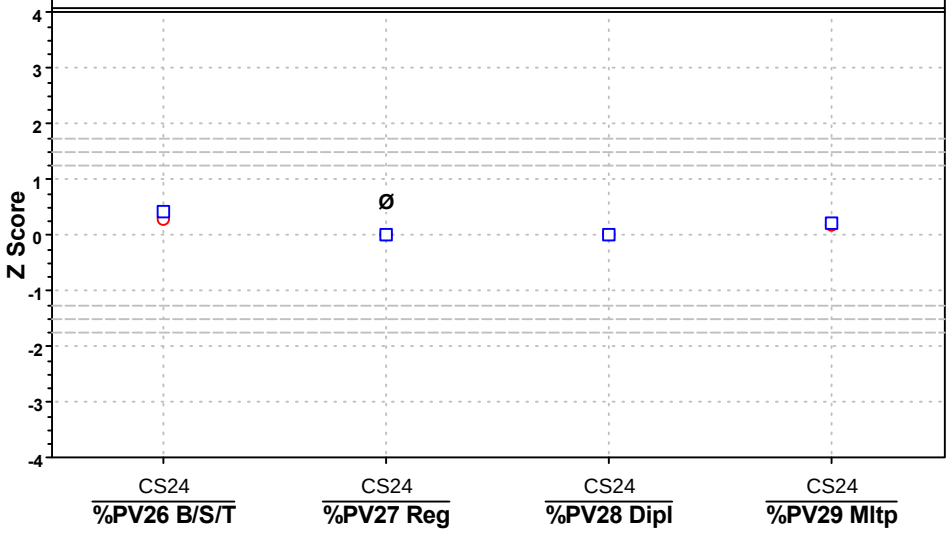


*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2

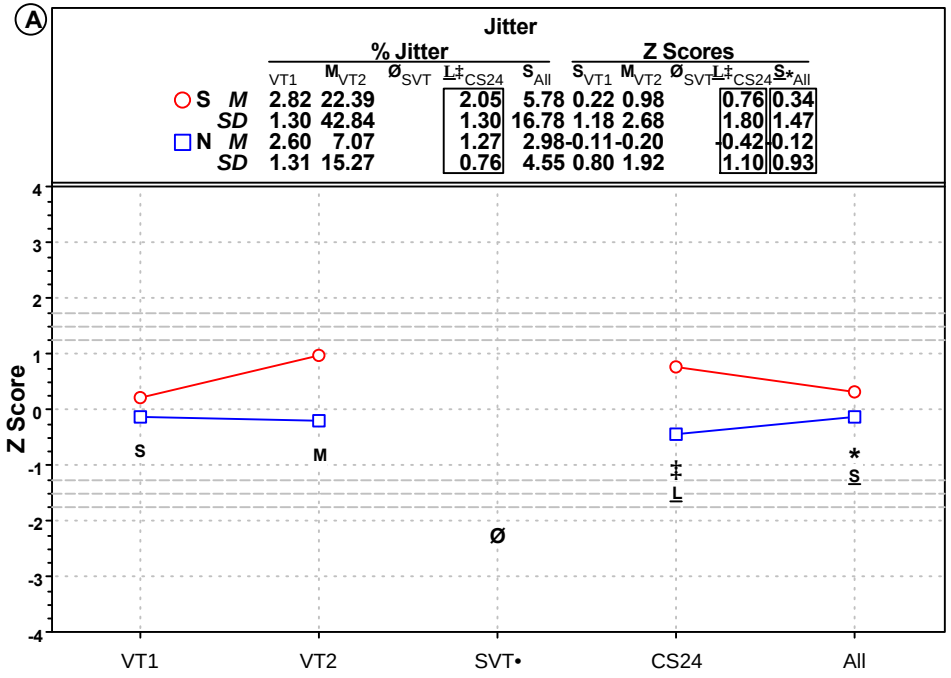
C

PVSP Laryngeal Quality Part 2

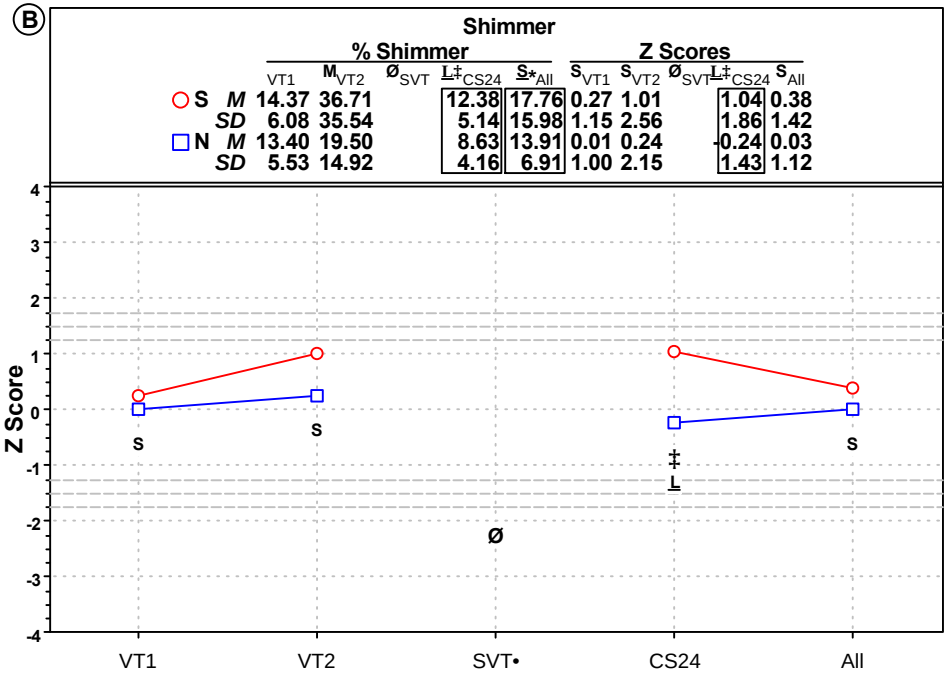
		% PV26 CS24	% PV27 $Ø_{CS24}$	% PV28 CS24	% PV29 CS24	ZPV26 CS24	ZPV27 $Ø_{CS24}$	ZPV28 CS24	ZPV29 CS24
S	*M*	2.54	0.00	0.00	0.25	0.28	0.00	0.00	0.18
	SD	4.30	0.00	0.00	1.01	1.44	0.00	0.00	1.01
N	*M*	2.06	0.00	0.01	0.66	0.42	0.00	0.01	0.22
	SD	4.03	0.00	0.23	4.31	1.67	0.00	0.27	1.21



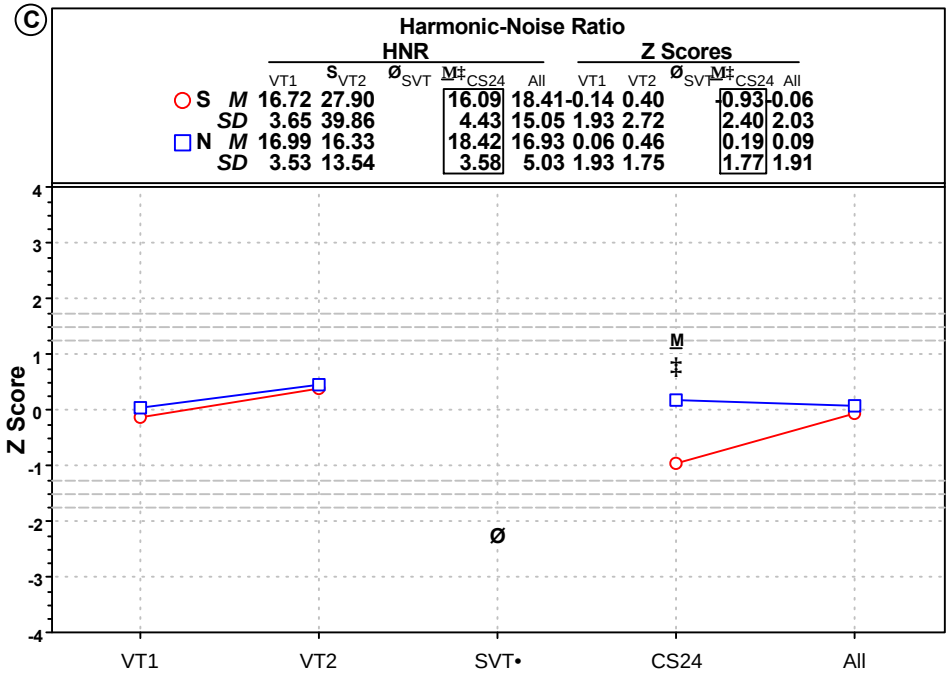
*p < .05, †p < .01, ‡p < .001, Øno test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2



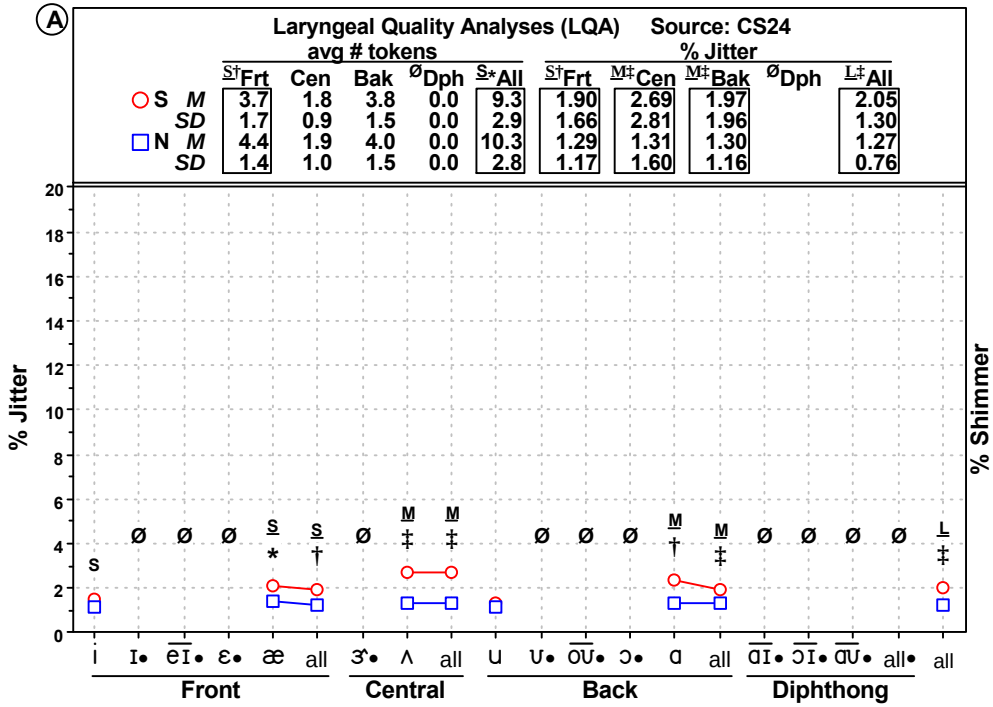
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

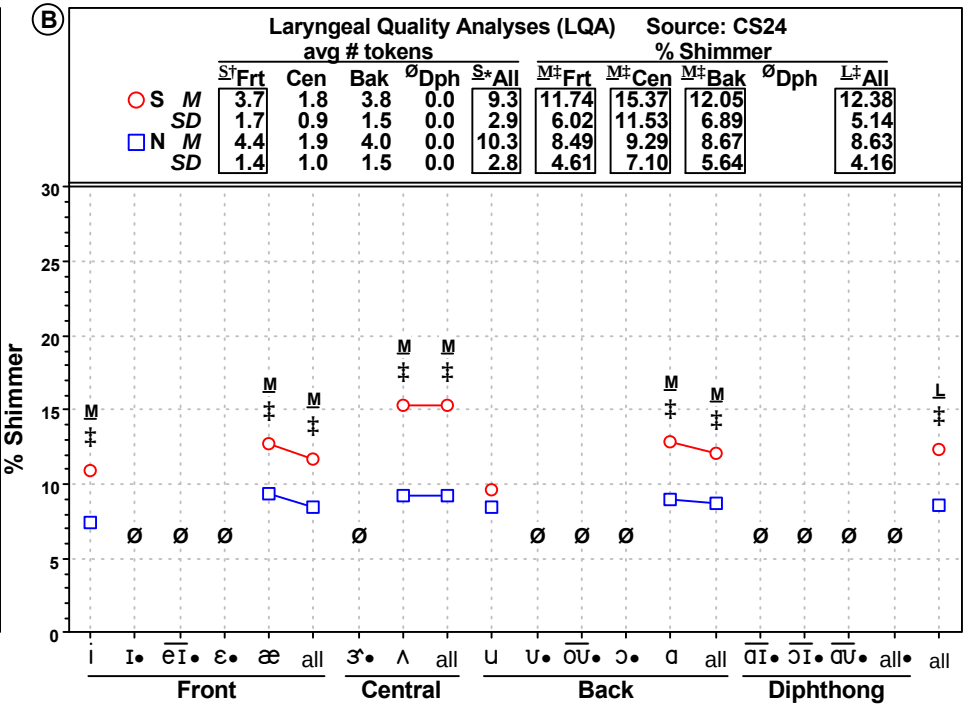


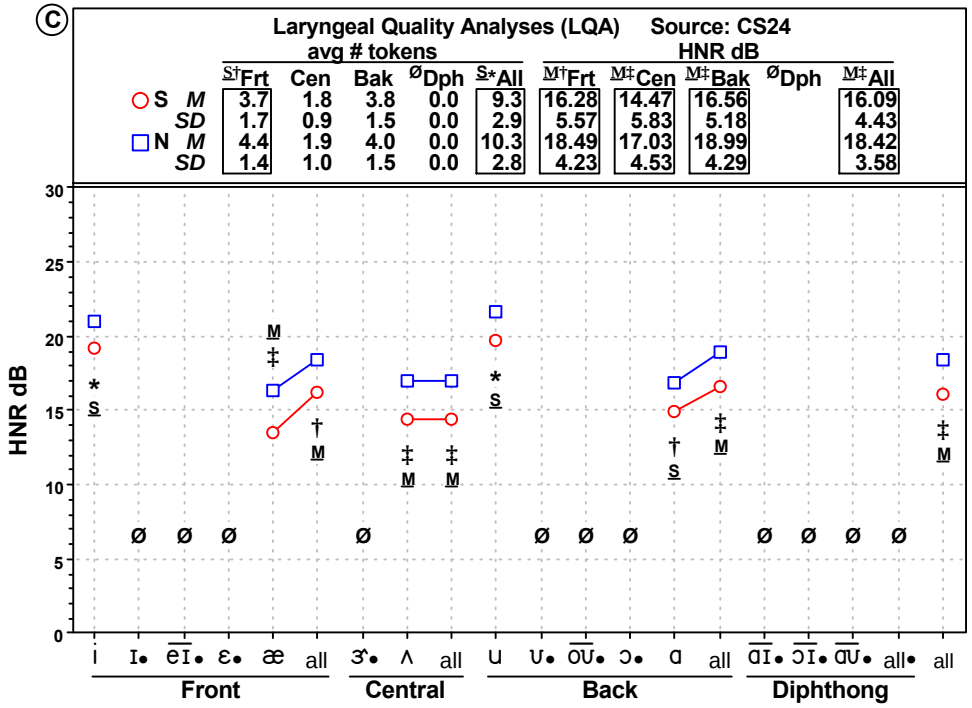
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

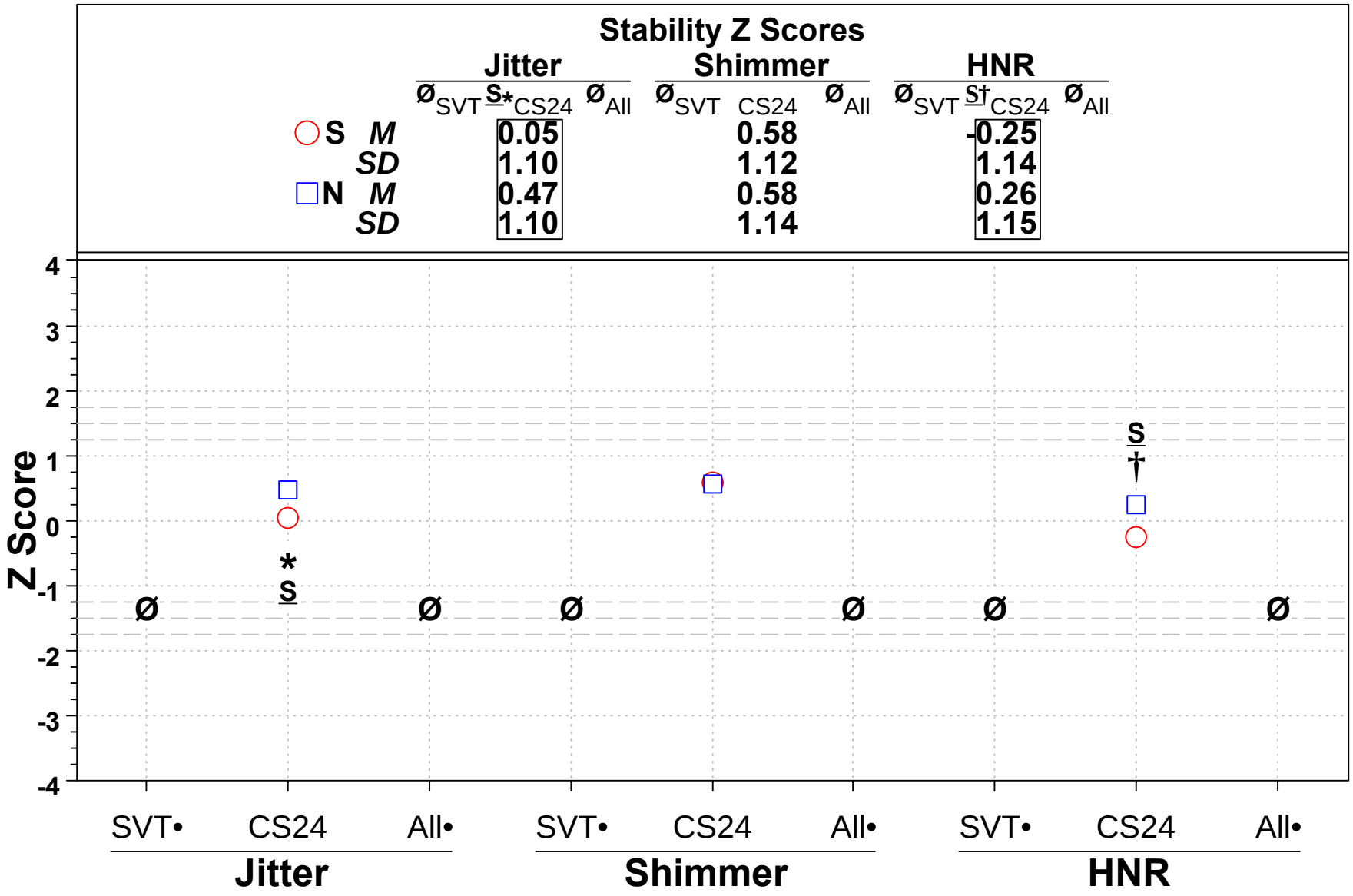


*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


A
Laryngeal Quality Analyses (LQA) Source: CS24
avg # tokens
% Jitter
S†Frt Cen Bak ØDph S*All S†Frt M‡Cen M‡Bak ØDph L‡All
S M 3.7 1.8 3.8 0.0 9.3 1.90 2.69 1.97 2.05
SD 1.7 0.9 1.5 0.0 2.9 1.66 2.81 1.96 1.30
N M 4.4 1.9 4.0 0.0 10.3 1.29 1.31 1.30 1.27
SD 1.4 1.0 1.5 0.0 2.8 1.17 1.60 1.16 0.76
% Jitter
Front
Central
Back
Diphthong
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


B
Laryngeal Quality Analyses (LQA) Source: CS24
avg # tokens
% Shimmer
S†Frt Cen Bak ØDph S*All M‡Frt M‡Cen M‡Bak ØDph L‡All
S M 3.7 1.8 3.8 0.0 9.3 11.74 15.37 12.05 12.38
SD 1.7 0.9 1.5 0.0 2.9 6.02 11.53 6.89 5.14
N M 4.4 1.9 4.0 0.0 10.3 8.49 9.29 8.67 8.63
SD 1.4 1.0 1.5 0.0 2.8 4.61 7.10 5.64 4.16
% Shimmer
Front
Central
Back
Diphthong
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

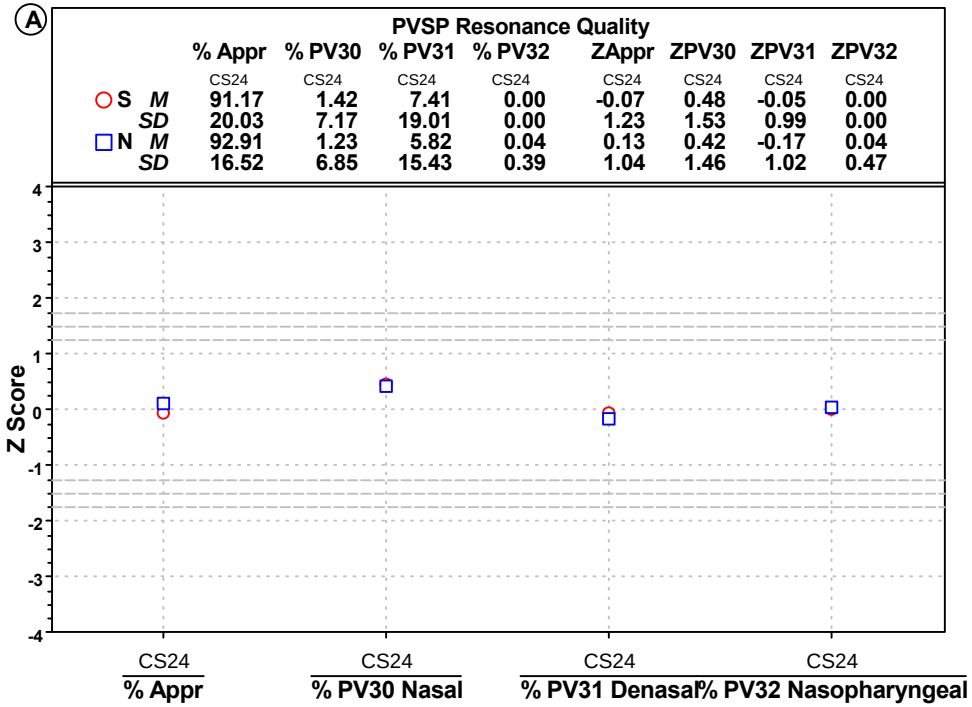

C
Laryngeal Quality Analyses (LQA) Source: CS24
avg # tokens
HNR dB
S†Frt Cen Bak ØDph S*All M†Frt M‡Cen M‡Bak ØDph M‡All
S M 3.7 1.8 3.8 0.0 9.3 16.28 14.47 16.56 16.09
SD 1.7 0.9 1.5 0.0 2.9 5.57 5.83 5.18 4.43
N M 4.4 1.9 4.0 0.0 10.3 18.49 17.03 18.99 18.42
SD 1.4 1.0 1.5 0.0 2.8 4.23 4.53 4.29 3.58
HNR dB
Front
Central
Back
Diphthong
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

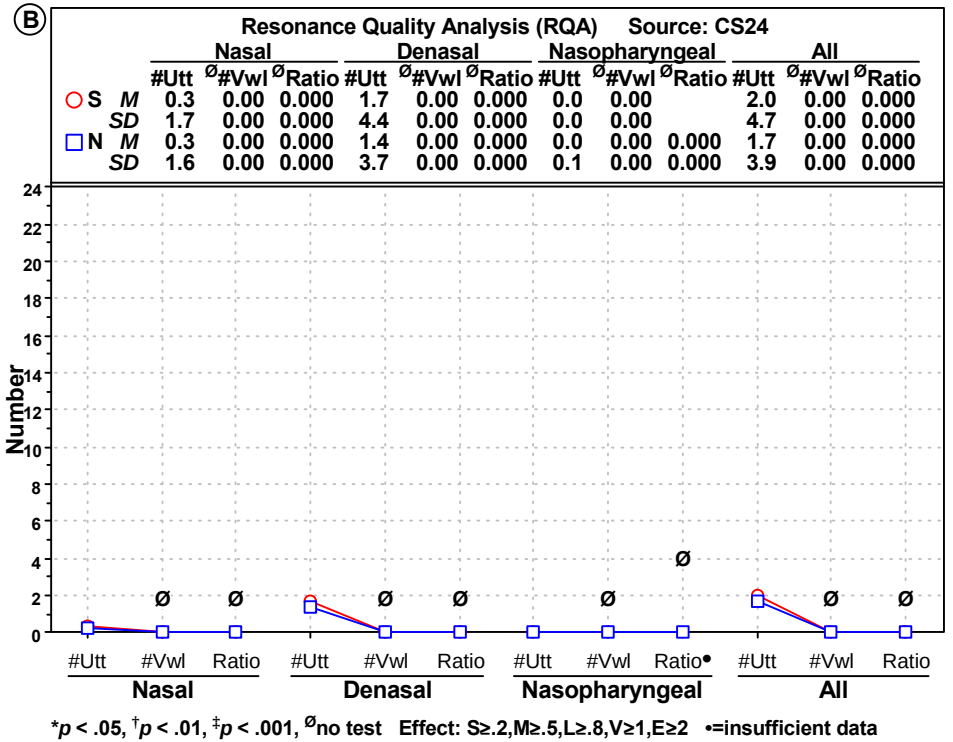


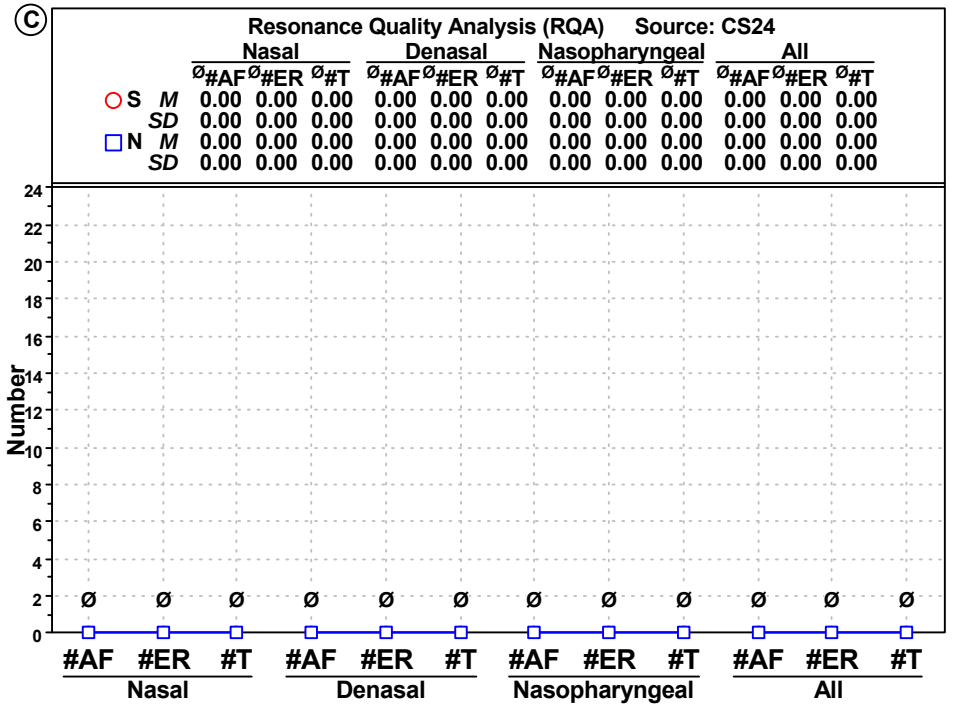
*p < .05, †p < .01, ‡p < .001, Ø no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

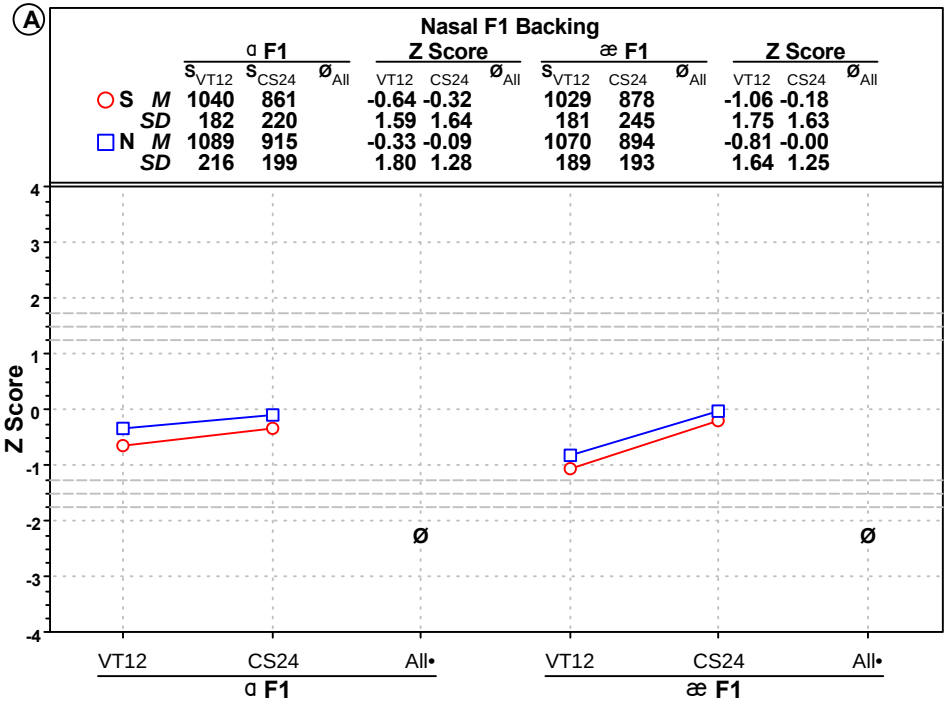
Laryn Profile 4, S and N

RESONANCE QUALITY PROFILES

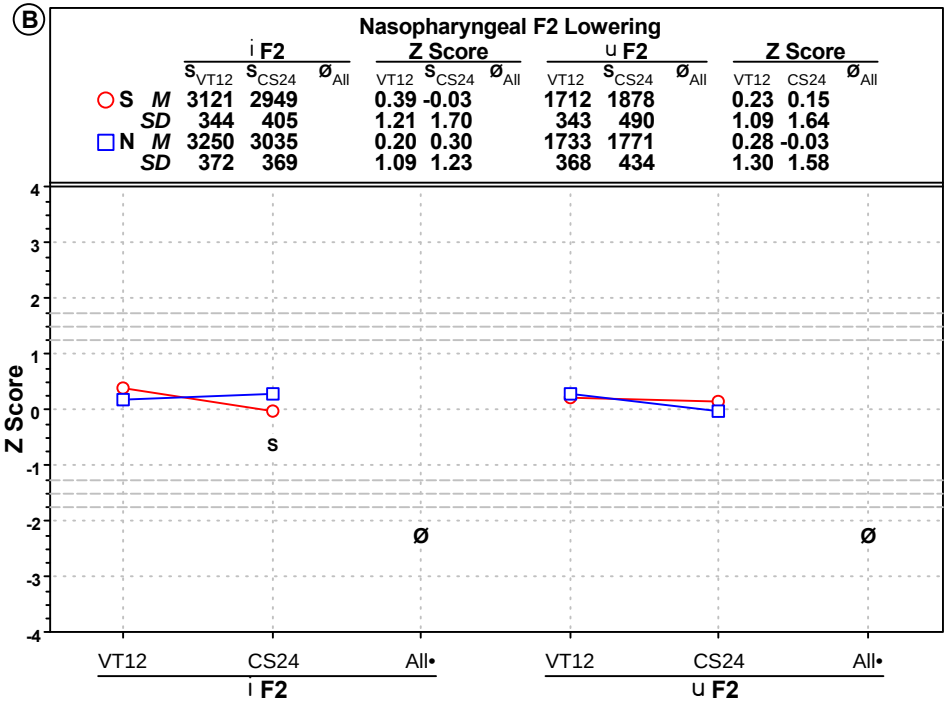

A
PVSP Resonance Quality
% Appr % PV30 % PV31 % PV32 ZAppr ZPV30 ZPV31 ZPV32
CS24 CS24 CS24 CS24 CS24 CS24 CS24 CS24
S M 91.17 1.42 7.41 0.00 -0.07 0.48 -0.05 0.00
SD 20.03 7.17 19.01 0.00 1.23 1.53 0.99 0.00
N M 92.91 1.23 5.82 0.04 0.13 0.42 -0.17 0.04
SD 16.52 6.85 15.43 0.39 1.04 1.46 1.02 0.47
Z Score
CS24 % Appr
CS24 % PV30 Nasal
CS24 % PV31 Denasal
CS24 % PV32 Nasopharyngeal
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2


B
Resonance Quality Analysis (RQA) Source: CS24
Nasal Denasal Nasopharyngeal All
#Utt Ø#Vwl ØRatio #Utt Ø#Vwl ØRatio #Utt Ø#Vwl ØRatio #Utt Ø#Vwl ØRatio
S M 0.3 0.00 0.000 1.7 0.00 0.000 0.0 0.00 2.0 0.00 0.000
SD 1.7 0.00 0.000 4.4 0.00 0.000 0.0 0.00 4.7 0.00 0.000
N M 0.3 0.00 0.000 1.4 0.00 0.000 0.0 0.00 0.000 1.7 0.00 0.000
SD 1.6 0.00 0.000 3.7 0.00 0.000 0.1 0.00 0.000 3.9 0.00 0.000
Number
#Utt #Vwl Ratio #Utt #Vwl Ratio #Utt #Vwl Ratio• #Utt #Vwl Ratio
Nasal Denasal Nasopharyngeal All
*p < .05, †p < .01, ‡p < .001, Ønot test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data


C
Resonance Quality Analysis (RQA) Source: CS24
Nasal Denasal Nasopharyngeal All
Ø#AF Ø#ER Ø#T Ø#AF Ø#ER Ø#T Ø#AF Ø#ER Ø#T Ø#AF Ø#ER Ø#T
S M 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
SD 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
N M 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
SD 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
Number
#AF #ER #T #AF #ER #T #AF #ER #T #AF #ER #T
Nasal Denasal Nasopharyngeal All



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



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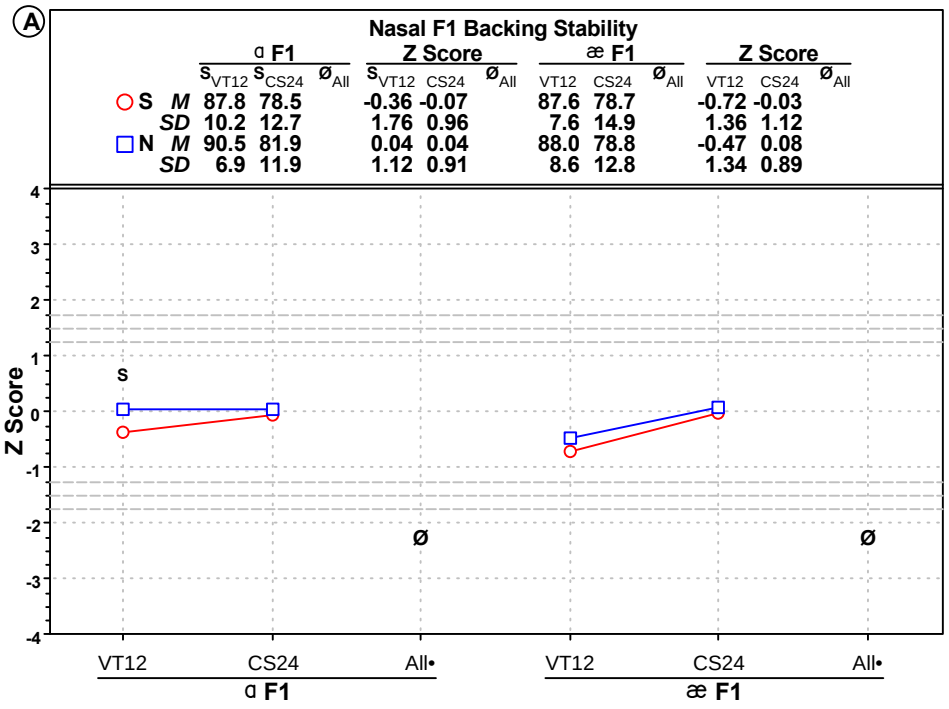
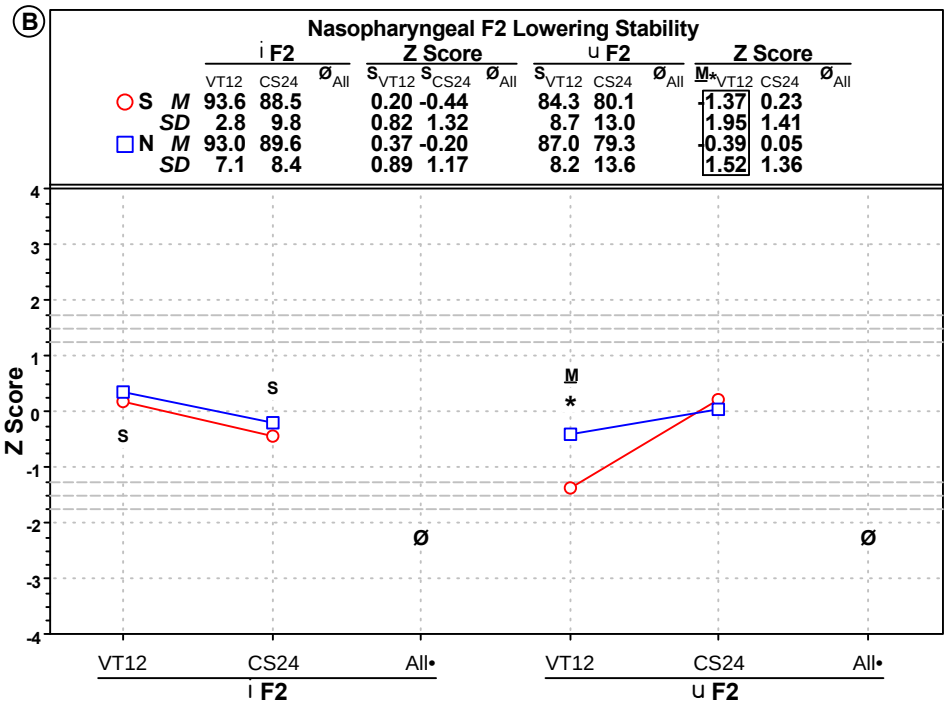


*p < .05, †p < .01, ‡p < .001, ⁰no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data



*p < .05, †p < .01, ‡p < .001, ⁰no test Effect: S≥.2,M≥.5,L≥.8,V≥1,E≥2 •=insufficient data

Resonance Profile 3, S and N

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