

**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**

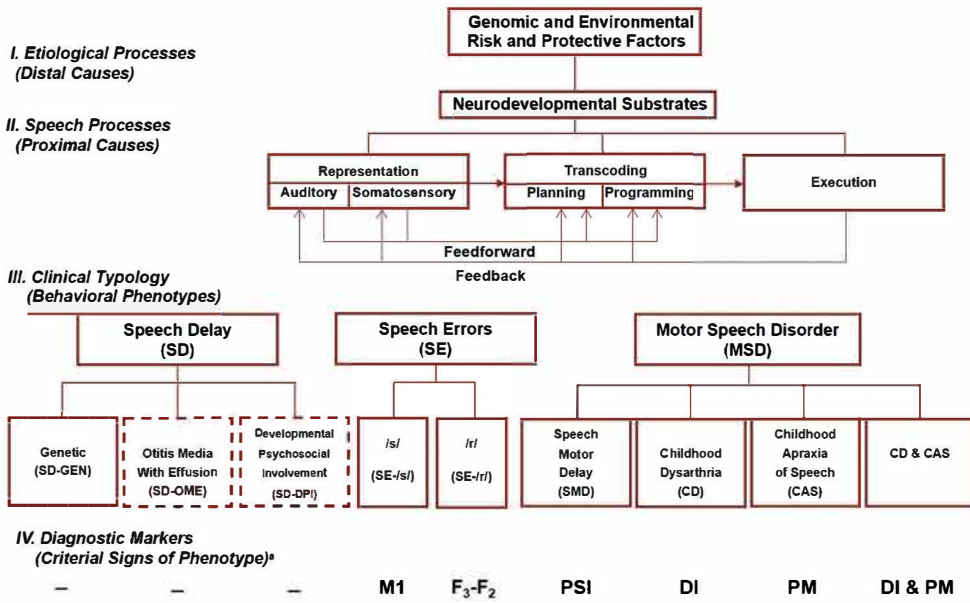
Phonology Project Technical Reports provide technical information, reference data, and additional data on measures and analyses available in the PEPPER software suite that were used in research presentations, publications, and in other Phonology Project technical reports. The present technical report provides speech and motor speech data from the 391 children with idiopathic Speech Delay (SD) described in Shriberg, Campbell, Mabile, 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, McSweeney, and Wilson (1997); Shriberg et al. (2010); and Shriberg, Kwiatkowski, and Mabie (2019). The



<sup>a</sup> M1: First Spectral Moment; F<sub>3</sub> - F<sub>2</sub>: Formant 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
<i>n</i>	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**

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

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
<b>INTELLIGIBILITY INDEX</b>		<b>86.98</b>

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
Fricatives and Affricates	g	2104	643	415	128	537	178	3056	4005	3.16	76.30
	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
Liquids	tʃ	225	171	100	100	130	127	455	853	0.67	53.34
	ɟʃ	311	321	83	41	60	71	454	887	0.70	51.18
	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

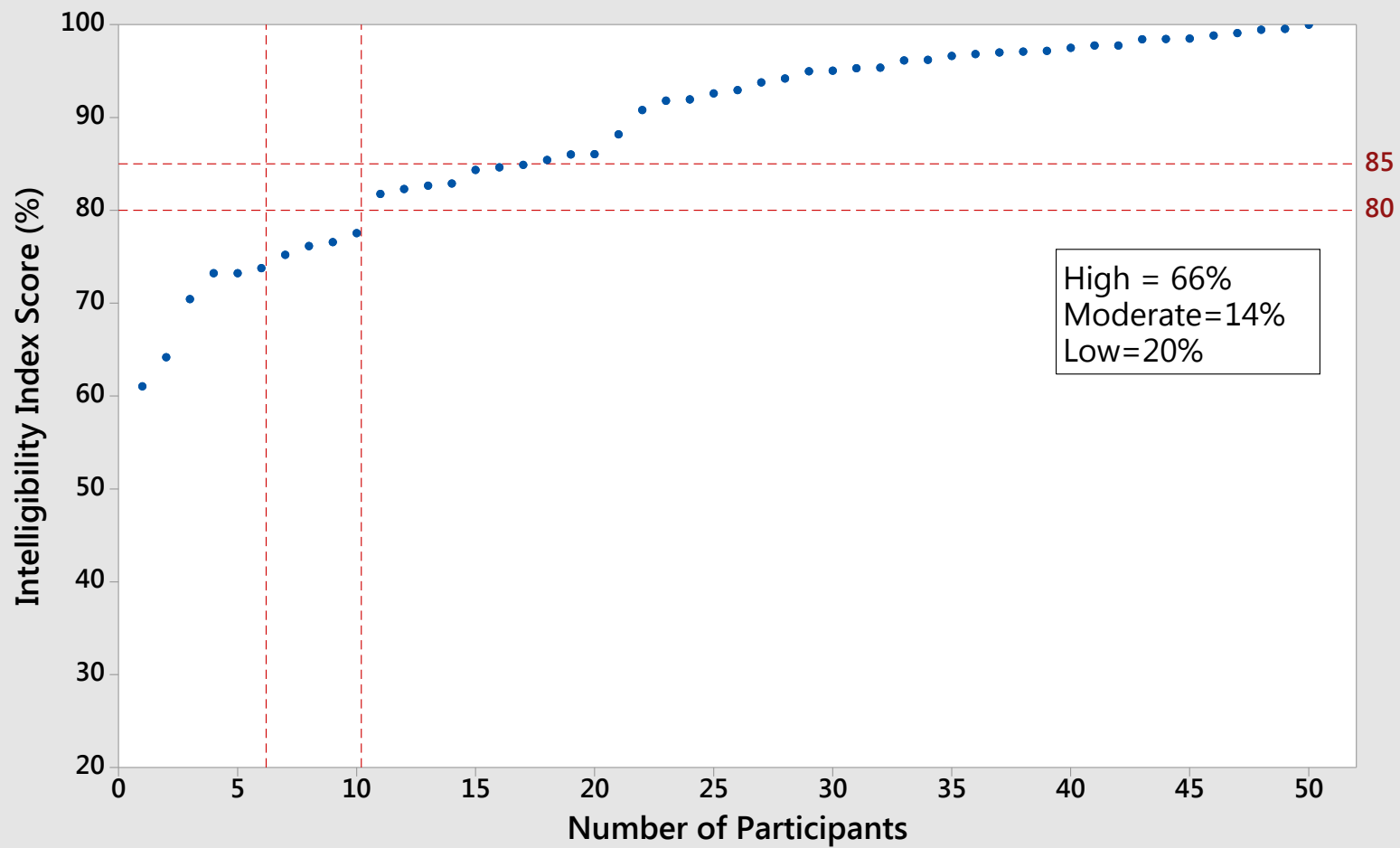
75.32

Percentage  
 Consonants  
 Correct  
 (PCC)

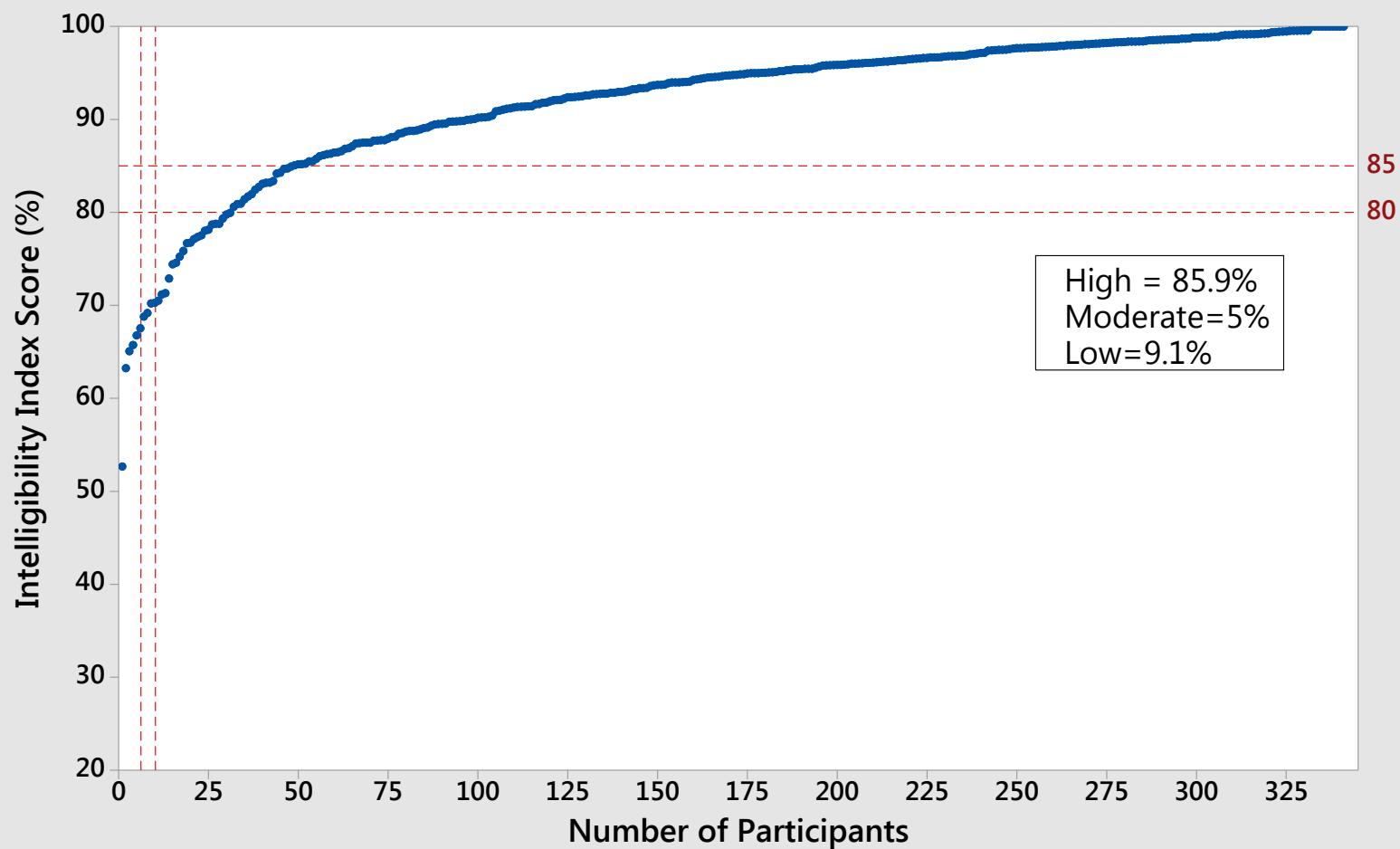
Severity Adjective

MILD-MODERATE

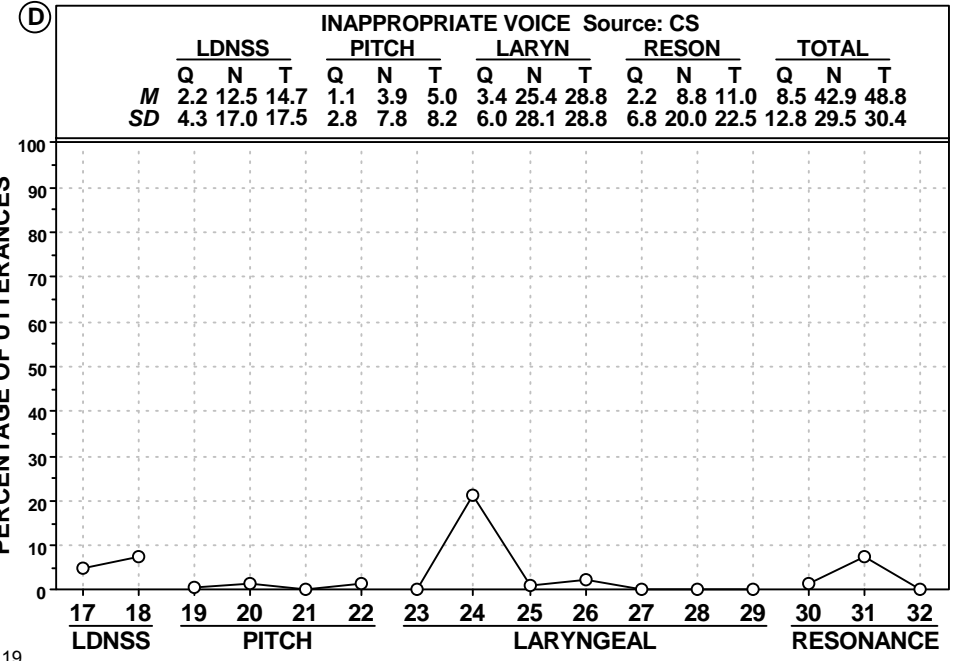
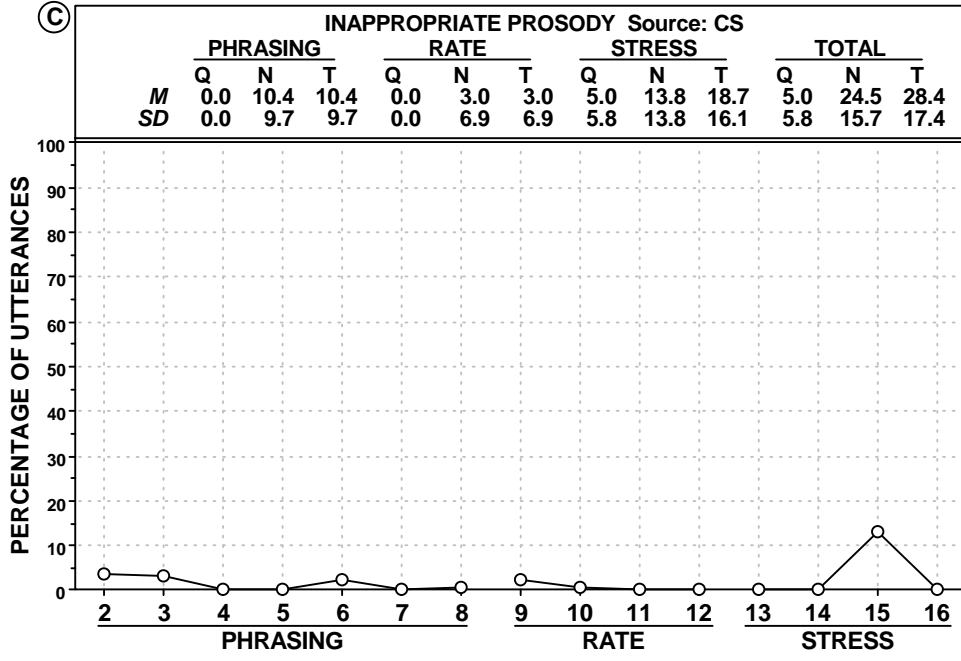
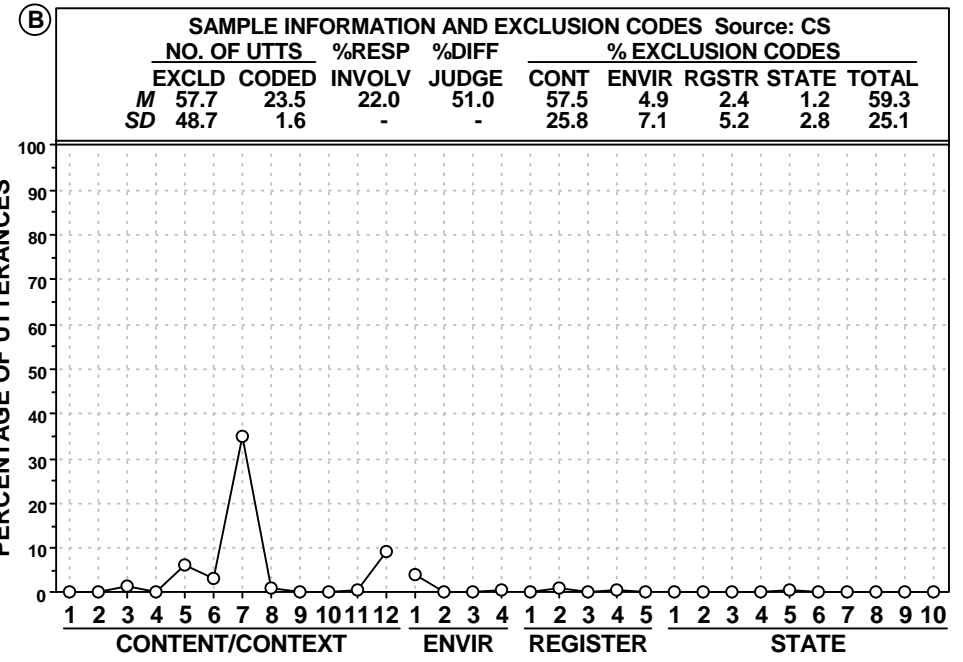
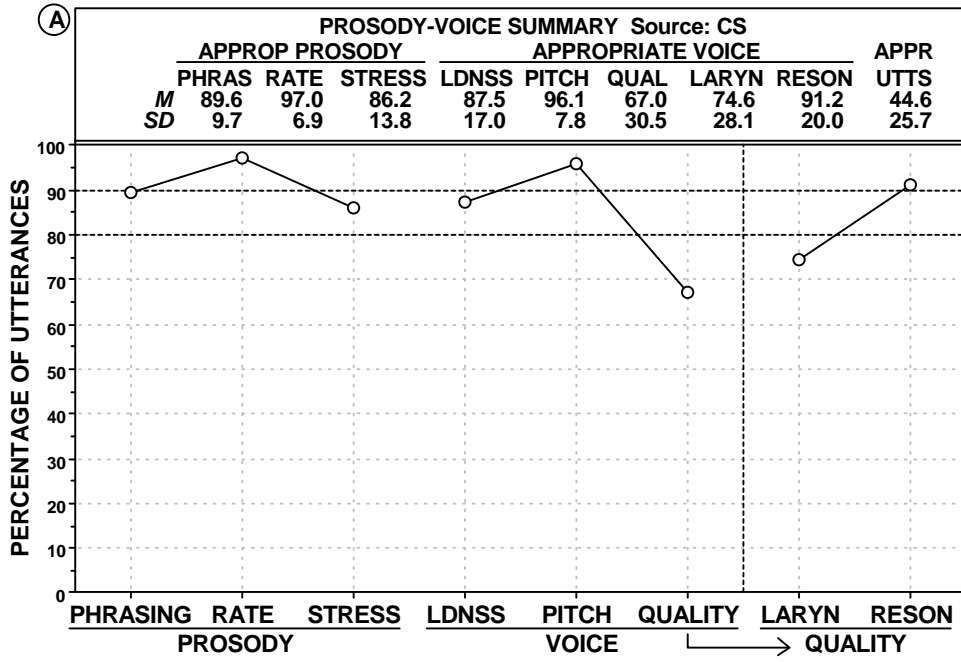
### 50 Participants with Idiopathic Speech Delay and Speech Motor Delay (SMD)



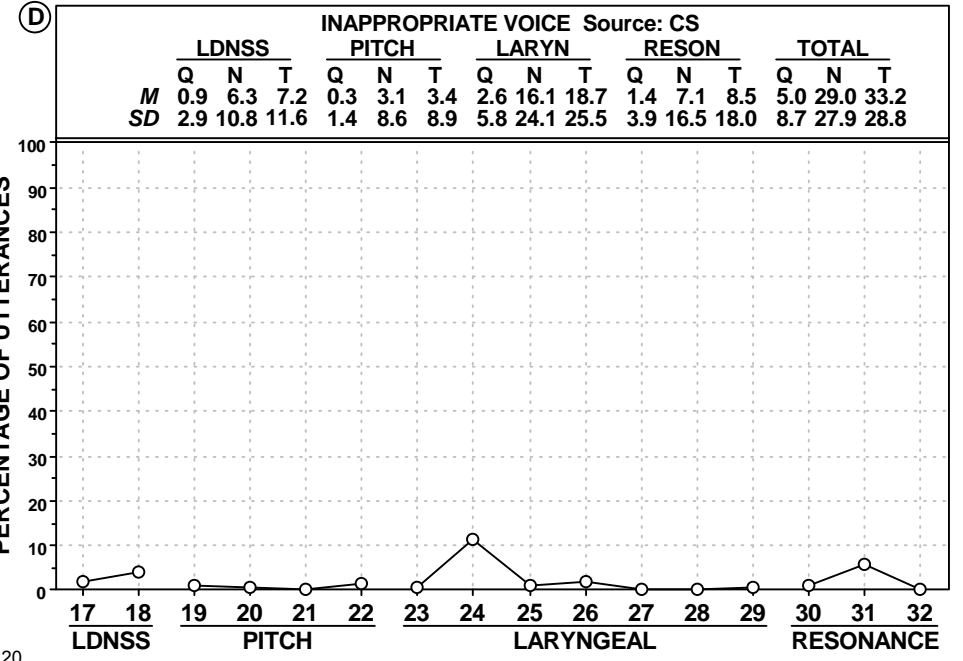
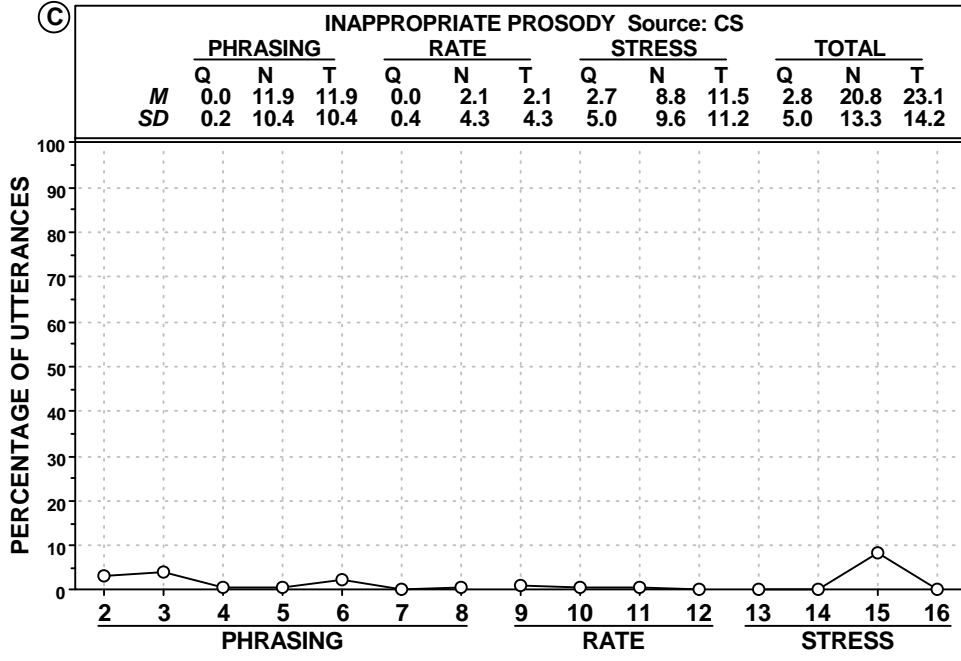
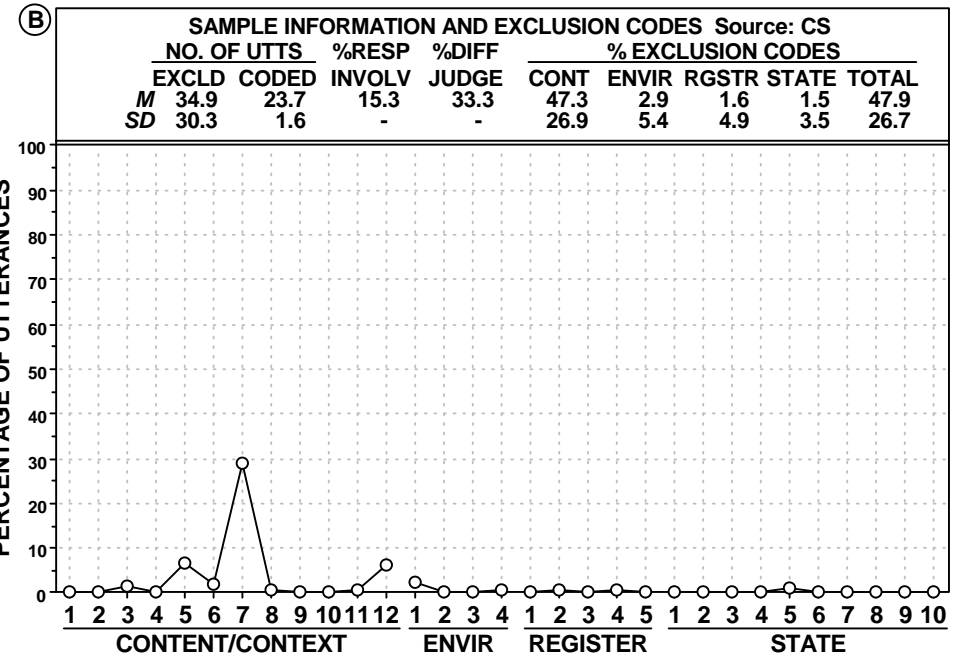
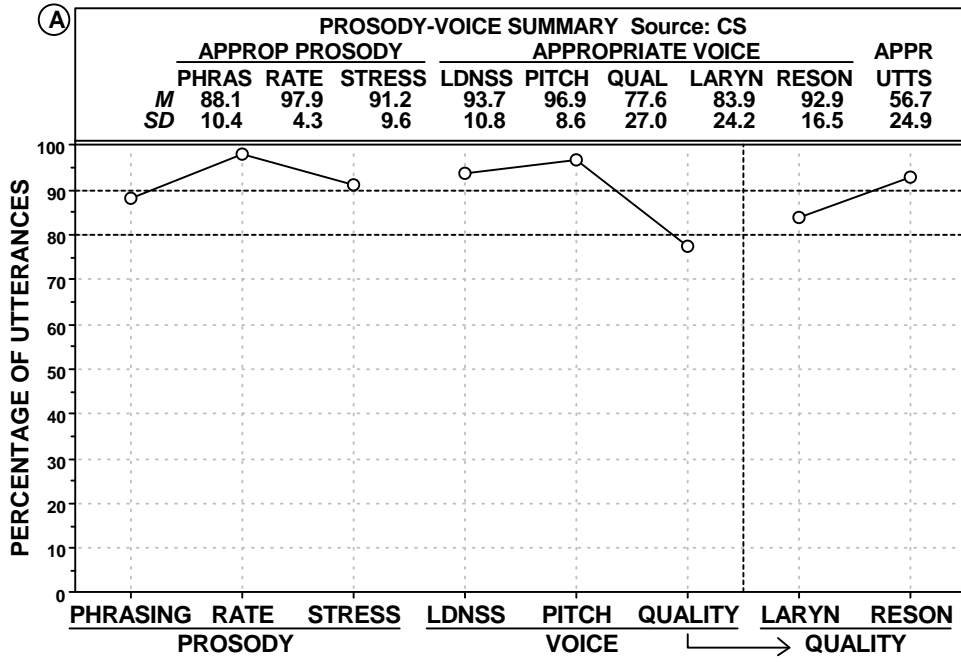
### 341 Participants with Idiopathic Speech Delay and No Motor Speech Disorder (No MSD)



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



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



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

Speech Competence Index (SCI): Group

Linguistic Domain	SCI Sign		Participants Positive on Sign		Ordinal Classification <sup>b</sup>
	No.	Description	Findings	% <sup>a</sup>	
<b>Vowels</b>					
	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
<b>Consonants</b>					
	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
<b>Vowels and Consonants</b>					
	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

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

<b>SCI Scores Summary</b>		<b>SCI Signs Summary</b>	
		<b>Number of signs with each ordinal classification</b>	
<b>Count</b>	<b>50</b>	<b>Very Frequent (VF): 80.0-100%</b>	<b>12</b>
<b>Mean</b>	<b>40.5</b>	<b>Frequent (F): 60.0-79.9%</b>	<b>12</b>
<b>Standard Deviation</b>	<b>18.3</b>	<b>Somewhat Frequent (SF): 40.0-59.9%</b>	<b>3</b>
<b>Range</b>	<b>21.1 - 97.4</b>	<b>Somewhat Infrequent (SI): 20.0-39.9%</b>	<b>5</b>
		<b>Infrequent (I): 0.0-19.9%</b>	<b>6</b>
		<b>Not Used</b>	<b>0</b>

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

<sup>b</sup> 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		Ordinal Classification <sup>b</sup>
Linguistic Domain	No.	Description	Positive on Sign			
			Findings	% <sup>a</sup>		
<b>Vowels</b>						
	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	
<b>Consonants</b>						
	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	
<b>Vowels and Consonants</b>						
	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	

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

SCI Scores Summary		SCI Signs Summary	
		<b>Number of signs with each ordinal classification</b>	
<b>Count</b>	<b>341</b>	<b>Very Frequent (VF): 80.0-100%</b>	<b>6</b>
<b>Mean</b>	<b>49.0</b>	<b>Frequent (F): 60.0-79.9%</b>	<b>13</b>
<b>Standard Deviation</b>	<b>18.6</b>	<b>Somewhat Frequent (SF): 40.0-59.9%</b>	<b>7</b>
<b>Range</b>	<b>18.4 - 100.0</b>	<b>Somewhat Infrequent (SI): 20.0-39.9%</b>	<b>2</b>
		<b>Infrequent (I): 0.0-19.9%</b>	<b>10</b>
		<b>Not Used</b>	<b>0</b>

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

<sup>b</sup> 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	
			%	Z	%	Z	%	Z	%	Z
<b>Intelligibility Index</b>	<b>II</b>	<b>50</b>	<b>88.8</b>	<b>-3.35</b>	<b>10.2</b>	<b>2.02</b>	<b>61.0</b>	<b>-5.00</b>	<b>100.0</b>	<b>1.08</b>

Ordinal Intelligibility Index	OII	n	High		Moderate		Low		n	%
			n	%	n	%	n	%		
			<b>33</b>	<b>66.0</b>	<b>7</b>	<b>14.0</b>	<b>10</b>	<b>20.0</b>		

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

Speech Competence Index	SCI	n	Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		<b>50</b>	<b>40.5</b>		<b>18.3</b>		<b>21.1</b>		<b>97.4</b>	

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

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

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	
			%	Z	%	Z	%	Z	%	Z
Intelligibility Index	II	341	92.1	-2.65	7.8	2.10	52.7	-5.00	100.0	0.95

Ordinal Intelligibility Index	OII	n	High		Moderate		Low		n	%
			%	Z	n	%	n	%		
			293	85.9	17	5.0	31	9.1		

Percentage of Consonants Correct	PCC	n	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	n	Mean		Standard Deviation		Minimum		Maximum	
			%	Z	%	Z	%	Z	%	Z
		341	49.0		18.6		18.4		100.0	

Prosody-Voice Screening Profile	PVSP	n	% of Participants with Inappropriate (<80%) Scores	
			%	Z
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	n	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

Linguistic Domain	PSI Sign				Participants Positive on Sign		Ordinal Classification <sup>c</sup>
	No.	Description	Assessment		Findings	% <sup>b</sup>	
			P	A			
Vowels							
	1	Reduced Dispersion of Corner Vowels from Center		X	10/36	27.8	SI
	2	Reduced Dispersion of Corner Vowels from $\wedge$		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 Modification 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

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

<b>PSI Scores Summary</b>		<b>PSI Signs Summary</b>	
		<b>Number of signs with each ordinal classification</b>	
<b>Count</b>	<b>50</b>	<b>Very Frequent (VF): 80.0-100%</b>	<b>0</b>
<b>Mean</b>	<b>63.8</b>	<b>Frequent (F): 60.0-79.9%</b>	<b>3</b>
<b>Standard Deviation</b>	<b>5.2</b>	<b>Somewhat Frequent (SF): 40.0-59.9%</b>	<b>10</b>
<b>Range</b>	<b>46.7 - 69.2</b>	<b>Somewhat Infrequent (SI): 20.0-39.9%</b>	<b>15</b>
		<b>Infrequent (I): 0.0-19.9%</b>	<b>4</b>
		<b>Not Used</b>	<b>0</b>

<sup>a</sup> **A: Acoustic; P: Perceptual**

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

<sup>c</sup> **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

Linguistic Domain	PSI Sign				Participants Positive on Sign		Ordinal Classification <sup>c</sup>
	No.	Description	Assessment		Findings	% <sup>b</sup>	
			P	A			
Vowels							
	1	Reduced Dispersion of Corner Vowels from Center		X	36/301	12.0	I
	2	Reduced Dispersion of Corner Vowels from $\wedge$		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 Modification 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

<b>Laryngeal Quality</b>							
	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
<b>Resonance Quality</b>							
	30	Increased % Inappropriate Resonance	X		29/341	8.5	I
	31	Decreased F1 /a/ (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	
		<b>Number of signs with each ordinal classification</b>	
<b>Count</b>	<b>341</b>	<b>Very Frequent (VF): 80.0-100%</b>	<b>0</b>
<b>Mean</b>	<b>83.5</b>	<b>Frequent (F): 60.0-79.9%</b>	<b>0</b>
<b>Standard Deviation</b>	<b>7.3</b>	<b>Somewhat Frequent (SF): 40.0-59.9%</b>	<b>1</b>
<b>Range</b>	<b>70.0 - 100.0</b>	<b>Somewhat Infrequent (SI): 20.0-39.9%</b>	<b>12</b>
		<b>Infrequent (I): 0.0-19.9%</b>	<b>19</b>
		<b>Not Used</b>	<b>0</b>

<sup>a</sup> **A: Acoustic; P: Perceptual**

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

<sup>c</sup> **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 <sup>a</sup>		Participants Positive on Sign		Ordinal Classification <sup>b</sup>	Five Dysarthria Subtype Indices (DSI) <sup>c</sup>						
			P	A	No.	% <sup>d</sup>		Ataxia	Spastic	Hyperkinetic	Hypokinetic	Flaccid		
<b>Vowels</b>														
	<b>1</b>	<b>Increased Percentage of Vowels/Diphthongs Distortions</b>	<b>X</b>		<b>21</b>	<b>42.0</b>	<b>SF</b>	<b>X(2)</b>		<b>X(2)</b>				
<b>Consonants</b>														
	<b>2</b>	<b>Number of Nasal Emissions</b>	<b>X</b>		<b>0</b>	<b>0.0</b>	<b>I</b>							<b>X(2)</b>
	<b>3</b>	<b>Increased Percentage of Weak Consonants</b>	<b>X</b>		<b>21</b>	<b>42.0</b>	<b>SF</b>							<b>X(1)</b>
<b>Vowels and Consonants</b>														
	<b>4</b>	<b>Increased Diacritic Modification Index Class Duration</b>	<b>X</b>		<b>20</b>	<b>40.0</b>	<b>SF</b>	<b>X(1)</b>		<b>X(1)</b>				
<b>Phrasing</b>														
	<b>5</b>	<b>Increased Slow/Pause Time</b>	<b>X</b>		<b>7</b>	<b>14.0</b>	<b>I</b>			<b>X(1)</b>	<b>X(2)</b>			
<b>Rate</b>														
	<b>6</b>	<b>Increased Slow Articulation/Pause Time</b>	<b>X</b>		<b>12</b>	<b>24.0</b>	<b>SI</b>	<b>X(1)</b>	<b>X(2)</b>	<b>X(1)</b>				
	<b>7</b>	<b>Decreased Average syllable speaking rate (with pauses)</b>		<b>X</b>	<b>12</b>	<b>24.0</b>	<b>SI</b>	<b>X(1)</b>	<b>X(2)</b>	<b>X(1)</b>				
	<b>8</b>	<b>Decreased Average syllable articulation rate (without pauses)</b>		<b>X</b>	<b>17</b>	<b>34.0</b>	<b>SI</b>	<b>X(1)</b>	<b>X(2)</b>	<b>X(1)</b>				
	<b>9</b>	<b>Increased Fast Rate</b>	<b>X</b>		<b>0</b>	<b>0.0</b>	<b>I</b>					<b>X(2)</b>		
	<b>10</b>	<b>Decreased Stability of syllable speaking rate</b>		<b>X</b>	<b>0</b>	<b>0.0</b>	<b>I</b>			<b>X(1)</b>	<b>X(2)</b>			
<b>Stress</b>														
	<b>11</b>	<b>Increased Excessive/Equal/Misplaced Stress</b>	<b>X</b>		<b>8</b>	<b>16.0</b>	<b>I</b>	<b>X(2)</b>	<b>X(1)</b>					
	<b>12</b>	<b>Increased Reduced/Equal Stress</b>	<b>X</b>		<b>1</b>	<b>2.0</b>	<b>I</b>					<b>X(2)</b>		
<b>Loudness</b>														
	<b>13</b>	<b>Decreased Stability of Speech Intensity Index</b>		<b>X</b>	<b>5</b>	<b>10.0</b>	<b>I</b>	<b>X(2)</b>		<b>X(2)</b>				
	<b>14</b>	<b>Increased Stability of Speech Intensity Index</b>		<b>X</b>	<b>13</b>	<b>26.0</b>	<b>SI</b>		<b>X(1)</b>		<b>X(2)</b>	<b>X(1)</b>		
	<b>15</b>	<b>Increased Soft</b>	<b>X</b>		<b>6</b>	<b>12.0</b>	<b>I</b>				<b>X(2)</b>	<b>X(1)</b>		
	<b>16</b>	<b>Decreased Speech Intensity Index</b>		<b>X</b>	<b>13</b>	<b>26.0</b>	<b>SI</b>				<b>X(2)</b>	<b>X(1)</b>		

<b>Pitch</b>													
	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)					
<b>Laryngeal Quality</b>													
	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)					
<b>Resonance Quality</b>													
	33	Increased Nasal	X		5	10.0	I		X(1)	X(1)	X(1)	X(2)	
	34	Decreased F1 for /a/ (Nasal)		X	10	21.7	SI		X(1)	X(1)	X(1)	X(2)	
		<b>Unweighted Total Possible Points</b>							<b>12</b>	<b>15</b>	<b>19</b>	<b>11</b>	<b>10</b>
		<b>Weighted Total Possible Points</b>							<b>15</b>	<b>23</b>	<b>22</b>	<b>19</b>	<b>15</b>

<sup>a</sup> A: Acoustic; P: Perceptual

<sup>b</sup> 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%

<sup>c</sup> 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  $\leq$  10<sup>th</sup> %ile.

<sup>d</sup> 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).

<b>DI Summary</b>	
<b>n</b>	<b>50</b>
<b>Mean Percentage Score</b>	<b>84.0</b>
<b>Standard Deviation</b>	<b>5.3</b>
<b>Range</b>	<b>73.5 - 94.1</b>

<b>DSI Summary</b>					
	<b>Ataxia</b>	<b>Spastic</b>	<b>Hyper-kinetic</b>	<b>Hypo-kinetic</b>	<b>Flaccid</b>
<b>Mean DSI Percentage Score</b>	<b>75.1</b>	<b>83.5</b>	<b>83.1</b>	<b>89.3</b>	<b>88.4</b>
<b>Mean DSI Percentile Score</b>	<b>50.2</b>	<b>47.8</b>	<b>51.1</b>	<b>48.7</b>	<b>46.2</b>
<b>Percentage of Participants <math>\leq</math> 10<sup>th</sup> %ile</b>	<b>2.0</b>	<b>0.0</b>	<b>0.0</b>	<b>2.0</b>	<b>8.0</b>

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 <sup>a</sup>		Participants Positive on Sign		Ordinal Classification <sup>b</sup>	Five Dysarthria Subtype Indices (DSI) <sup>c</sup>					
			P	A	No.	% <sup>d</sup>		Ataxia	Spastic	Hyperkinetic	Hypokinetic	Flaccid	
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)	

<b>Pitch</b>												
	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)				
<b>Laryngeal Quality</b>												
	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)				
<b>Resonance Quality</b>												
	33	Increased Nasal	X		31	9.1	I		X(1)	X(1)	X(1)	X(2)
	34	Decreased F1 for /a/ (Nasal)		X	44	13.4	I		X(1)	X(1)	X(1)	X(2)
					<b>Unweighted Total Possible Points</b>			<b>12</b>	<b>15</b>	<b>19</b>	<b>11</b>	<b>10</b>
					<b>Weighted Total Possible Points</b>			<b>15</b>	<b>23</b>	<b>22</b>	<b>19</b>	<b>15</b>

<sup>a</sup> A: Acoustic; P: Perceptual

<sup>b</sup> 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%

<sup>c</sup> 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  $\leq$  10<sup>th</sup> %ile.

<sup>d</sup> 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).

<b>DI Summary</b>	
<b>n</b>	<b>341</b>
<b>Mean Percentage Score</b>	<b>90.4</b>
<b>Standard Deviation</b>	<b>5.3</b>
<b>Range</b>	<b>76.5 - 100.0</b>

<b>DSI Summary</b>					
	<b>Ataxia</b>	<b>Spastic</b>	<b>Hyper-kinetic</b>	<b>Hypo-kinetic</b>	<b>Flaccid</b>
<b>Mean DSI Percentage Score</b>	<b>86.7</b>	<b>93.0</b>	<b>89.1</b>	<b>92.8</b>	<b>90.5</b>
<b>Mean DSI Percentile Score</b>	<b>69.9</b>	<b>68.2</b>	<b>65.5</b>	<b>61.3</b>	<b>53.8</b>
<b>Percentage of Participants <math>\leq</math> 10<sup>th</sup> %ile</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>4.1</b>	<b>7.9</b>

**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) <sup>b</sup>			Inappropriate Pauses						
Before		After			Rate		Stress		Transcoding		n	%	Type I	n	%	Type II		n	%	
n	%	n	%		n	%	n	%	n	%										
					Code 1	0	0.0	0	0.0	0	0.0	Mild	50	100.0	Abrupt	50	0.5	Long	50	0.4
PM+	0	0.0	0	0.0		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
? <sup>a</sup>	2	4.0	0	0.0								Severe	0	0.0	Grope	50	0.1	Addition	50	0.0

<sup>a</sup> ? = Indeterminate (Shriberg, Strand, Fourakis et al., 2017)

<sup>b</sup> Mild =  $\geq 90.0$   
 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) <sup>b</sup>			Inappropriate Pauses							
Before		After		Rate		Stress		Transcoding		n	%	Type I	n	%	Type II	n	%			
n	%	n	%	n	%	n	%	n	%											
												<b>Mild</b>	<b>341</b>	<b>100.0</b>	<b>Abrupt</b>	<b>341</b>	<b>0.4</b>	<b>Long</b>	<b>341</b>	<b>0.2</b>
<b>PM+</b>	<b>0</b>	<b>0.0</b>	<b>0</b>	<b>0.0</b>	<b>Code 1</b>	<b>1</b>	<b>16.7</b>	<b>1</b>	<b>16.7</b>	<b>1</b>	<b>16.7</b>	<b>Mild-Moderate</b>	<b>0</b>	<b>0.0</b>	<b>Alone</b>	<b>341</b>	<b>0.1</b>	<b>Repeat/Revise</b>	<b>341</b>	<b>0.2</b>
<b>PM-</b>	<b>335</b>	<b>98.2</b>	<b>341</b>	<b>100.0</b>	<b>Code 0</b>	<b>5</b>	<b>83.3</b>	<b>5</b>	<b>83.3</b>	<b>3</b>	<b>50.0</b>	<b>Moderate-Severe</b>	<b>0</b>	<b>0.0</b>	<b>Change</b>	<b>341</b>	<b>0.1</b>	<b>Breath</b>	<b>341</b>	<b>0.2</b>
<b>?<sup>a</sup></b>	<b>6</b>	<b>1.8</b>	<b>0</b>	<b>0.0</b>								<b>Severe</b>	<b>0</b>	<b>0.0</b>	<b>Grope</b>	<b>341</b>	<b>0.0</b>	<b>Addition</b>	<b>341</b>	<b>0.0</b>

<sup>a</sup> ? = Indeterminate (Shriberg, Strand, Fourakis et al., 2017)

<sup>b</sup> Mild =  $\geq 90.0$   
 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)**

<b>Speech Disorders Classification System Summary (SDCSS): Group</b>								
<b>Speech Classification</b>		<b>Motor Speech Classification</b>					<b>Totals</b>	
		<b>No Motor Speech Disorder (No MSD)</b>	<b>Speech Motor Delay (SMD)</b>	<b>Childhood Dysarthria (CD)</b>	<b>Childhood Apraxia of Speech (CAS)</b>	<b>Childhood Dysarthria and Childhood Apraxia of Speech (CD &amp; CAS)</b>	<b>n</b>	<b>%</b>
<b>Normal(ized) Speech Acquisition (NSA)<sup>a</sup></b>		<b>0</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>16.0</b>
<b>Speech Errors (SE)</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.0</b>
<b>Persistent Speech Errors (PSE)</b>		<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2.0</b>
<b>(SE/PSE)</b>		<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2.0</b>
<b>Speech Delay (SD)</b>		<b>0</b>	<b>40</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>40</b>	<b>80.0</b>
<b>Persistent Speech Delay (PSD)</b>		<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>2.0</b>
<b>(SD/PSD)</b>		<b>0</b>	<b>41</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>41</b>	<b>82.0</b>
<b>Totals</b>								
	<b>n</b>	<b>0</b>	<b>50</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>50</b>	
	<b>%</b>	<b>0.0</b>	<b>100.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>		<b>100.0</b>

<sup>a</sup> Includes children younger than 9 years old with age-appropriate distortions

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

<b>Speech Disorders Classification System Summary (SDCSS): Group</b>								
<b>Speech Classification</b>		<b>Motor Speech Classification</b>					<b>Totals</b>	
		<b>No Motor Speech Disorder (No MSD)</b>	<b>Speech Motor Delay (SMD)</b>	<b>Childhood Dysarthria (CD)</b>	<b>Childhood Apraxia of Speech (CAS)</b>	<b>Childhood Dysarthria and Childhood Apraxia of Speech (CD &amp; CAS)</b>	<b>n</b>	<b>%</b>
<b>Normal(ized) Speech Acquisition (NSA)<sup>a</sup></b>		<b>45</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>45</b>	<b>13.2</b>
<b>Speech Errors (SE)</b>		<b>10</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>10</b>	<b>2.9</b>
<b>Persistent Speech Errors (PSE)</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0.6</b>
<b>(SE/PSE)</b>		<b>12</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>12</b>	<b>3.5</b>
<b>Speech Delay (SD)</b>		<b>284</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>284</b>	<b>83.3</b>
<b>Persistent Speech Delay (PSD)</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.0</b>
<b>(SD/PSD)</b>		<b>284</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>284</b>	<b>83.3</b>
<b>Totals</b>		<b>341</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>341</b>	
		<b>100.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>		<b>100.0</b>

<sup>a</sup> Includes children younger than 9 years old with age-appropriate distortions

**PART III:**  
**SPEECH ANALYSES**

## **VOWEL/DIPHTHONG ANALYSES**

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		Deletion		Substitution		Distortion		Total Sounds
		N	%	N	%	N	%	N	%	
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
ʊ	Initial									
	Medial									
	Final									
	Total									
ɜ	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
o	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
ɔ	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		Deletion		Substitution		Distortion		Total Sounds
		N	%	N	%	N	%	N	%	
u	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
U	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
D	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
ɑ̄	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
ɑ̄	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
ē	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
oū	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
ɔ̄	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 N \_\_\_\_\_ Sampling Date \_\_\_\_\_ \*  
 Date of Birth \_\_\_\_\_ \* Sampling Clinician \_\_\_\_\_ \*  
 Age at Sampling Date \_\_\_\_\_ 0 yrs 0 mos Analysis Date \_\_\_\_\_

Sound	Position In Word	Correct		Deletion		Substitution		Distortion		Total Sounds
		N	%	N	%	N	%	N	%	
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
ʊ	Initial									
	Medial	2	100.00							2
	Final					1	100.00			1
	Total	2	66.67			1	33.33			3
ɜ	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
o	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
ɔ	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		Deletion		Substitution		Distortion		Total Sounds
		N	%	N	%	N	%	N	%	
U	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
u	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
o	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
D	Initial									
	Medial									
	Final									
	Total									
a	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
aI	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
au	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
eI	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
ou	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
oI	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



## **CONSONANT ANALYSES**

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

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	
ɟʃ	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
<b>INTELLIGIBILITY INDEX</b>		<b>86.98</b>

71.73

Percentage  
 Consonants  
 Correct  
 (PCC)

Severity Adjective

MILD-MODERATE

PERCENTAGE CONSONANTS CORRECT (PCC)

Child \_\_\_\_\_  
 Study Identification \_\_\_\_\_  
 DOB \_\_\_\_\_  
 Age at Sampling Date \_\_\_\_\_  
 Sampling Date \_\_\_\_\_  
 Sampling Clinician \_\_\_\_\_  
 Pepfile Entry Date \_\_\_\_\_

Severity Adjective:

<u>PCC</u>	<u>Adjective</u>
>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
Fricatives and Affricates	g	2104	643	415	128	537	178	3056	4005	3.16	76.30
	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
Liquids	tʃ	225	171	100	100	130	127	455	853	0.67	53.34
	ɟʃ	311	321	83	41	60	71	454	887	0.70	51.18
	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
<b>INTELLIGIBILITY INDEX</b>		<b>90.95</b>

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:

<u>PCC</u>	<u>Adjective</u>
>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
dʒ	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
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<u>Single</u>	<u>Cluster</u>	<u>Single</u>	<u>Cluster</u>	<u>Single</u>	<u>Cluster</u>
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:

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

MULTISYLLABLE WORDS

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

Notes: \_\_\_\_\_

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## **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: \_\_\_\_\_  
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STRUCTURAL STATISTICS

Filename \_\_\_\_\_  
 Study Identification \_\_\_\_\_  
 DOB \_\_\_\_\_  
 Age at Sampling Date \_\_\_\_\_

Sampling Date \* \_\_\_\_\_  
 Sampling Clinician \* \_\_\_\_\_  
 Pepfile Entry Date \* \_\_\_\_\_  
 Transcriber \* \_\_\_\_\_

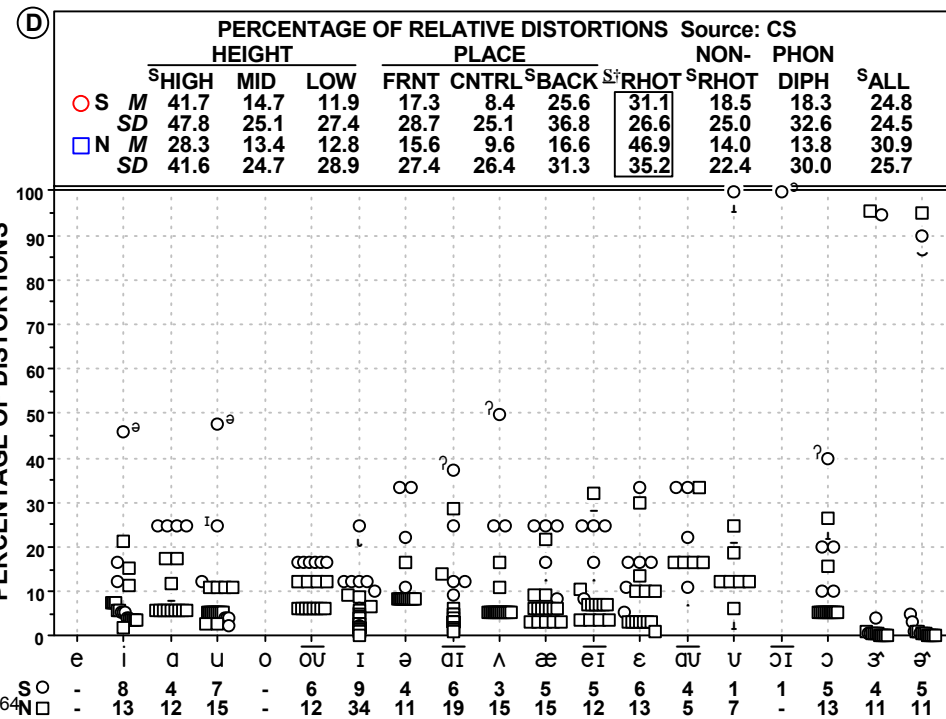
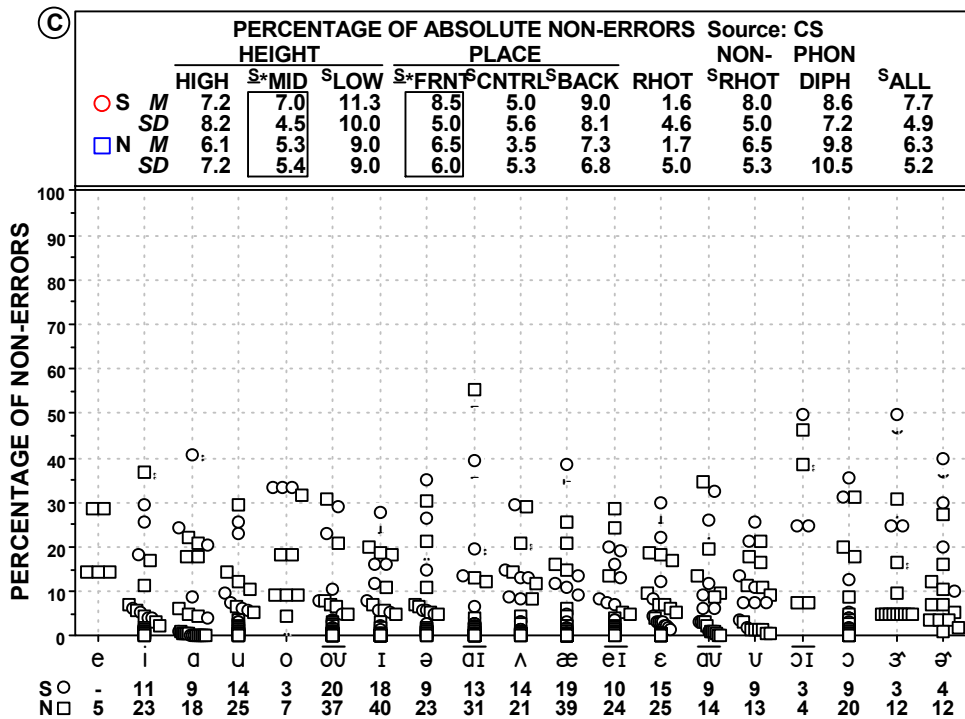
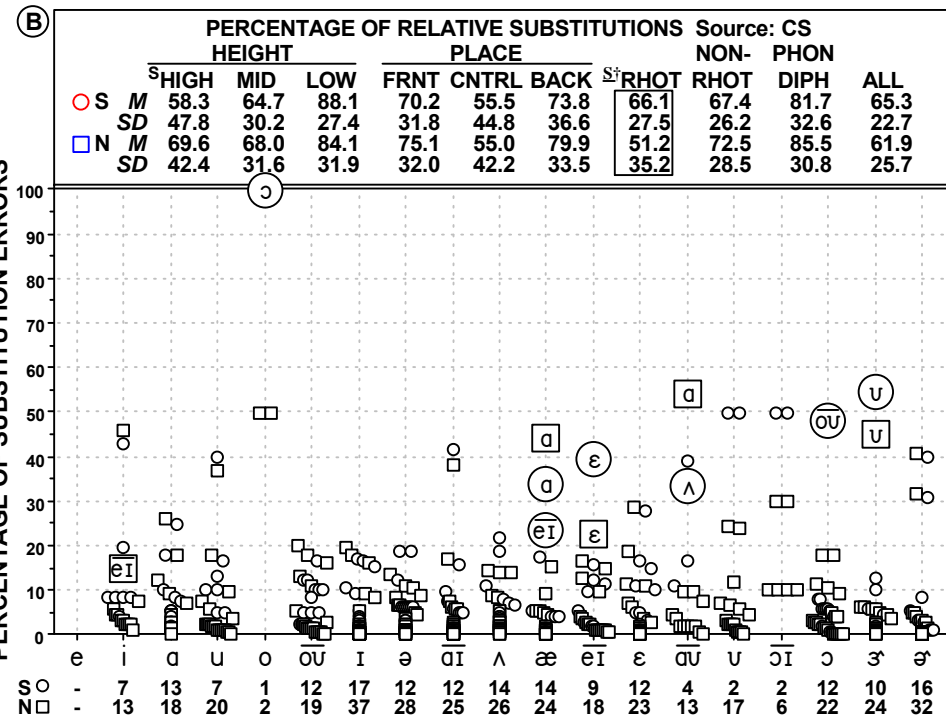
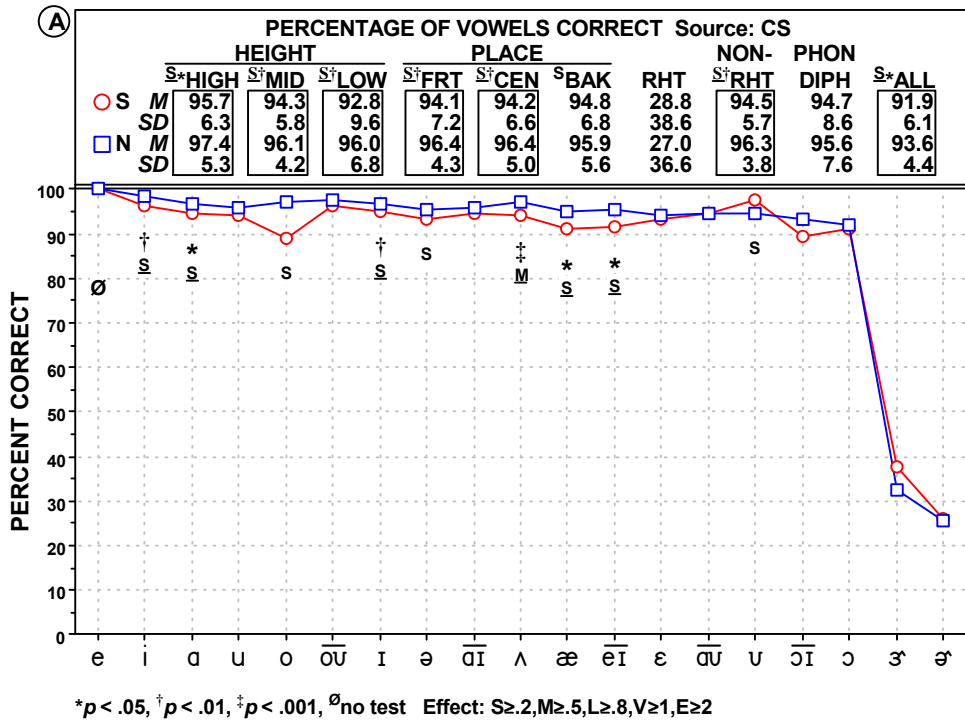
TYPE	CANONICAL FORM	INTENDED (Y)		OBTAINED (Z)		OBTAINED=INTENDED	
		n	%	n	%	n	%
1	V	8044	9.46	9236	10.86	8002	99.48
2	CV	18479	21.72	21078	24.78	18094	97.92
3	VC	11997	14.10	11605	13.64	11043	92.05
4	CVC	23686	27.84	21275	25.01	20176	85.18
5	CnV	1004	1.18	723	0.85	617	61.45
6	CnVC	1579	1.86	1004	1.18	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			

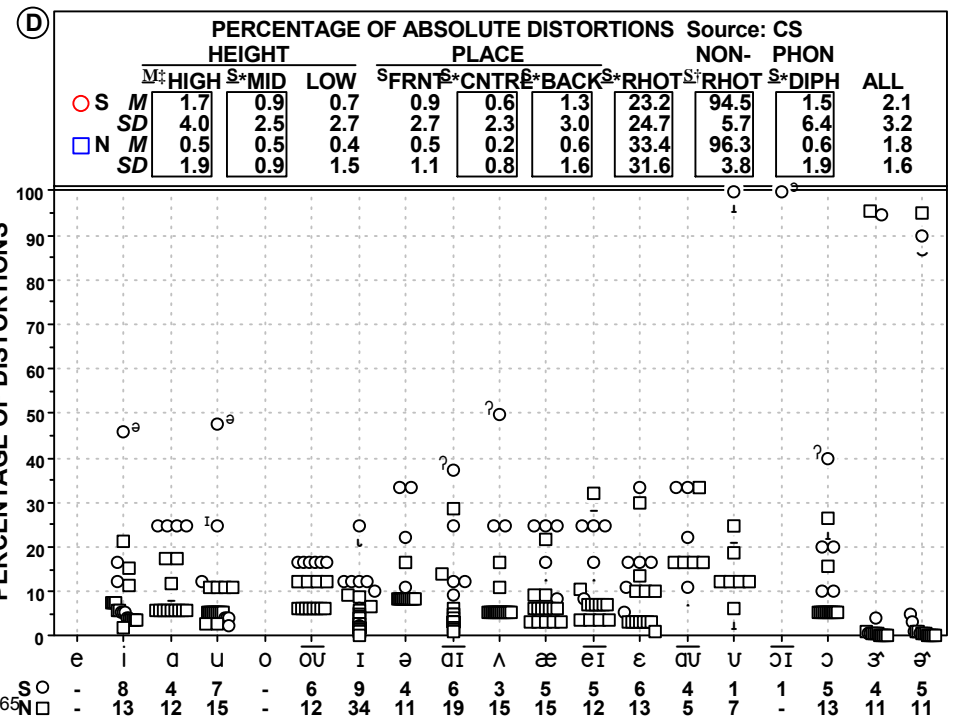
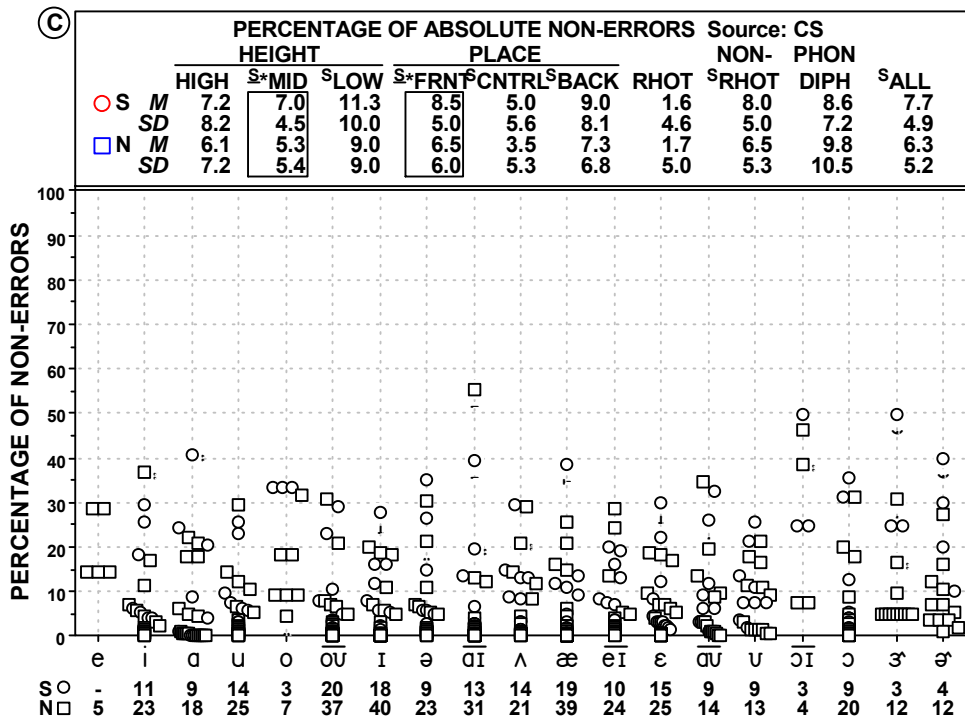
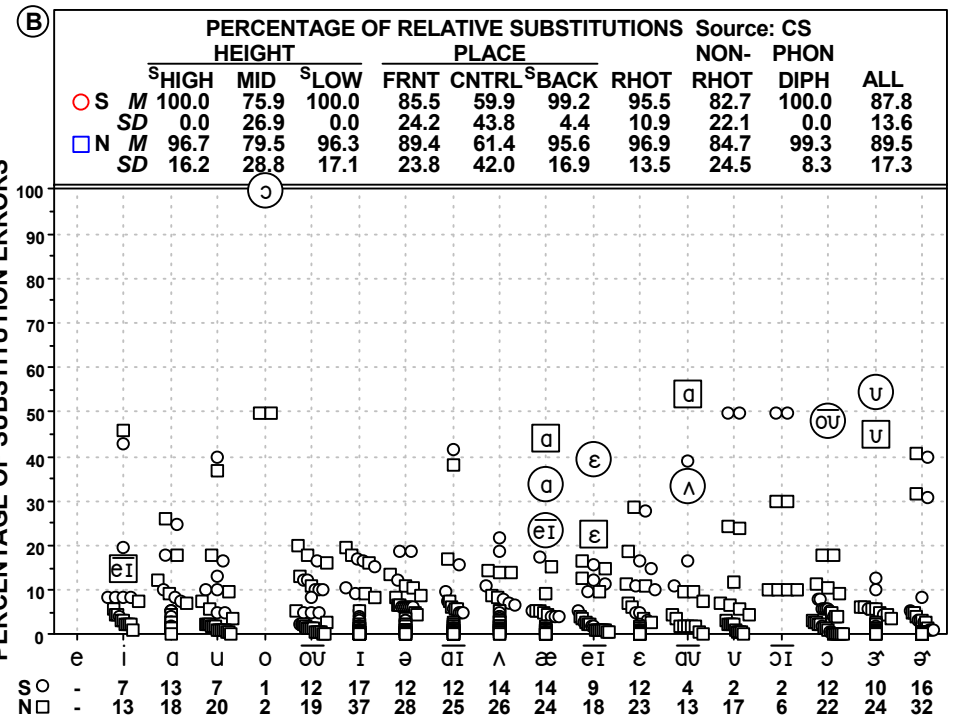
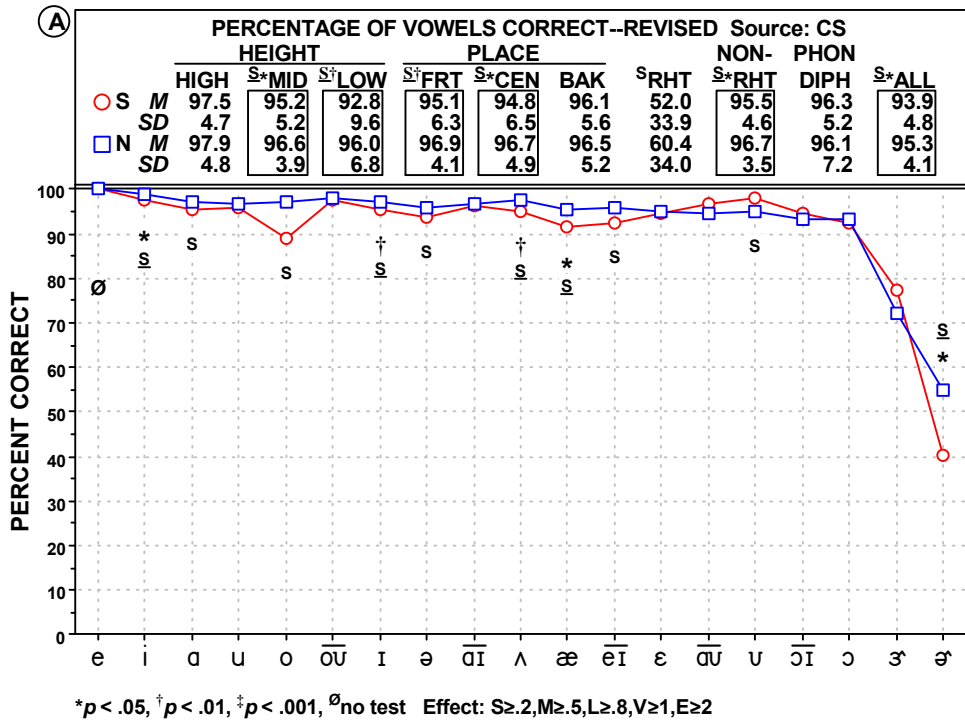
Average Words / Utterance	Type-Token Percentage
94333 / 26636 = 3.54	4130 / 72053 = 5.73

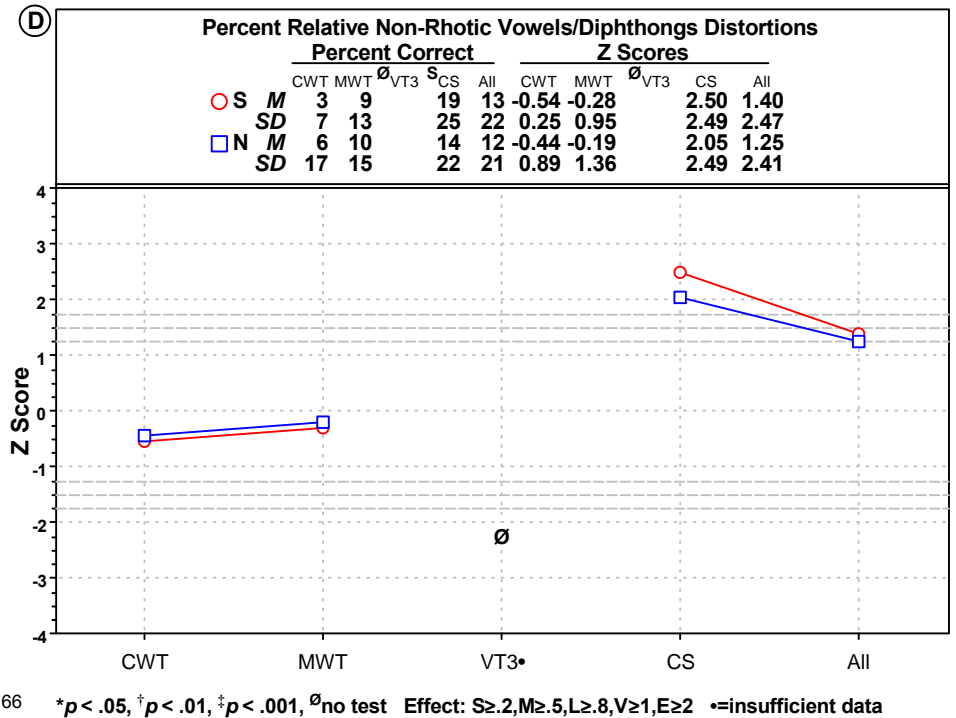
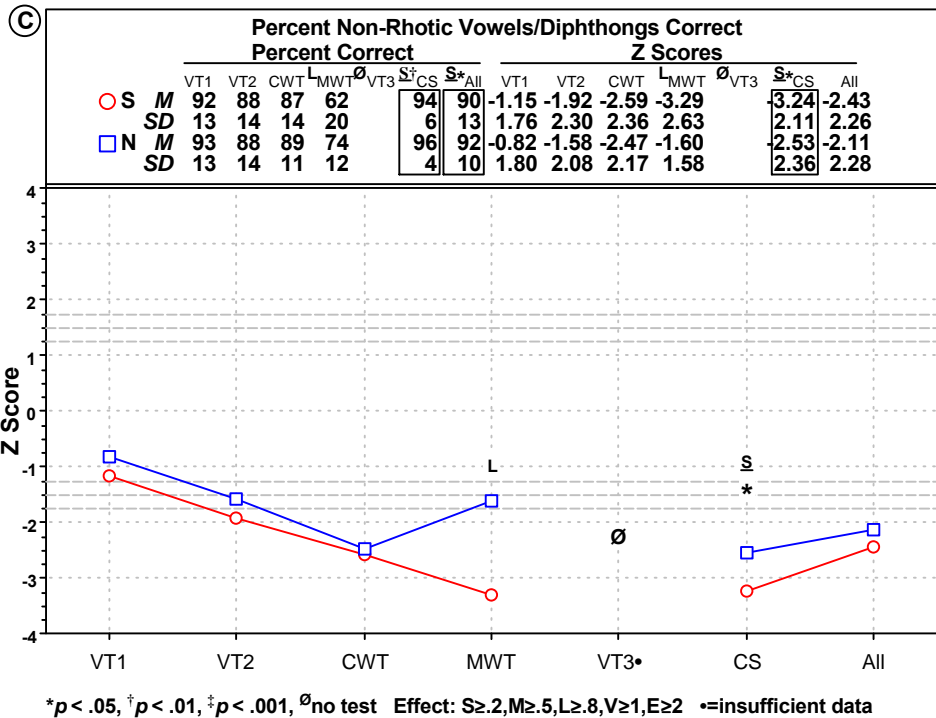
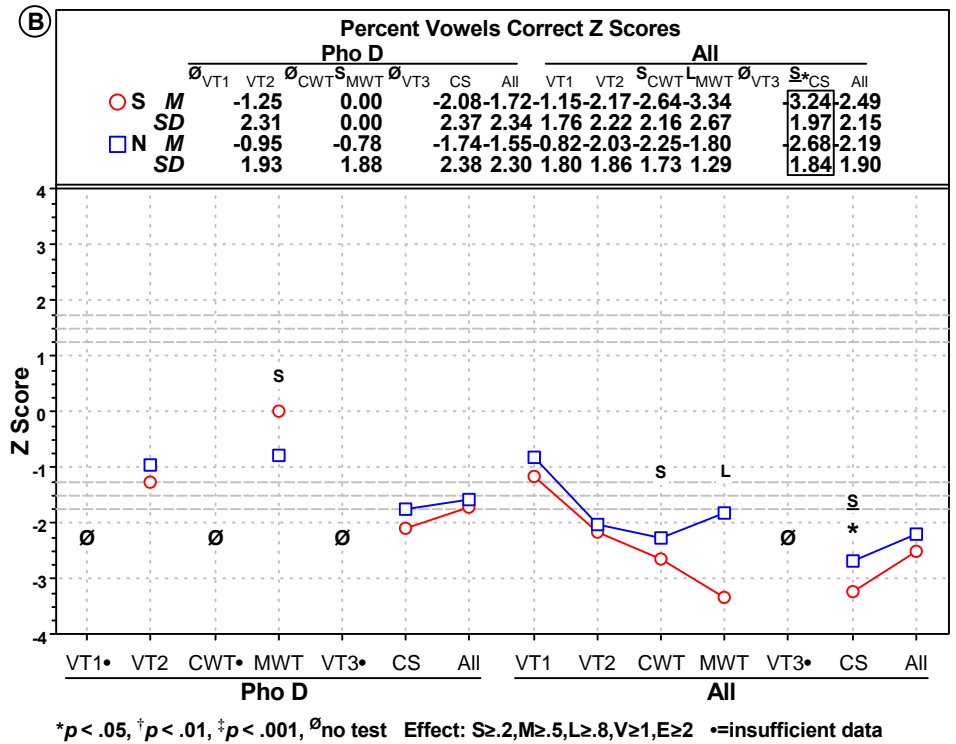
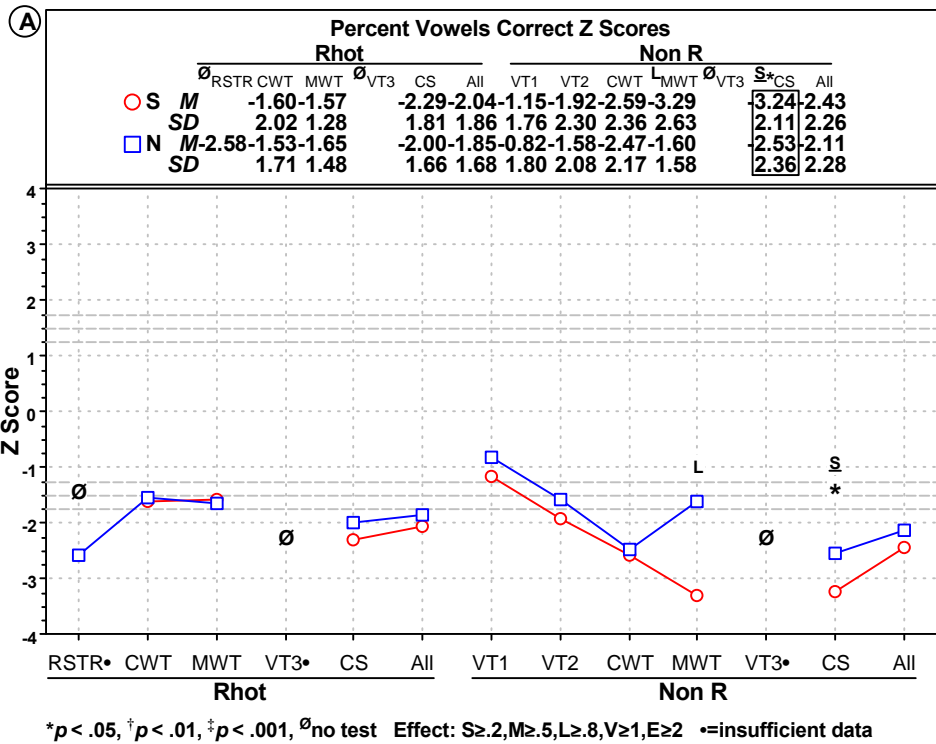
Notes: \_\_\_\_\_  
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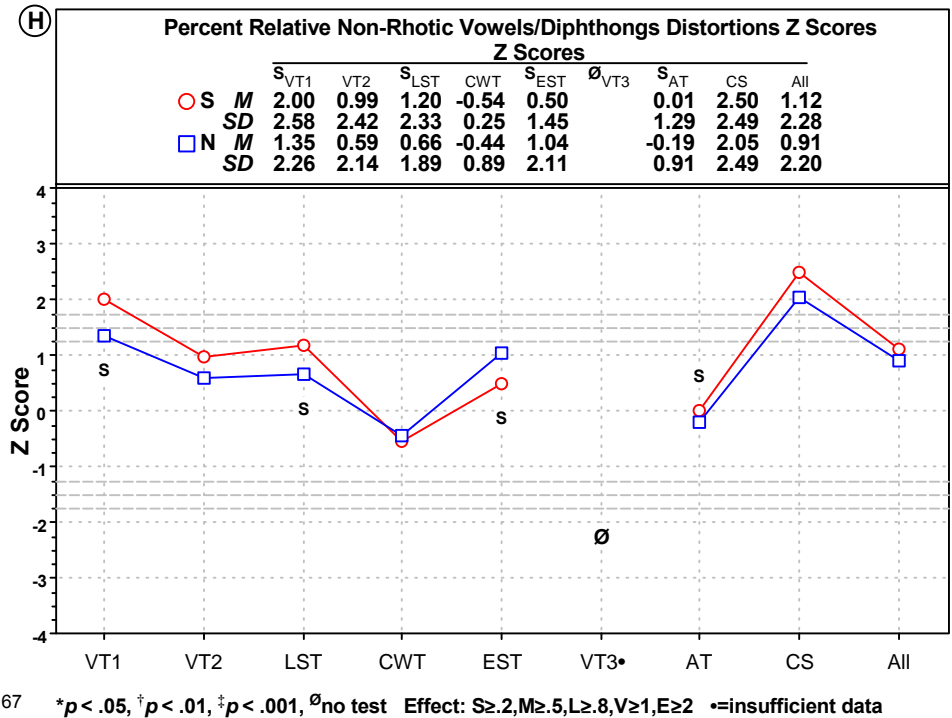
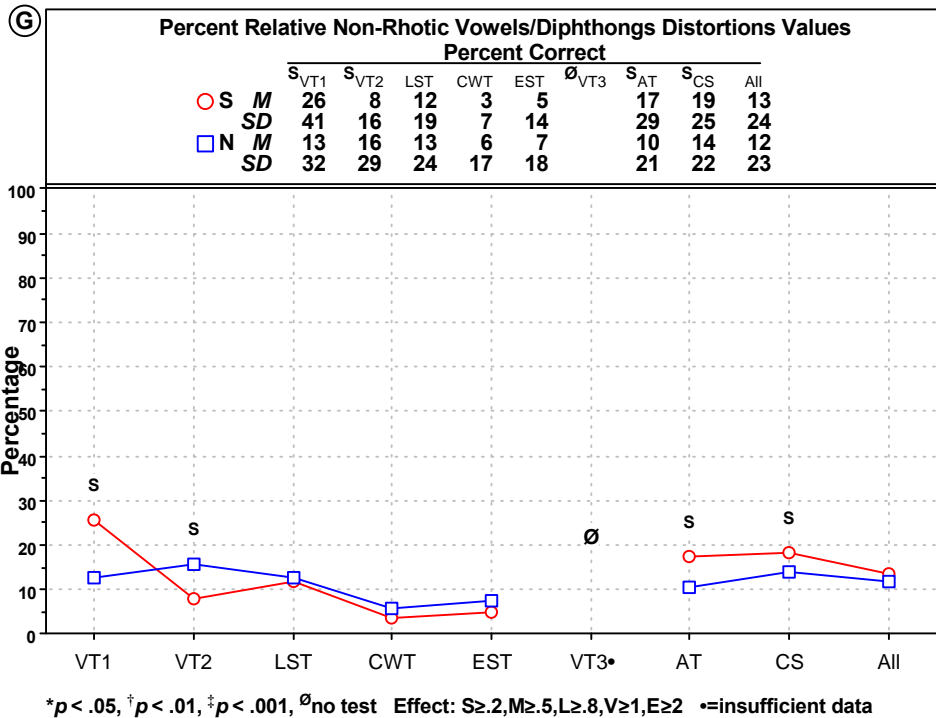
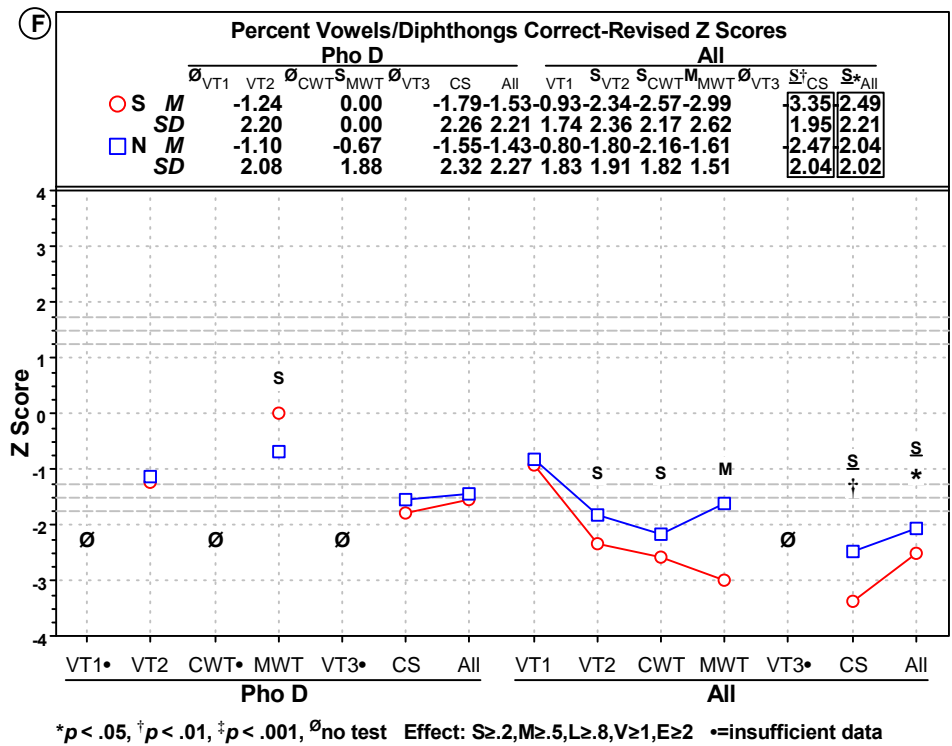
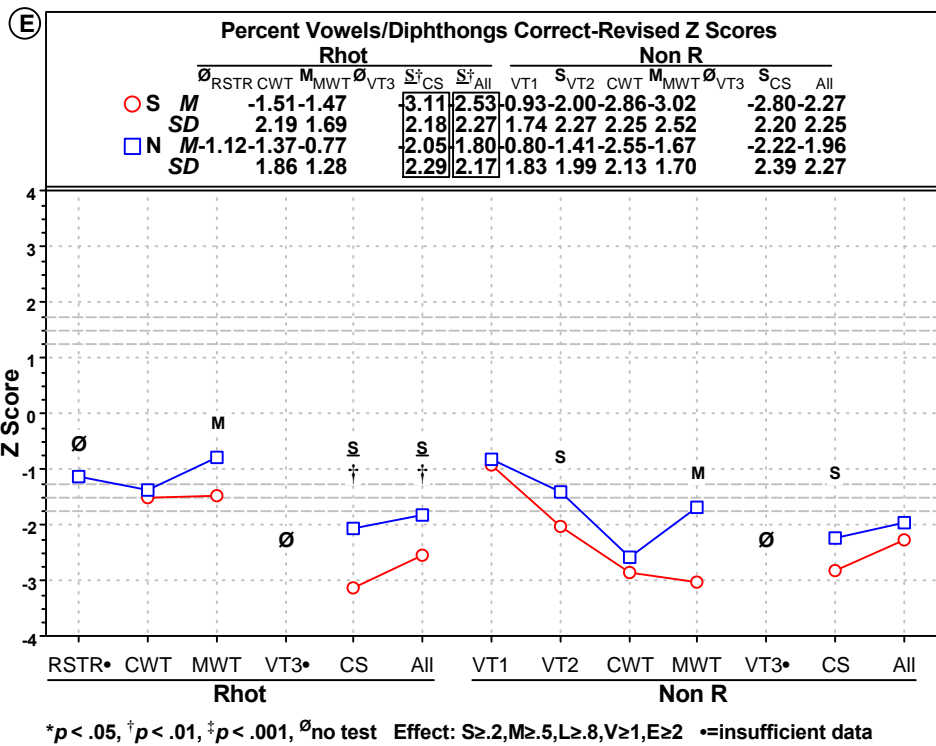
**PART IV:**  
**TEN LINGUISTIC DOMAINS PROFILES**

## **VOWEL PROFILES**





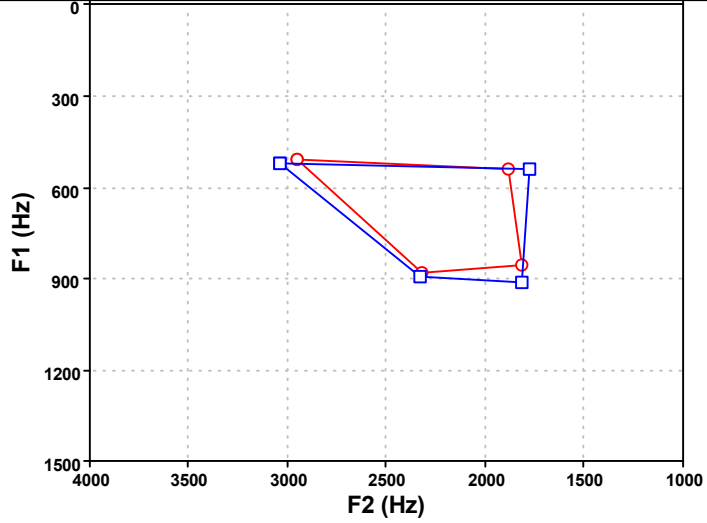




Vowel Profile 3, S and N

**(A) Vowel Space Quadrilateral Source: CS24**

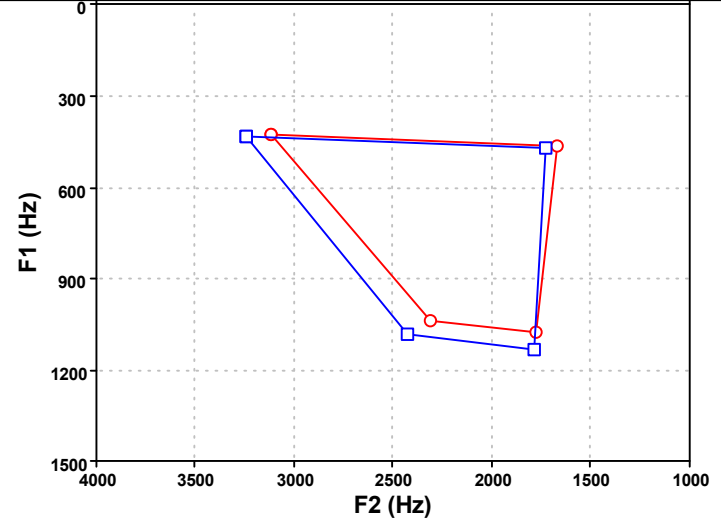
	i									æ			u			ɑ			All	Planar Area	
	F1	SF2	S†N	F1	F2	N	F1	SF2	N	SF1	F2	N	SF1	F2	N	S†N	S <sup>‡</sup> VSQ	M <sup>‡</sup> VSQL			
○ S	M 506	2949	2	882	2317	3	537	1878	2	854	1811	2	9	239,765	0.144						
	SD 97	405	1	246	301	1	83	490	1	222	228	1	3	188,062	0.107						
□ N	M 517	3035	3	895	2321	3	540	1771	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						



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

**(B) Vowel Space Quadrilateral Source: VT1**

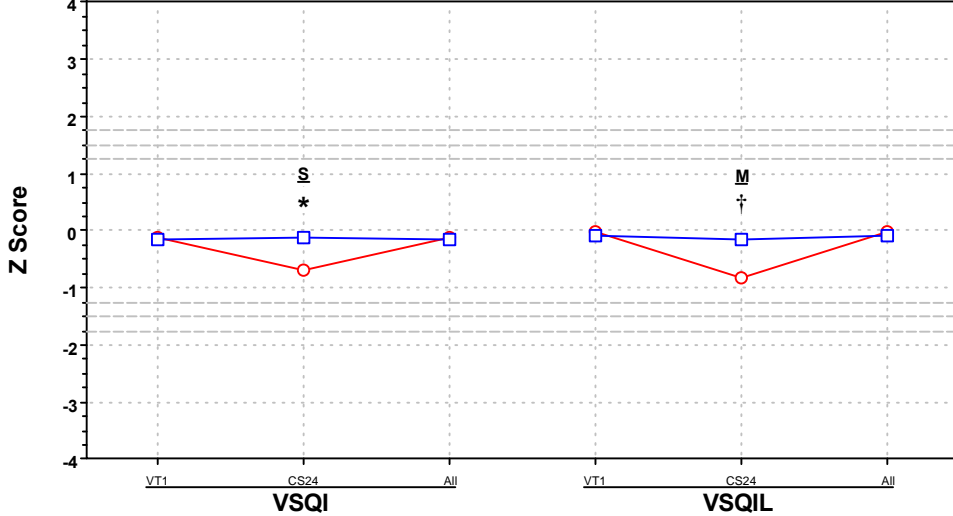
	i									æ			u			ɑ			All	Planar Area	
	F1	SF2	S†N	F1	F2	N	F1	SF2	N	SF1	F2	N	SF1	F2	N	S†N	S <sup>‡</sup> VSQ	M <sup>‡</sup> VSQL			
○ S	M 427	3115	3	1036	2308	3	463	1668	4	1076	1773	3	13	642,777	0.418						
	SD 48	317	1	175	219	1	49	341	1	183	225	1	3	242,665	0.148						
□ N	M 432	3235	4	1081	2421	4	468	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						



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

**(C) Vowel Space Quadrilateral**

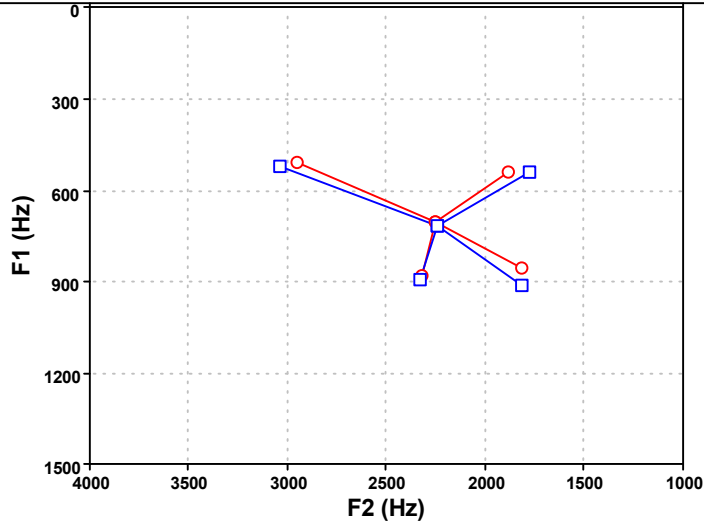
	VSQI			VSQIL			Z VSQI			Z VSQIL		
	S <sup>‡</sup> VT1	S <sup>‡</sup> CS24	S <sup>‡</sup> All	VT1	M <sup>‡</sup> CS24	All	VT1	S <sup>‡</sup> CS24	All	VT1	M <sup>‡</sup> CS24	All
○ S	M 642777	239765	642777	0.42	0.14	0.42	-0.13	0.68	-0.13	-0.01	0.84	-0.01
	SD 242665	188062	242665	0.15	0.11	0.15	1.21	1.33	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



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

**(A) Vowel Space Dispersion--Corner Vowels from Center Source: CS24**

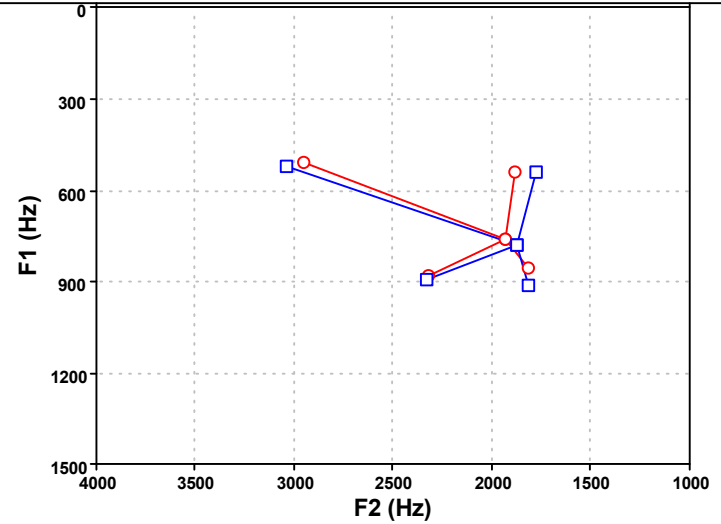
	Center		Dist. from Center				Dispersion	
	F1	F2	M <sup>†</sup> <sub>i</sub>	æ	S <sup>*</sup> <sub>U</sub>	ɑ	M <sup>†</sup> <sub>VSD</sub>	VSDL
○ S	M 701	2244	707	415	509	537	545	0.371
	SD 117	214	253	176	209	163	120	0.083
□ N	M 716	2233	861	415	609	563	610	0.419
	SD 92	178	250	156	240	180	119	0.080



\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(B) Vowel Space Dispersion--Corner Vowels from ^ Source: CS24**

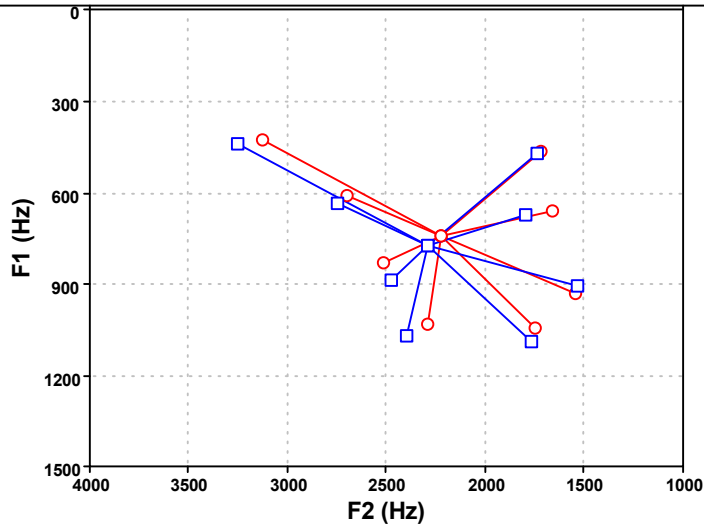
	^		Distance from ^				Dispersion	
	F1	F2	S <sup>*</sup> <sub>i</sub>	æ	u	ɑ	S <sup>*</sup> <sub>VSD</sub>	VSDL
○ S	M 761	1922	1058	505	490	389	599	0.401
	SD 180	300	375	339	311	212	189	0.118
□ N	M 782	1872	1218	553	500	353	655	0.445
	SD 145	270	392	288	272	202	154	0.095



\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(C) Vowel Space Dispersion--8 Vowels from Center Source: VT1+VT2**

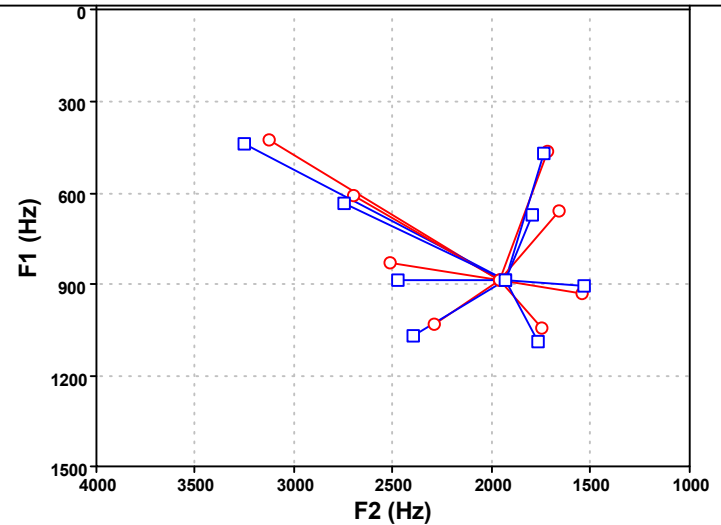
	Center		Distance from Center								Dispersion	
	S <sup>*</sup> <sub>F1</sub>	S <sup>*</sup> <sub>F2</sub>	S <sub>i</sub>	S <sub>æ</sub>	u	S <sub>ɑ</sub>	S <sub>I</sub>	S <sub>ε</sub>	S <sub>U</sub>	S <sub>o</sub>	VSD	VSDL
○ S	M 739	2219	959	398	649	634	530	361	594	720	614	0.435
	SD 78	124	265	85	251	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



\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(D) Vowel Space Dispersion--8 Vowels from ^ Source: VT1+VT2**

	^		Distance from ^								Dispersion	
	F1	F2	S <sub>i</sub>	M <sub>æ</sub>	u	ɑ	S <sub>I</sub>	ε	S <sub>U</sub>	o	VSD	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

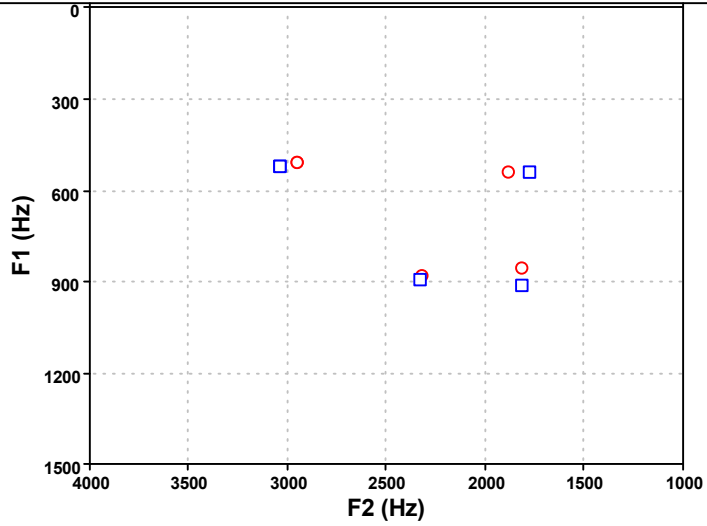


\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

Vowel Profile 5, S and N

**(A) Vowel Space Pairwise--Corner Vowels Source: CS24**

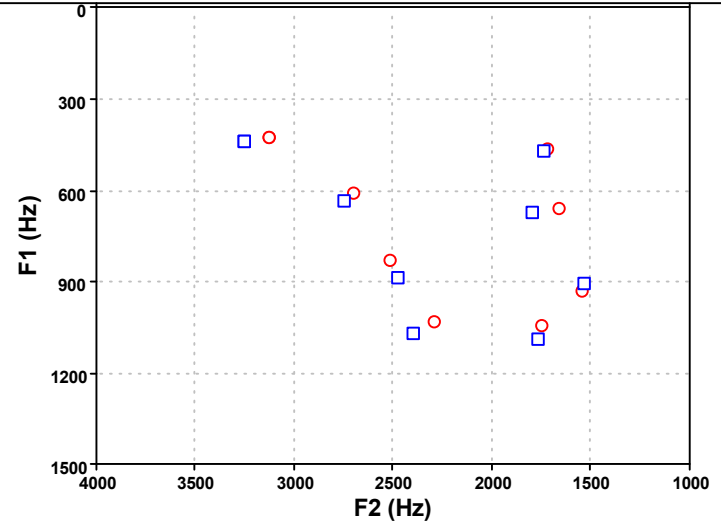
		Distance Between Vowels						Pairwise	
		i-æ	ɪ-ɑ	ɪ-i	æ-ɑ	æ-u	ɑ-u	M <sup>†</sup> VSP	M <sup>‡</sup> VSPL
○ S	M	829	1203	1029	576	717	553	781	0.523
	SD	366	439	573	281	347	295	201	0.138
□ N	M	860	1320	1279	591	771	607	905	0.608
	SD	365	388	520	284	352	270	213	0.132



\* $p < .05$ , <sup>†</sup> $p < .01$ , <sup>‡</sup> $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(B) Vowel Space Pairwise--8 Vowels Source: VT1+VT2**

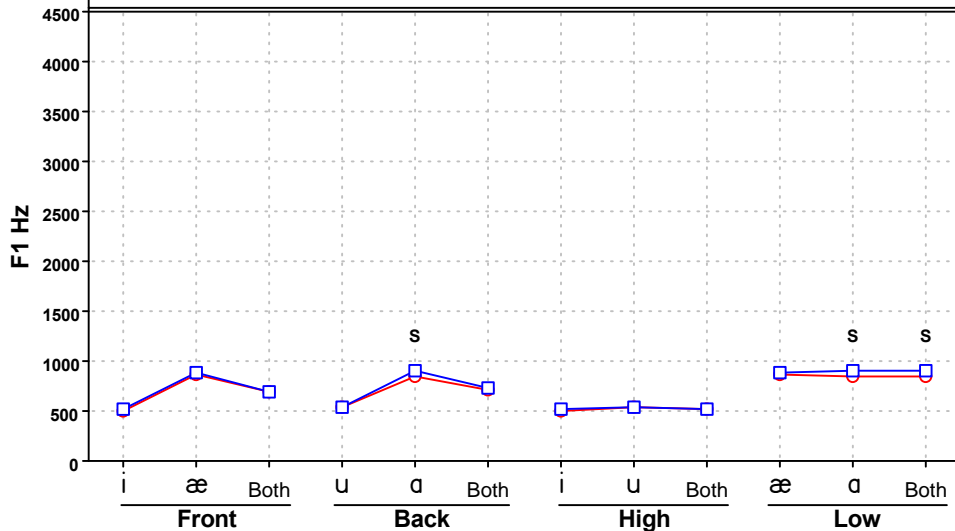
		I			ε			U			ɔ			All	Pairwise	
		SF1	SF2	M <sup>†</sup> N	SF1	F2	S <sup>‡</sup> N	F1	M <sup>†</sup> F2	S <sup>‡</sup> N	F1	F2	N	S <sup>‡</sup> N	VSP	VSPL
○ S	M	607	2699	3	826	2507	3	656	1655	3	931	1538	3	26	869	0.617
	SD	87	208	1	139	216	1	97	173	2	136	168	1	6	112	0.056
□ N	M	636	2743	4	883	2473	3	669	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



\* $p < .05$ , <sup>†</sup> $p < .01$ , <sup>‡</sup> $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(A) Vowel Formant Analysis (VFA): Corner F1 Source: CS24**

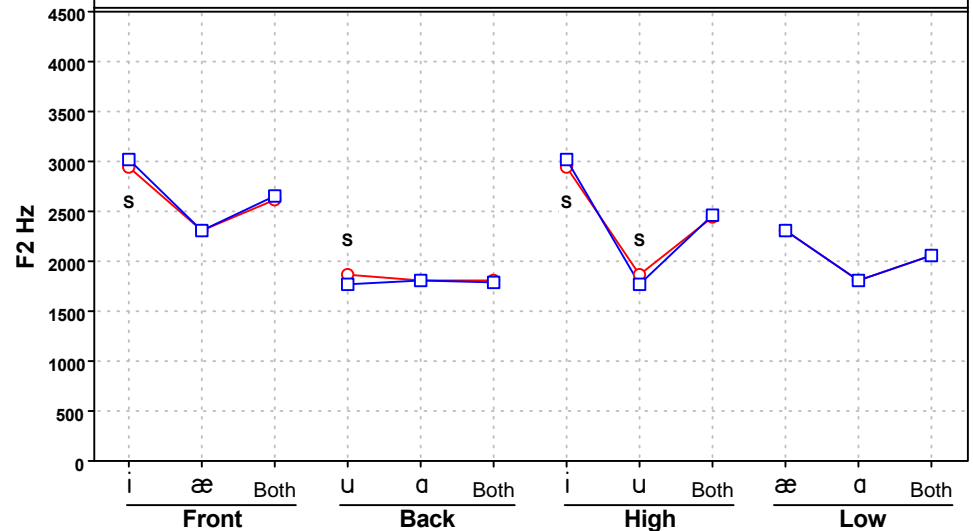
		No. of Tokens					Place Hz		Height Hz		All Hz
		S*Front	S*Back	S*High	S*Low	S*Total	Front	Back	High	Low	
S	M	5.0	4.7	4.7	5.0	9.7	698	717	519	861	704
	SD	2.0	1.8	2.1	1.9	3.3	150	187	74	194	137
N	M	5.4	4.8	4.9	5.3	10.2	711	741	529	904	724
	SD	1.3	1.4	1.3	1.3	2.2	124	130	77	157	97



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

**(B) Vowel Formant Analysis (VFA): Corner F2 Source: CS24**

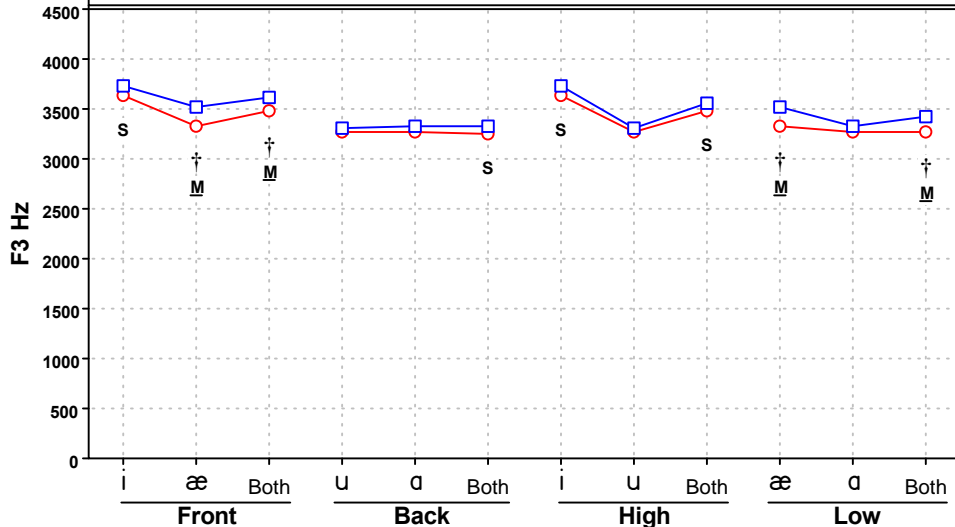
		No. of Tokens					Place Hz		Height Hz		All Hz
		S*Front	S*Back	S*High	S*Low	S*Total	Front	Back	High	Low	
S	M	4.8	4.5	4.3	5.0	9.3	2623	1815	2459	2059	2235
	SD	2.1	1.8	2.2	1.9	3.4	306	262	510	239	262
N	M	5.3	4.7	4.7	5.3	10.0	2660	1790	2480	2075	2252
	SD	1.3	1.4	1.5	1.3	2.3	261	250	364	210	208



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

**(C) Vowel Formant Analysis (VFA): Corner F3 Source: CS24**

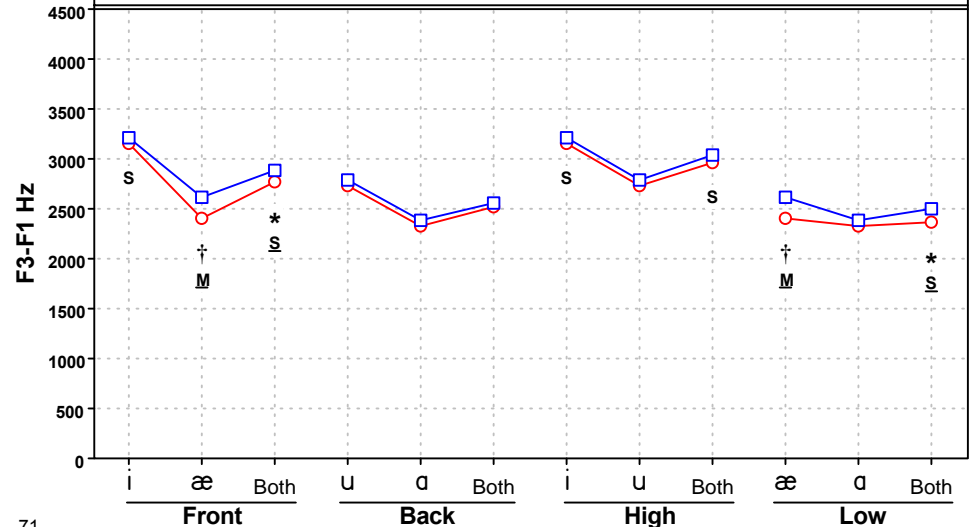
		No. of Tokens					Place Hz		Height Hz		All Hz
		S*Front	S*Back	S*High	S*Low	S*Total	Front	Back	High	Low	
S	M	2.9	2.6	2.7	2.8	5.5	3490	3254	3488	3281	3374
	SD	3.0	2.6	3.0	2.8	5.4	291	287	376	261	307
N	M	3.7	3.3	3.3	3.7	7.0	3621	3334	3569	3432	3484
	SD	2.5	2.3	2.4	2.5	4.7	250	306	281	300	254



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

**(D) Vowel Formant Analysis (VFA): Corner F3-F1 Source: CS24**

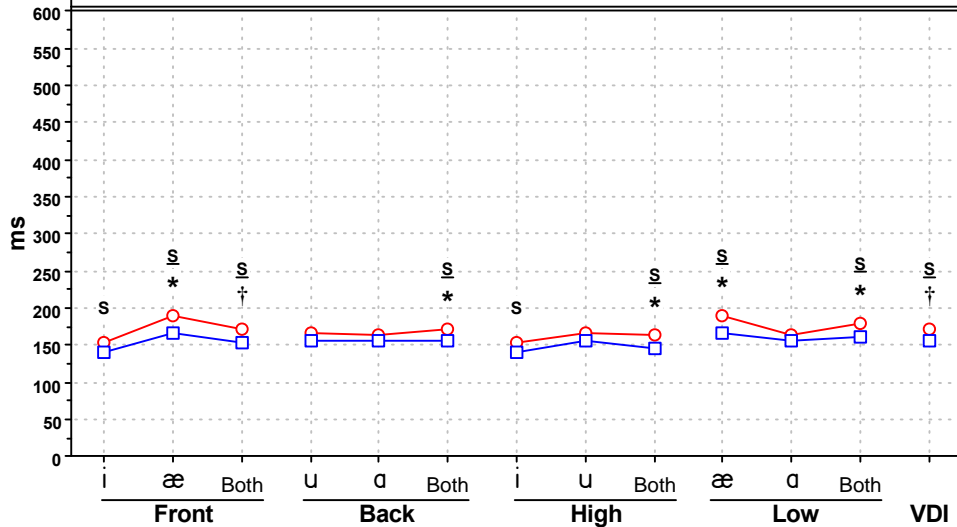
		No. of Tokens					Place Hz		Height Hz		All Hz
		S*Front	S*Back	S*High	S*Low	S*Total	Front	Back	High	Low	
S	M	2.9	2.6	2.7	2.8	5.5	2782	2533	2972	2369	2673
	SD	3.0	2.6	3.0	2.8	5.4	319	314	405	256	342
N	M	3.7	3.3	3.3	3.7	7.0	2901	2572	3041	2509	2742
	SD	2.5	2.3	2.4	2.5	4.7	278	324	279	309	265



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

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

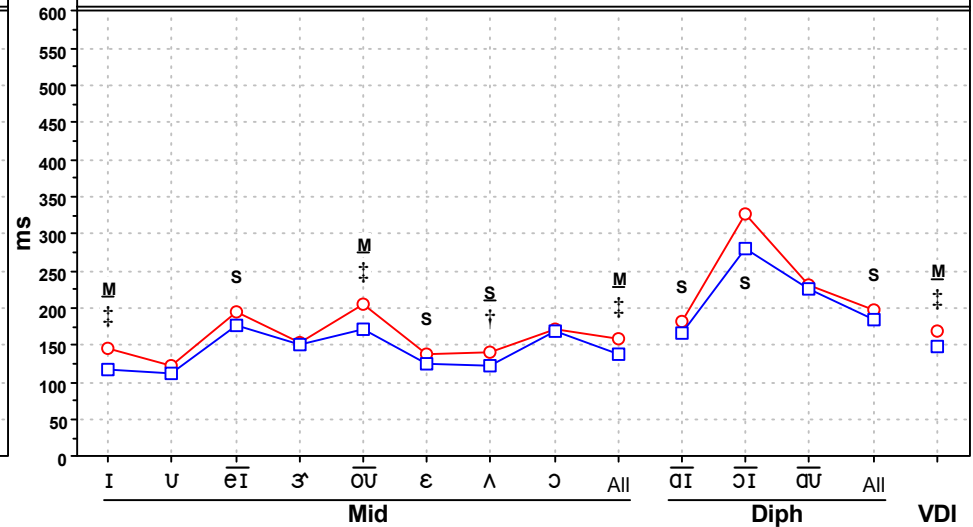
		No. of Tokens					Place ms				Height ms				VDI
		Front	Back	High	Low	Total	Front	Back	High	Low	Front	Back	High	Low	VDI
○ S	M	9.7	7.3	7.6	9.4	17.0	172.8	172.9	164.7	178.5	172.6				
	SD	3.9	2.8	3.1	3.8	5.7	56.5	73.4	67.7	57.0	54.2				
□ N	M	11.7	8.1	8.9	10.9	19.8	155.0	156.6	147.1	162.0	155.7				
	SD	4.7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



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

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

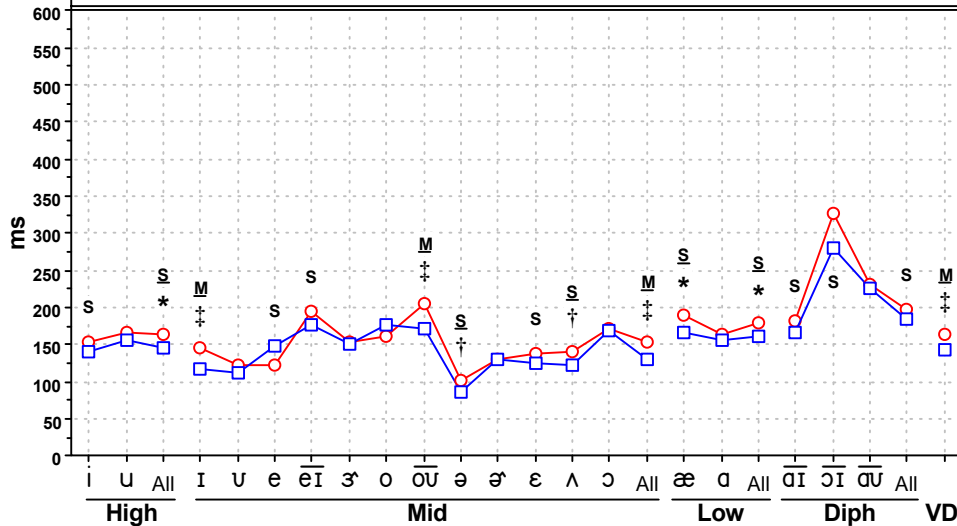
		No. of Tokens					Duration (ms)					VDI	
		Mid	AI	Mic	Dph	Mic	AI	Mid	Dph	Mic	VDI		
○ S	M	36	7	0	2	9	45	160	182	328	231	198	169
	SD	12	4	1	1	4	14	46	56	174	89	58	43
□ N	M	41	7	0	2	10	51	139	168	282	227	184	148
	SD	12	4	1	2	4	15	31	53	124	94	53	32



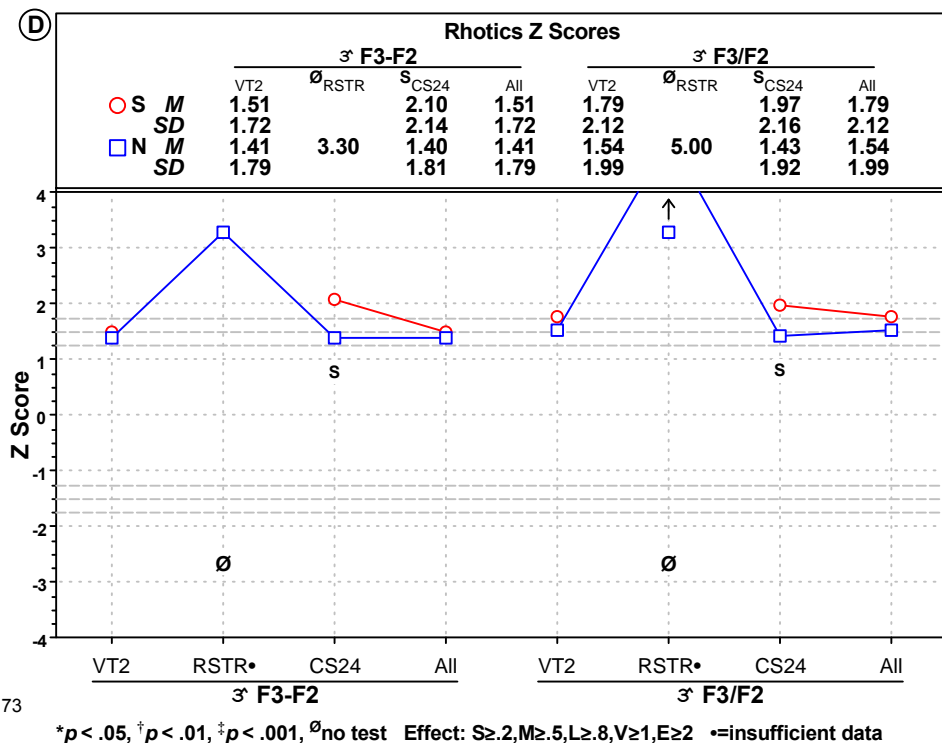
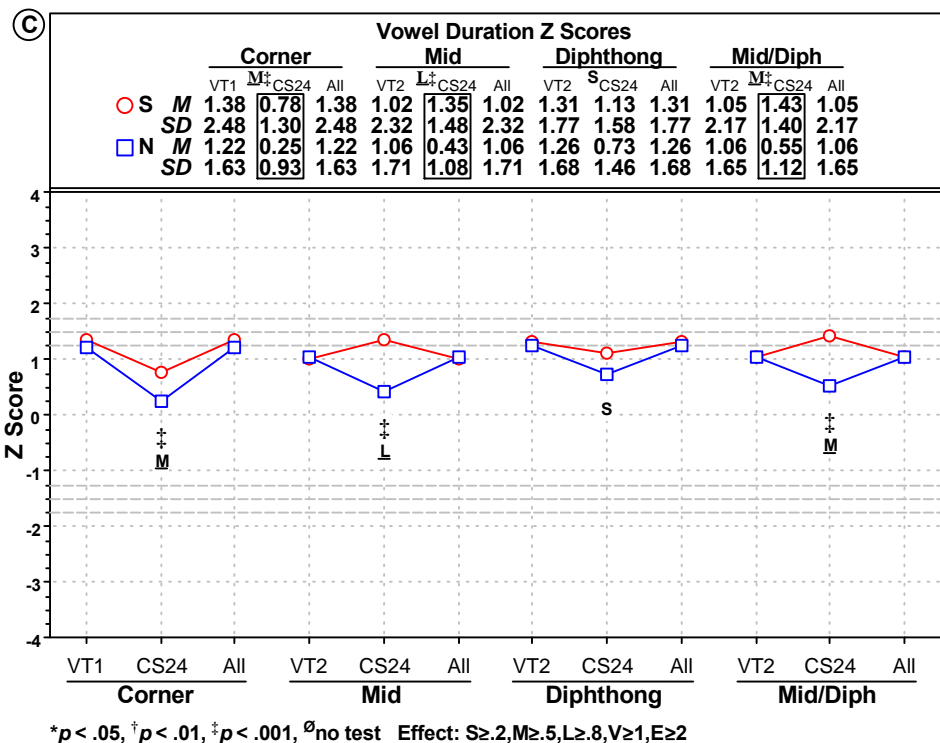
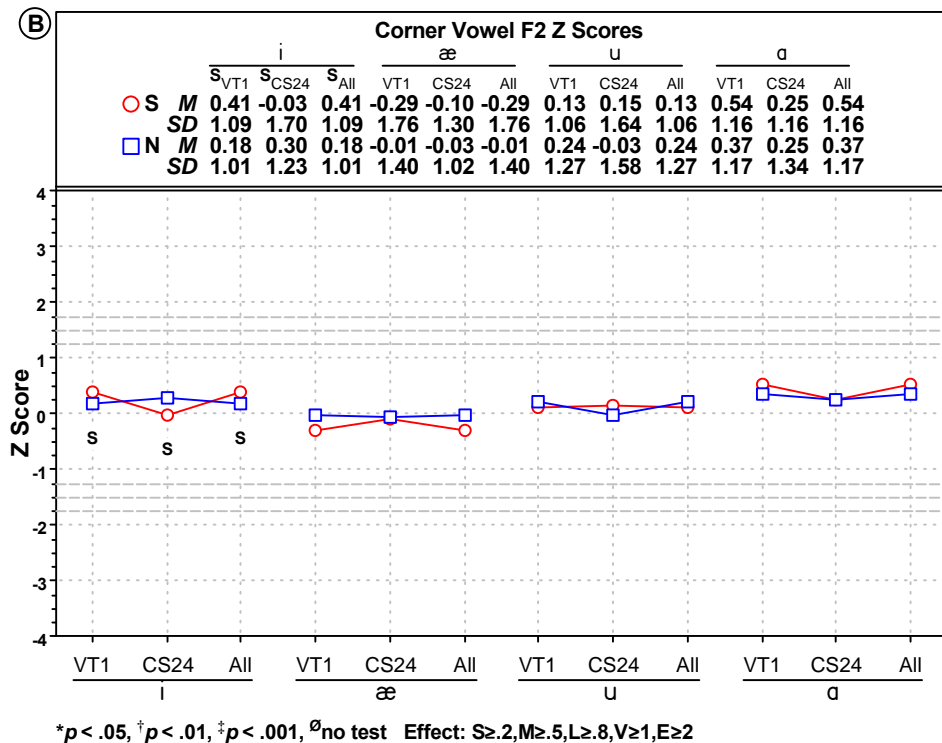
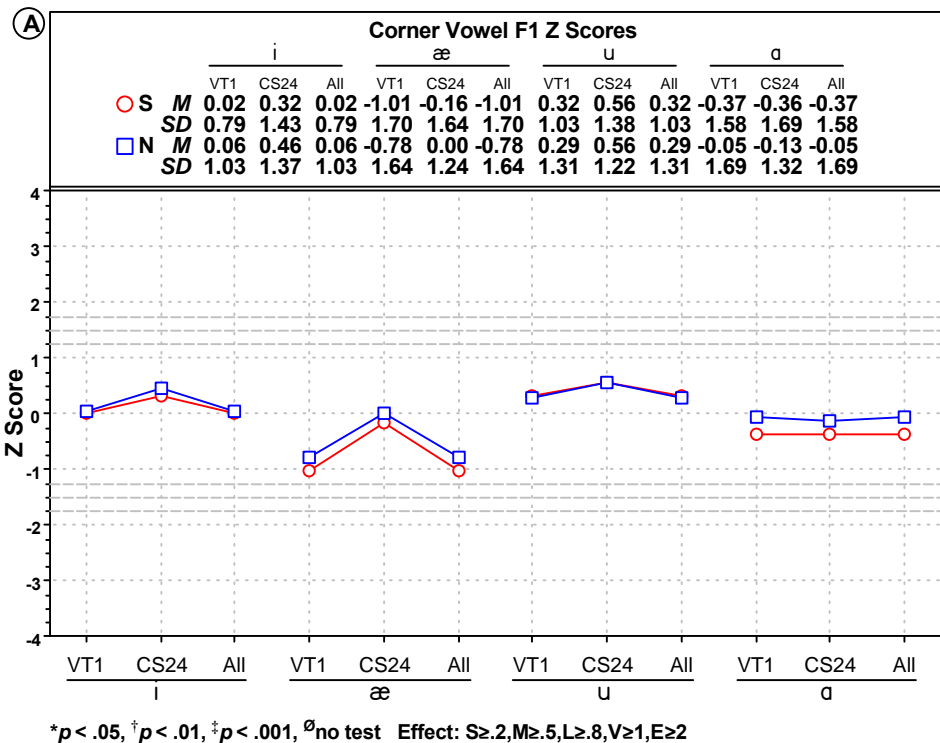
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

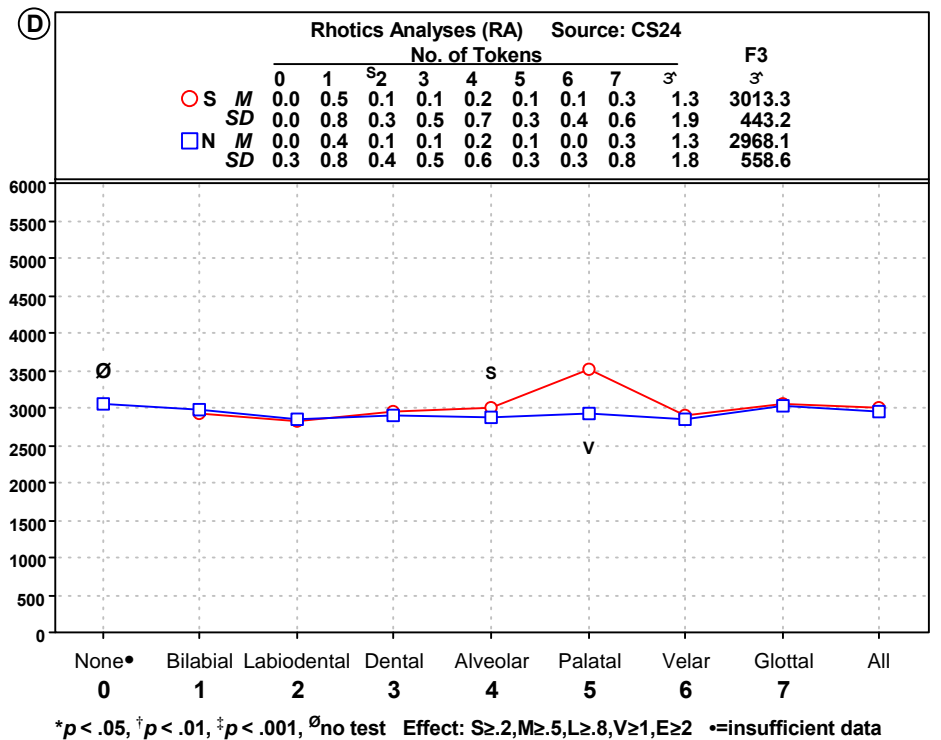
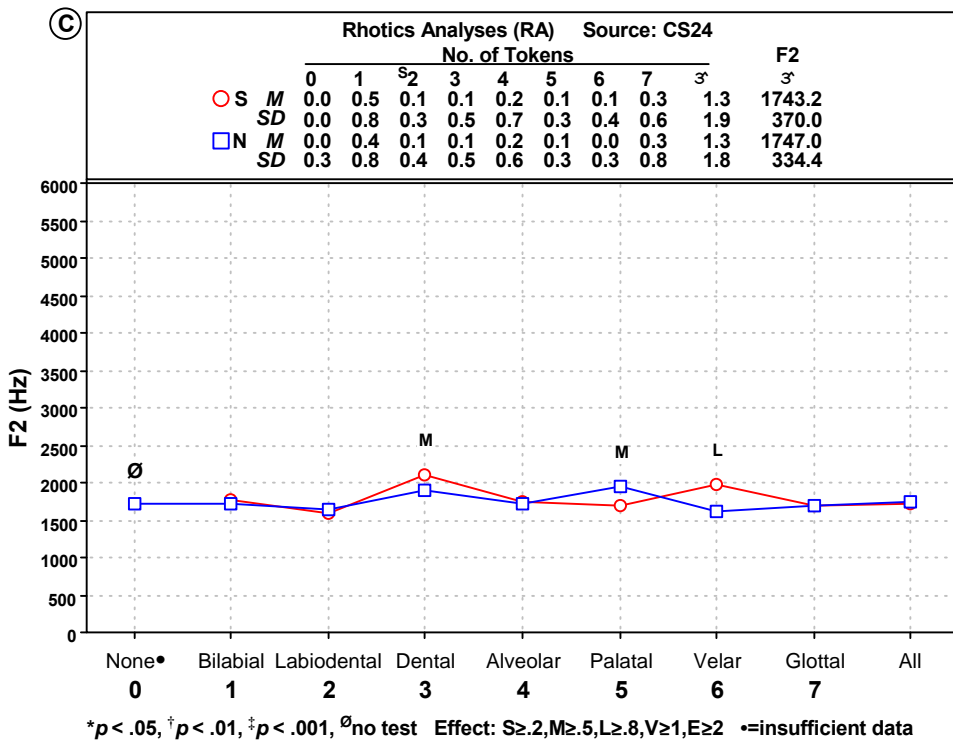
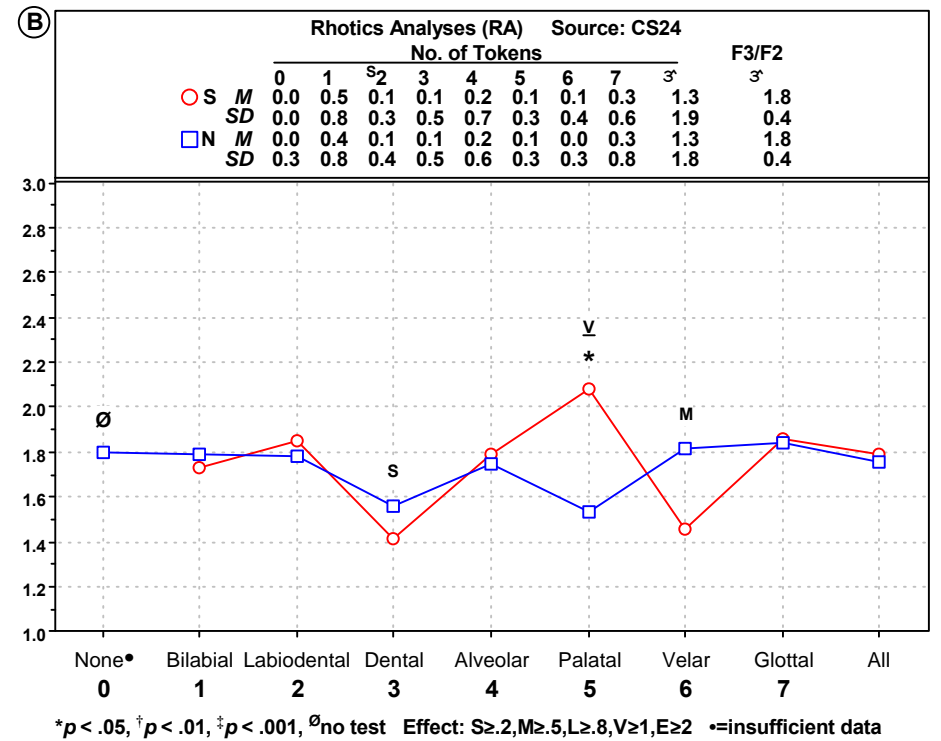
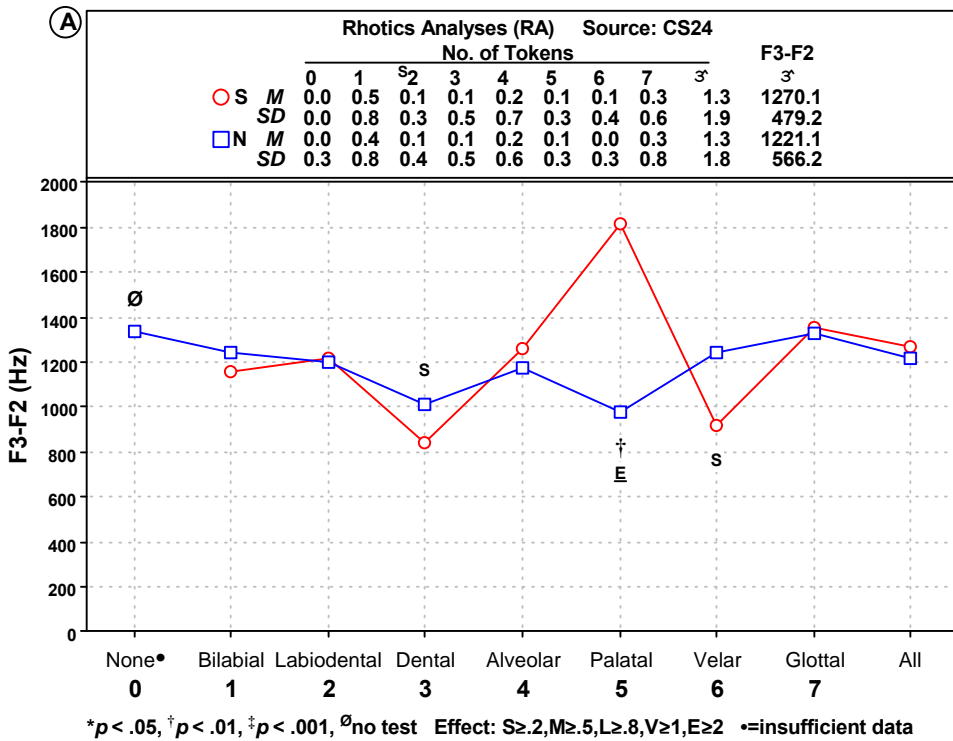
**(C) Vowel Duration Analysis (VDA): All Vwls & Dph Source: CS24**

		No. of Tokens							Place ms							Dph		VDI
		Fr	Cent	Bak	Hi	Mid	Lo	Dph	Fr	Cent	Bak	Hi	Mid	Lo	Dph	VDI		
○ 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	



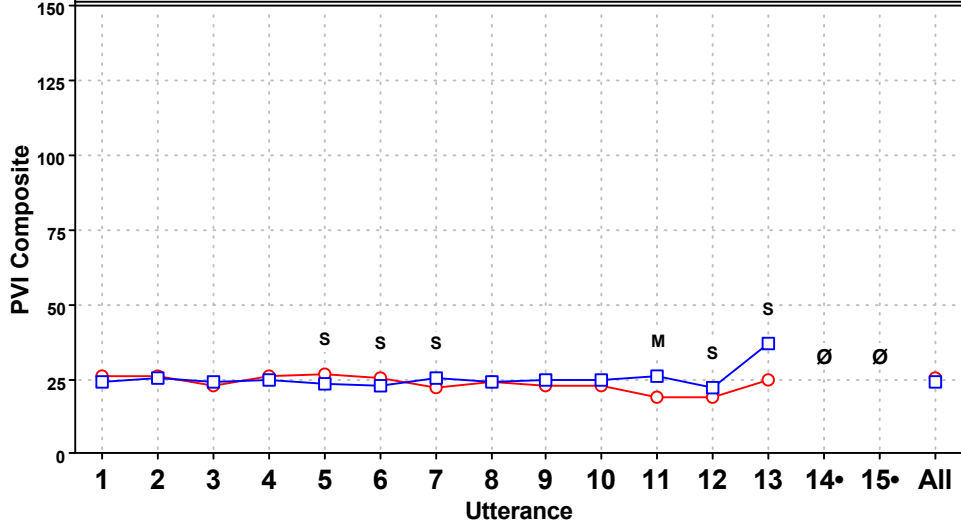
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2





**(A) Pairwise Variability Index (PVI) Composite Source: CS24**

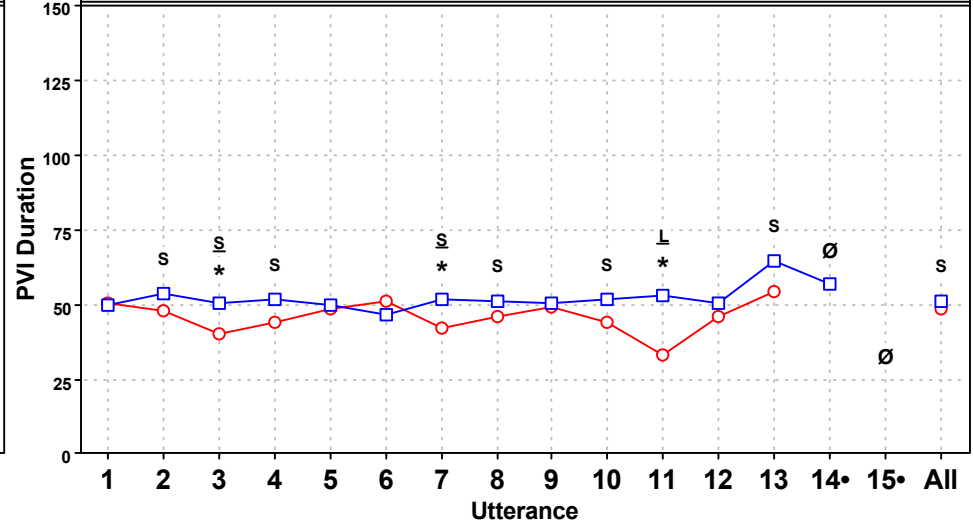
		No. Utts									No. Vowel Pairs									Pairs per Utt									PVI Composite								
		S+M			Lng			S*All			S+M			S*Lng			S*All			S+M			Lng			S*All											
		M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All												
○ S	M	5.7	0.9	6.6	14.8	7.0	21.8	2.54	7.72	3.20	25.1	24.2	25.3	○ N	M	5.8	1.4	7.1	15.9	12.5	28.4	2.83	8.71	3.94	24.6	23.7	24.4										
	SD	2.6	1.3	2.8	9.3	10.7	15.4	0.96	1.98	1.50	6.6	5.7	6.4		SD	2.6	1.6	2.7	7.9	16.5	18.1	0.90	2.70	1.89	6.0	5.7	5.4										



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

**(B) Pairwise Variability Index (PVI) Duration Source: CS24**

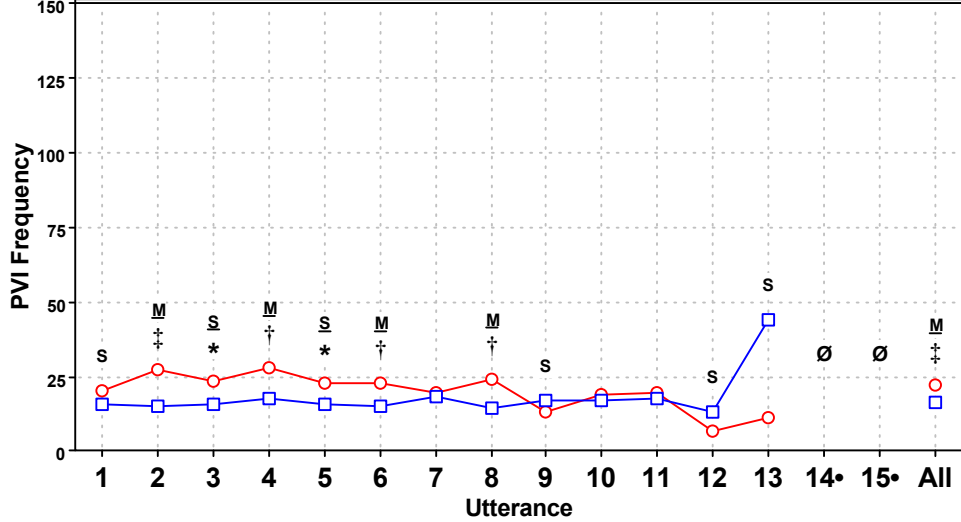
		No. Utts									No. Vowel Pairs									Pairs per Utt									PVI Duration								
		S+M			Lng			S*All			S+M			S*Lng			S*All			S+M			Lng			S*All											
		M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All												
○ S	M	6.6	1.2	7.9	17.7	9.9	27.7	2.67	7.81	3.39	48.4	48.4	48.6	○ N	M	6.8	1.7	8.6	19.2	16.4	35.6	2.90	8.85	4.09	51.2	49.9	51.0										
	SD	2.3	1.7	2.5	8.7	13.9	17.0	0.91	1.84	1.52	16.9	15.6	15.4		SD	2.3	1.8	2.2	7.6	20.3	20.8	0.86	2.71	1.92	12.5	12.4	11.0										



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

**(C) Pairwise Variability Index (PVI) Frequency Source: CS24**

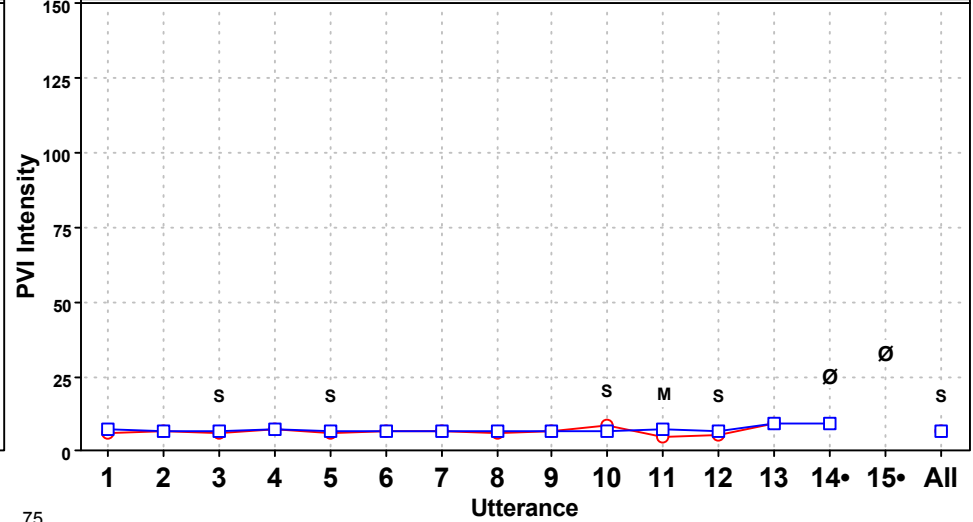
		No. Utts									No. Vowel Pairs									Pairs per Utt									PVI Frequency								
		S+M			Lng			S*All			S+M			S*Lng			S*All			S+M			Lng			S*All											
		M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All												
○ S	M	5.7	0.9	6.6	14.8	7.0	21.8	2.54	7.72	3.20	22.4	17.0	22.5	○ N	M	5.8	1.4	7.1	15.9	12.5	28.4	2.83	8.71	3.94	16.5	14.9	16.3										
	SD	2.6	1.3	2.8	9.3	10.7	15.4	0.96	1.98	1.50	13.8	11.4	13.5		SD	2.6	1.6	2.7	7.9	16.5	18.1	0.90	2.70	1.89	11.1	10.1	10.2										



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

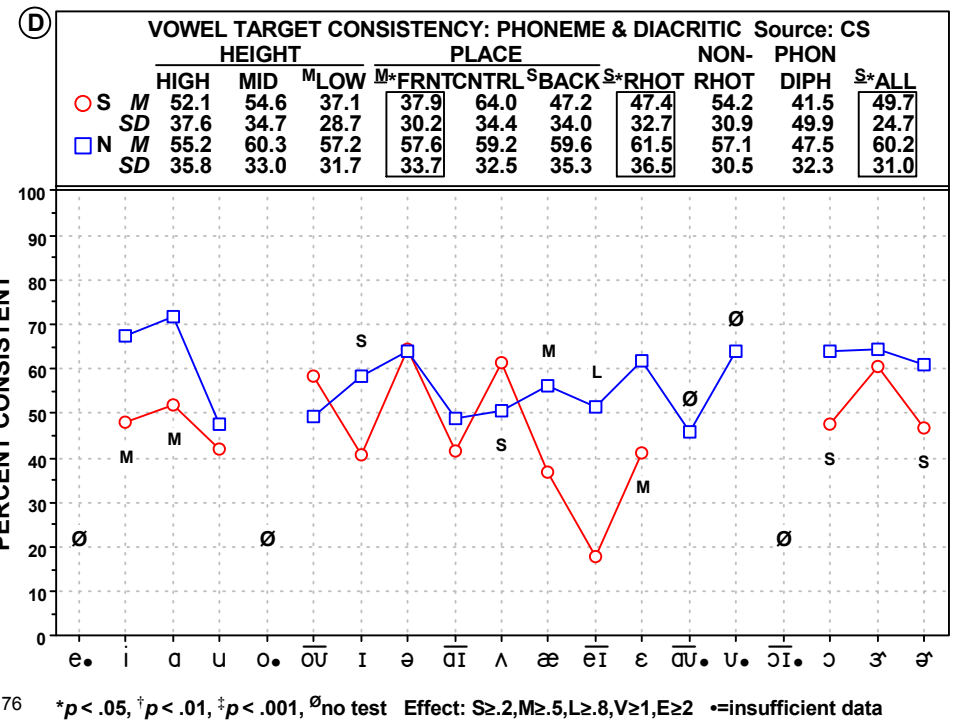
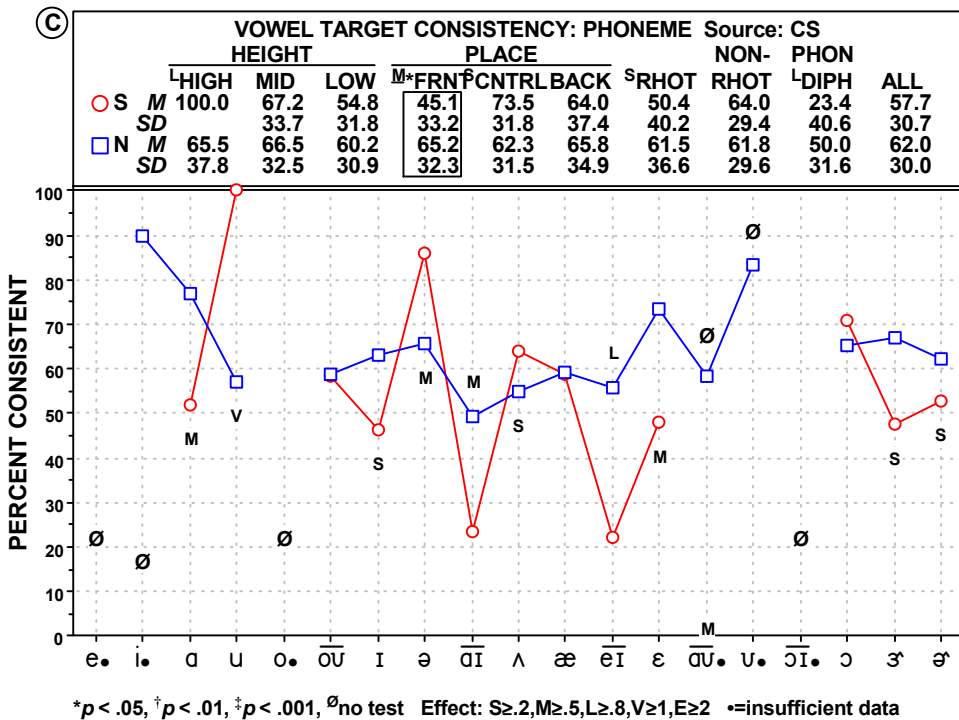
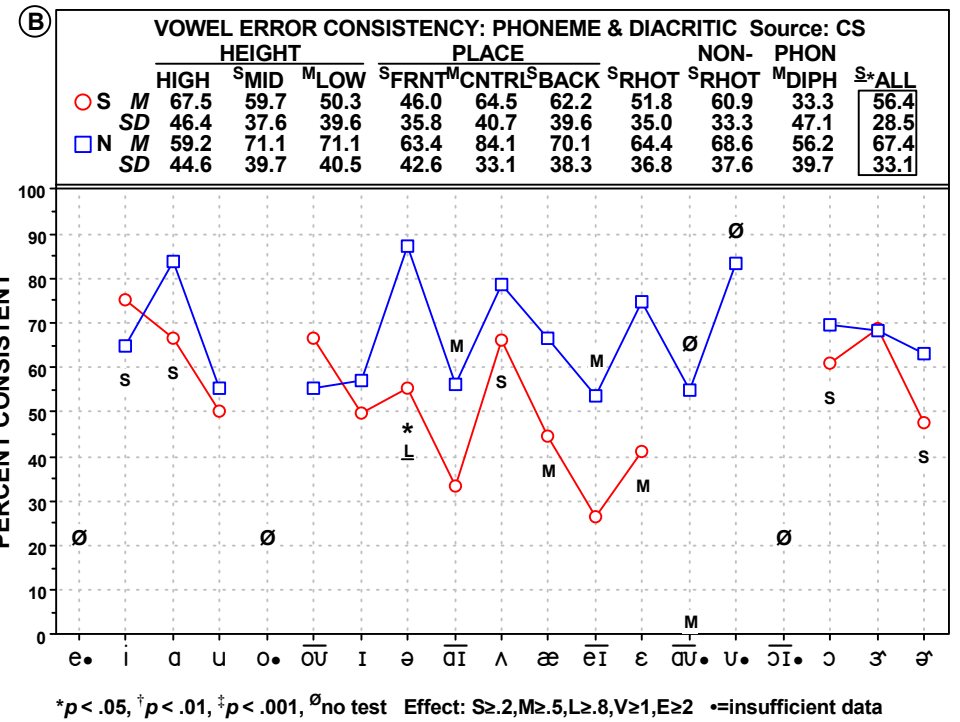
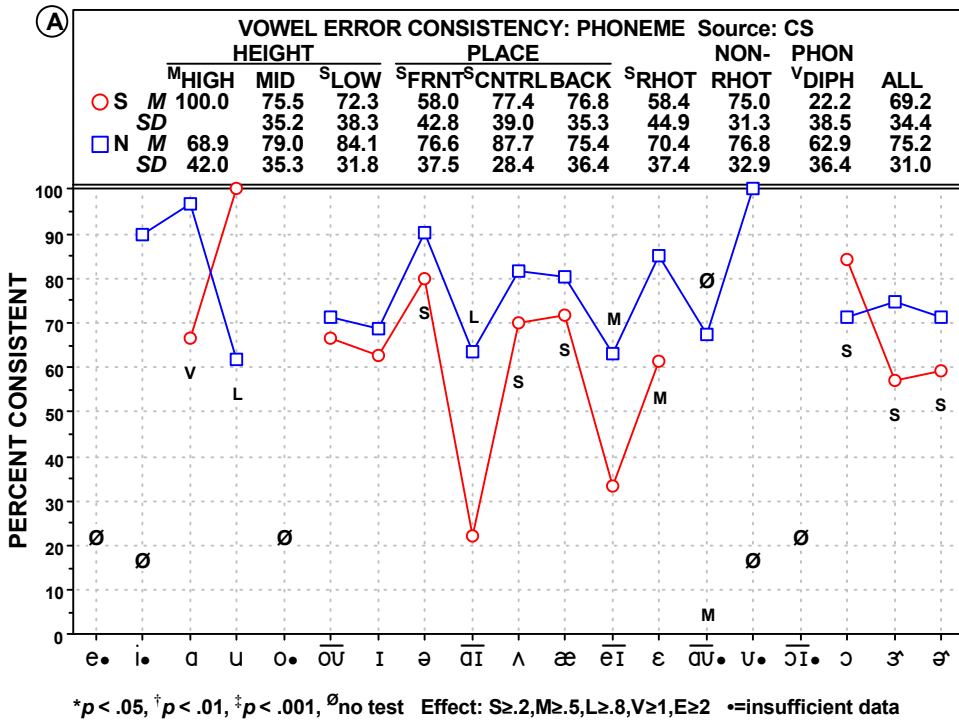
**(D) Pairwise Variability Index (PVI) Intensity Source: CS24**

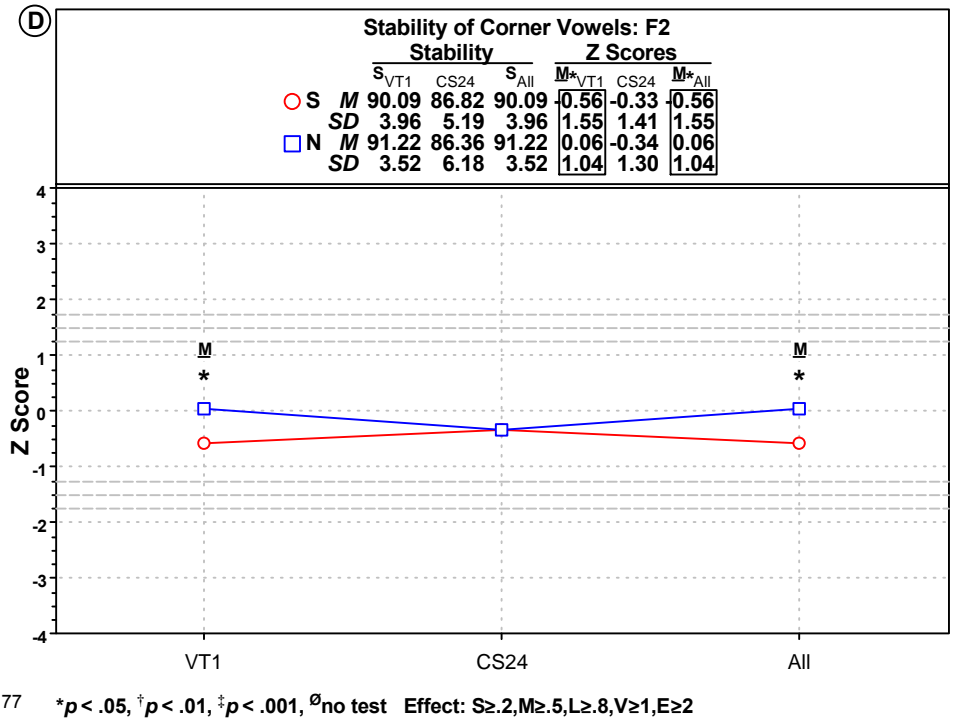
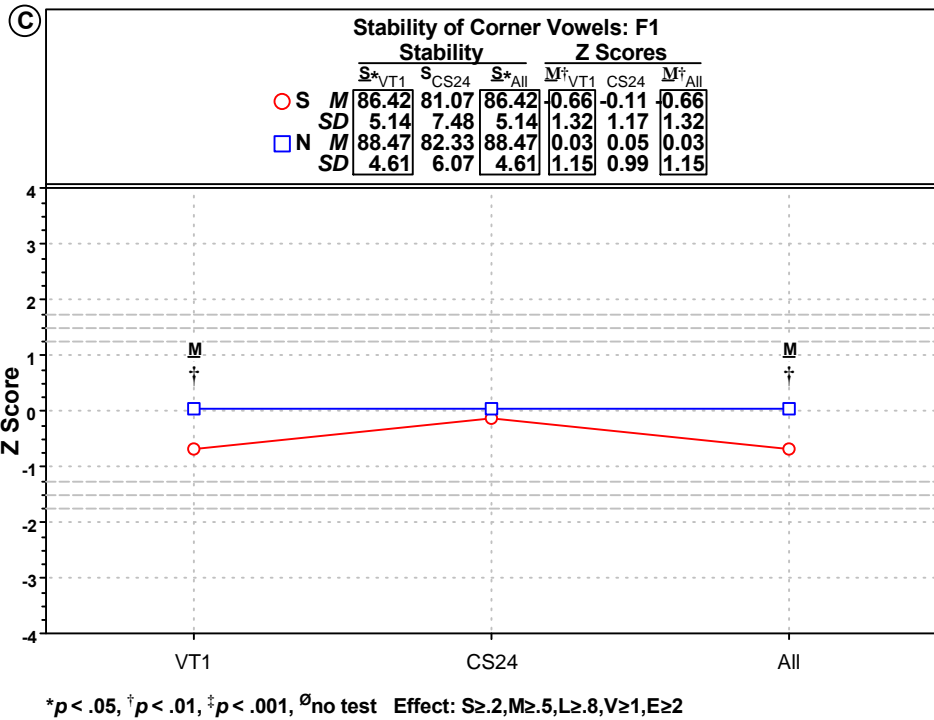
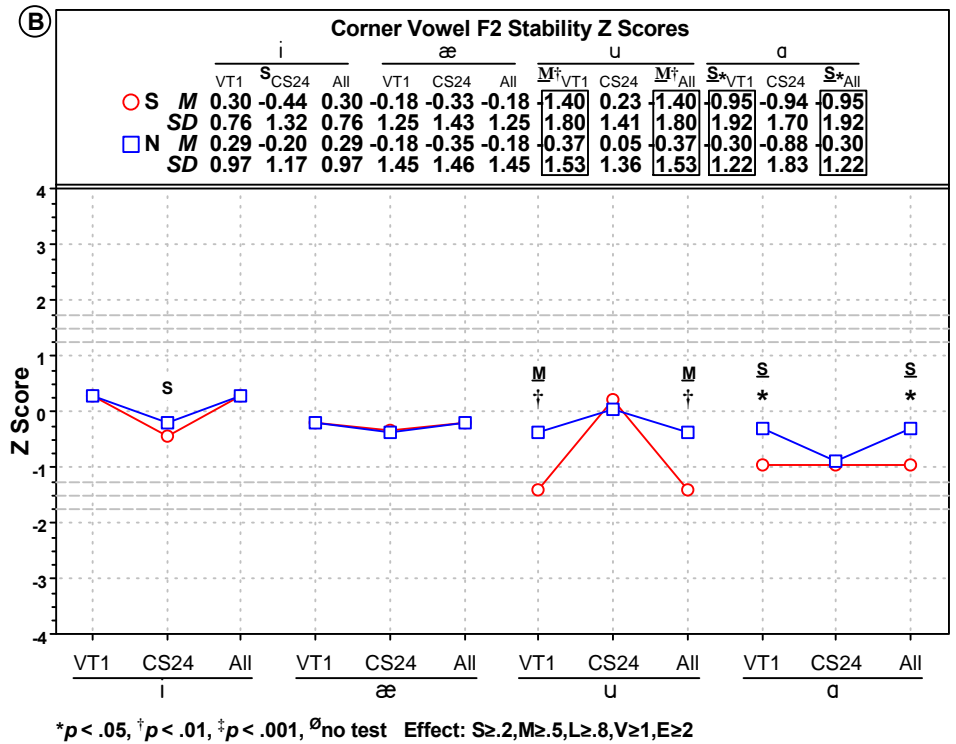
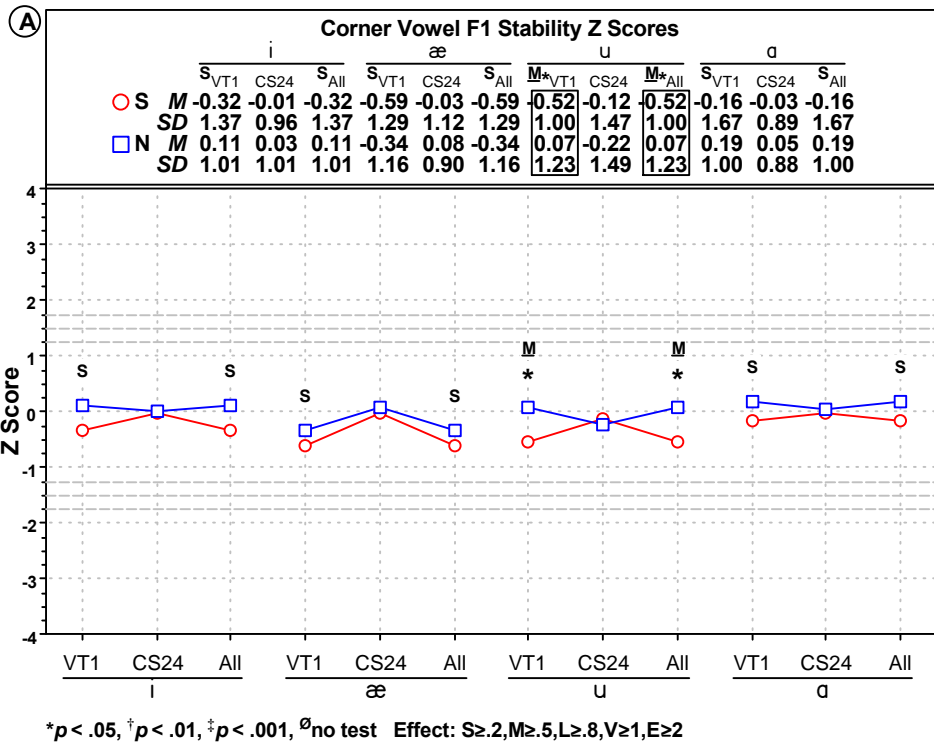
		No. Utts									No. Vowel Pairs									Pairs per Utt									PVI Intensity								
		S+M			Lng			S*All			S+M			S*Lng			S*All			S+M			Lng			S*All											
		M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All	M	SD	All												
○ S	M	6.6	1.2	7.9	17.7	9.9	27.7	2.67	7.81	3.39	6.6	7.0	6.6	○ N	M	6.8	1.7	8.6	19.2	16.4	35.6	2.90	8.85	4.09	7.1	6.6	7.0										
	SD	2.3	1.7	2.5	8.7	13.9	17.0	0.91	1.84	1.52	2.3	2.2	2.1		SD	2.3	1.8	2.2	7.6	20.3	20.8	0.86	2.71	1.92	2.3	2.2	2.1										

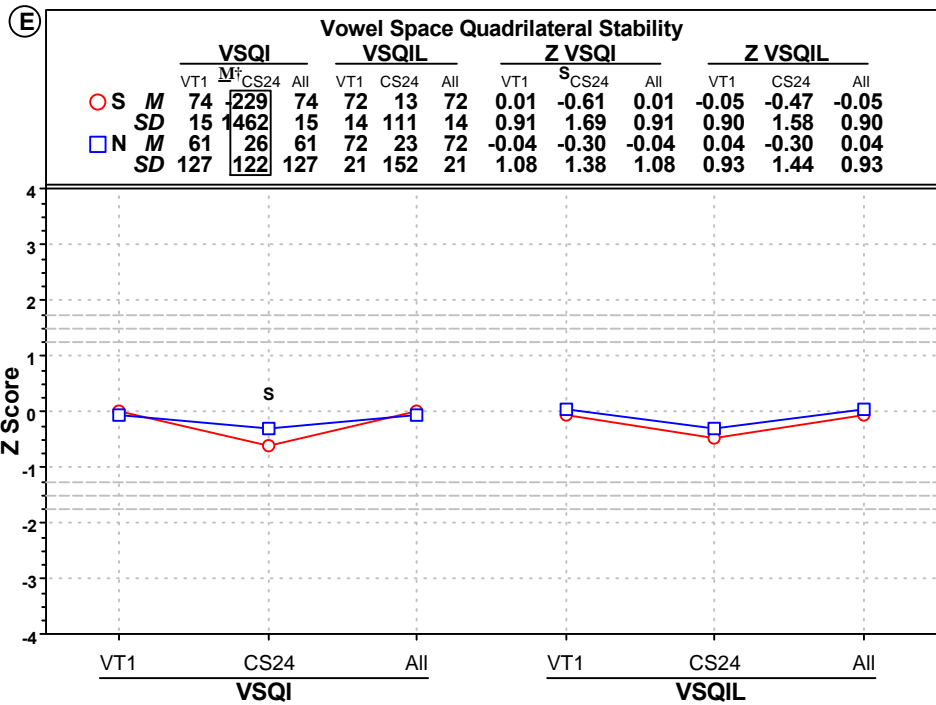


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , Ø no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2 •=insufficient data

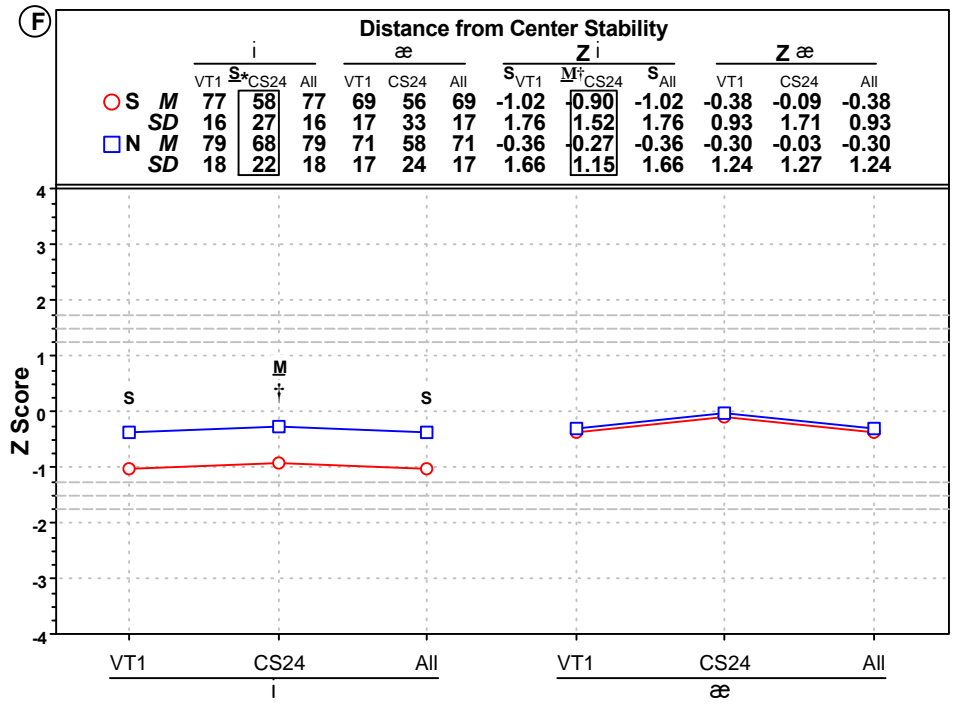
Vowel Profile 11, S and N



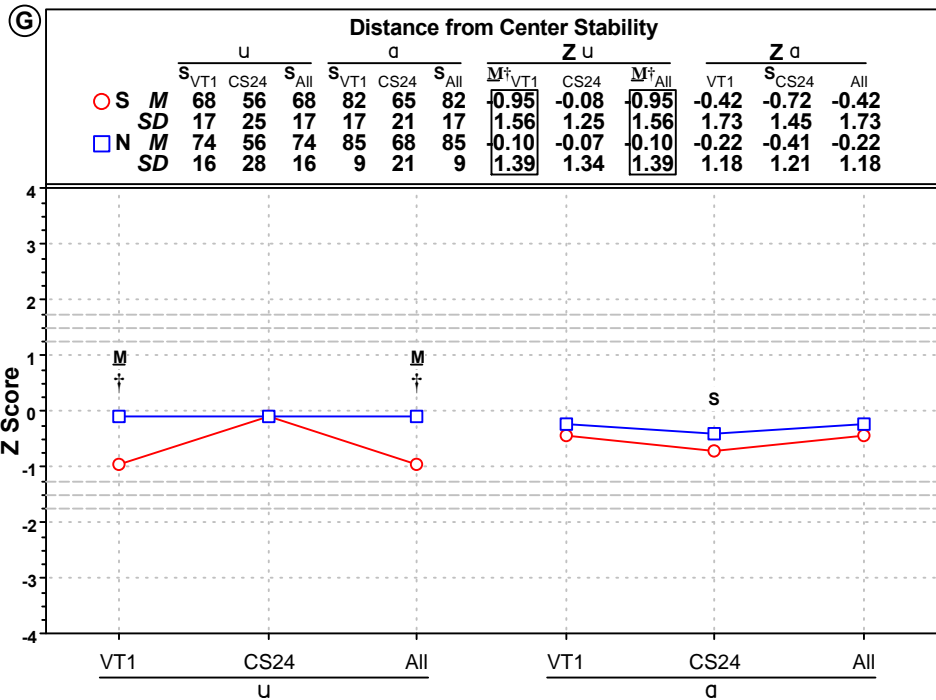




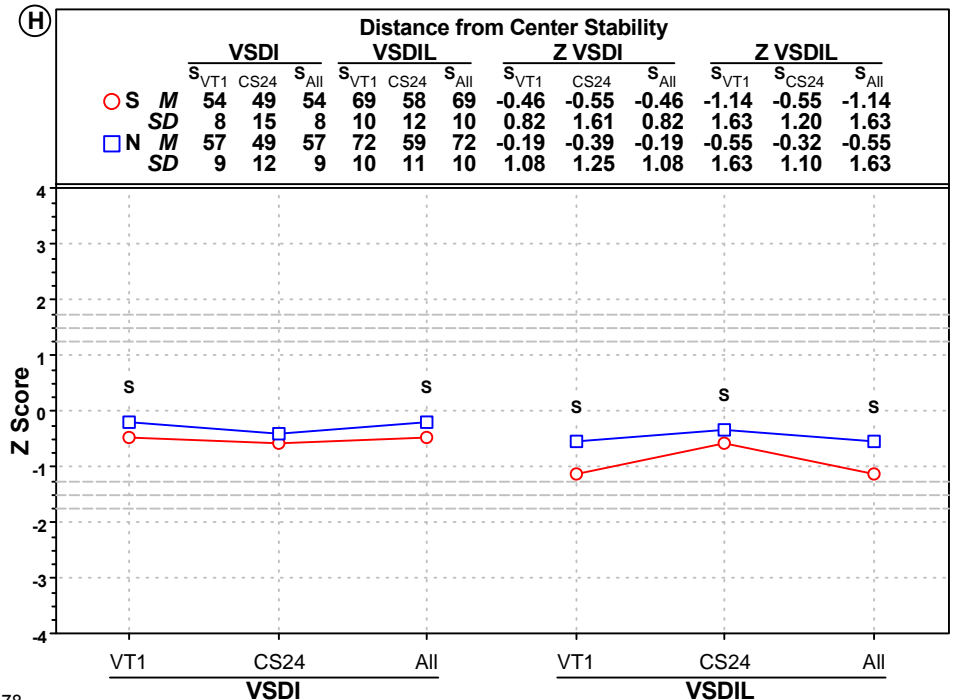
\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



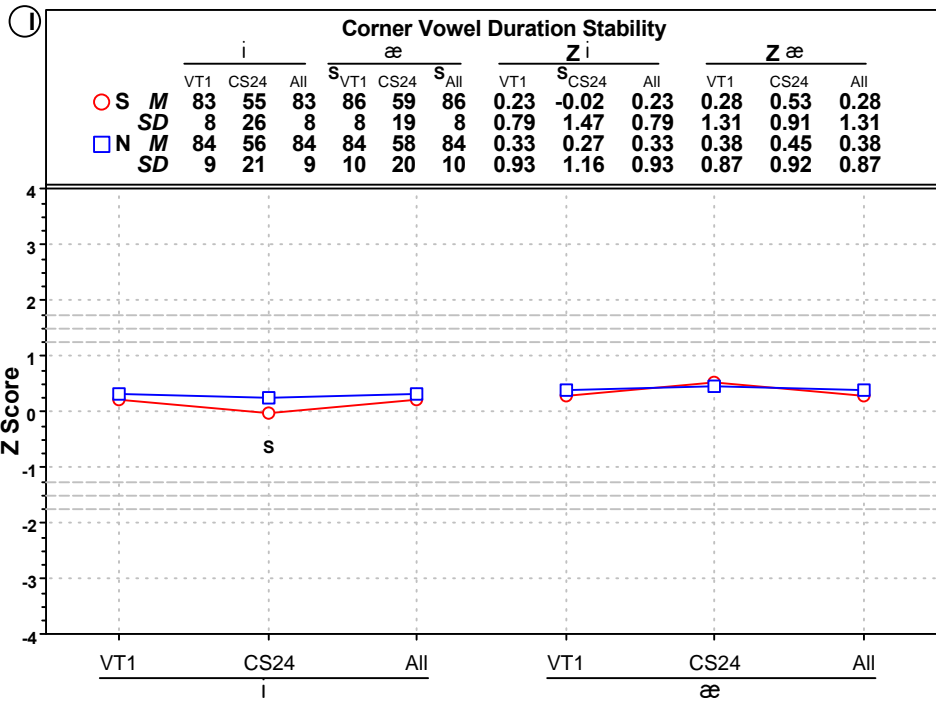
\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



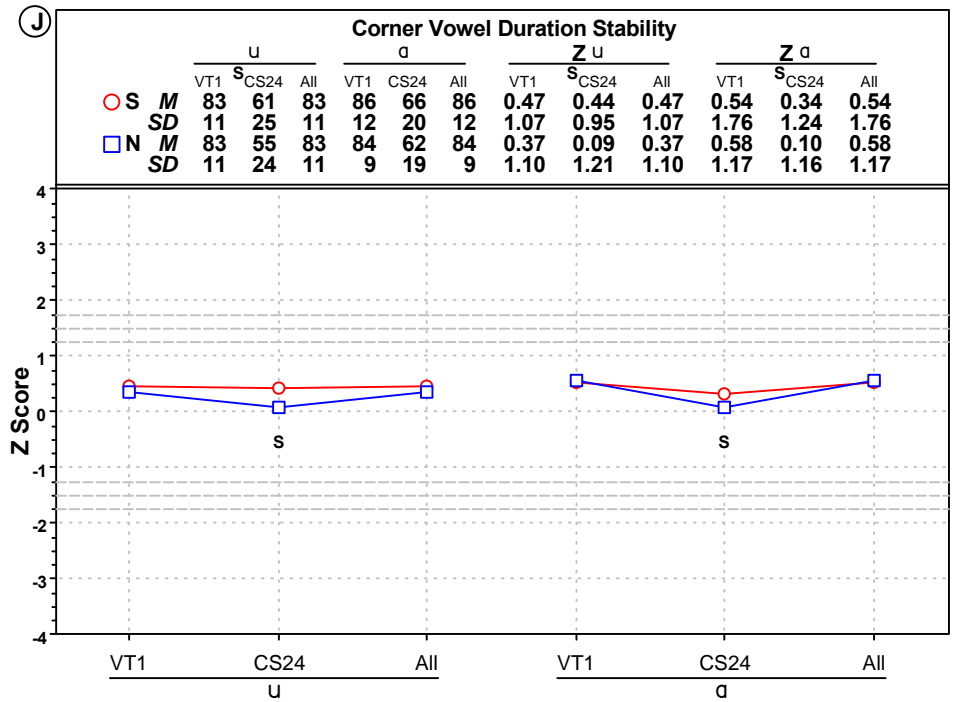
\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



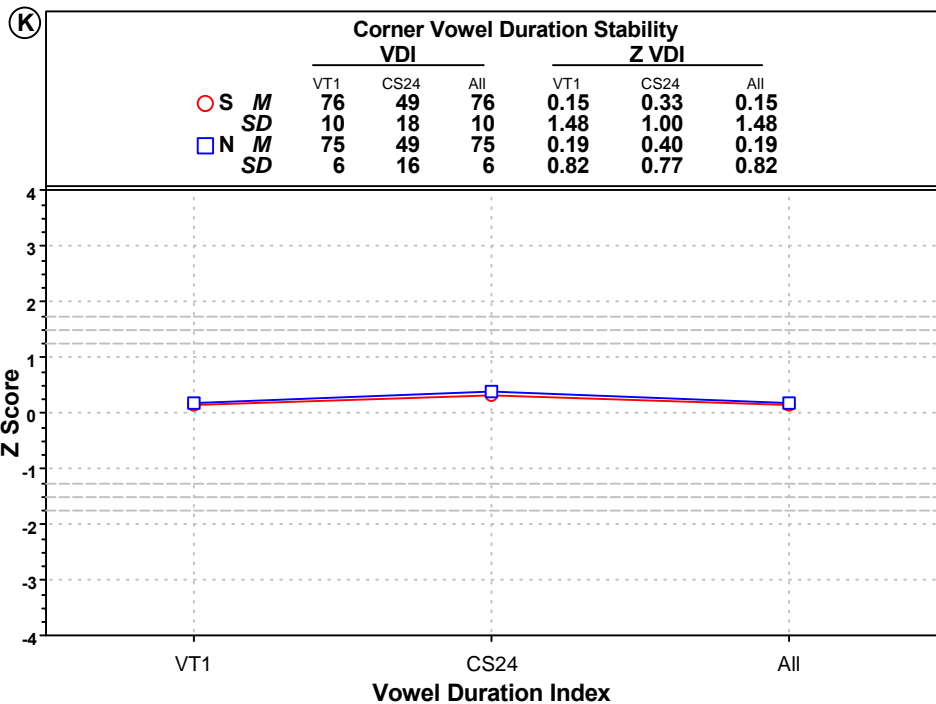
\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\theta}$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



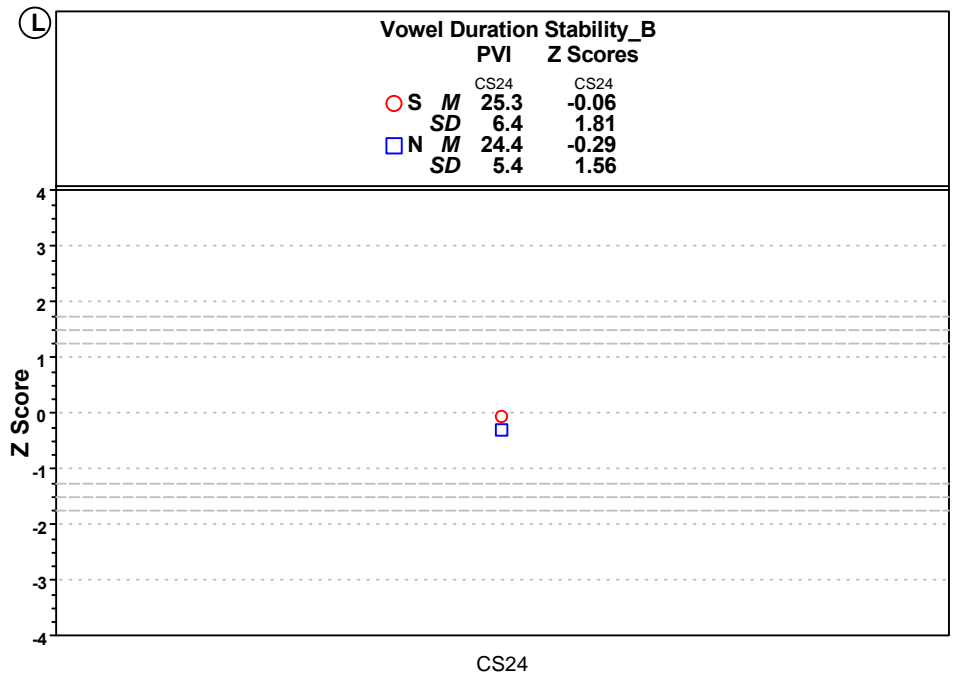
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



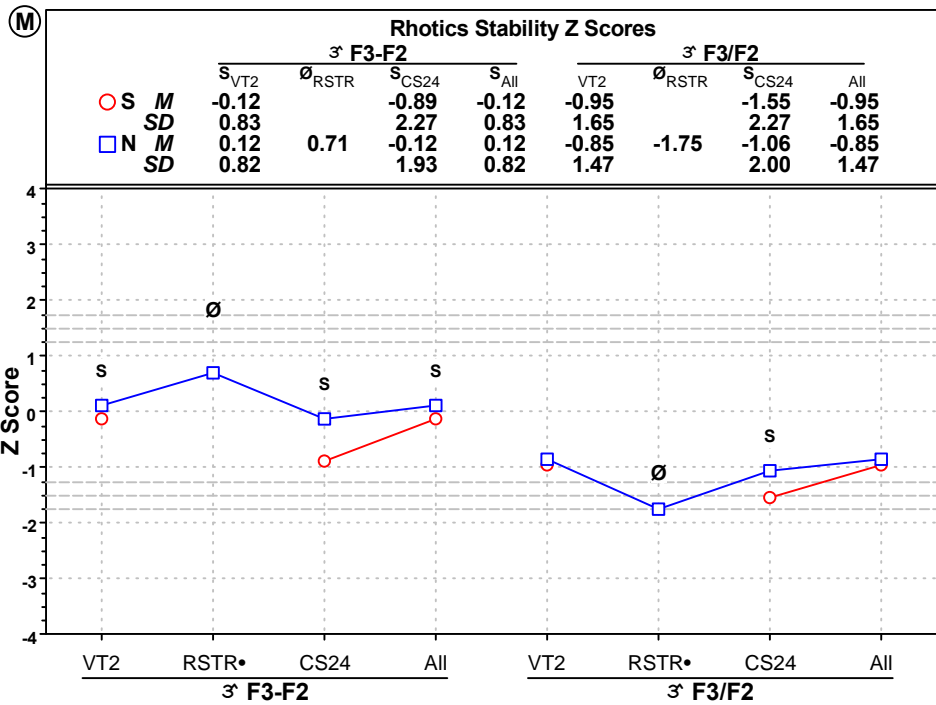
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



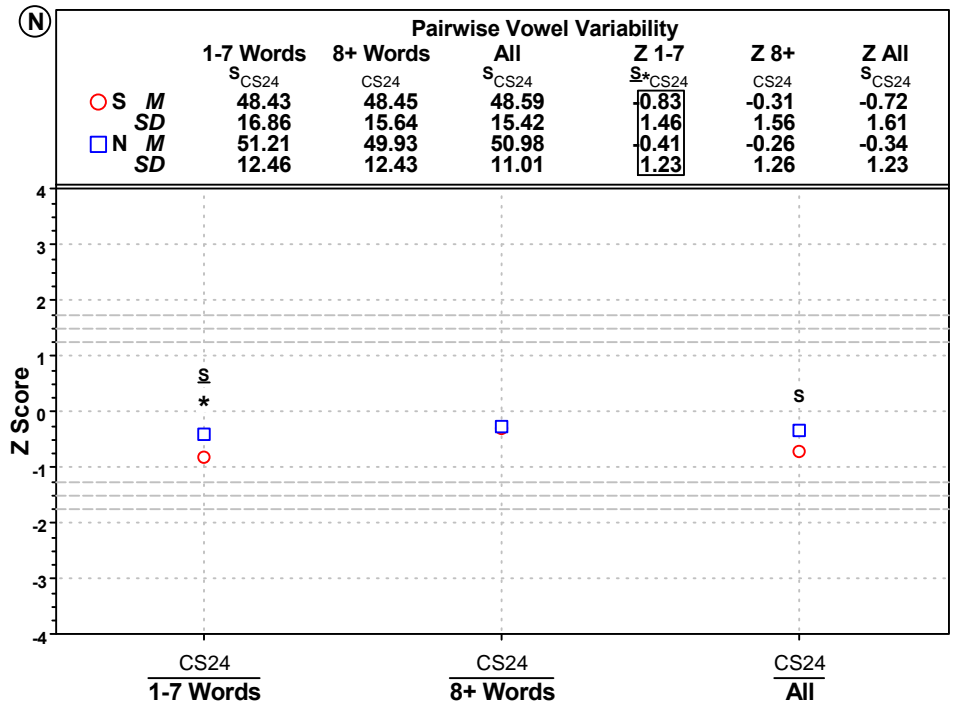
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



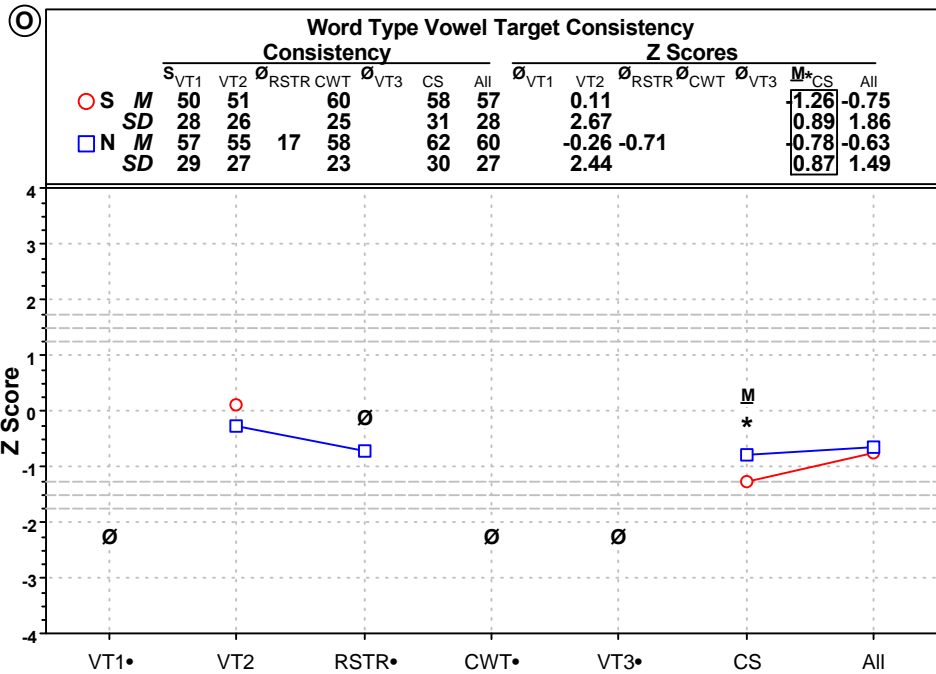
79 \* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



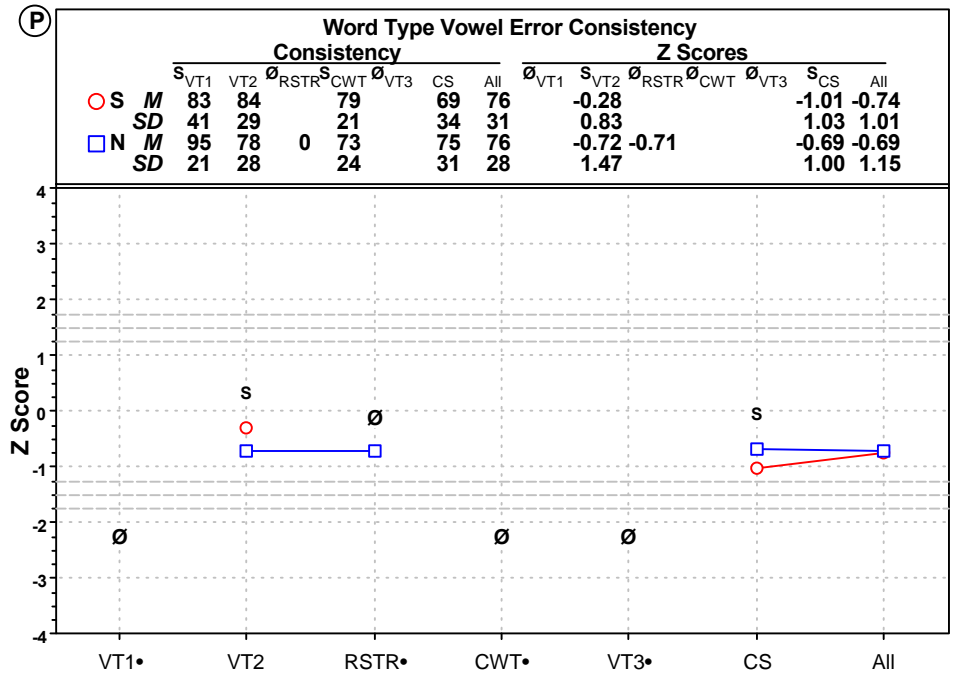
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2 ∅=insufficient data



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2

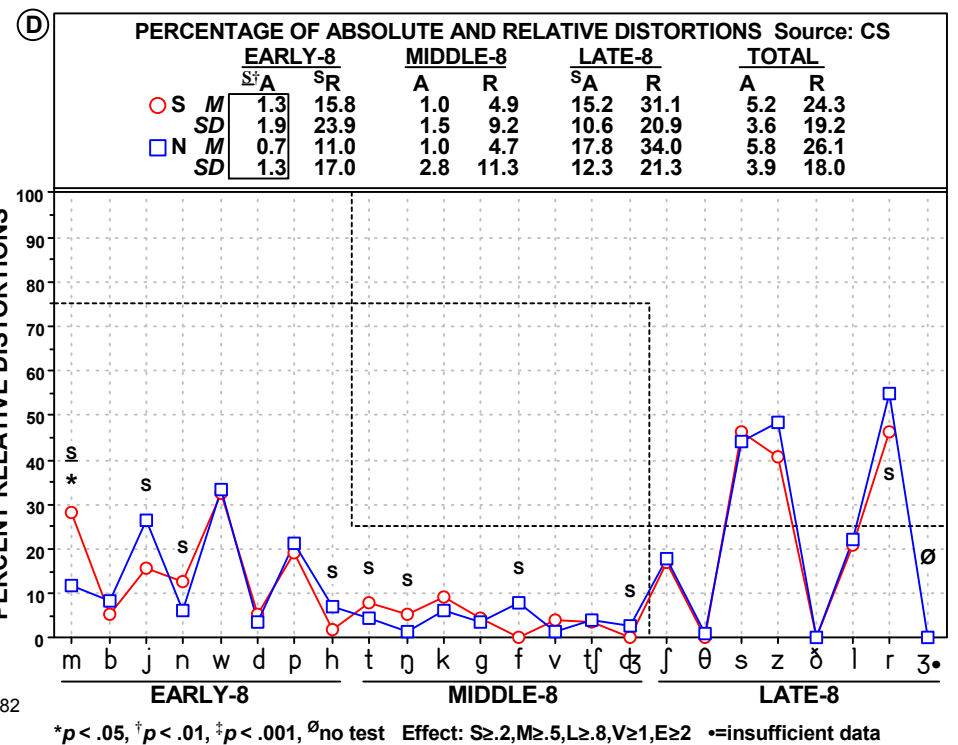
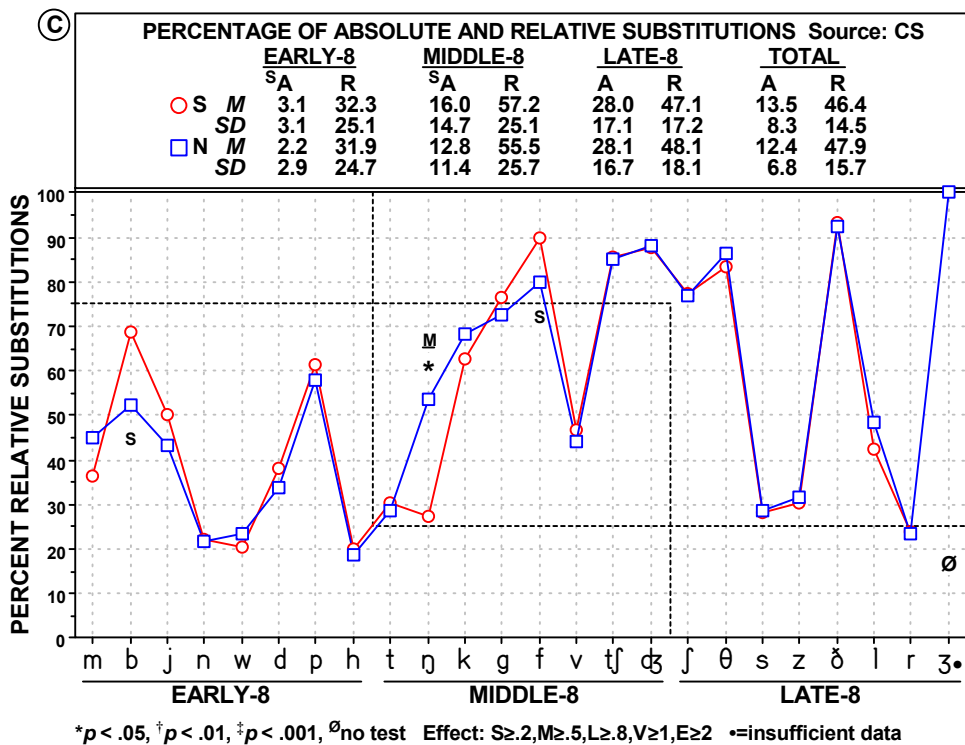
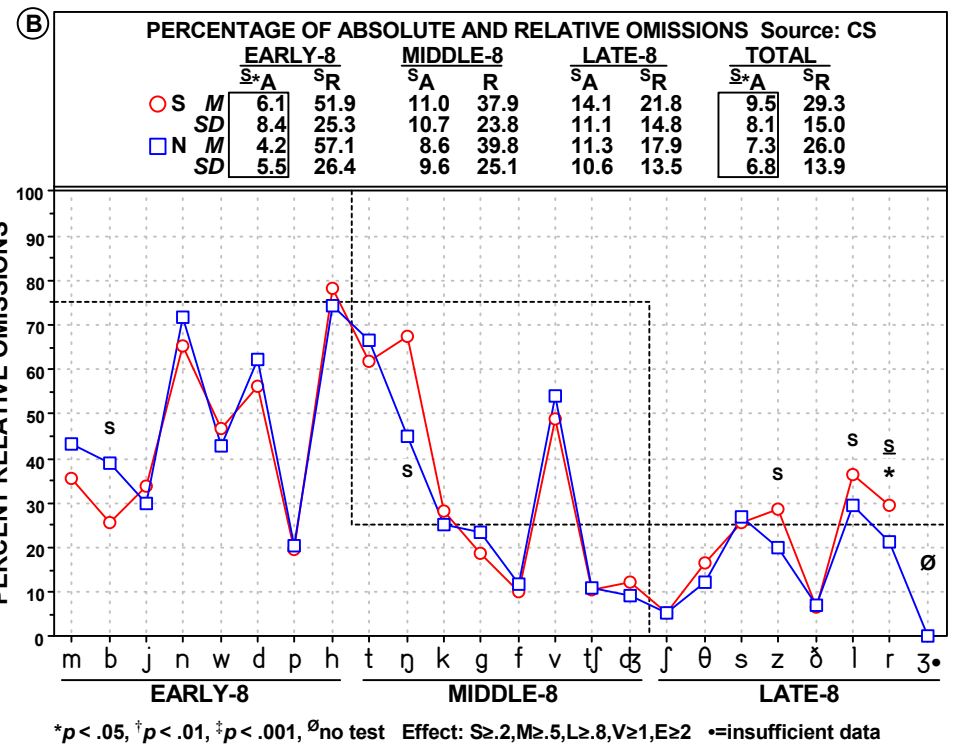
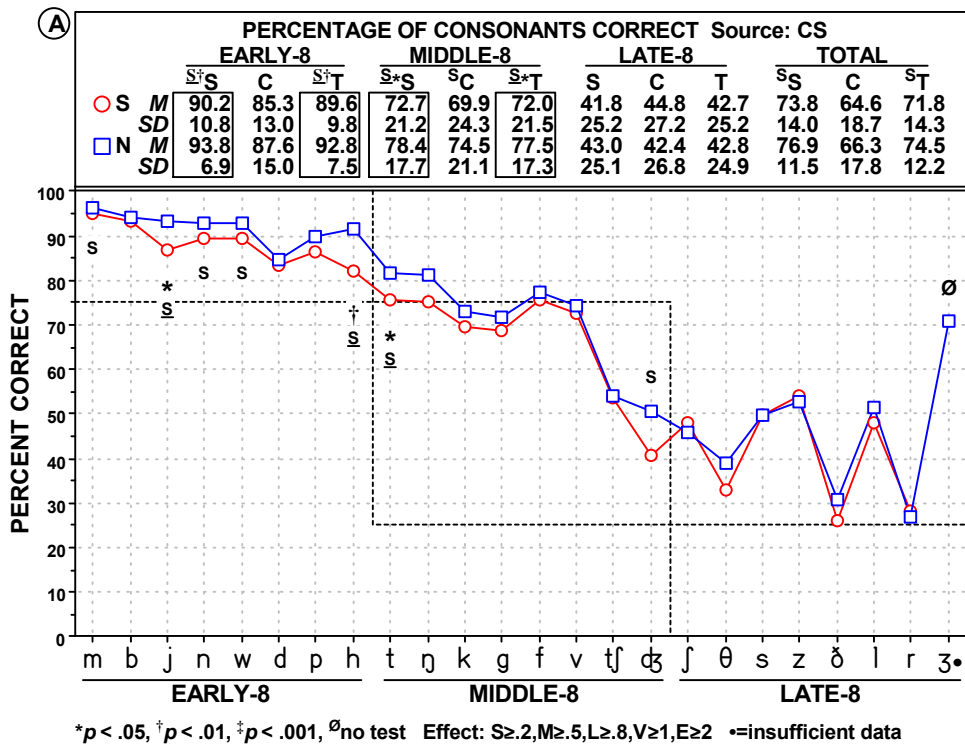


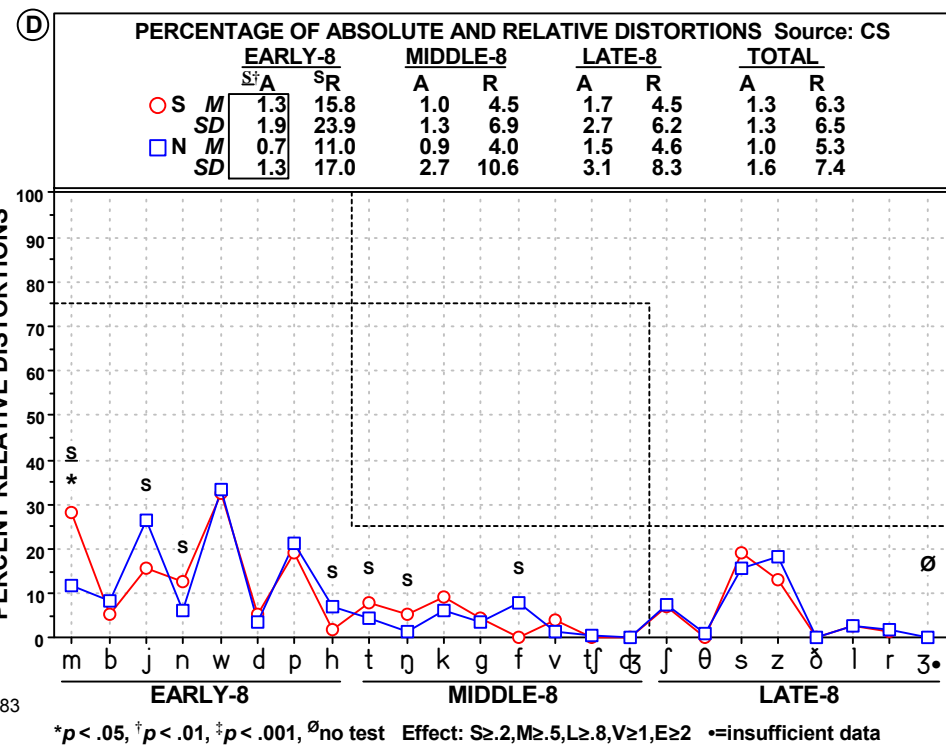
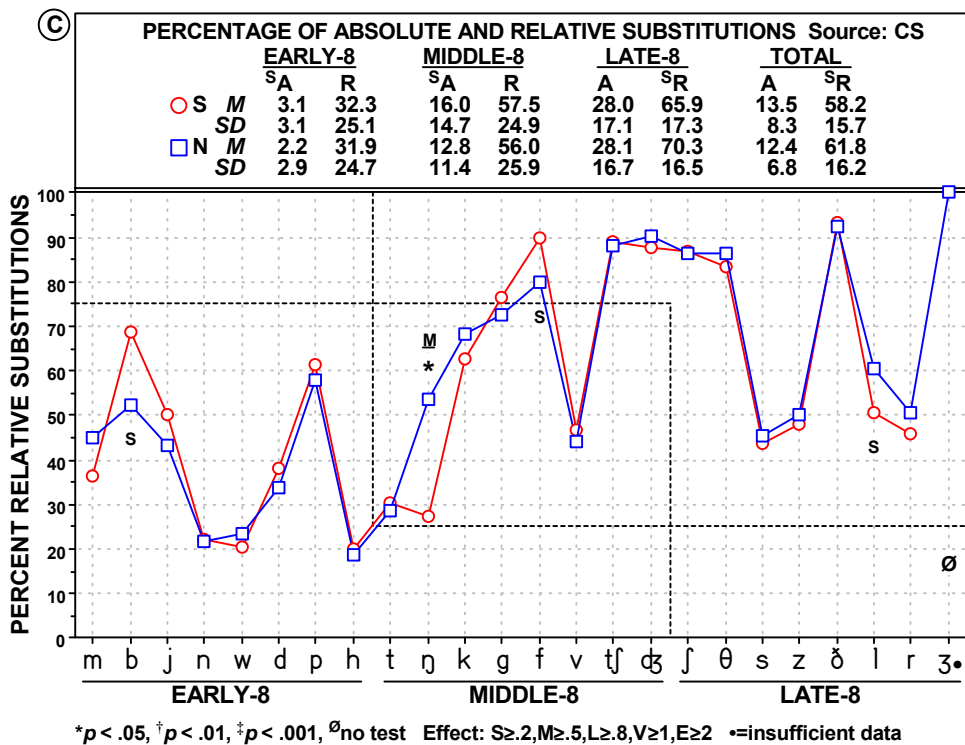
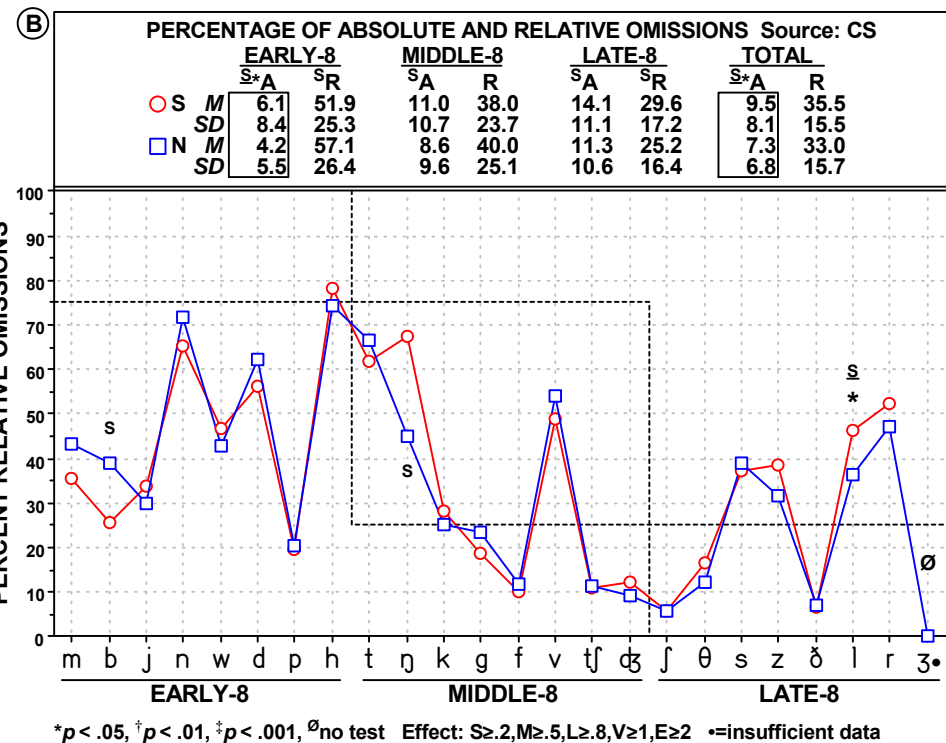
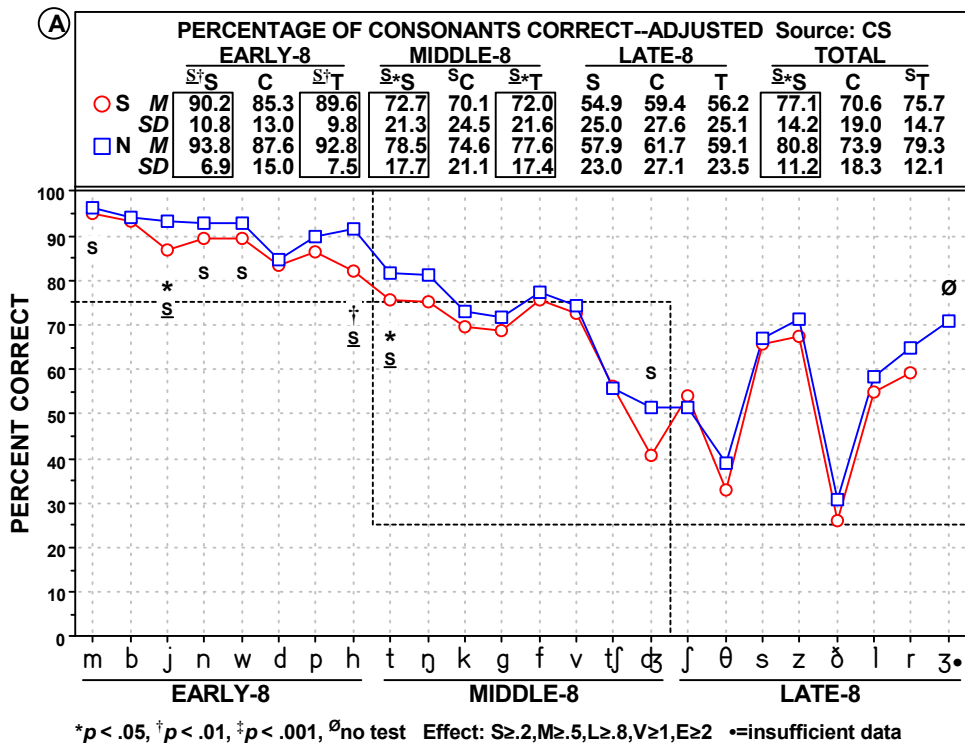
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2 ∅=insufficient data

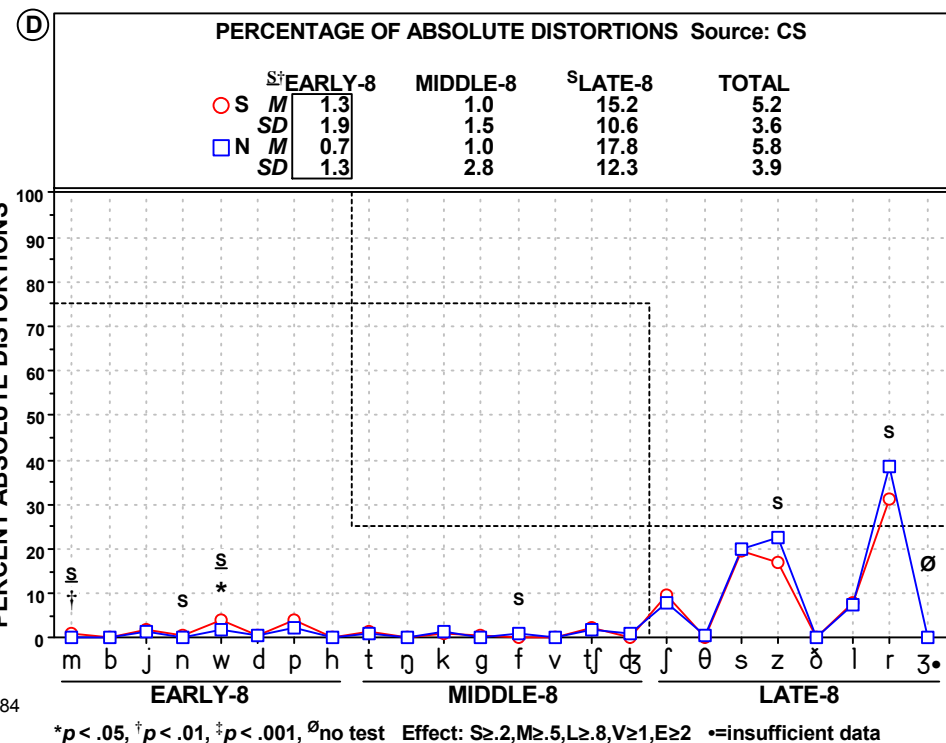
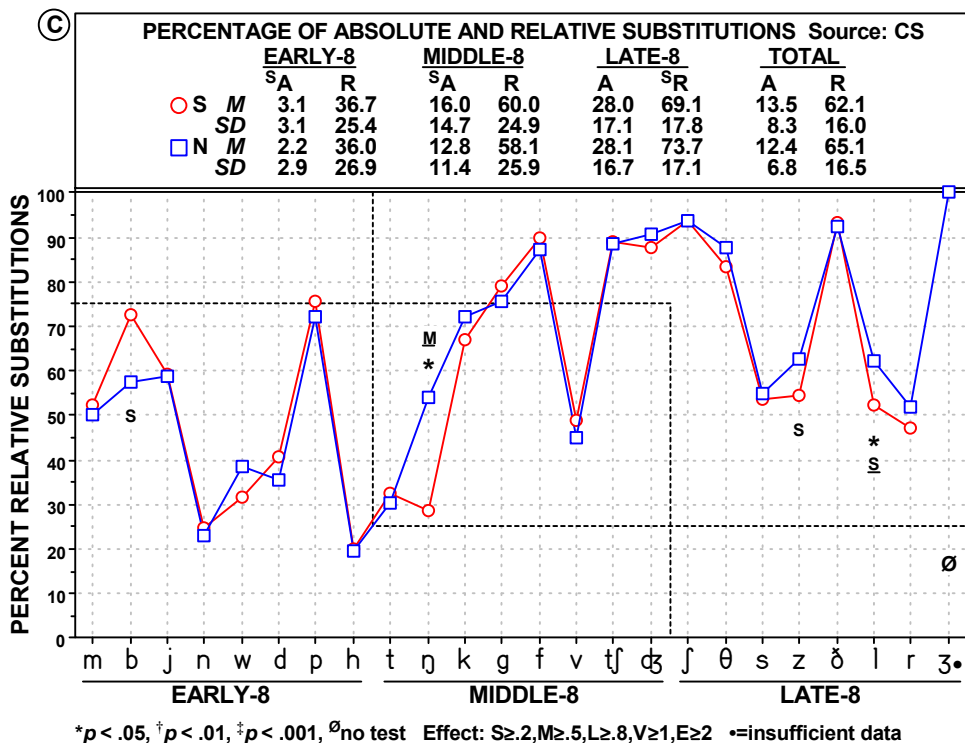
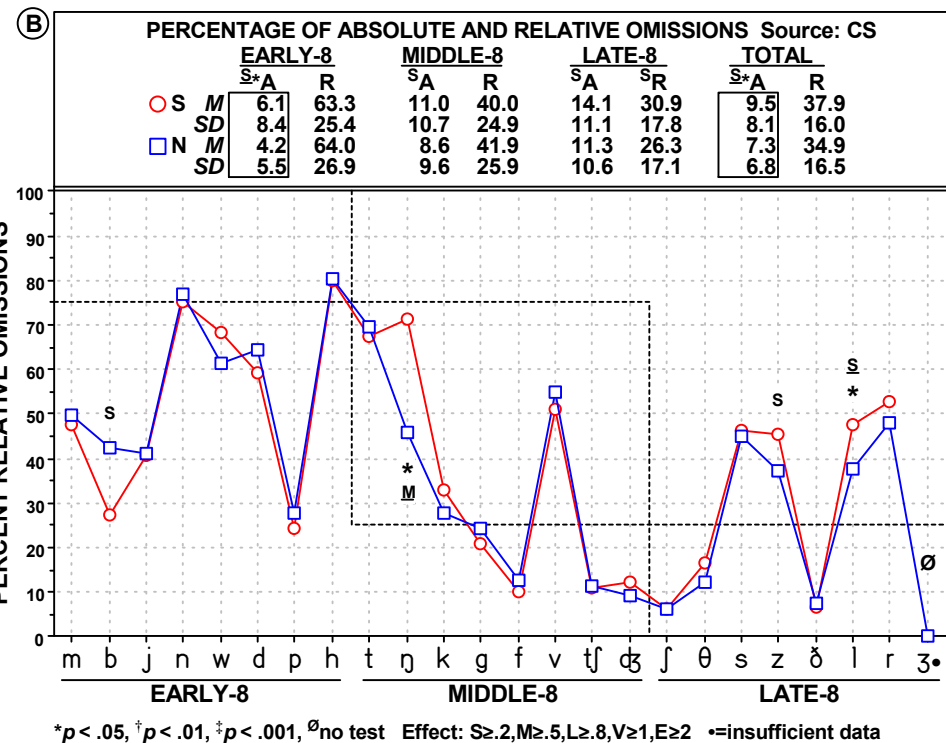
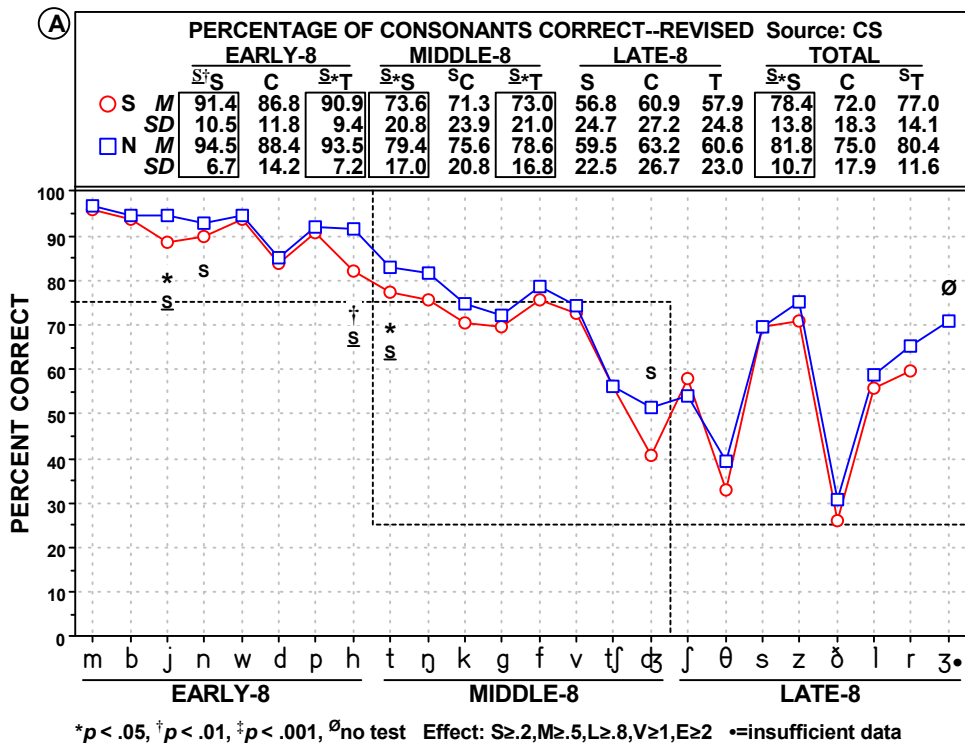


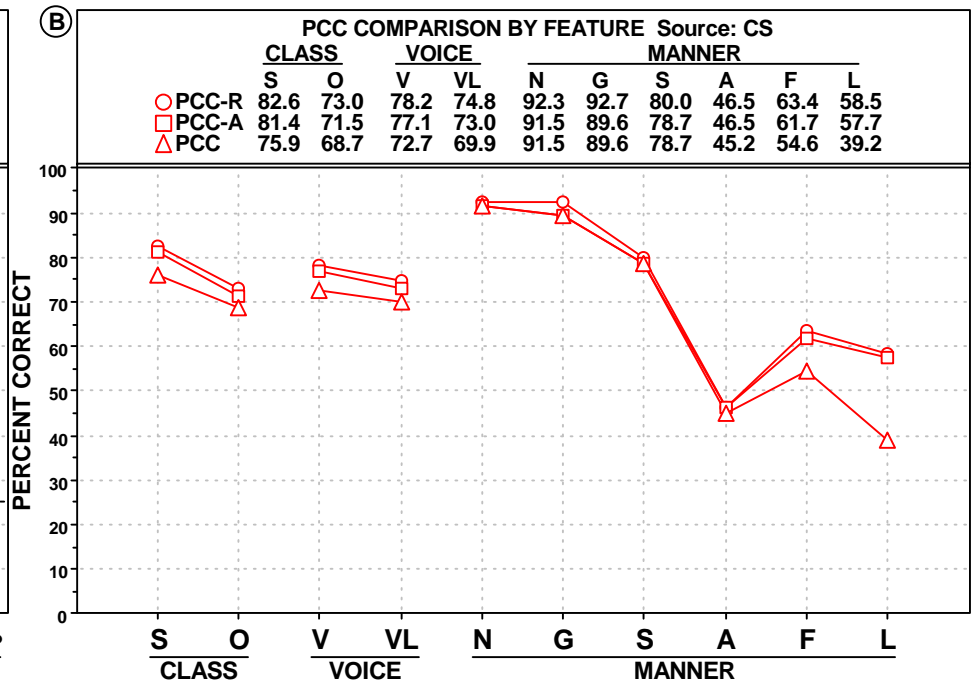
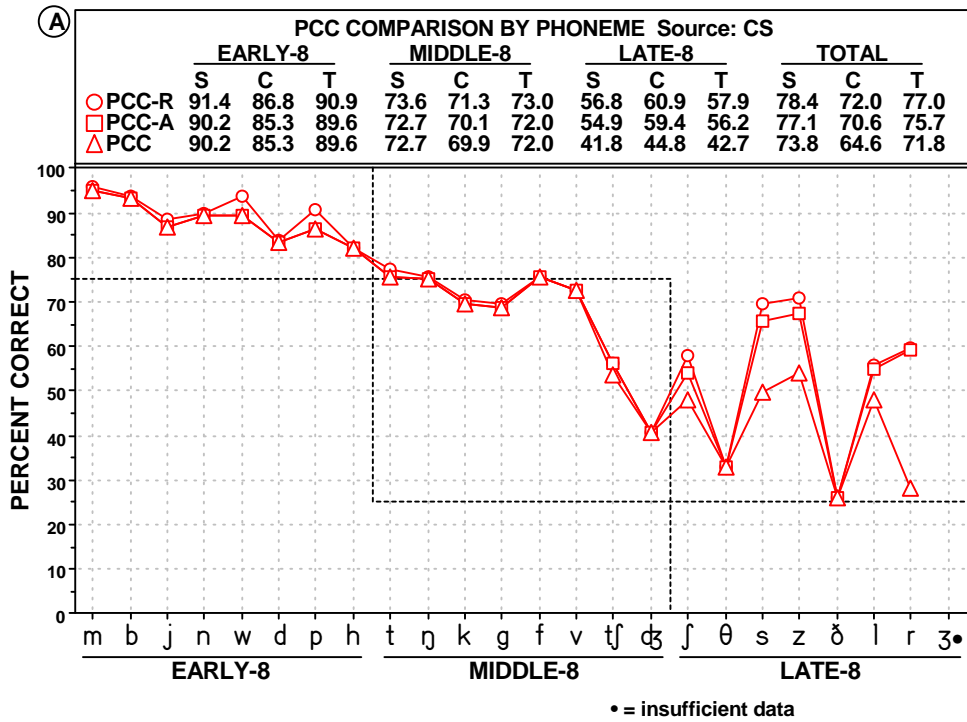
80 \* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2 ∅=insufficient data

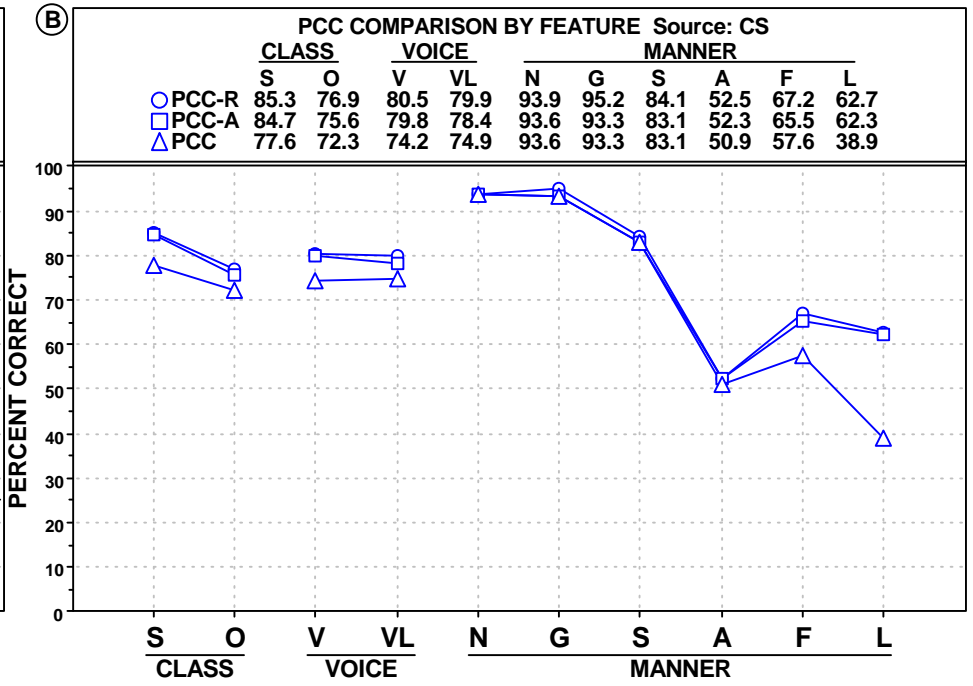
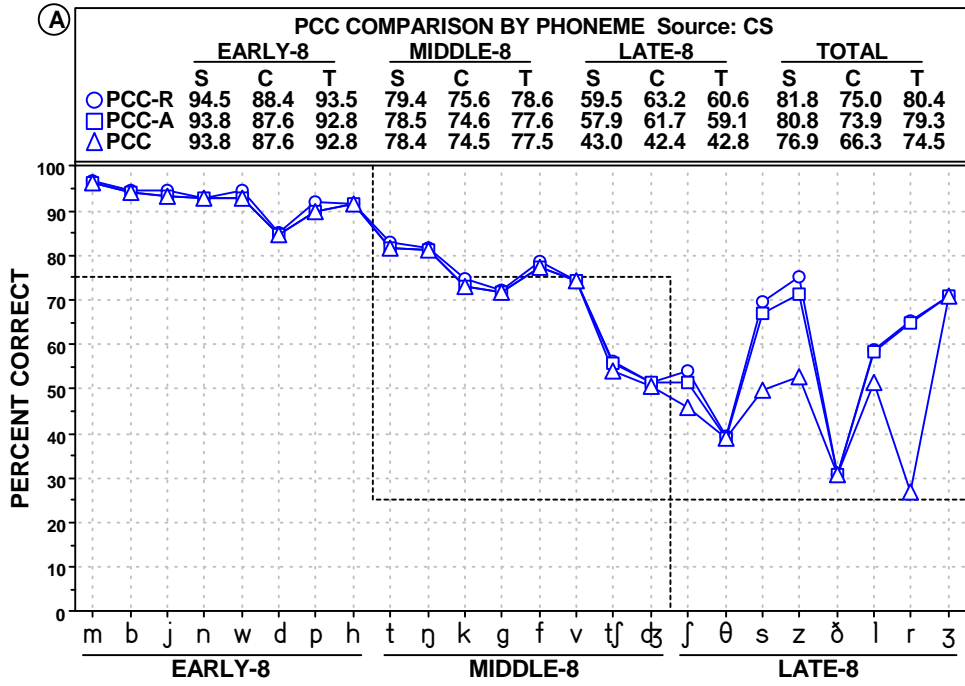
## **CONSONANT PROFILES**





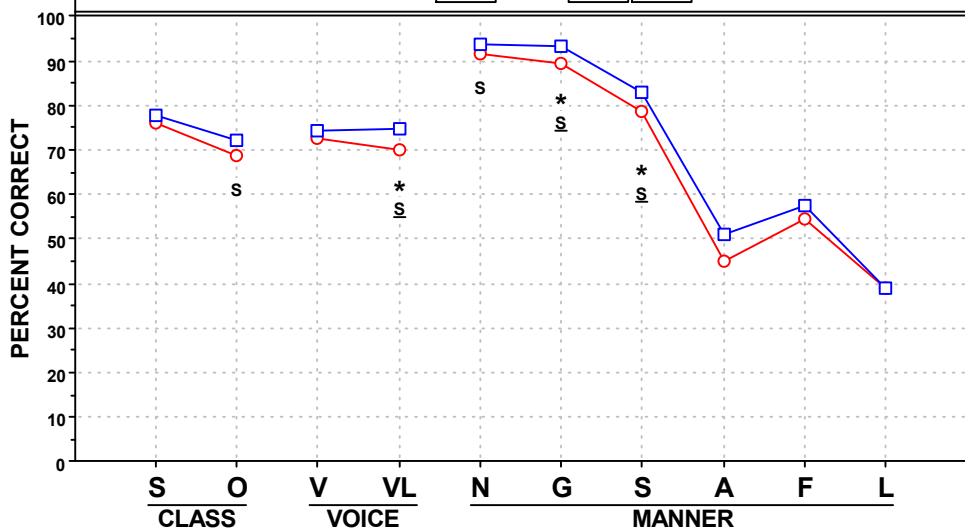






**(A) PERCENTAGE OF CONSONANT FEATURES CORRECT Source: CS**

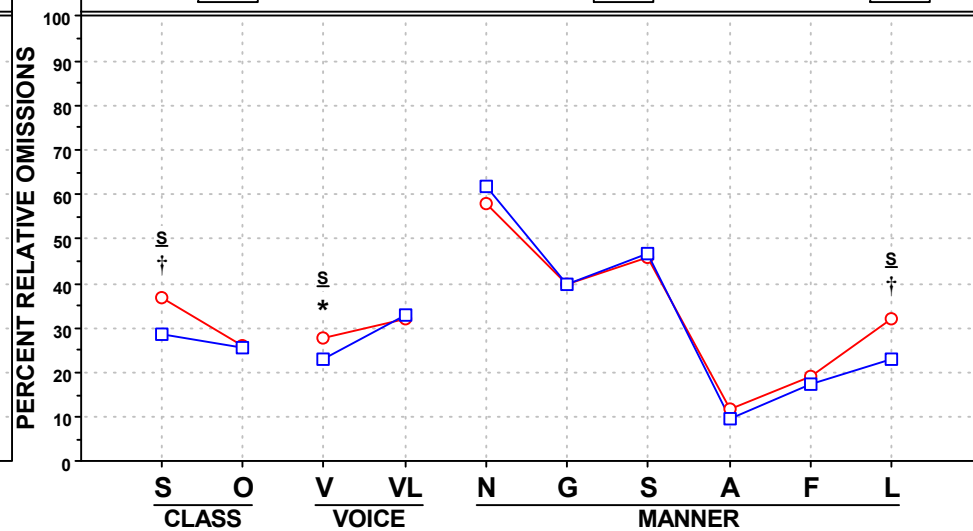
		CLASS		VOICE		MANNER					
		S	SO	V	S*VL	S <sup>N</sup>	S*G	S*S	A	F	L
○	S M	75.9	68.7	72.7	69.9	91.5	89.6	78.7	45.2	54.6	39.2
	SD	13.2	16.8	12.8	19.4	8.5	14.2	16.8	36.2	23.3	30.5
□	N M	77.6	72.3	74.2	74.9	93.6	93.3	83.1	50.9	57.6	38.9
	SD	12.1	14.2	11.7	15.5	9.4	11.1	13.6	38.2	22.2	27.9



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(B) PERCENTAGE OF ABSOLUTE OMISSIONS Source: CS**

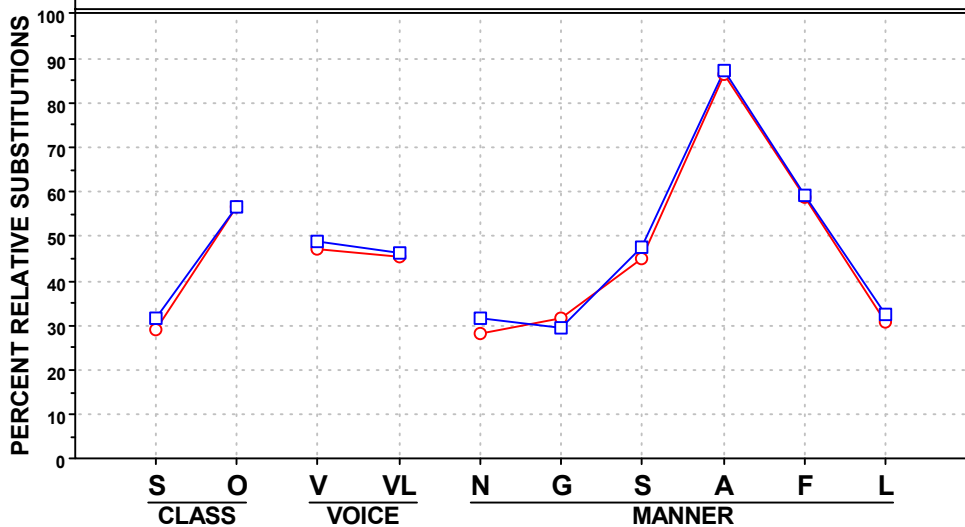
		CLASS		VOICE		MANNER					
		S*S	SO	SV	S*VL	N	S*G	S <sup>S</sup>	A	F	S*L
○	S M	9.5	9.5	8.4	11.2	5.8	4.4	9.5	7.0	10.4	19.2
	SD	8.2	9.0	7.4	10.5	6.9	11.2	9.5	19.0	10.7	16.3
□	N M	6.9	7.6	6.6	8.6	4.5	2.3	7.6	4.8	8.3	14.6
	SD	7.1	7.9	6.4	8.9	8.1	5.2	8.3	12.8	10.8	13.9



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(C) PERCENTAGE OF ABSOLUTE SUBSTITUTIONS Source: CS**

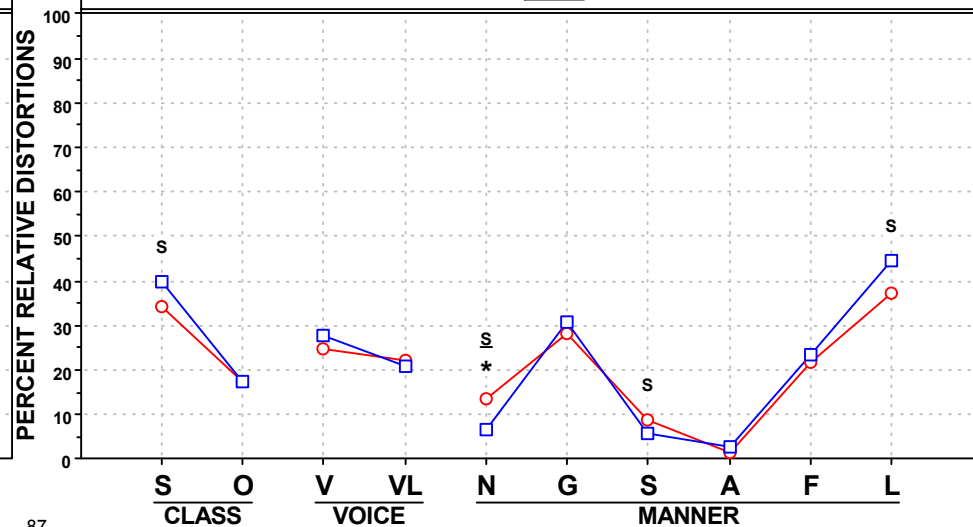
		CLASS		VOICE		MANNER					
		S	SO	V	S*VL	N	G	S <sup>S</sup>	A	F	L
○	S M	7.9	17.5	13.4	14.1	1.9	2.9	10.5	46.6	26.2	22.3
	SD	6.8	11.0	7.8	11.5	2.8	4.9	10.5	35.1	15.8	21.6
□	N M	7.8	15.5	12.9	11.5	1.7	2.5	8.4	42.7	24.4	22.7
	SD	6.9	8.7	7.3	8.7	2.7	7.0	8.2	35.8	15.0	21.8



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(D) PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS**

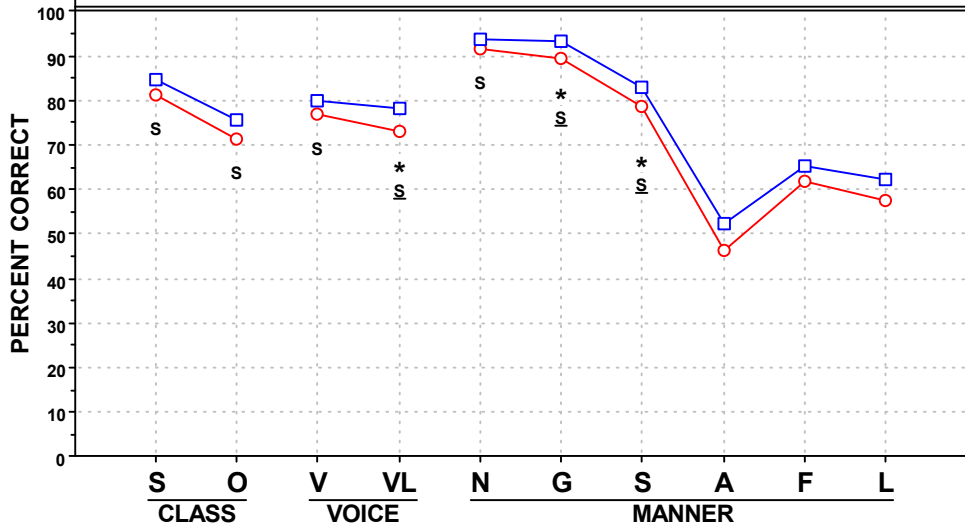
		CLASS		VOICE		MANNER					
		S	O	SV	VL	M:N	S*G	S	A	F	S <sup>L</sup>
○	S M	6.6	4.3	5.5	4.8	0.8	3.0	1.3	1.3	8.8	19.3
	SD	4.4	4.8	3.6	5.1	1.6	8.2	2.3	8.8	11.3	12.2
□	N M	7.6	4.6	6.4	5.0	0.3	1.9	1.0	1.6	9.6	23.8
	SD	5.3	5.6	4.0	6.1	0.8	4.5	2.5	8.8	12.2	16.5



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(A) PERCENTAGE OF CONSONANT FEATURES CORRECT--ADJUSTED Source: CS**

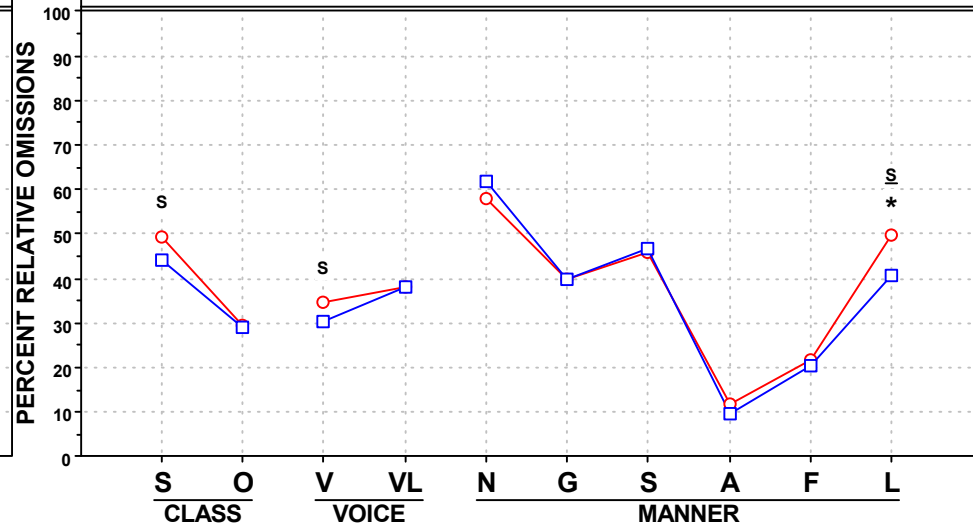
	CLASS	VOICE				MANNER						
		<sup>s</sup> S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	<sup>s</sup> N	<sup>s</sup> *G	<sup>s</sup> *S	A	F	L	
○ S	M	81.4	71.5	77.1	73.0	91.5	89.6	78.7	46.5	61.7	57.7	
	SD	12.3	17.5	12.5	20.1	8.5	14.2	16.8	35.6	23.7	29.0	
□ N	M	84.7	75.6	79.8	78.4	93.6	93.3	83.1	52.3	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	



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

**(B) PERCENTAGE OF ABSOLUTE OMISSIONS Source: CS**

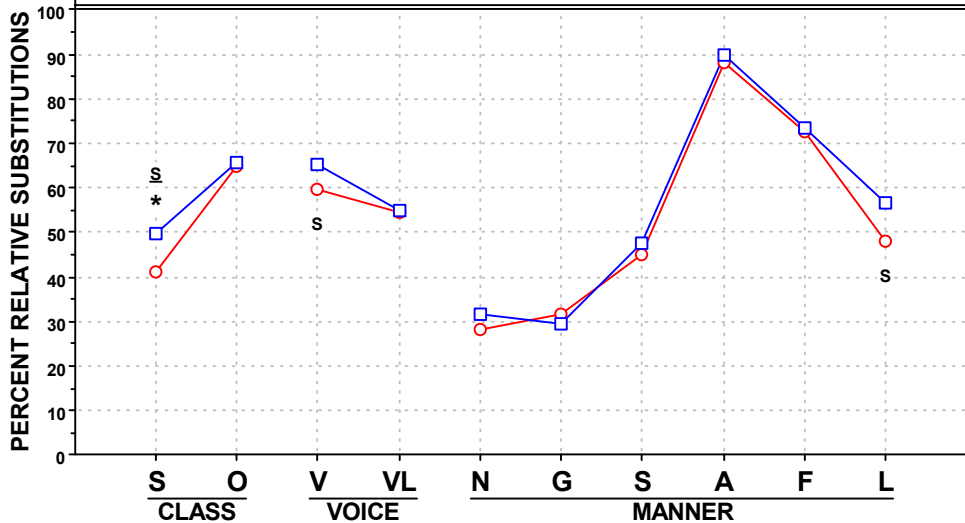
	CLASS	VOICE				MANNER						
		<sup>s</sup> *S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	N	<sup>s</sup> *G	<sup>s</sup> S	A	F	<sup>s</sup> *L	
○ S	M	9.5	9.5	8.4	11.2	5.8	4.4	9.5	7.0	10.4	19.2	
	SD	8.2	9.0	7.4	10.5	6.9	11.2	9.5	19.0	10.7	16.3	
□ N	M	6.9	7.6	6.6	8.6	4.5	2.3	7.6	4.8	8.3	14.6	
	SD	7.1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



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

**(C) PERCENTAGE OF ABSOLUTE SUBSTITUTIONS Source: CS**

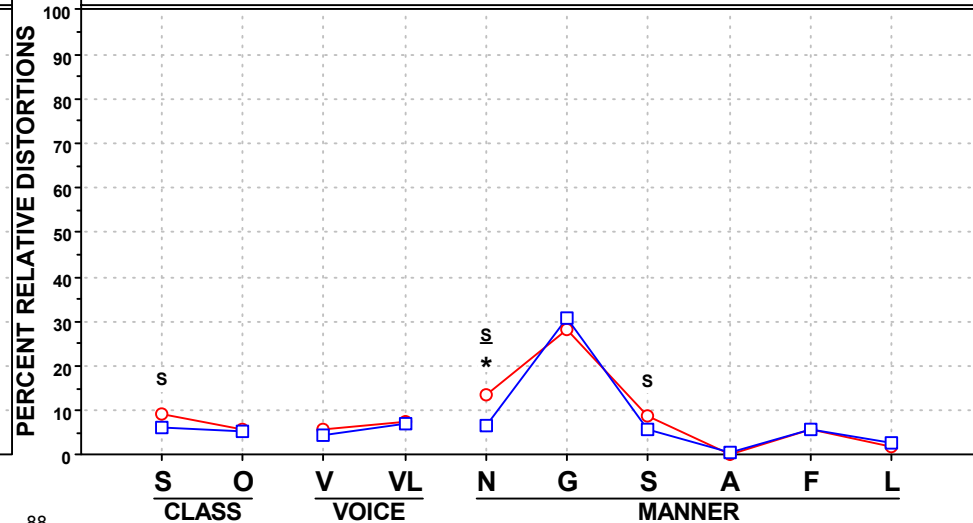
	CLASS	VOICE				MANNER						
		<sup>s</sup> S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	N	G	<sup>s</sup> S	A	F	L	
○ S	M	7.9	17.5	13.4	14.1	1.9	2.9	10.5	46.6	26.2	22.3	
	SD	6.8	11.0	7.8	11.5	2.8	4.9	10.5	35.1	15.8	21.6	
□ N	M	7.8	15.5	12.9	11.5	1.7	2.5	8.4	42.7	24.4	22.7	
	SD	6.9	8.7	7.3	8.7	2.7	7.0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



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

**(D) PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS**

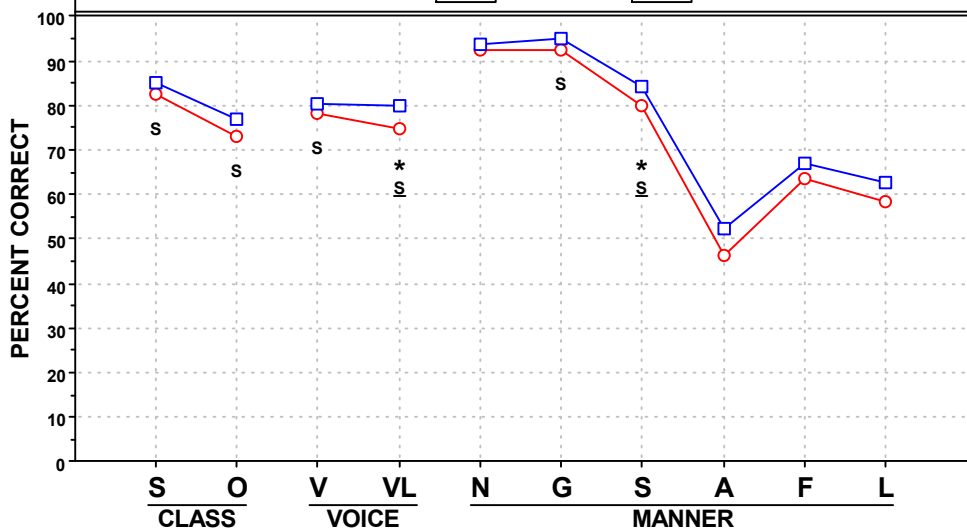
	CLASS	VOICE				MANNER						
		<sup>s</sup> *S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	<sup>s</sup> *N	<sup>s</sup> G	<sup>s</sup> S	A	F	<sup>s</sup> L	
○ S	M	1.1	1.5	1.0	1.8	0.8	3.0	1.3	0.0	1.8	0.8	
	SD	1.5	1.8	1.3	2.4	1.6	8.2	2.3	0.0	2.9	1.9	
□ N	M	0.6	1.3	0.7	1.5	0.3	1.9	1.0	0.3	1.7	0.4	
	SD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



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

**(A) PERCENTAGE OF CONSONANT FEATURES CORRECT—REVISED Source: CS**

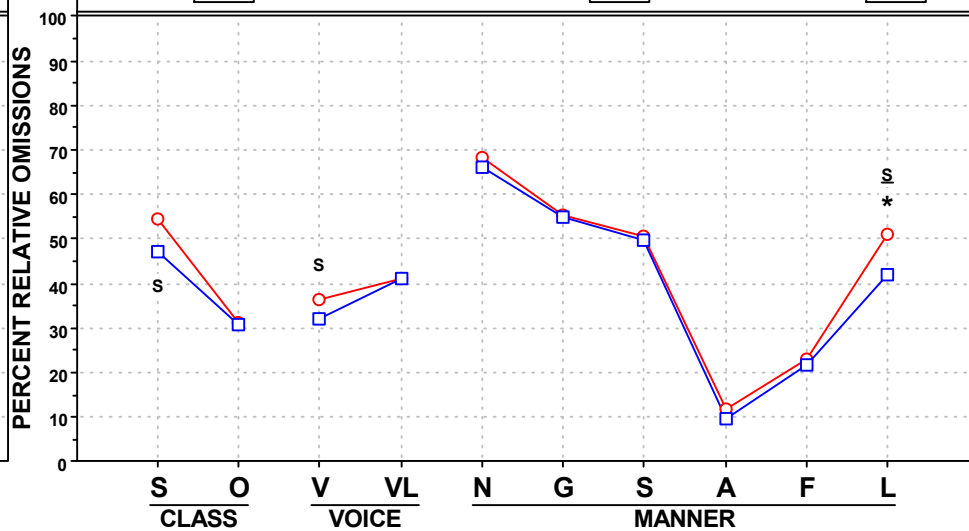
	CLASS		VOICE		MANNER						
	<sup>s</sup> S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	N	<sup>s</sup> G	<sup>s</sup> S	A	F	L	
○ S	M	82.6	73.0	78.2	74.8	92.3	92.7	80.0	46.5	63.4	58.5
	SD	12.0	16.9	12.3	19.0	8.2	12.3	15.9	35.6	23.7	29.0
□ N	M	85.3	76.9	80.5	79.9	93.9	95.2	84.1	52.5	67.2	62.7
	SD	11.5	13.5	11.1	14.5	9.3	9.7	13.0	37.9	21.0	28.2



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

**(B) PERCENTAGE OF ABSOLUTE OMISSIONS Source: CS**

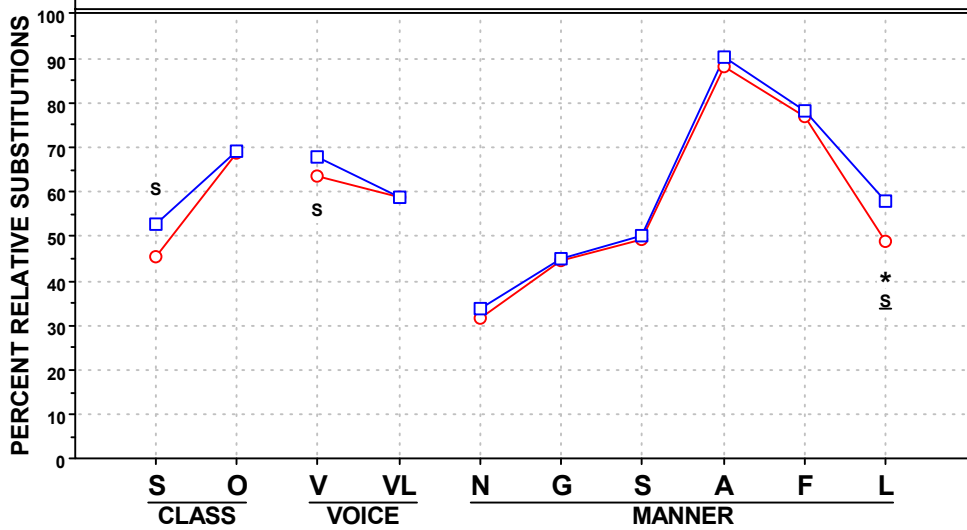
	CLASS		VOICE		MANNER						
	<sup>s</sup> S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	N	<sup>s</sup> G	<sup>s</sup> S	A	F	<sup>s</sup> L	
○ S	M	9.5	9.5	8.4	11.2	5.8	4.4	9.5	7.0	10.4	19.2
	SD	8.2	9.0	7.4	10.5	6.9	11.2	9.5	19.0	10.7	16.3
□ N	M	6.9	7.6	6.6	8.6	4.5	2.3	7.6	4.8	8.3	14.6
	SD	7.1	7.9	6.4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



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

**(C) PERCENTAGE OF ABSOLUTE SUBSTITUTIONS Source: CS**

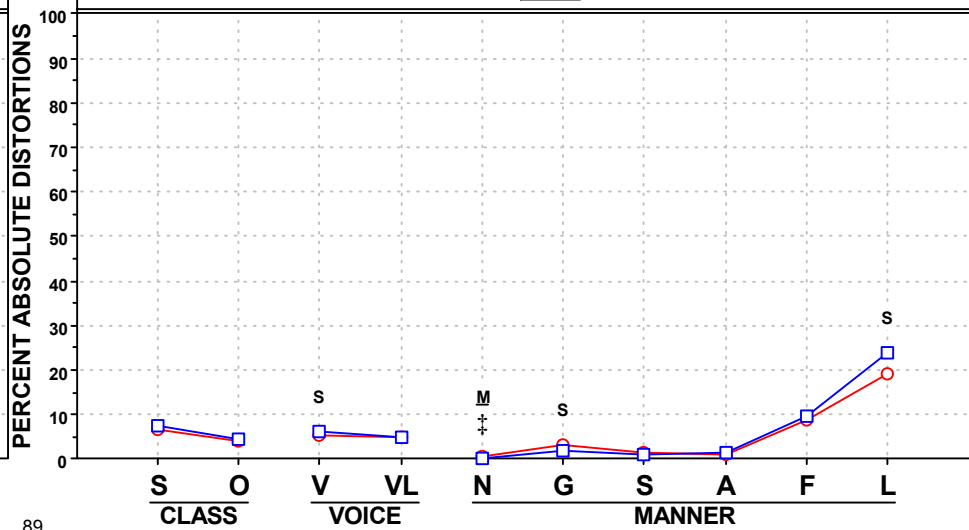
	CLASS		VOICE		MANNER						
	<sup>s</sup> S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	N	G	<sup>s</sup> S	A	F	L	
○ S	M	7.9	17.5	13.4	14.1	1.9	2.9	10.5	46.6	26.2	22.3
	SD	6.8	11.0	7.8	11.5	2.8	4.9	10.5	35.1	15.8	21.6
□ N	M	7.8	15.5	12.9	11.5	1.7	2.5	8.4	42.7	24.4	22.7
	SD	6.9	8.7	7.3	8.7	2.7	7.0	8.2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



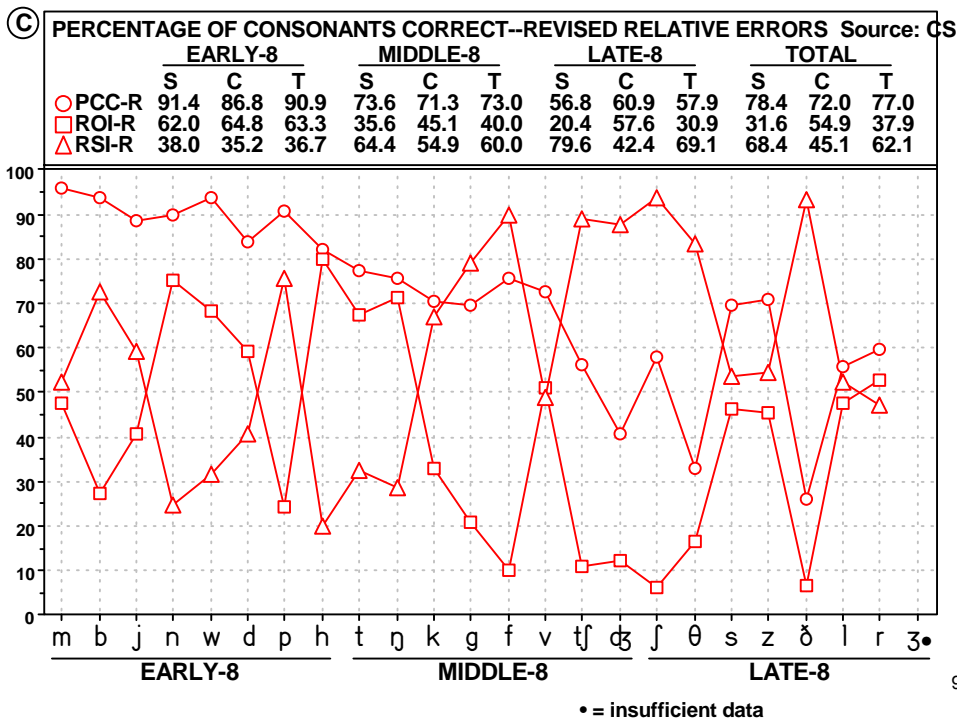
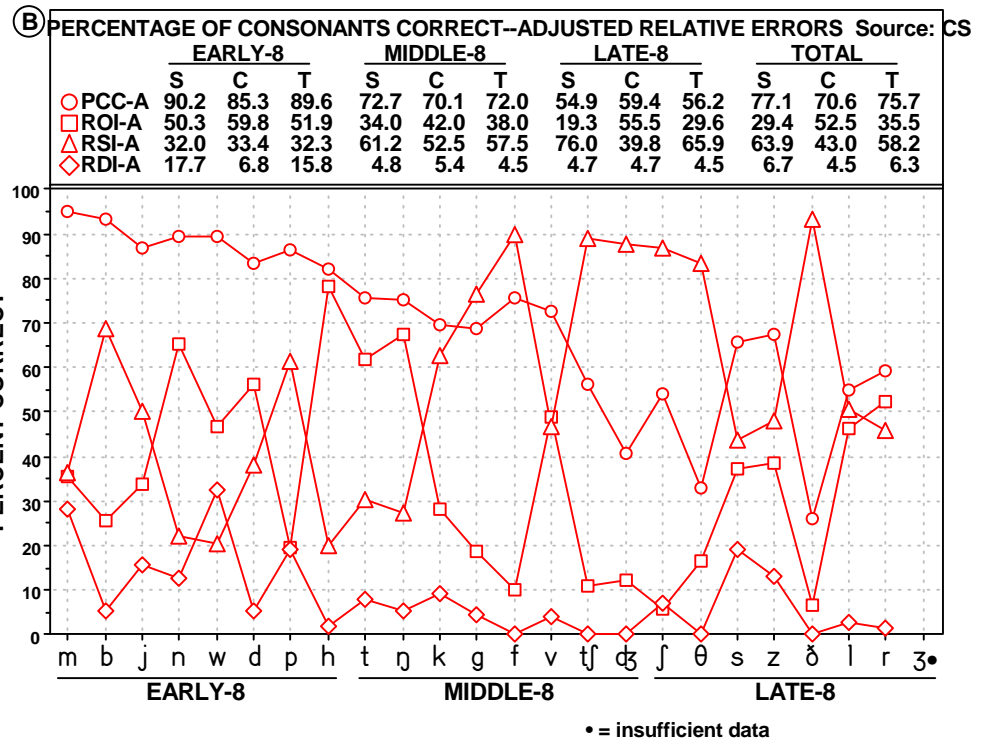
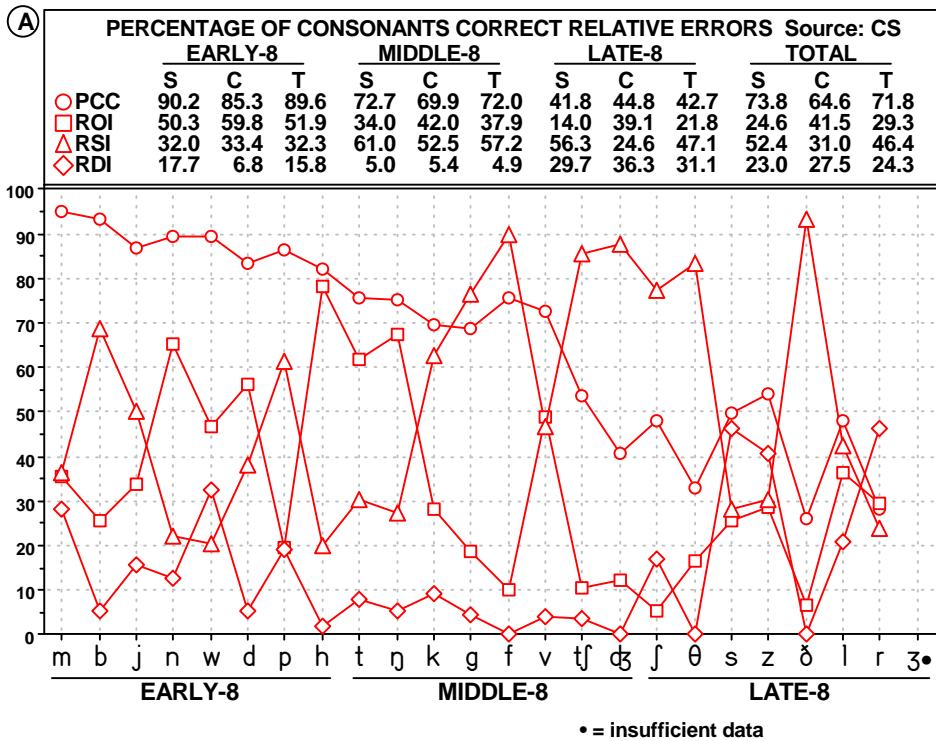
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

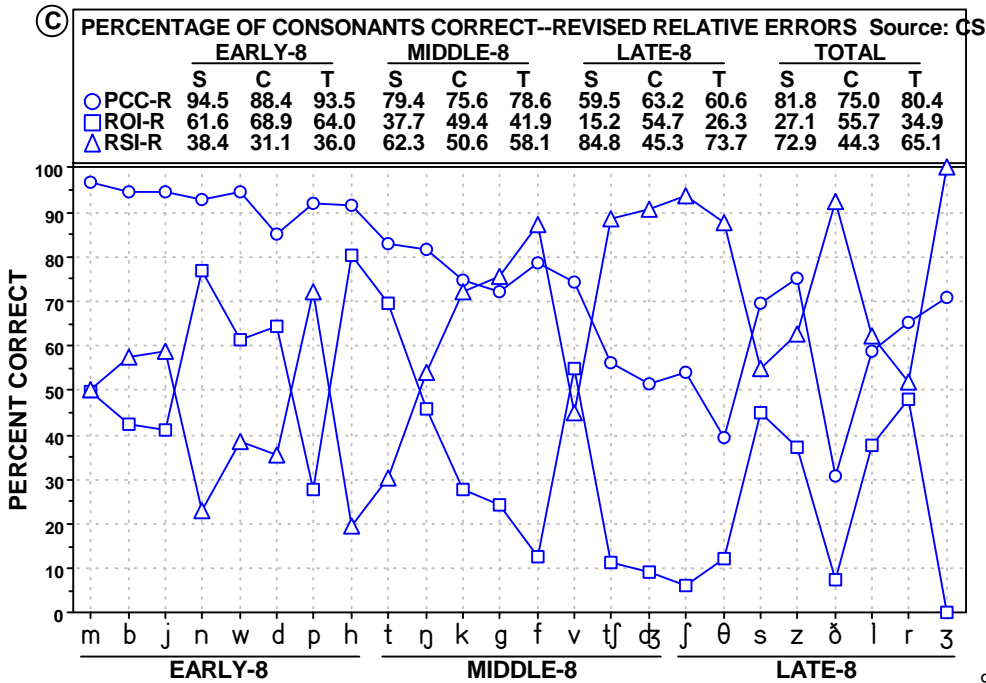
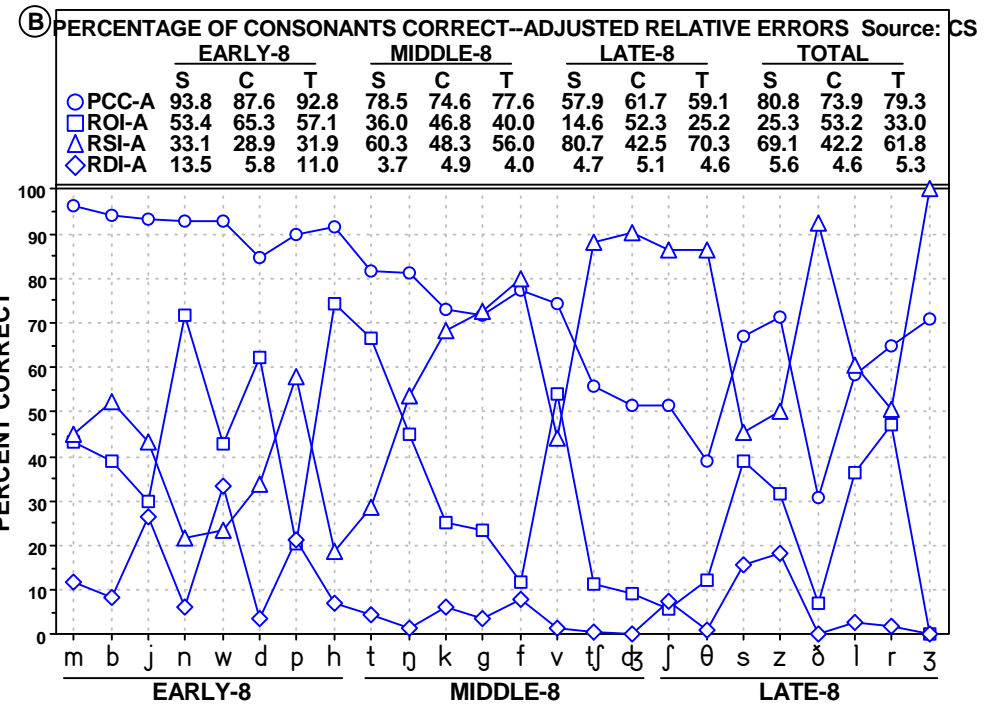
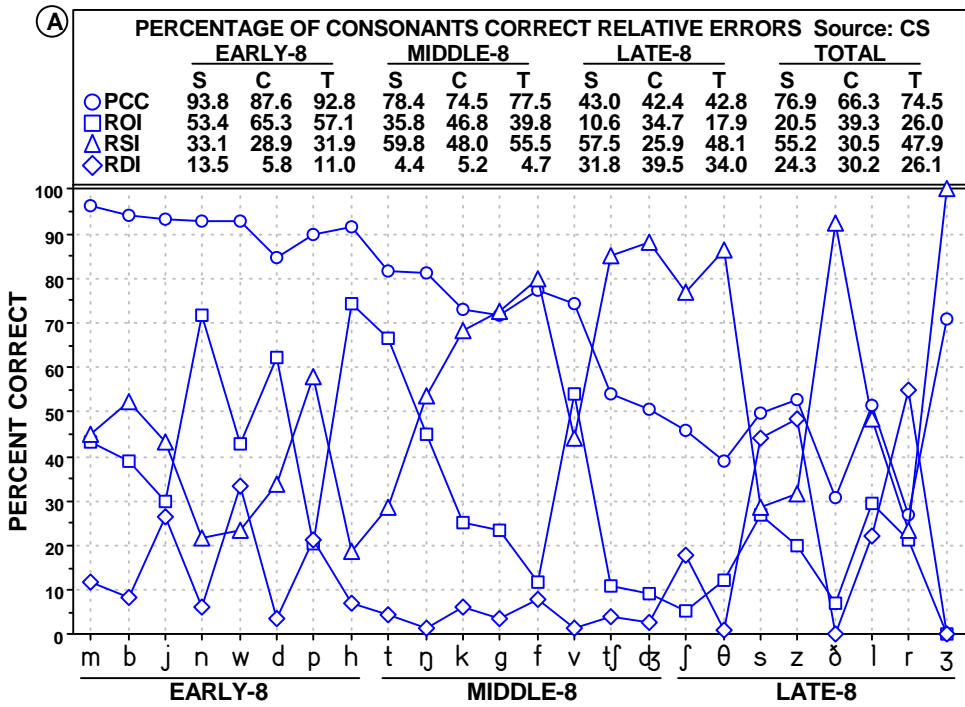
**(D) PERCENTAGE OF ABSOLUTE DISTORTIONS Source: CS**

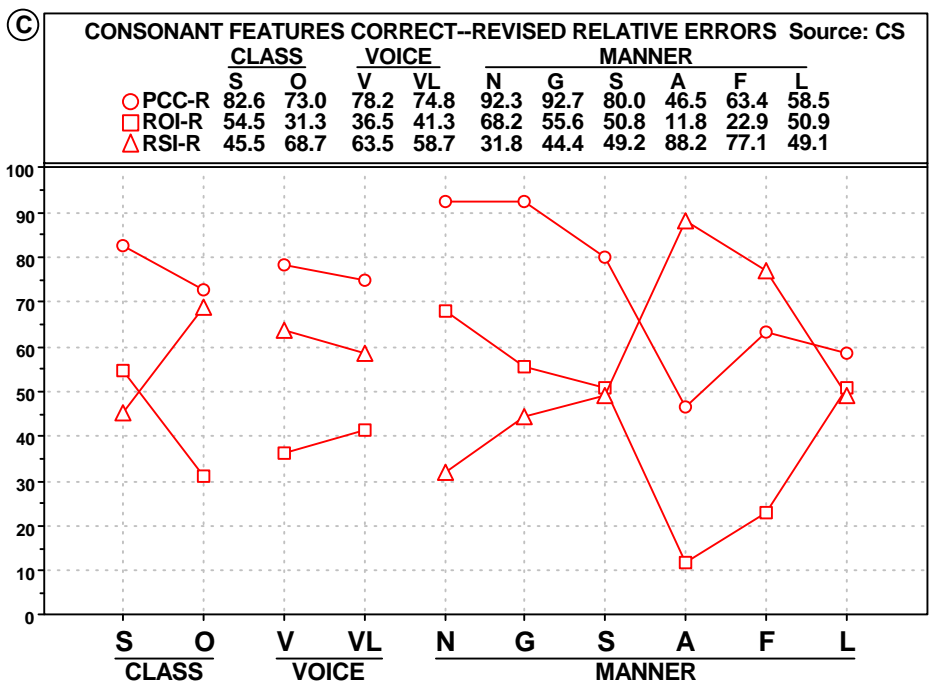
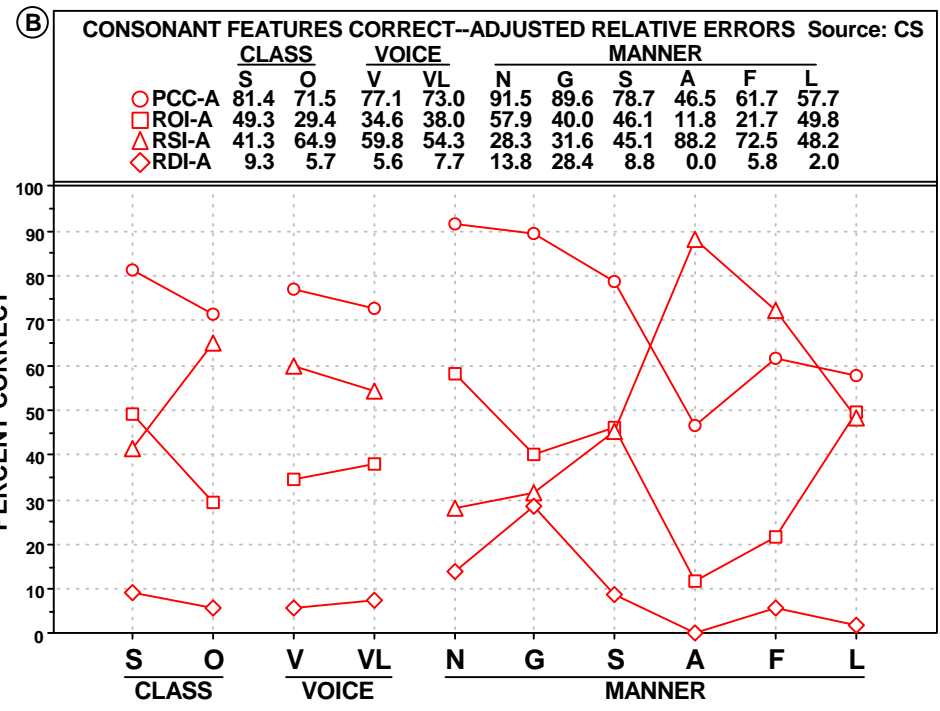
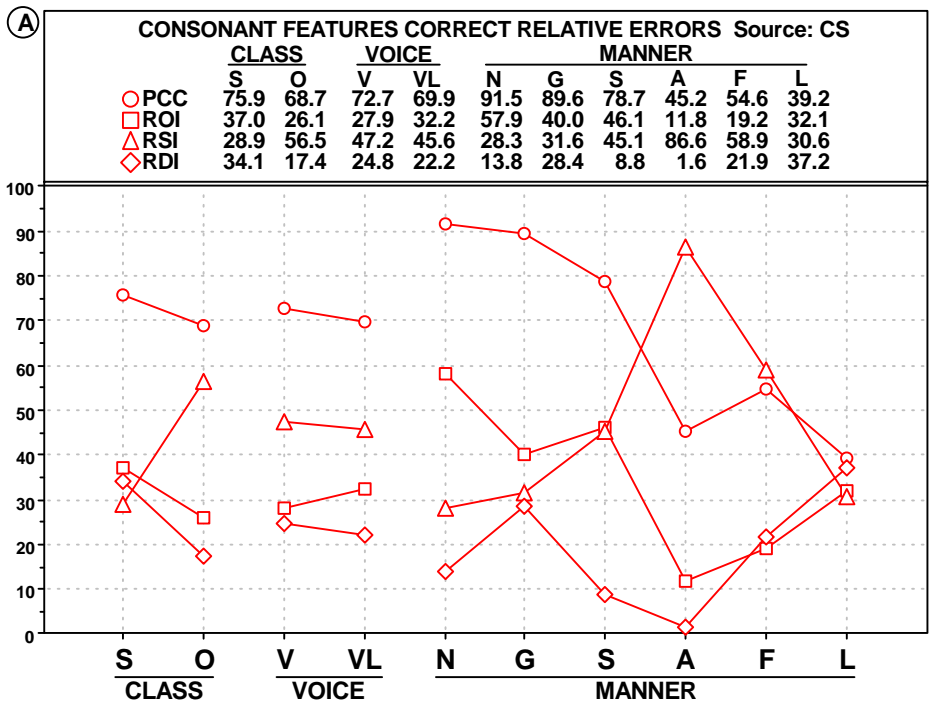
	CLASS		VOICE		MANNER						
	<sup>s</sup> S	<sup>s</sup> O	<sup>s</sup> V	<sup>s</sup> VL	<sup>M</sup> N	<sup>s</sup> G	S	A	F	<sup>s</sup> L	
○ S	M	6.6	4.3	5.5	4.8	0.8	3.0	1.3	1.3	8.8	19.3
	SD	4.4	4.8	3.6	5.1	1.6	8.2	2.3	8.8	11.3	12.2
□ N	M	7.6	4.6	6.4	5.0	0.3	1.9	1.0	1.6	9.6	23.8
	SD	5.3	5.6	4.0	6.1	0.8	4.5	2.5	8.8	12.2	16.5

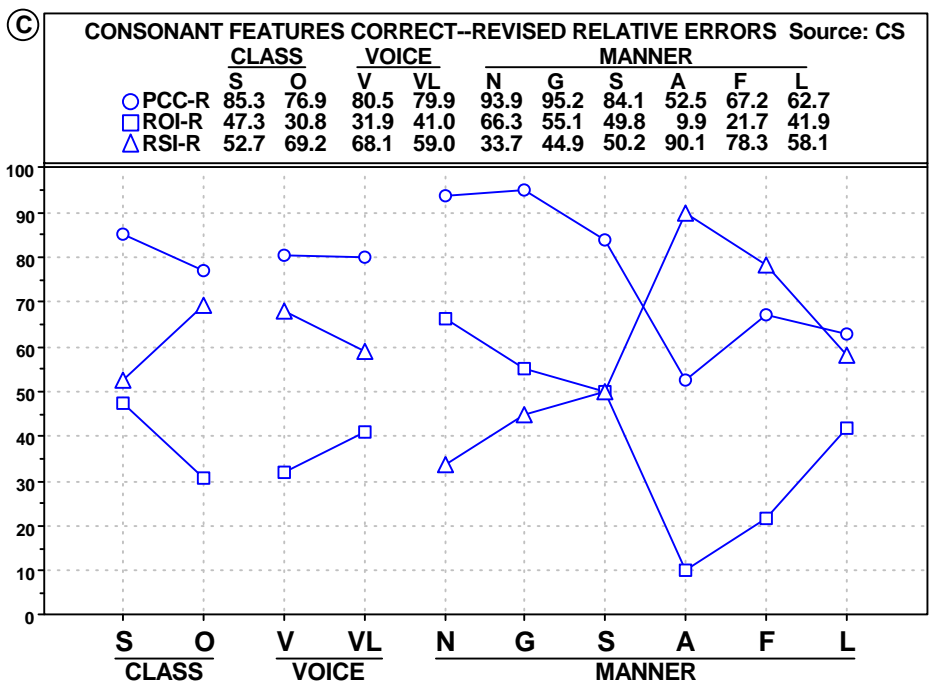
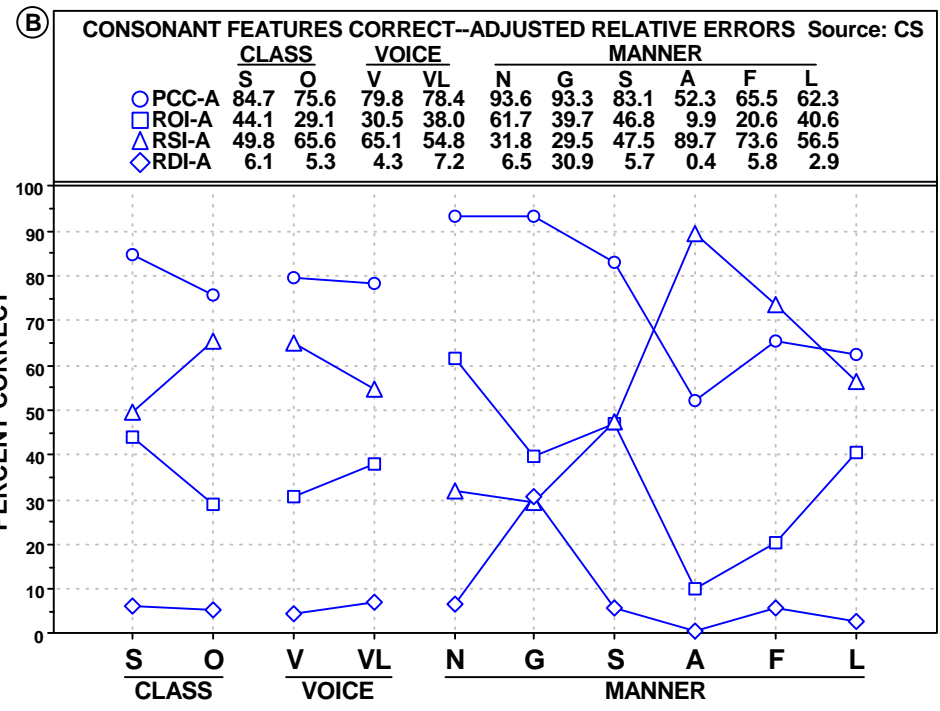
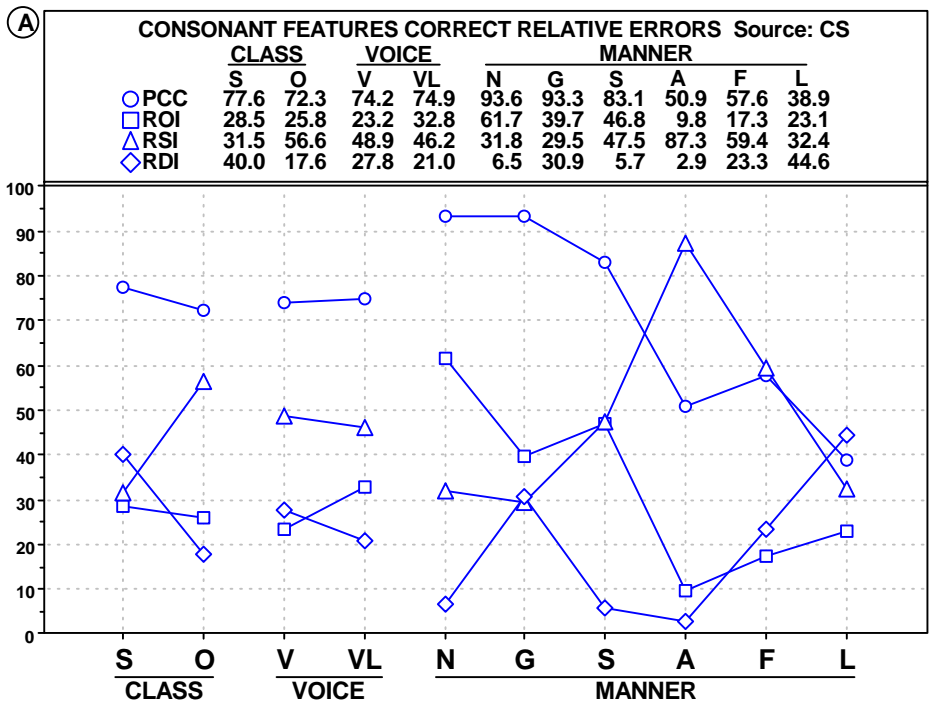


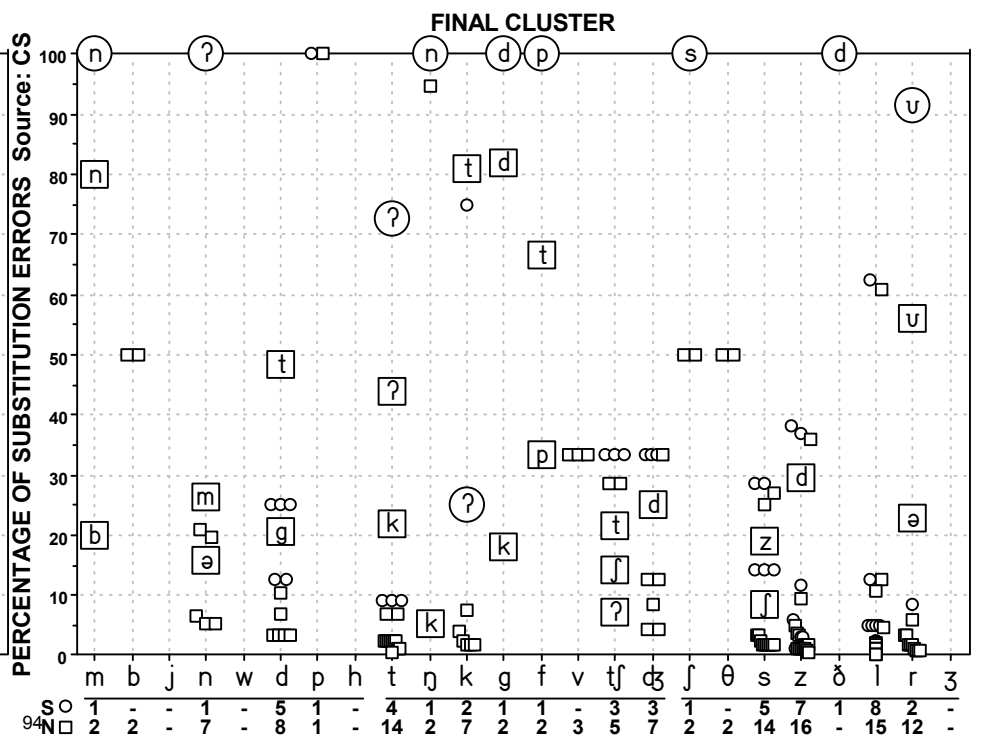
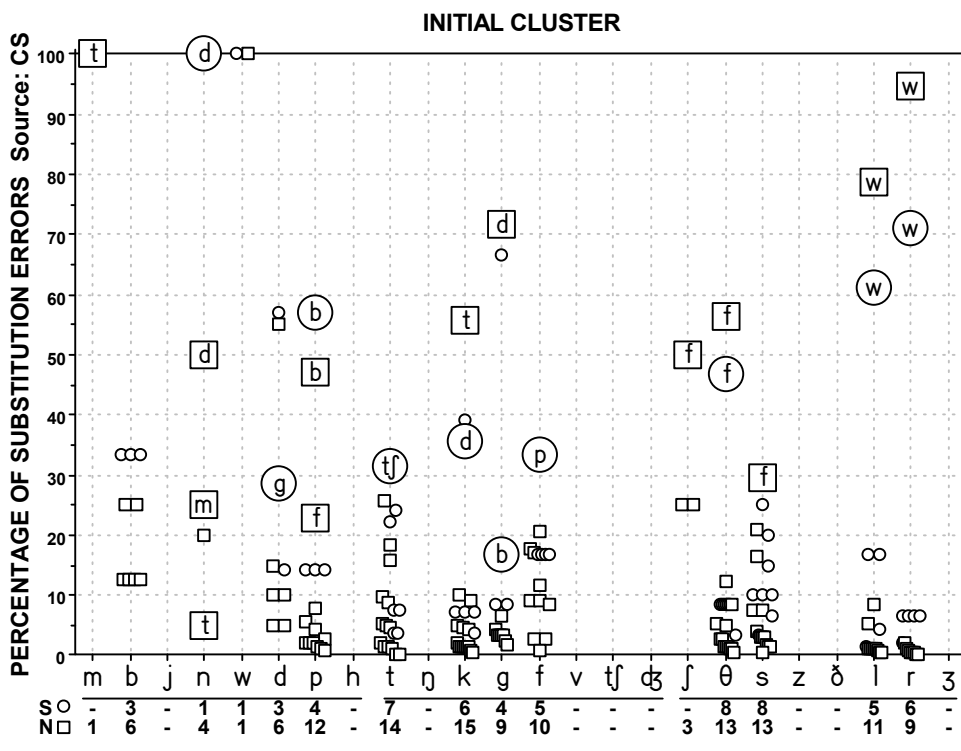
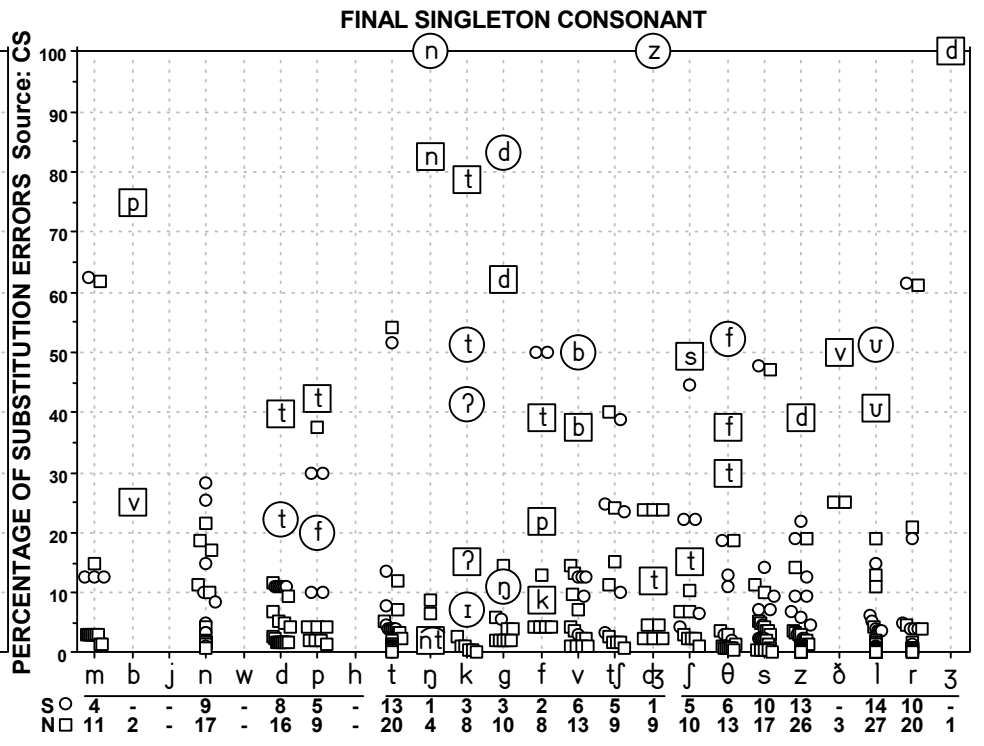
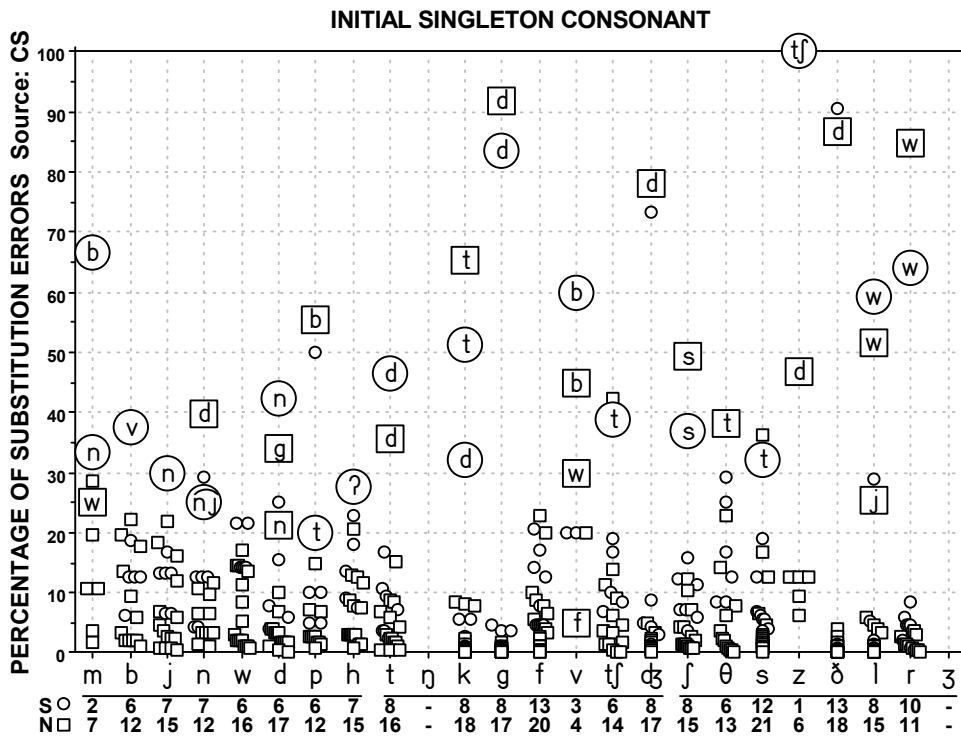
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



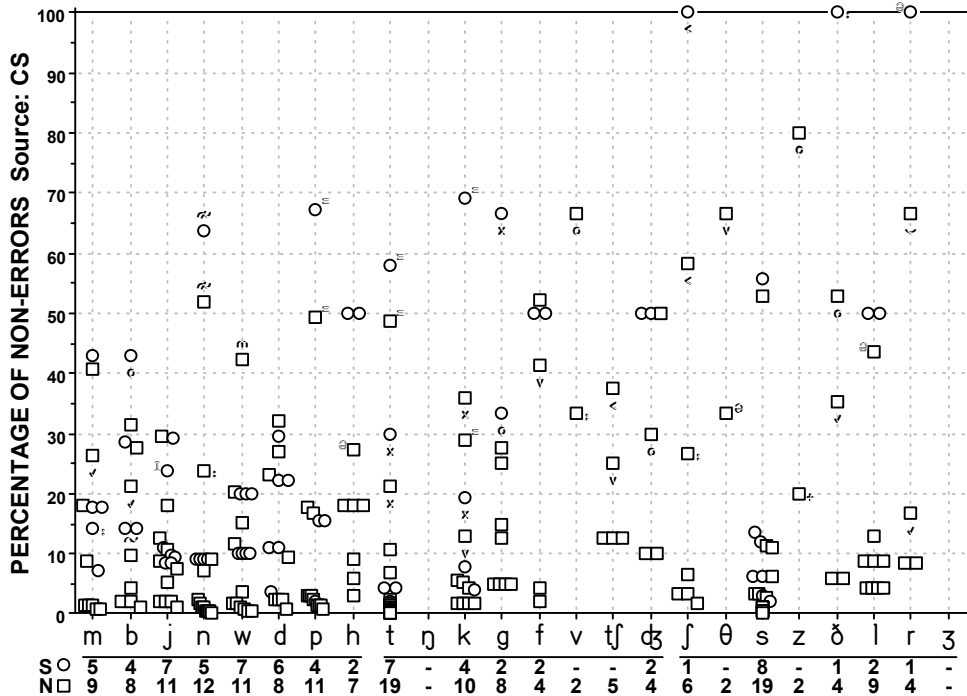




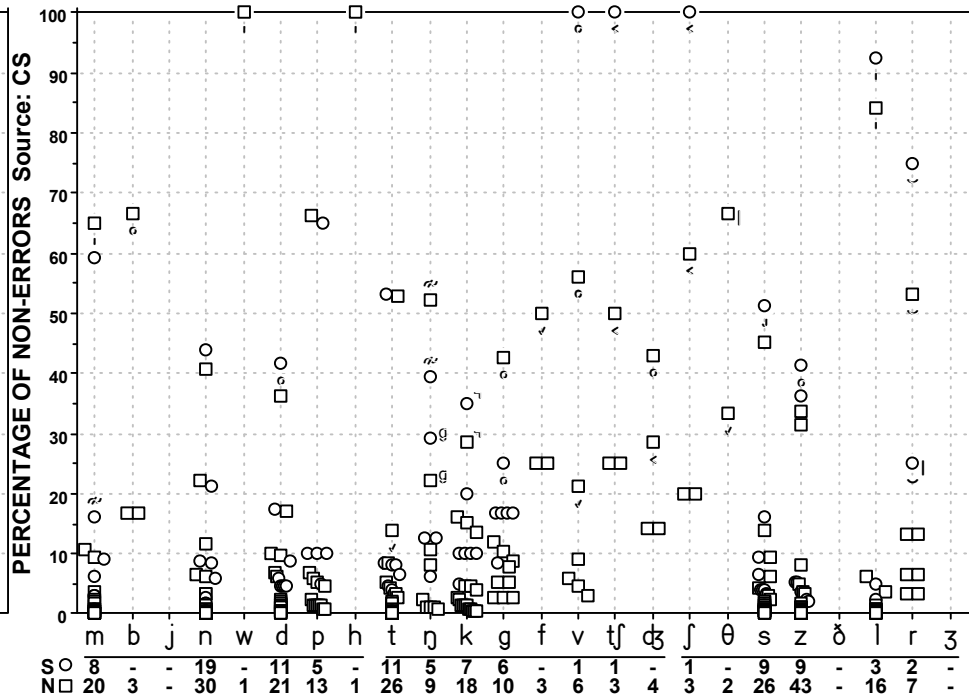




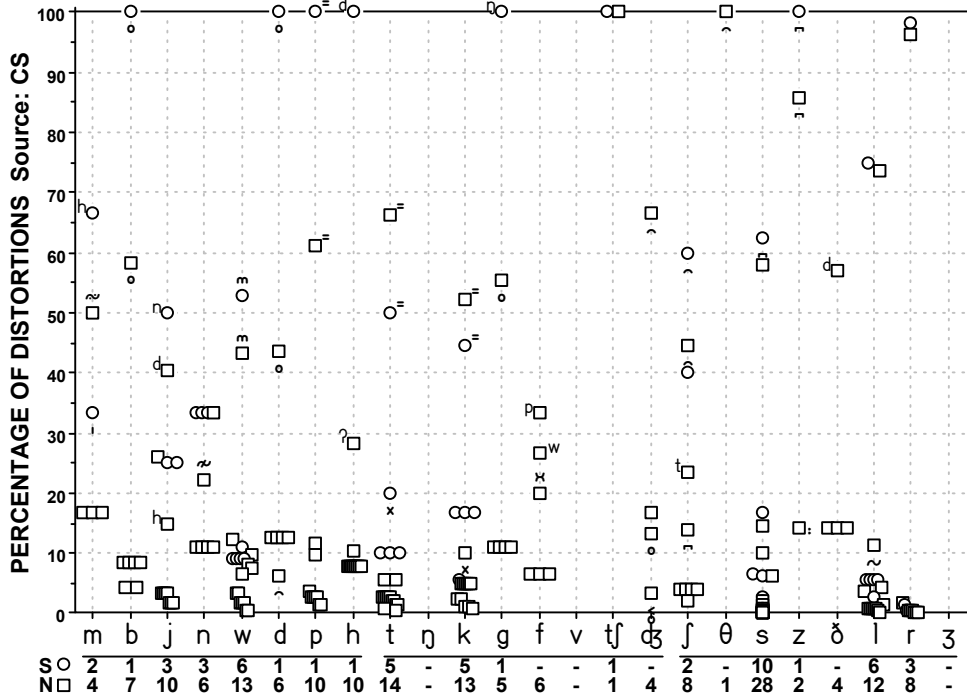
INITIAL CONSONANTS



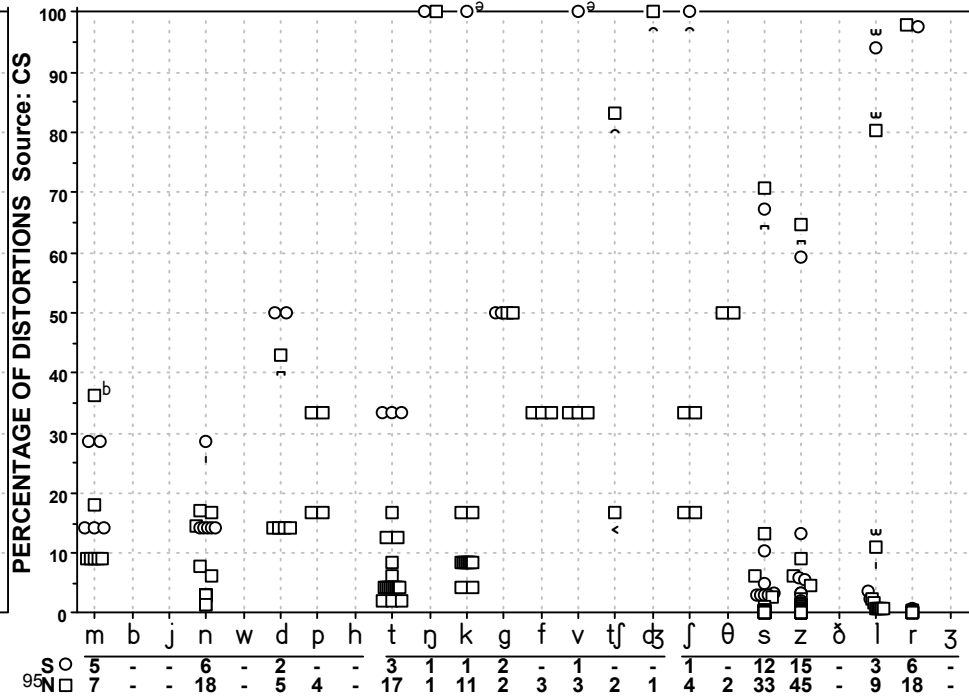
FINAL CONSONANTS



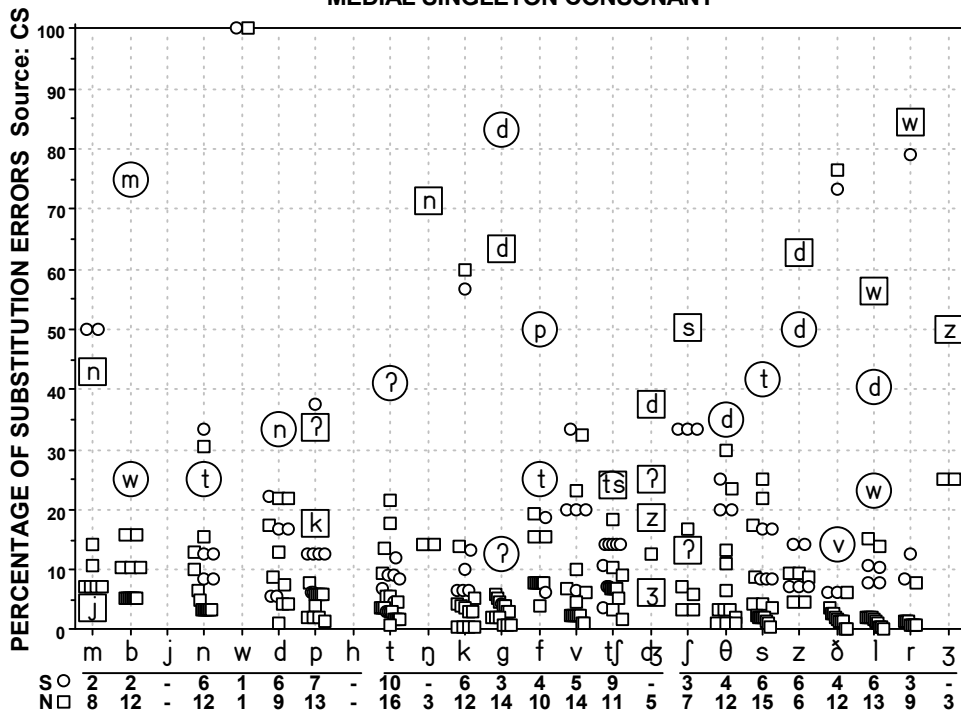
INITIAL CONSONANTS



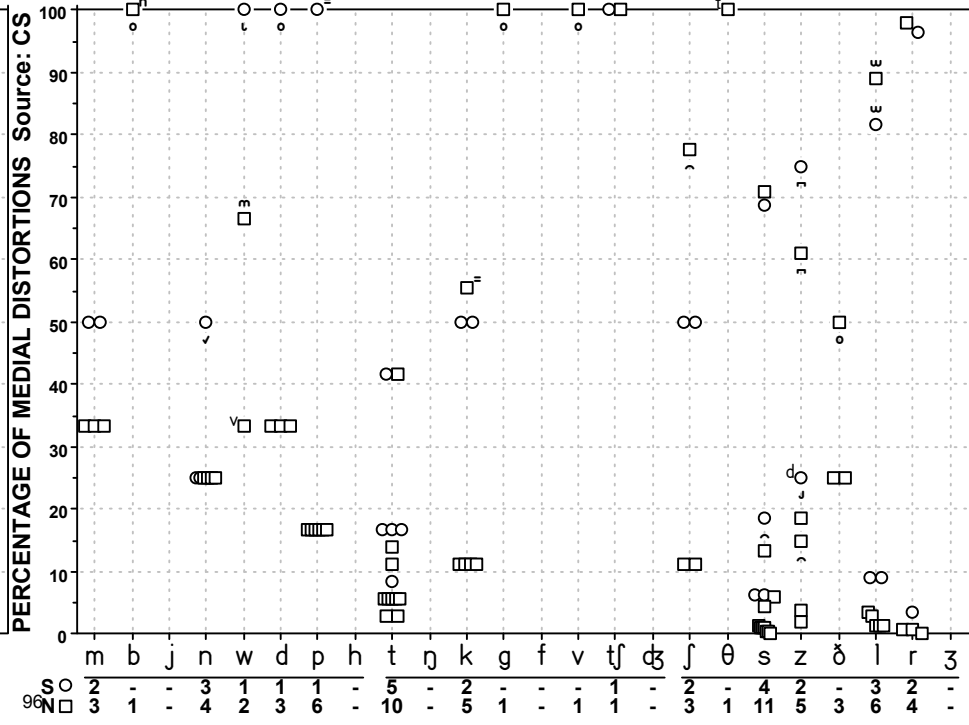
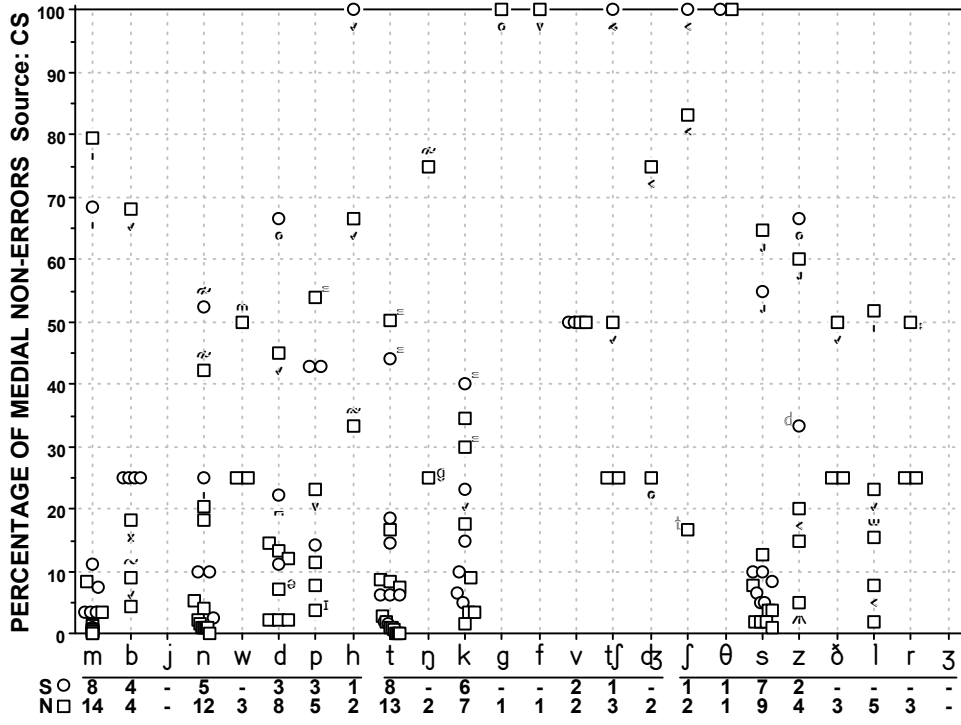
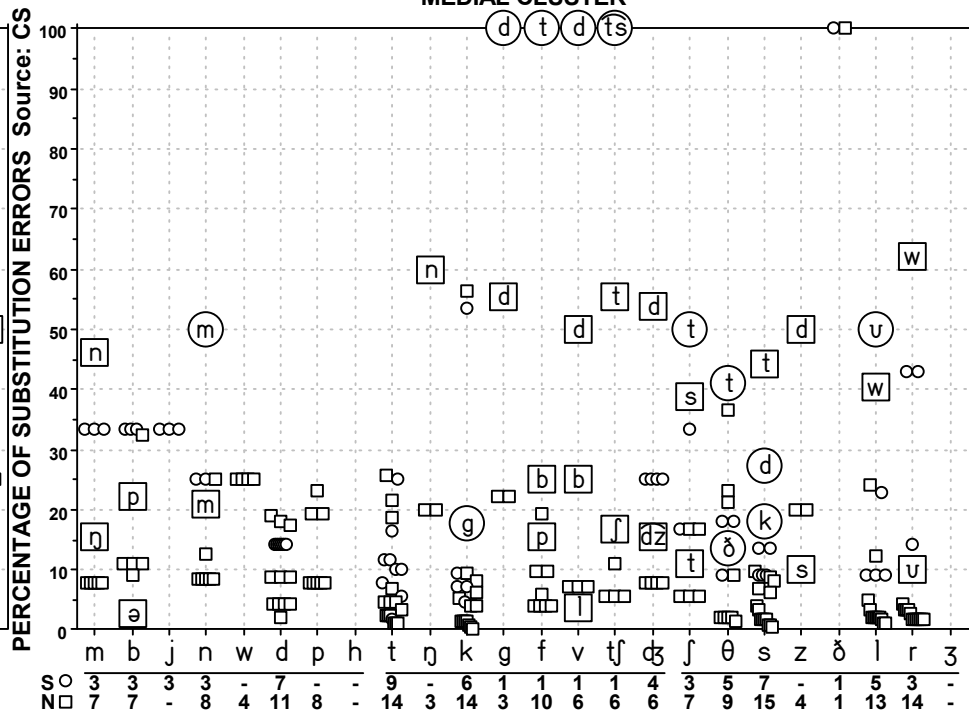
FINAL CONSONANTS



**MEDIAL SINGLETON CONSONANT**

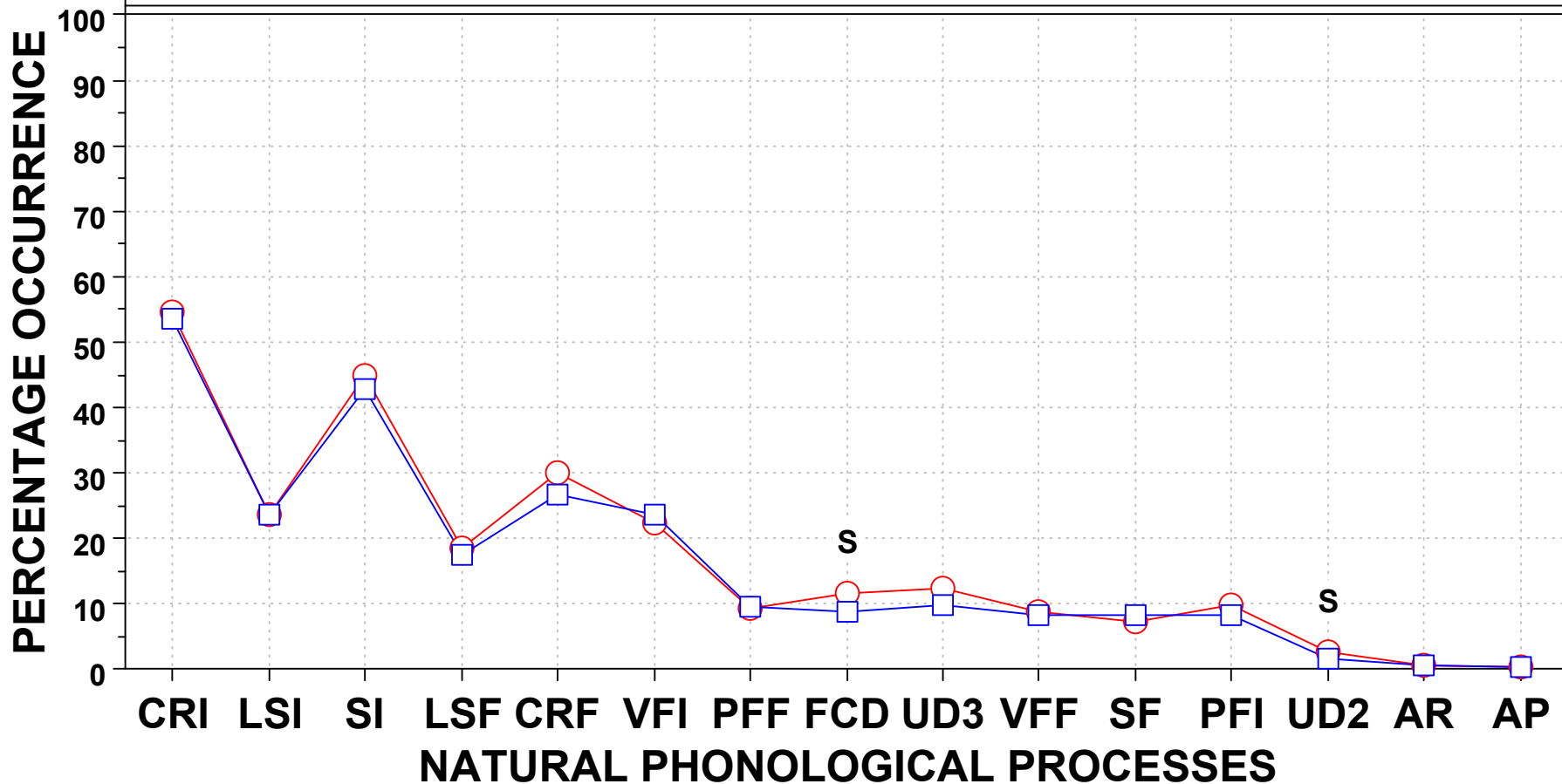


**MEDIAL CLUSTER**



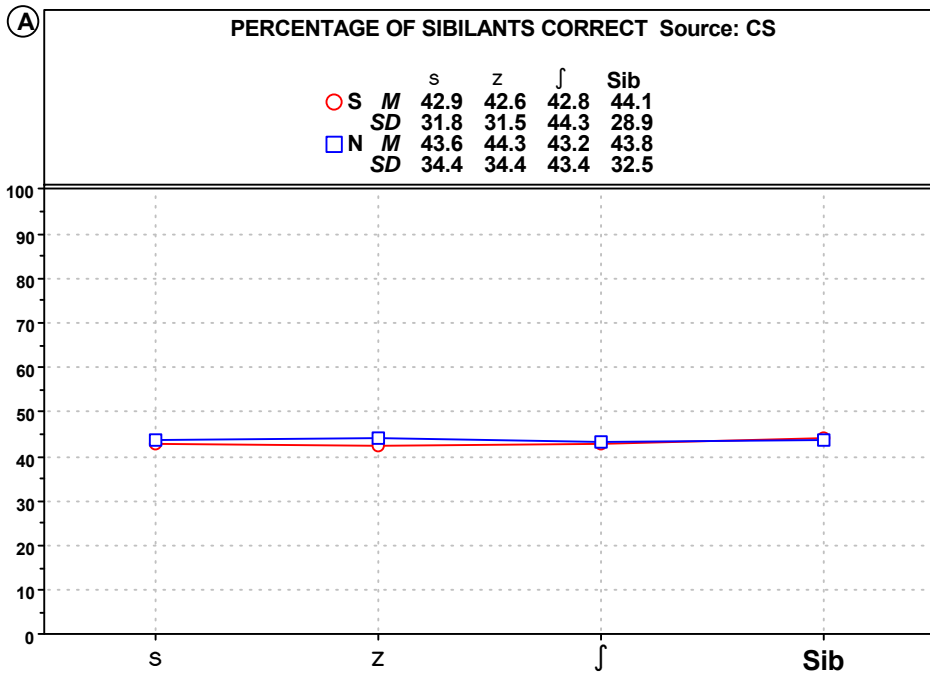
NATURAL PHONOLOGICAL PROCESSES Source: CS

		Assimilat		Clus Reduc		Final	Liq Simp		Palat Front		Stopping		Unstress Del		Velar Front	
		Regr	Progr	Init	Final	<sup>s</sup> Con Del	Init	Final	Init	Final	Init	Final	<sup>s</sup> 2 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

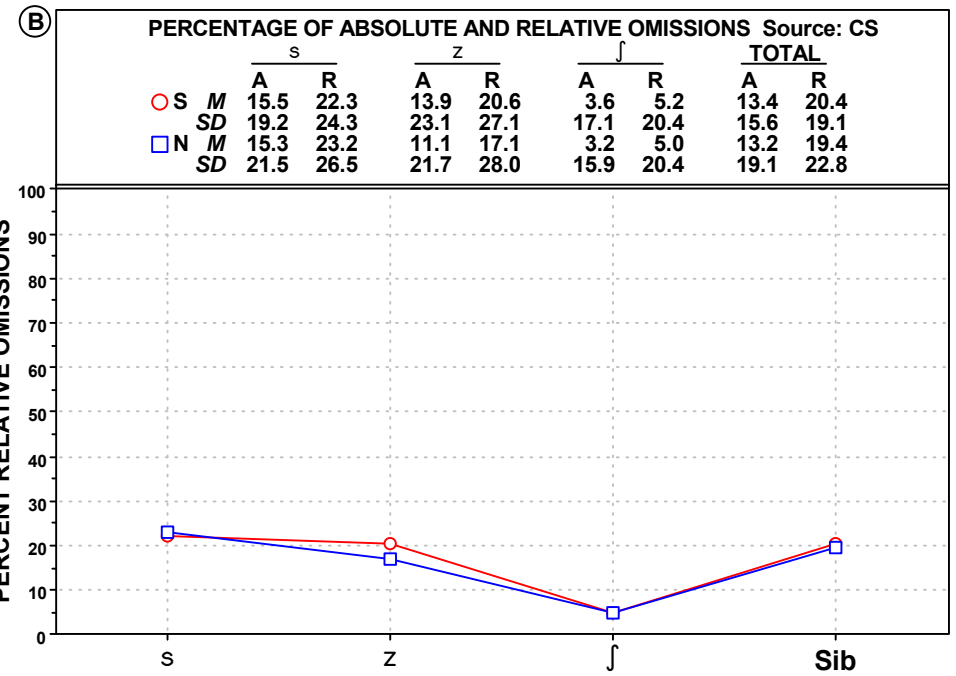


Consonant Profile 13, S and N

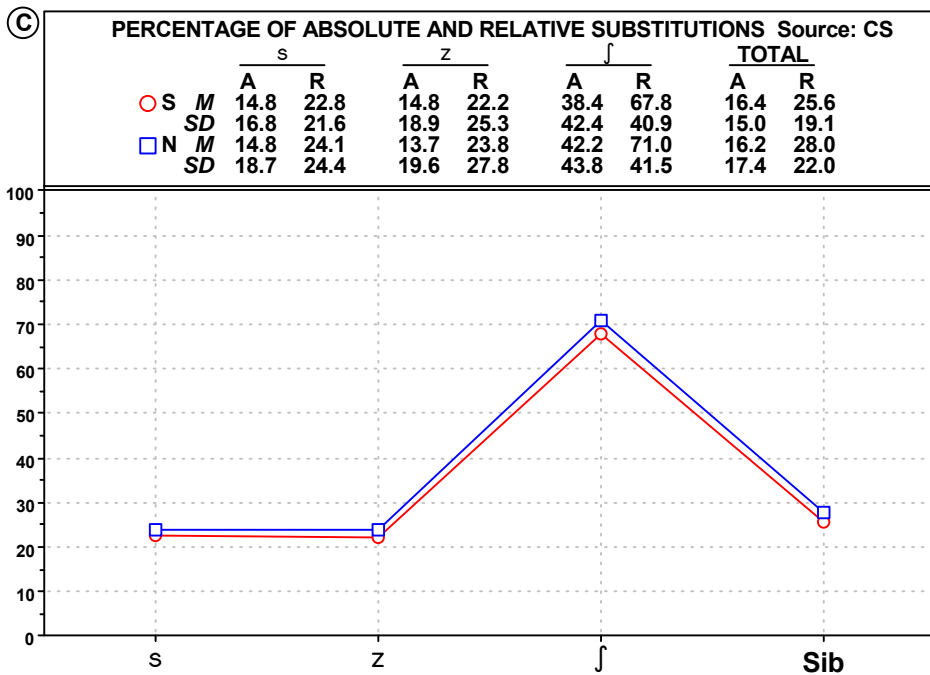
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: <sup>97</sup>S≥.2,M≥.5,L≥.8,V≥1,E≥2



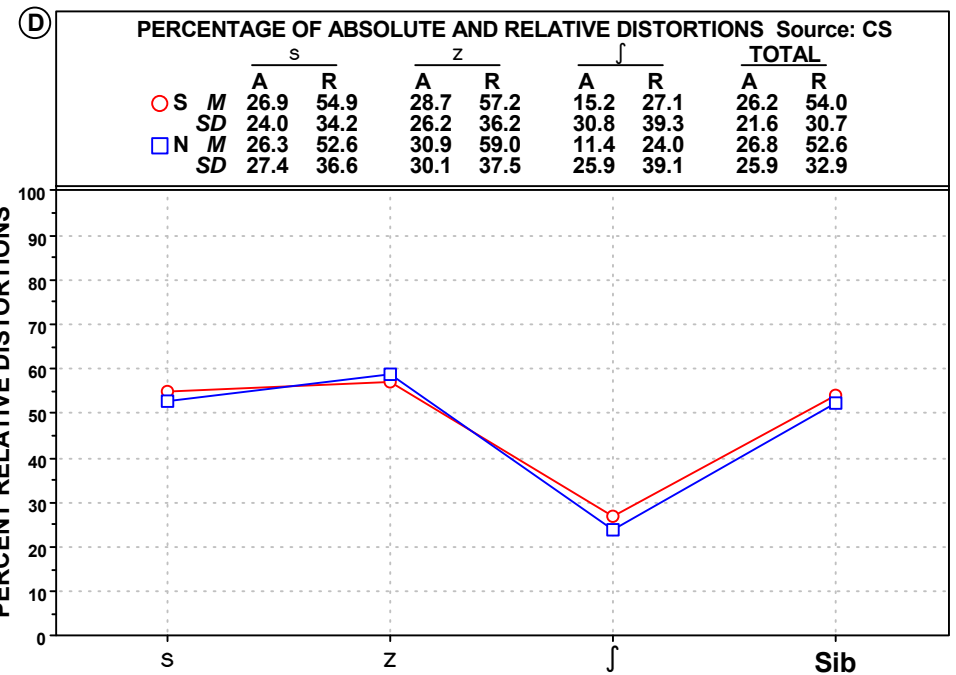
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



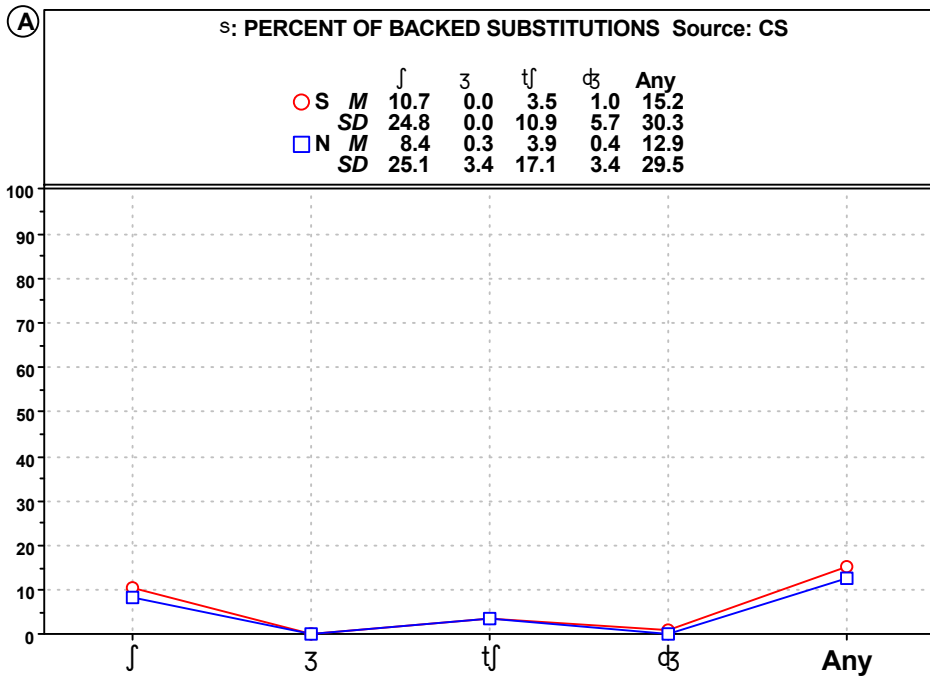
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



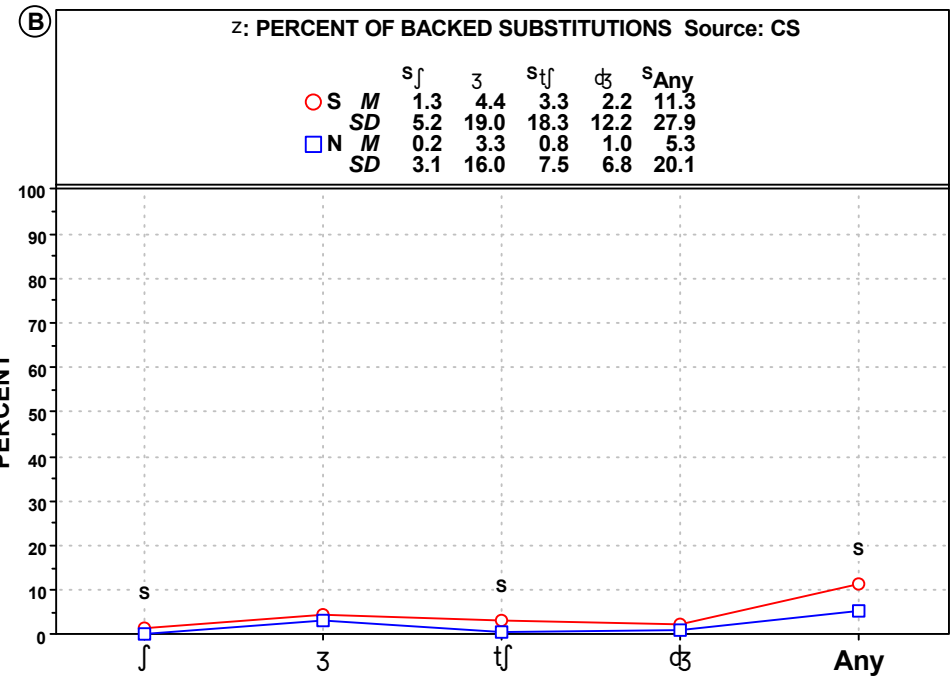
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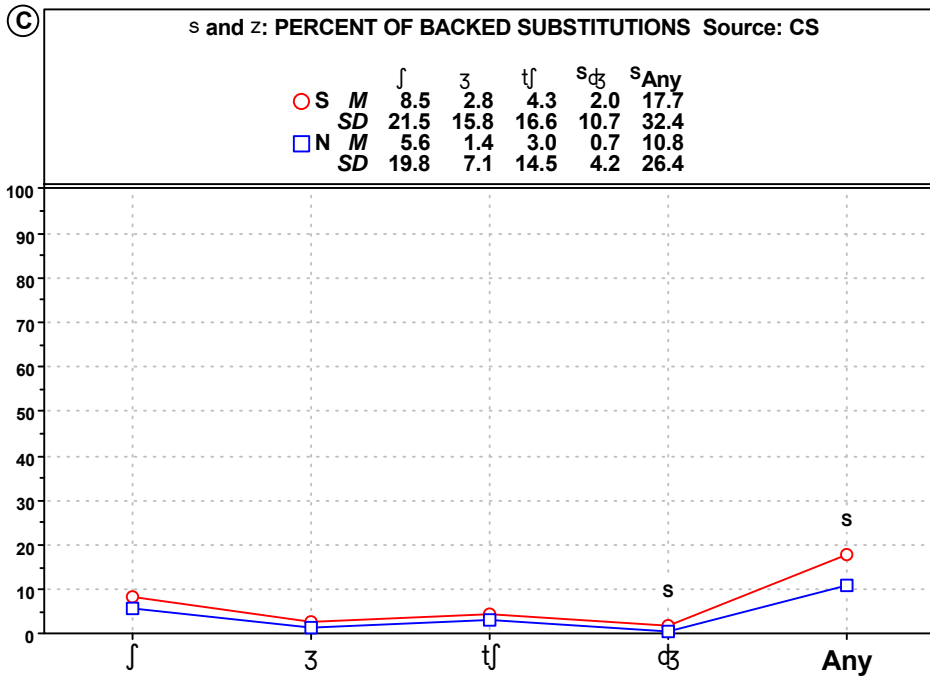
98 \* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



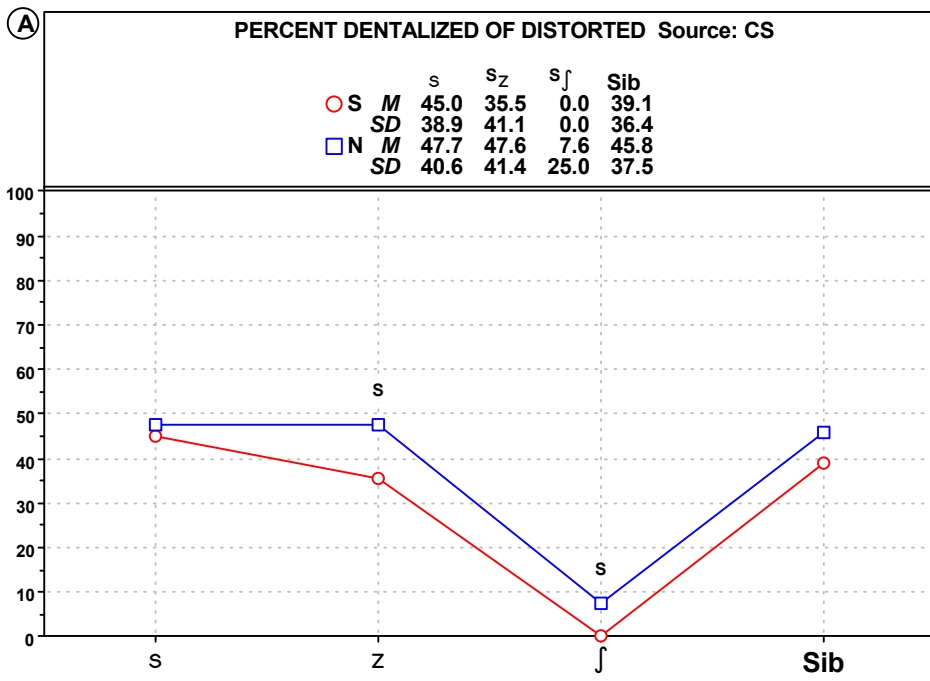
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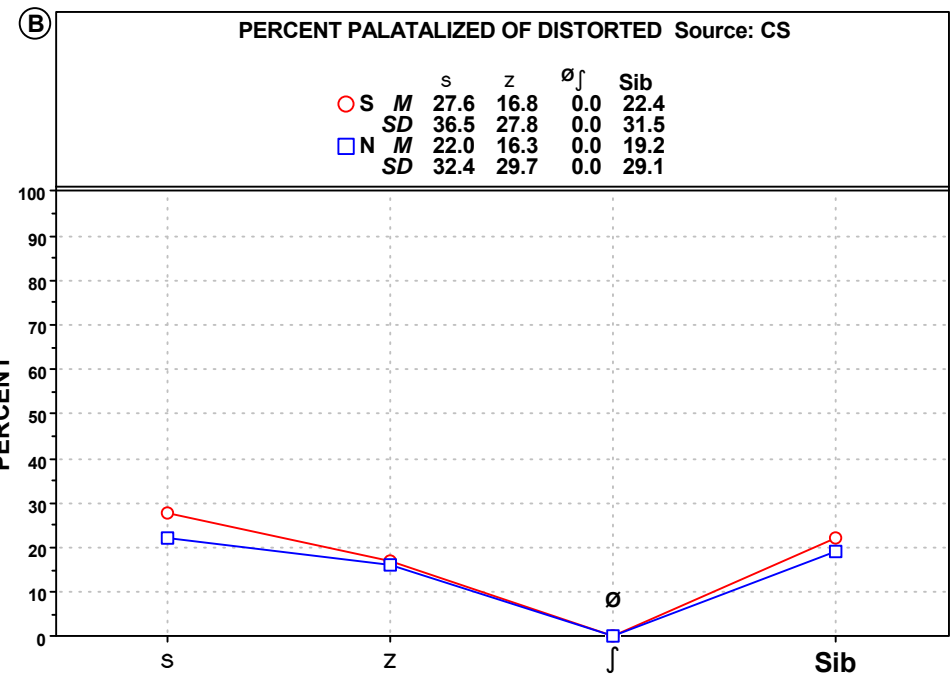
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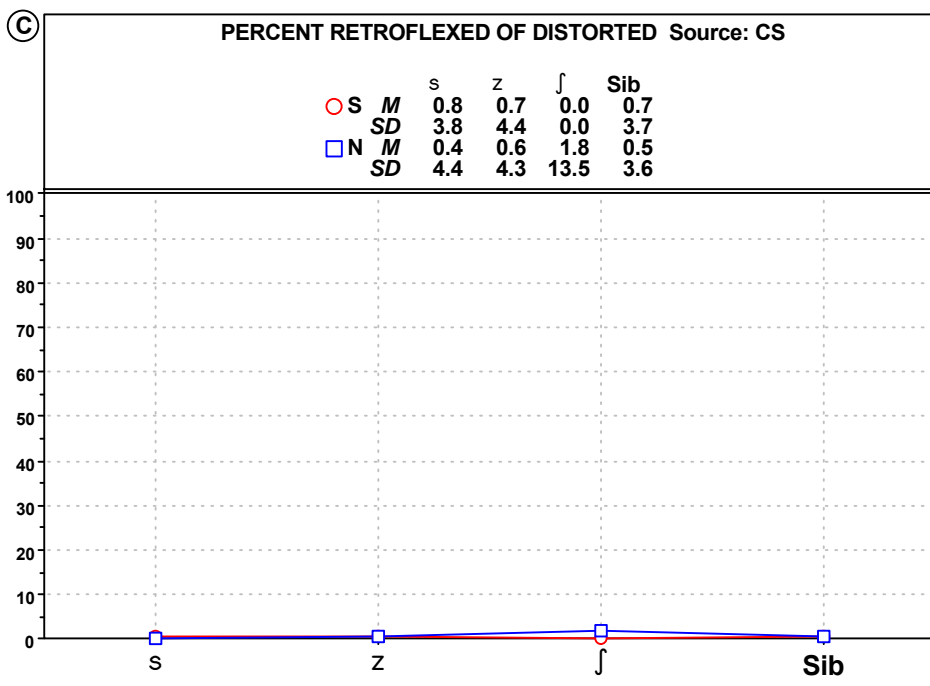
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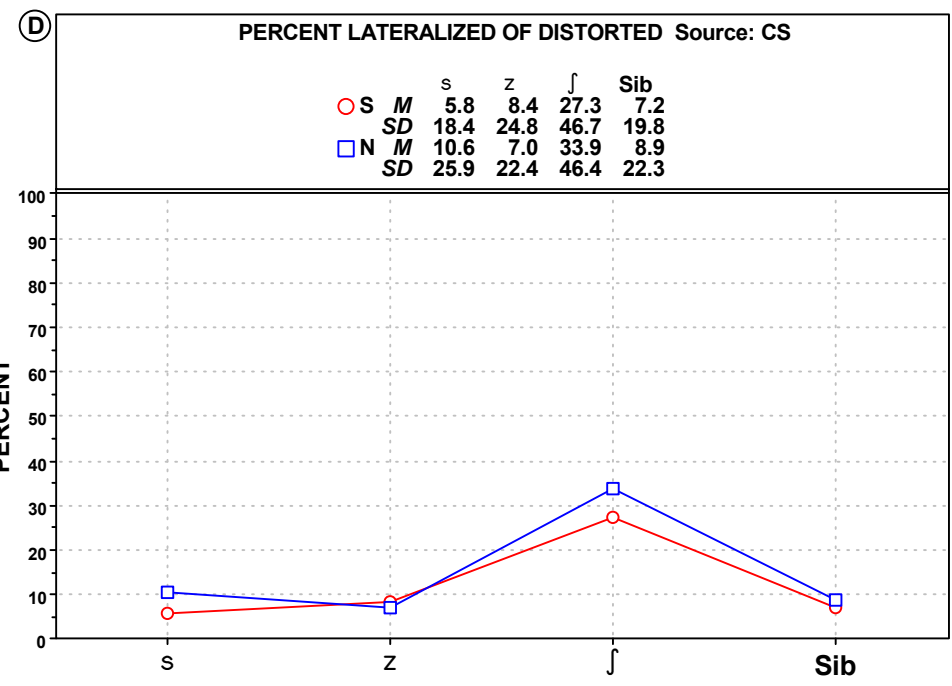
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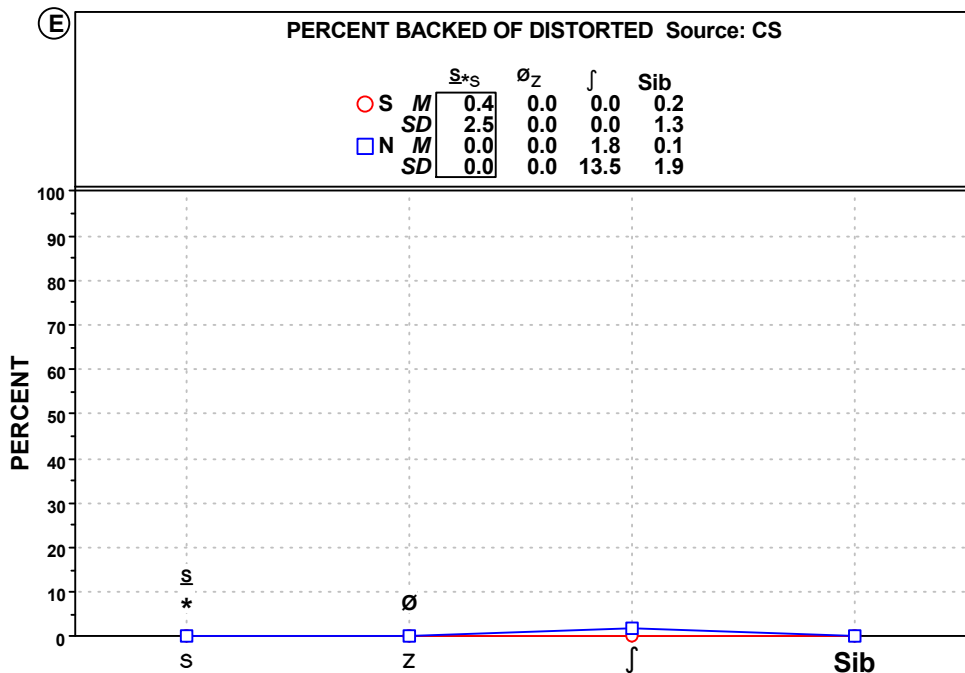
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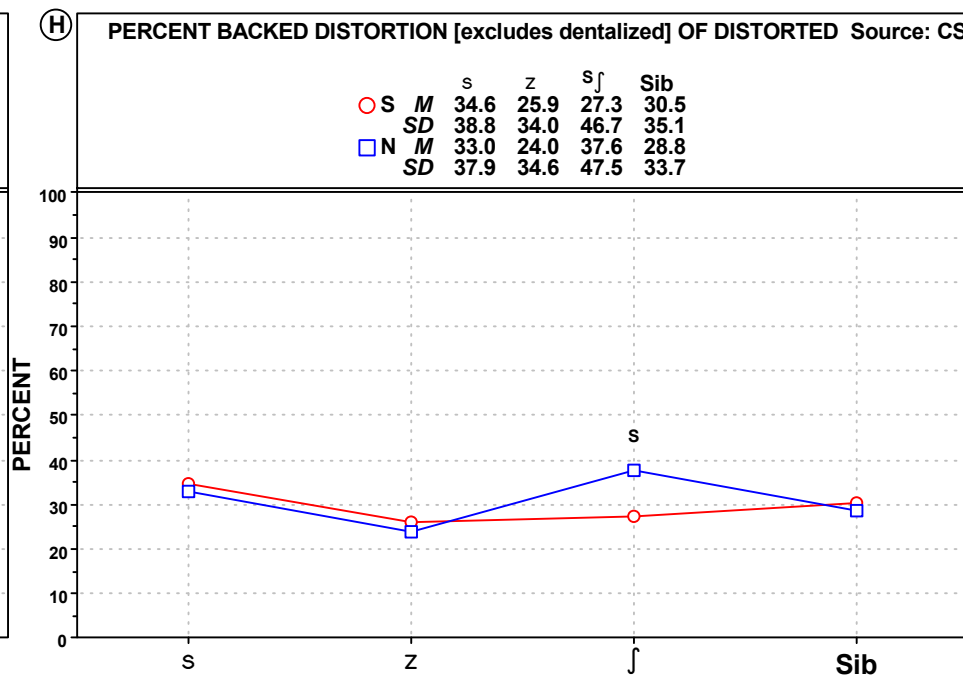
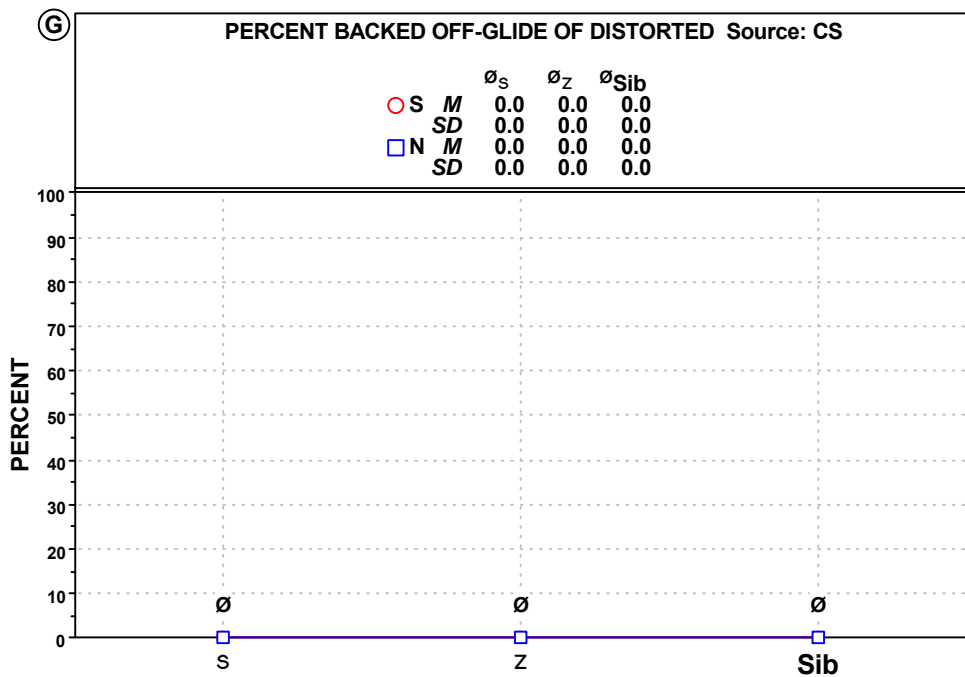
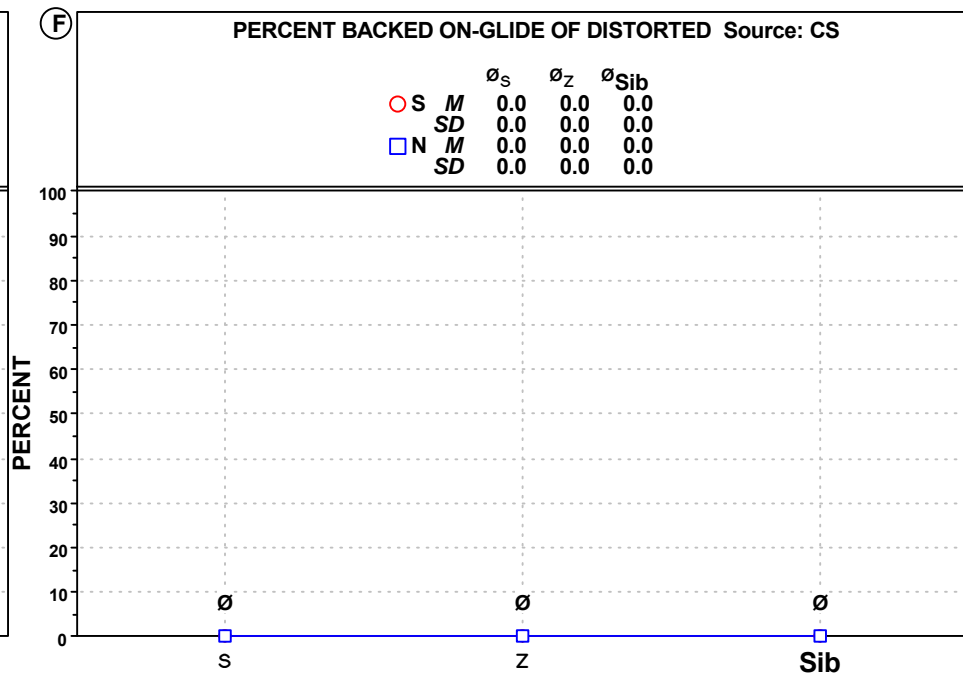
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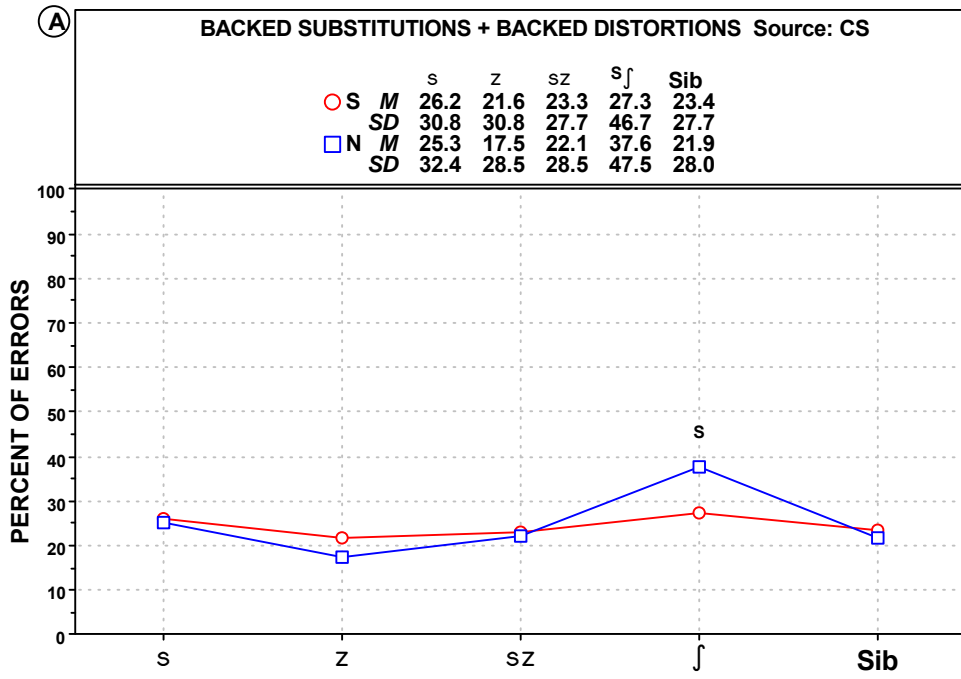
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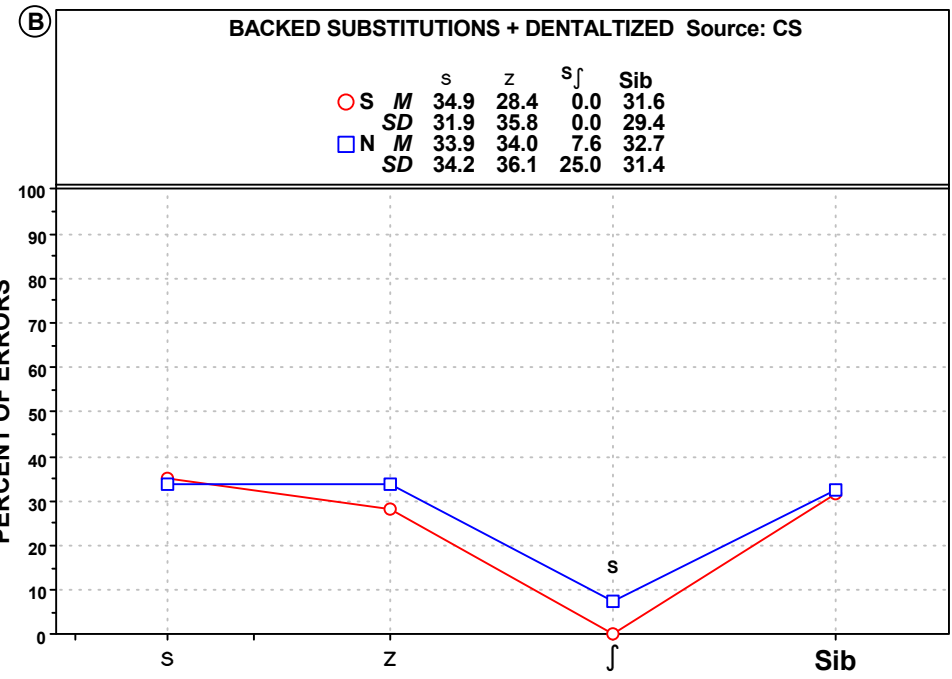
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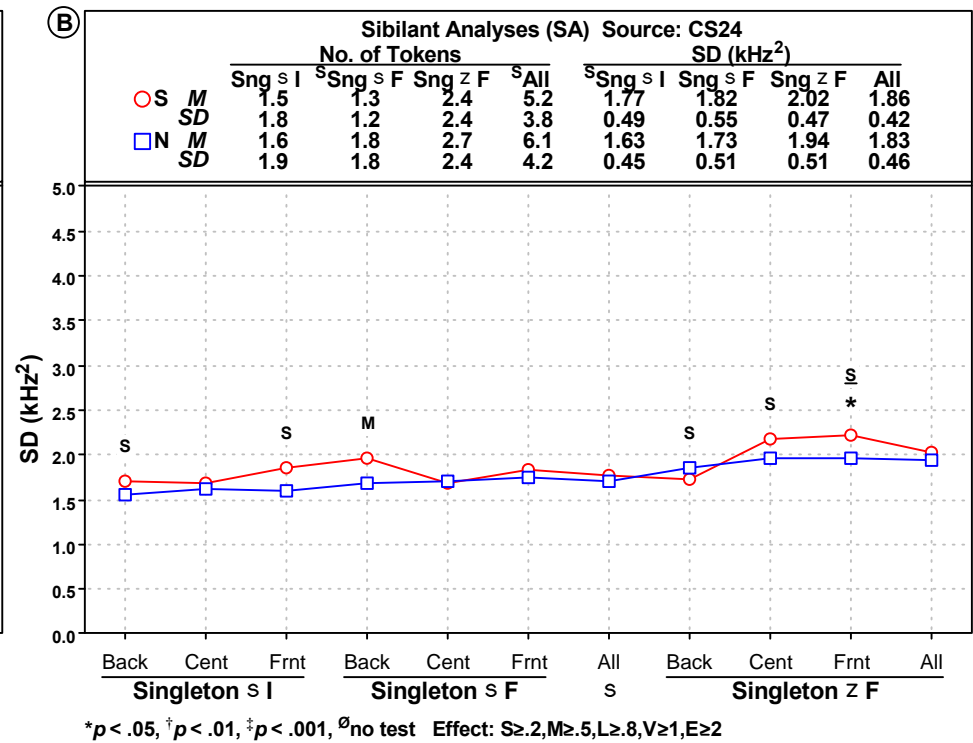
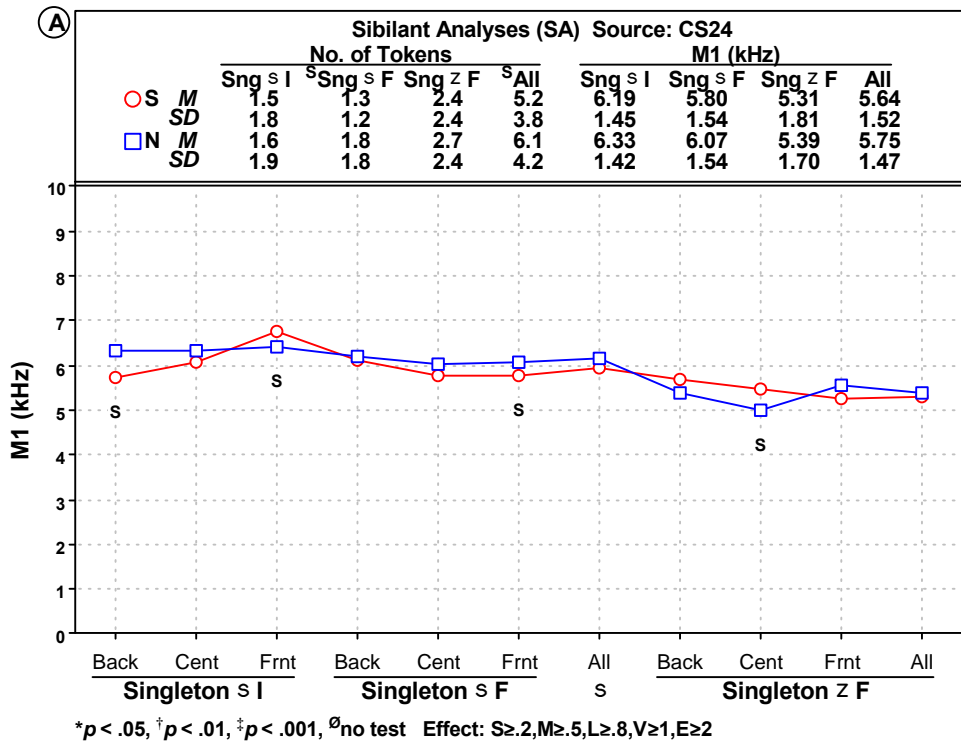
101 \* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

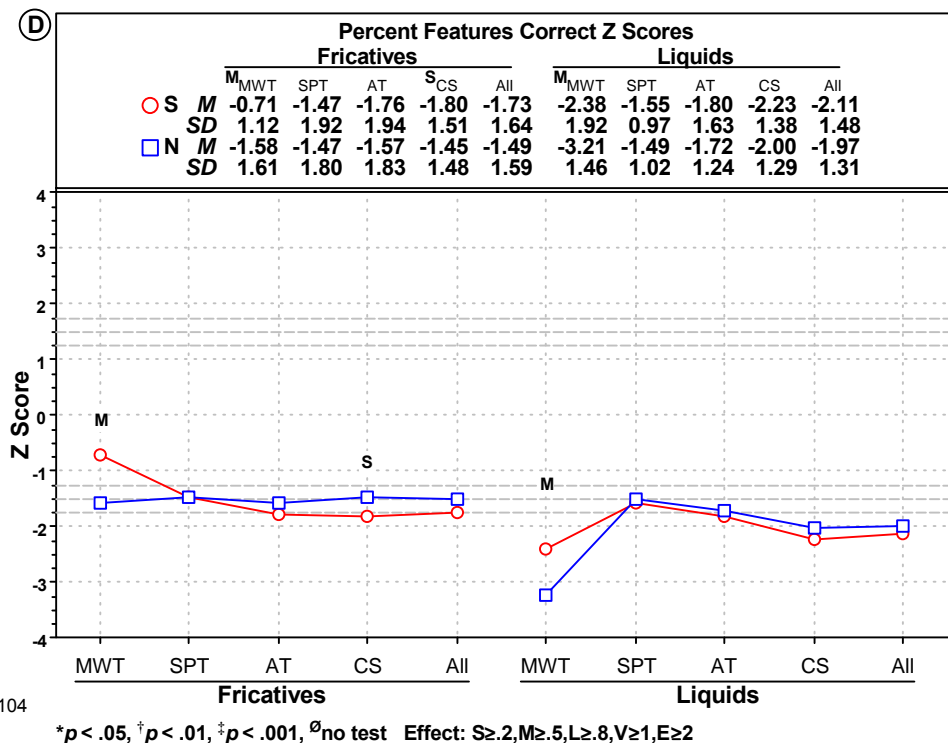
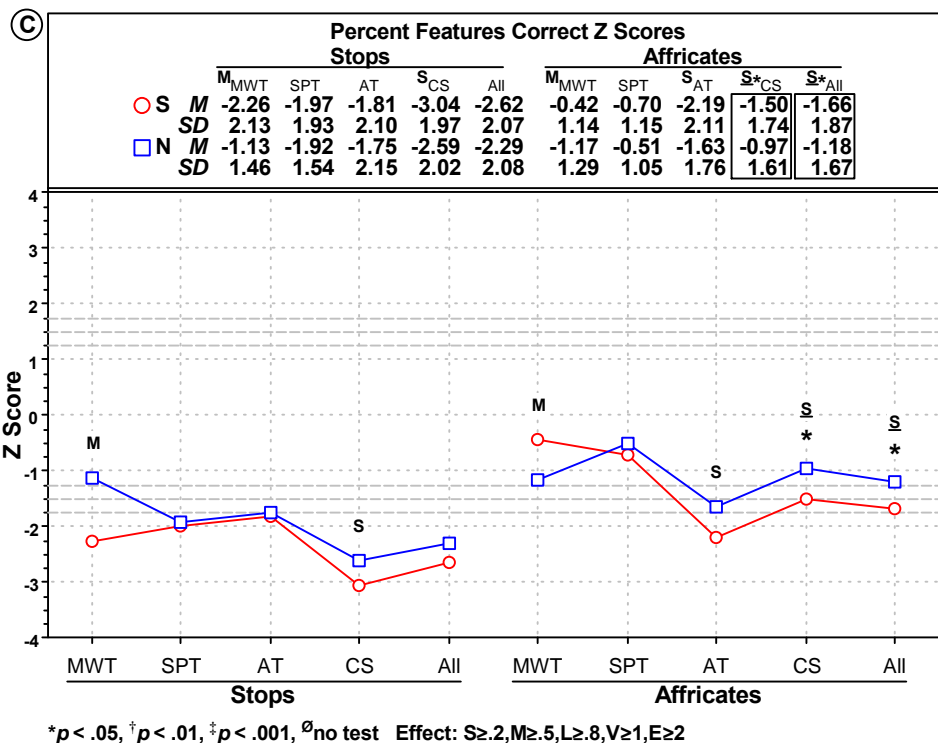
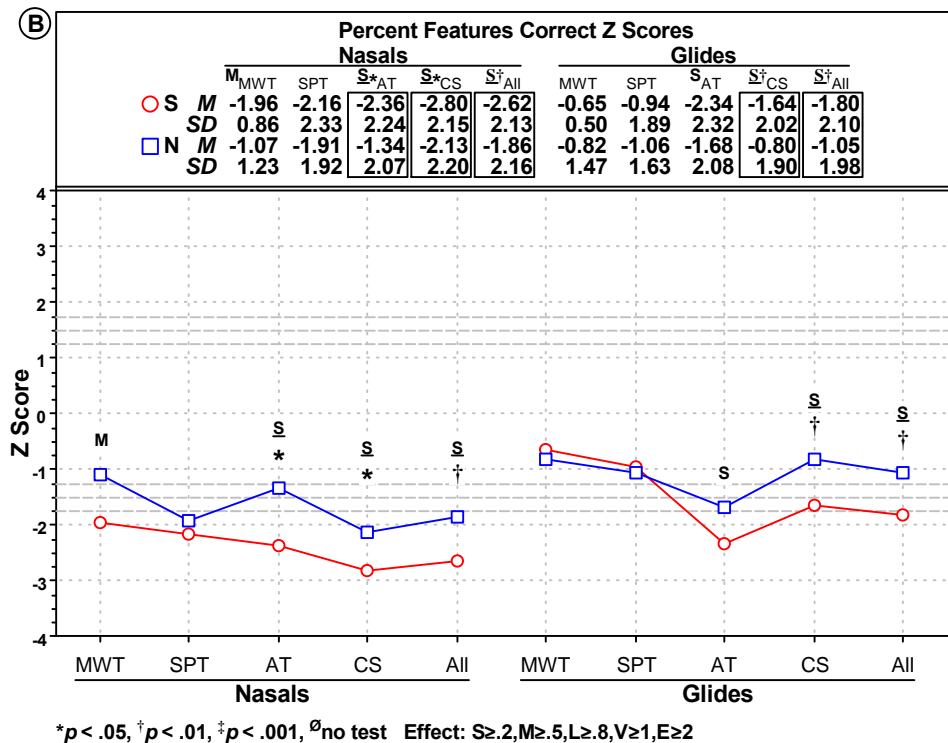
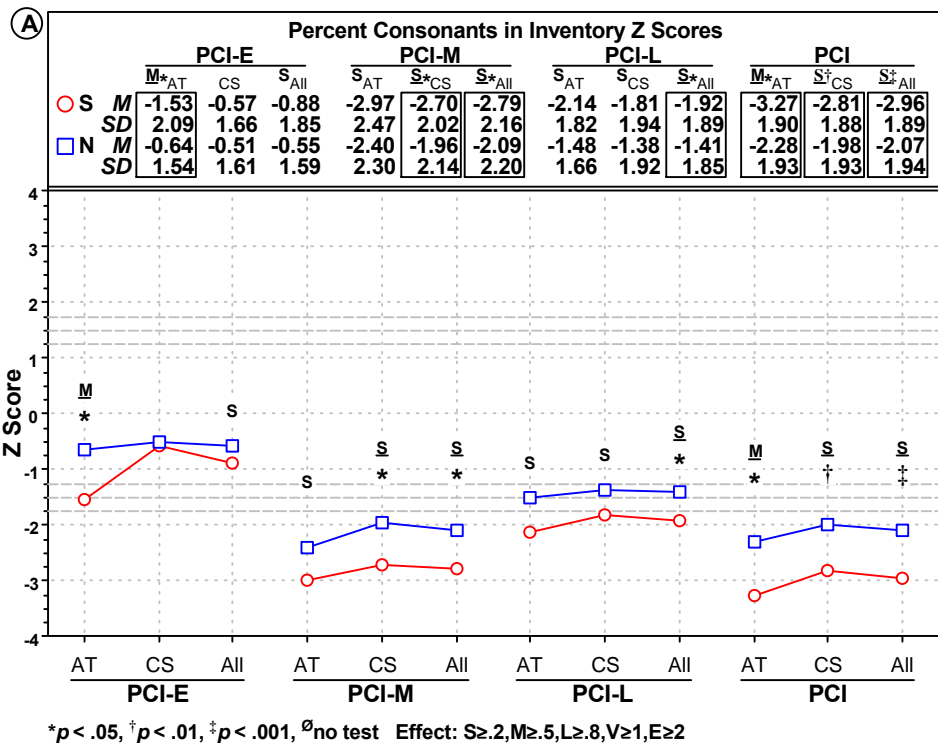


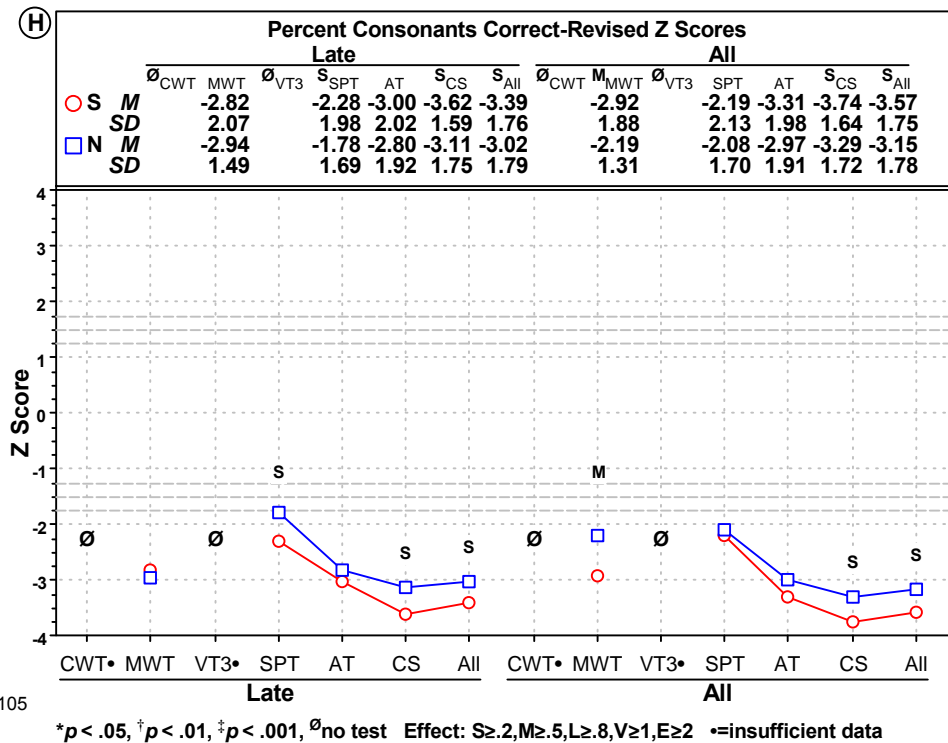
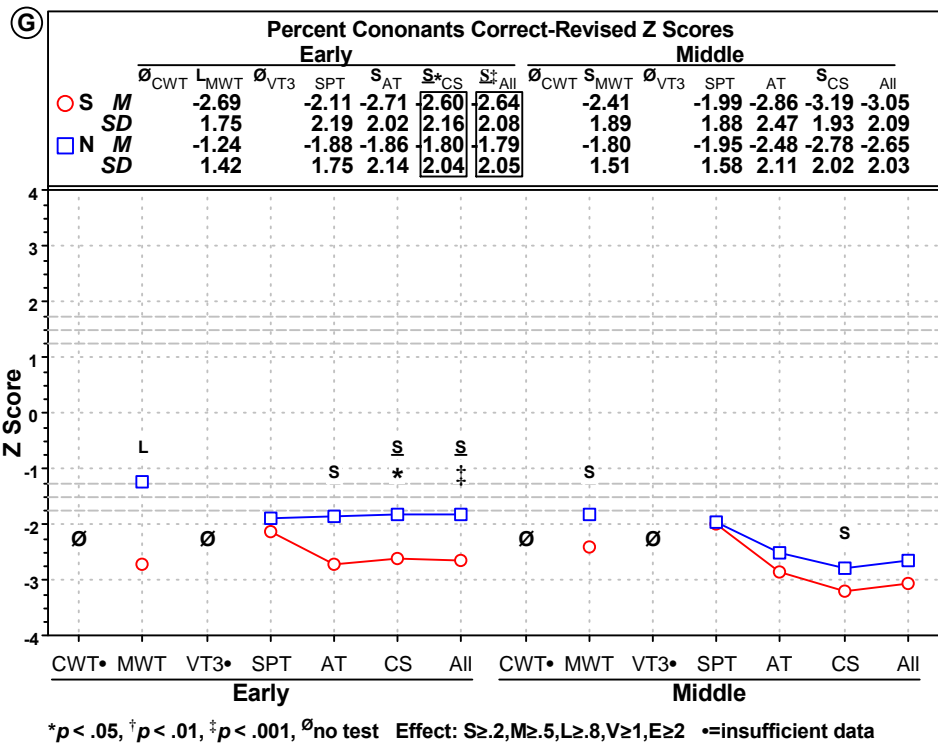
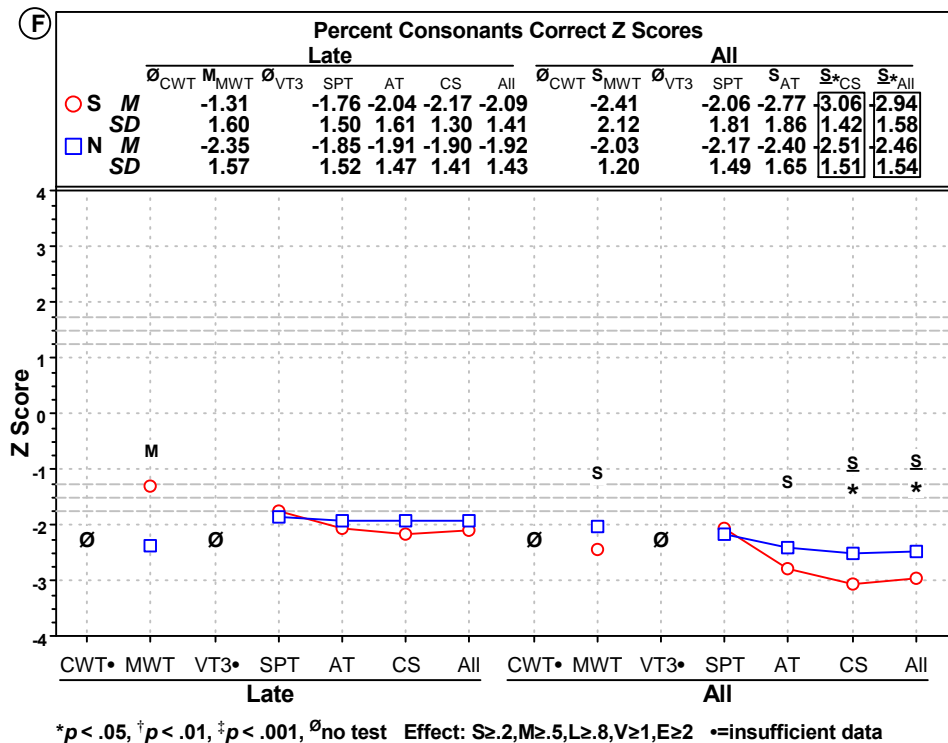
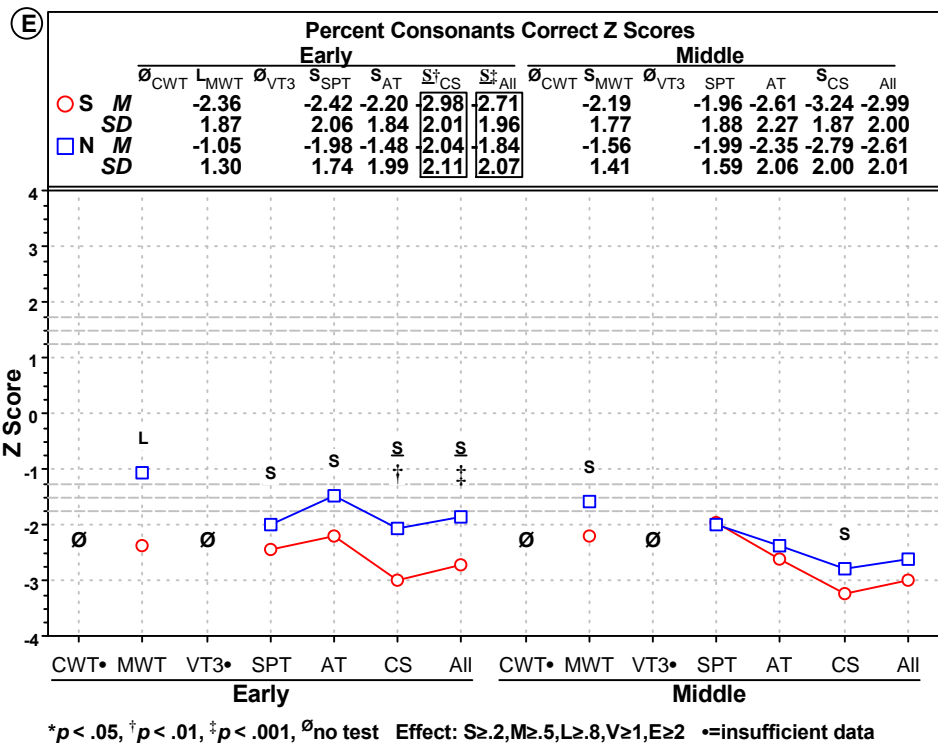
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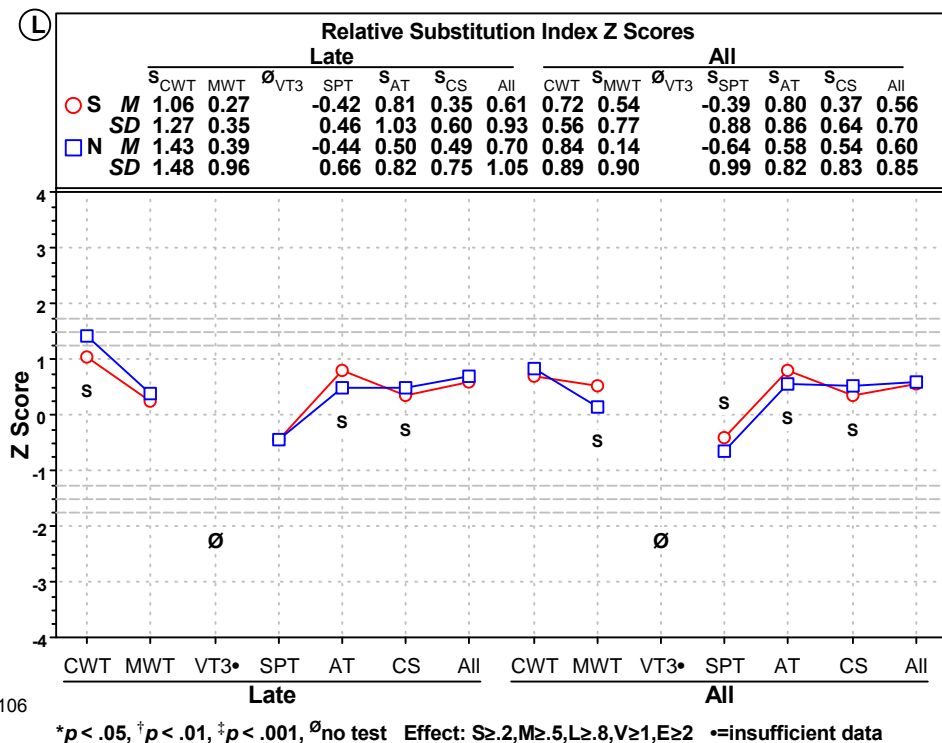
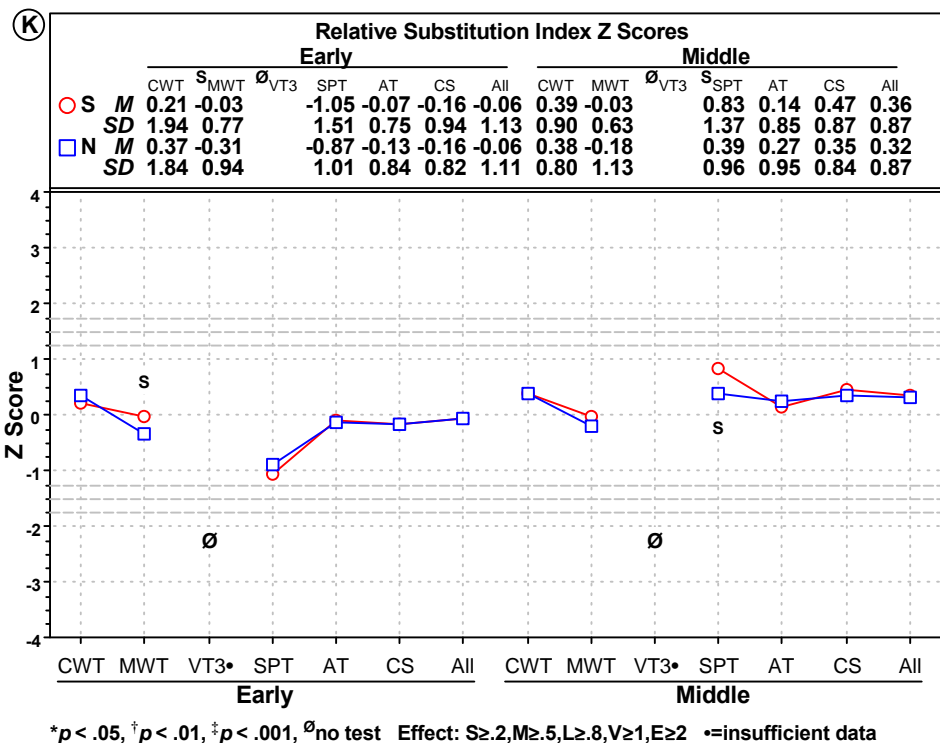
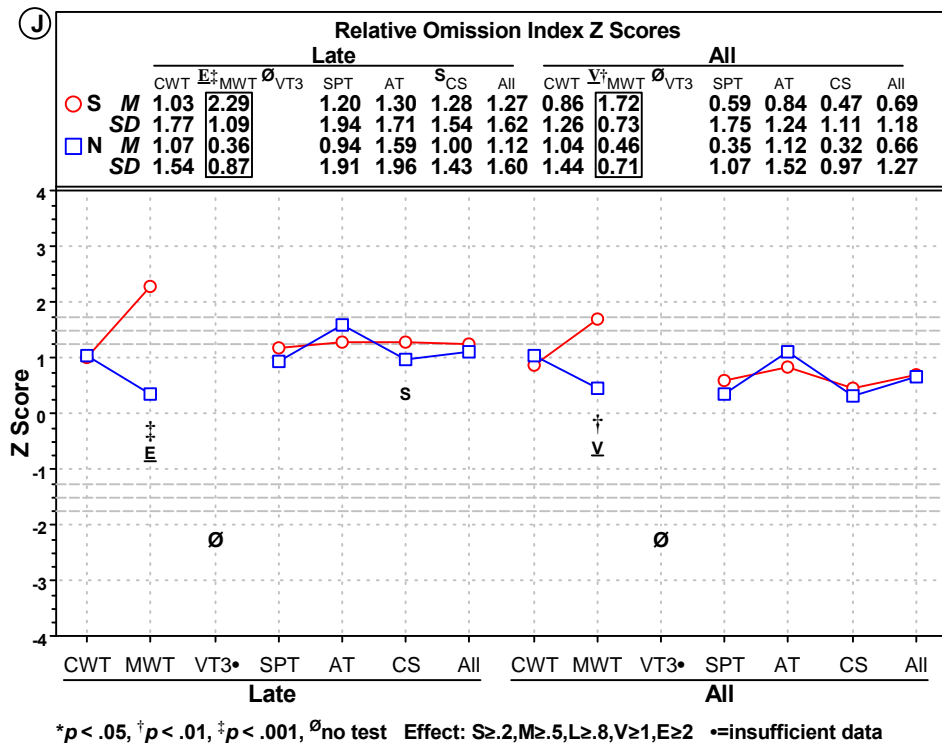
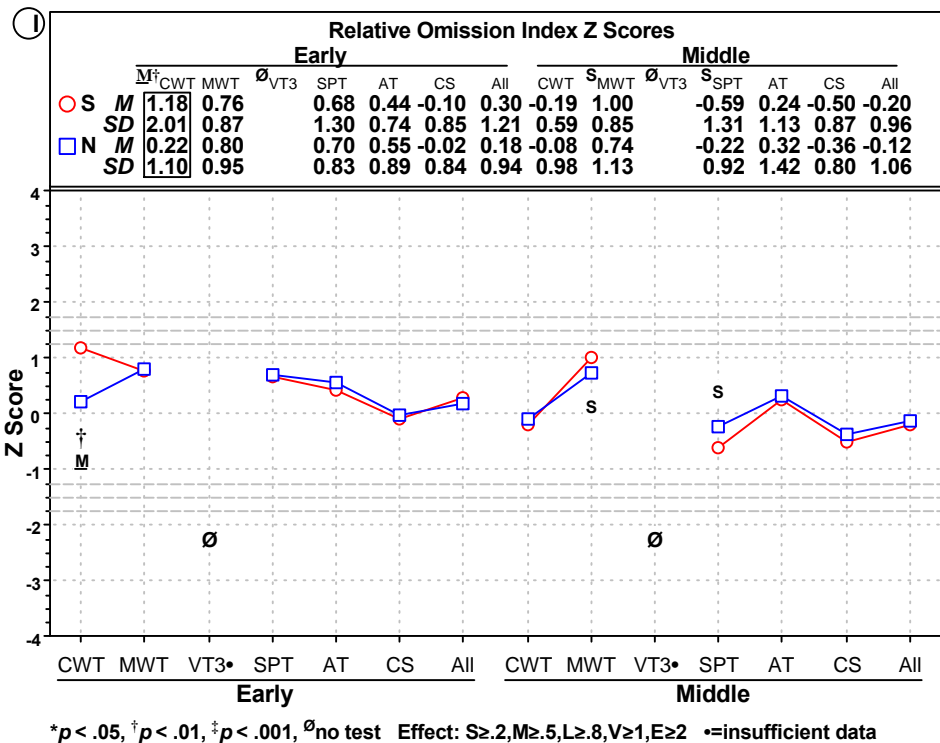


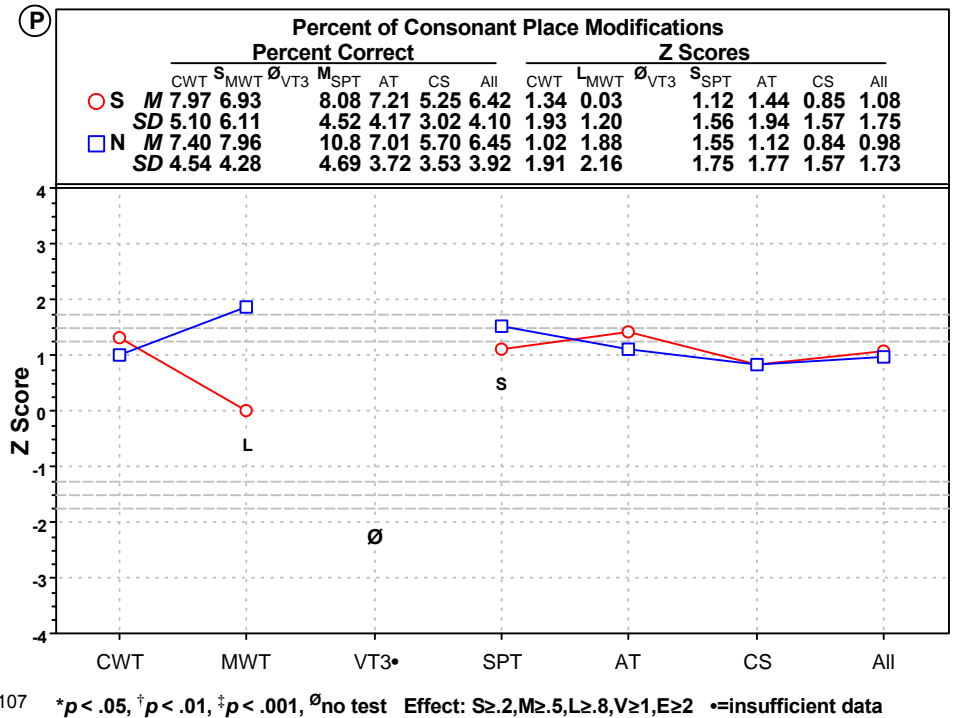
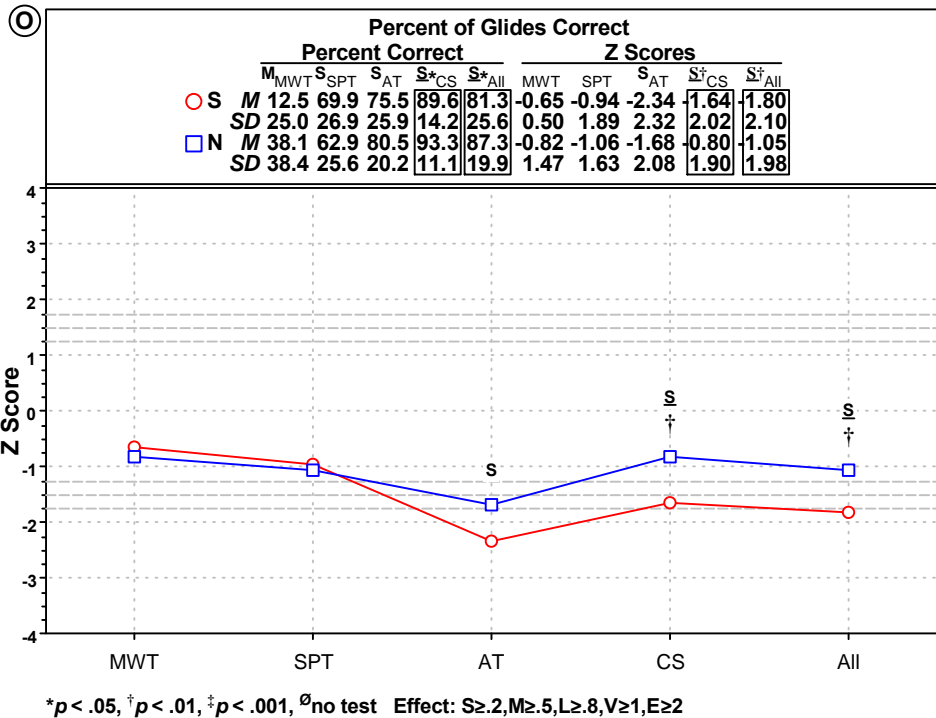
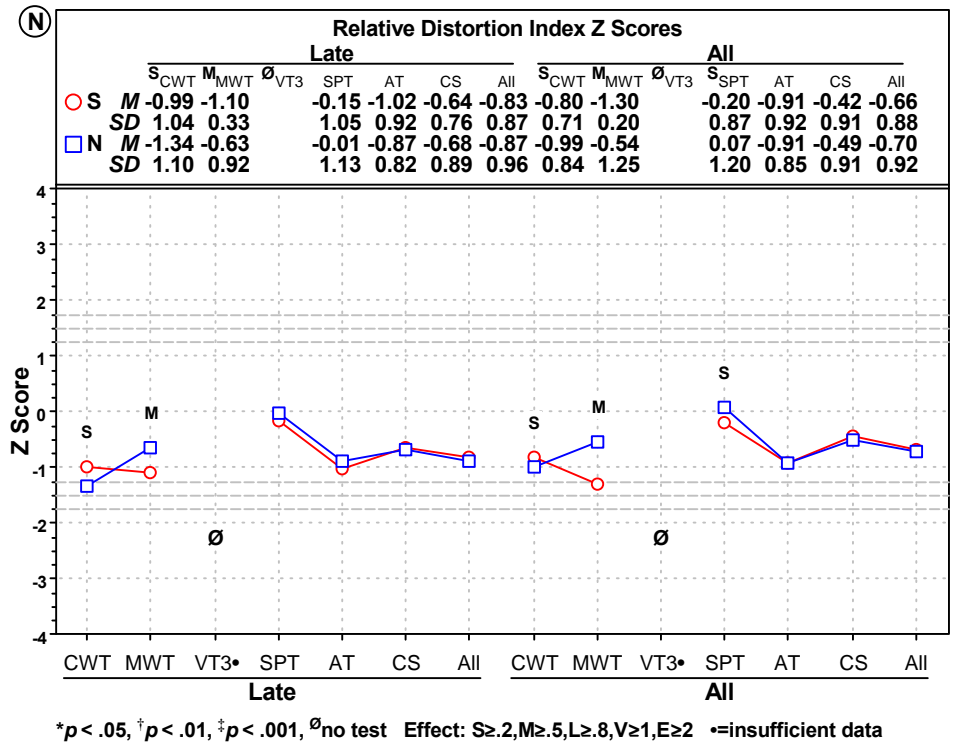
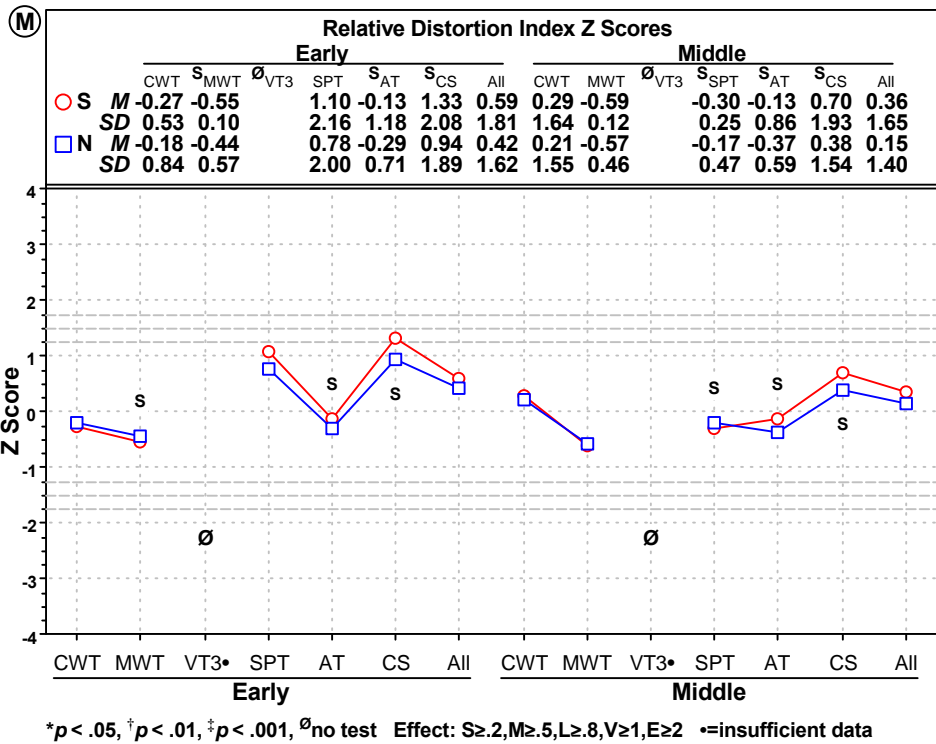
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2

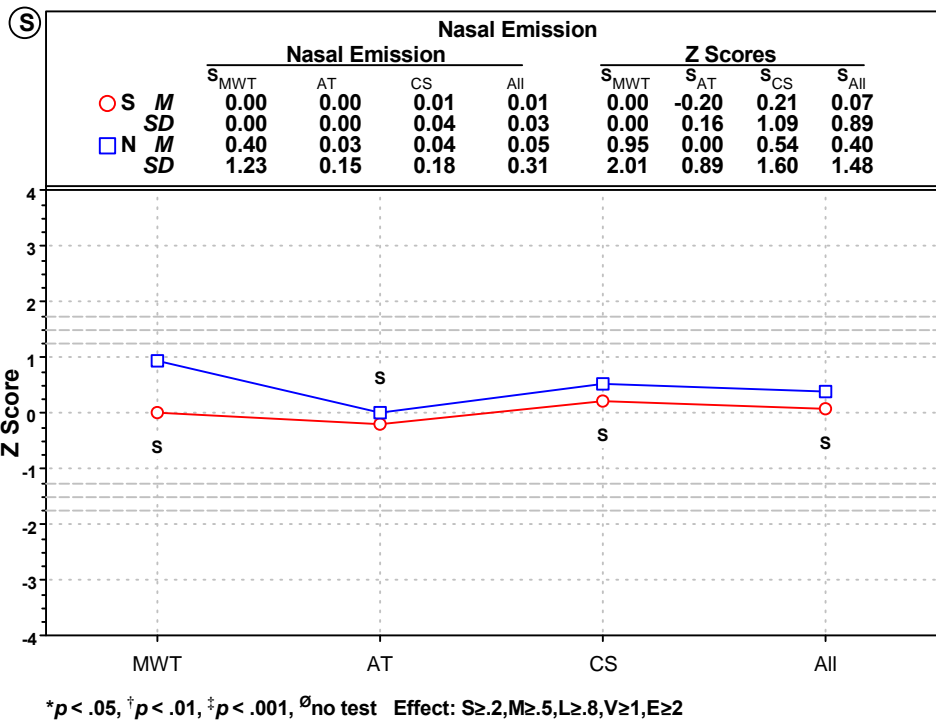
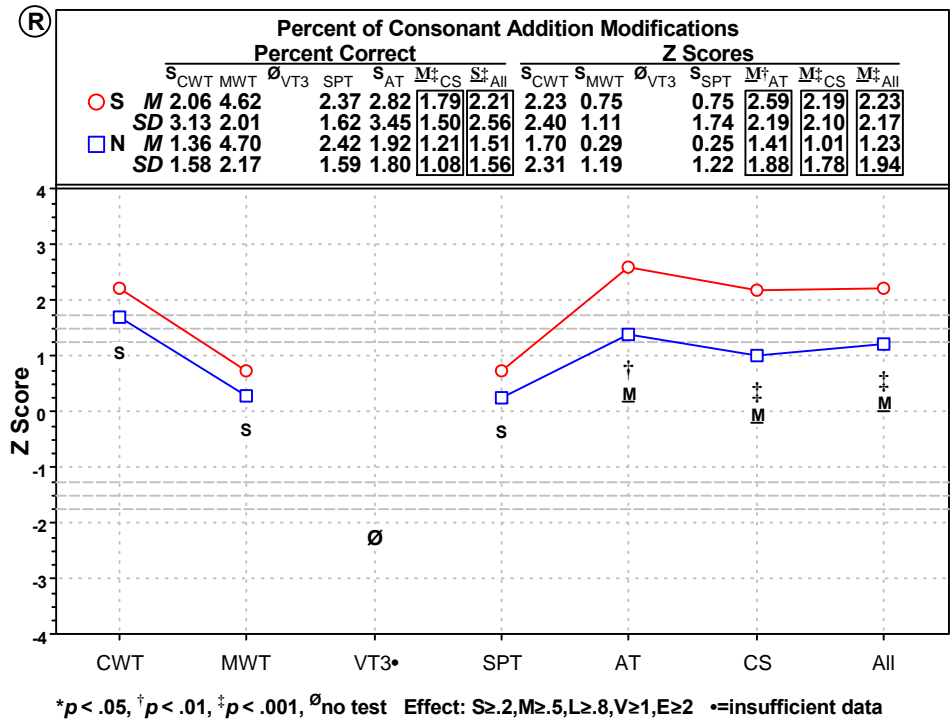
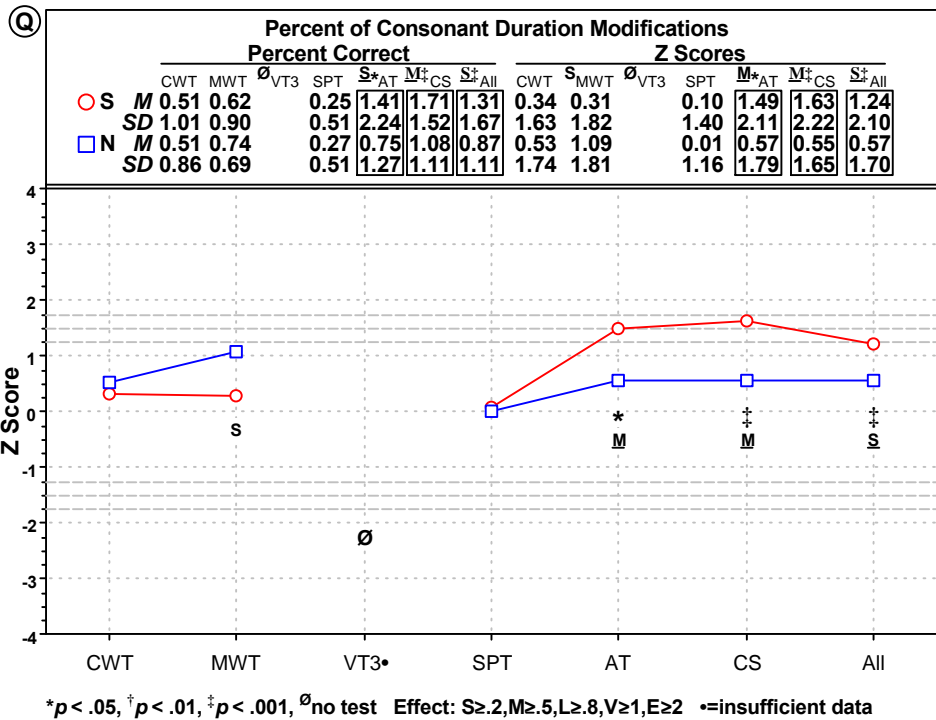


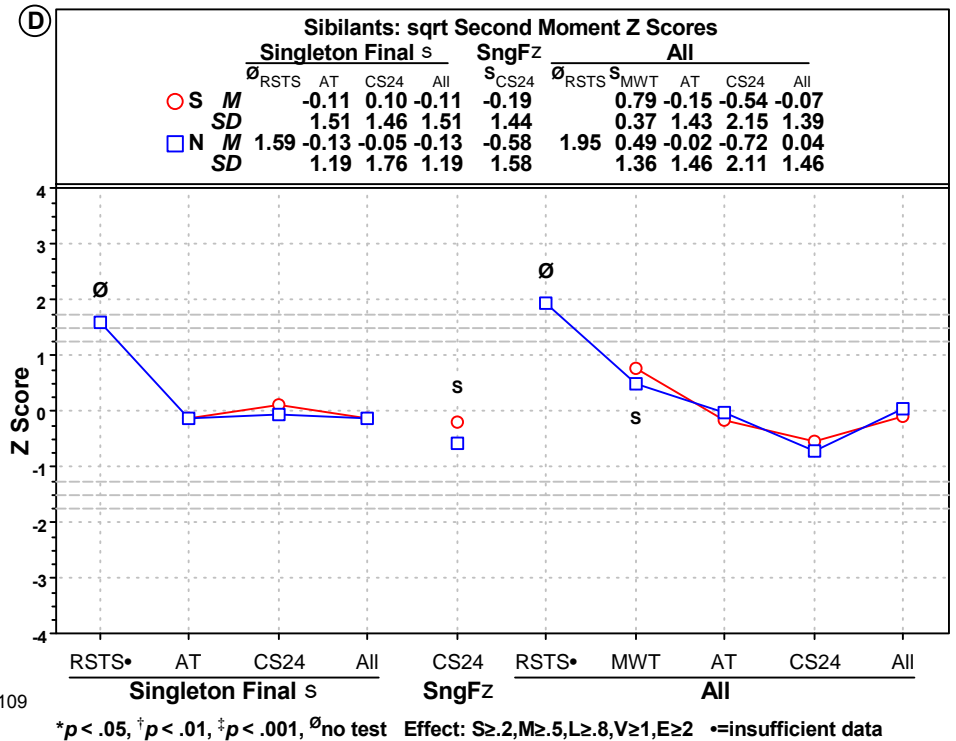
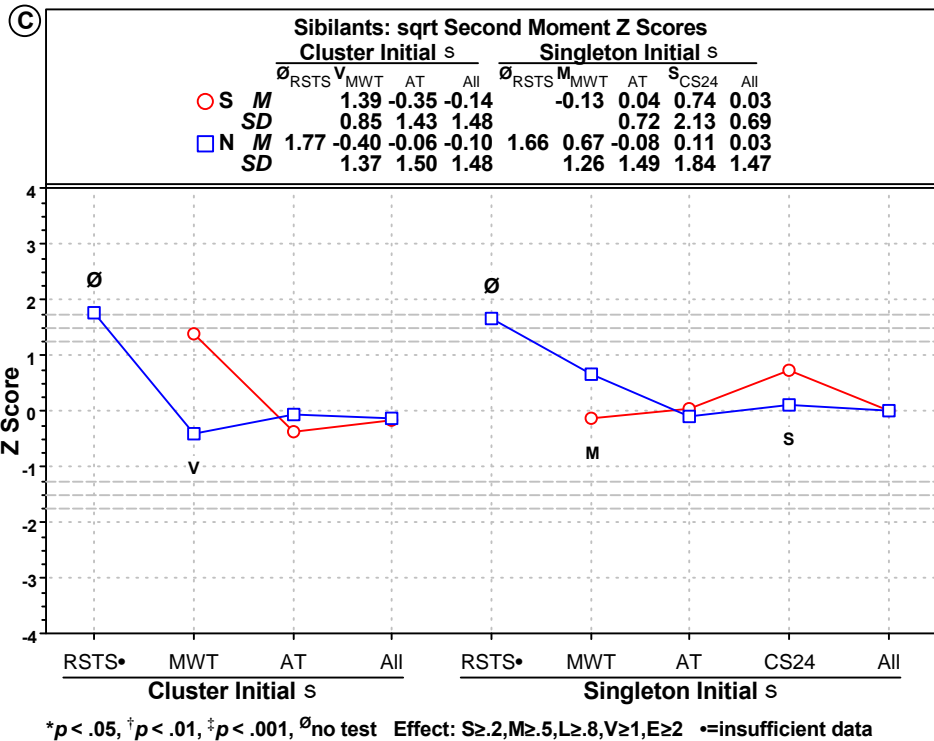
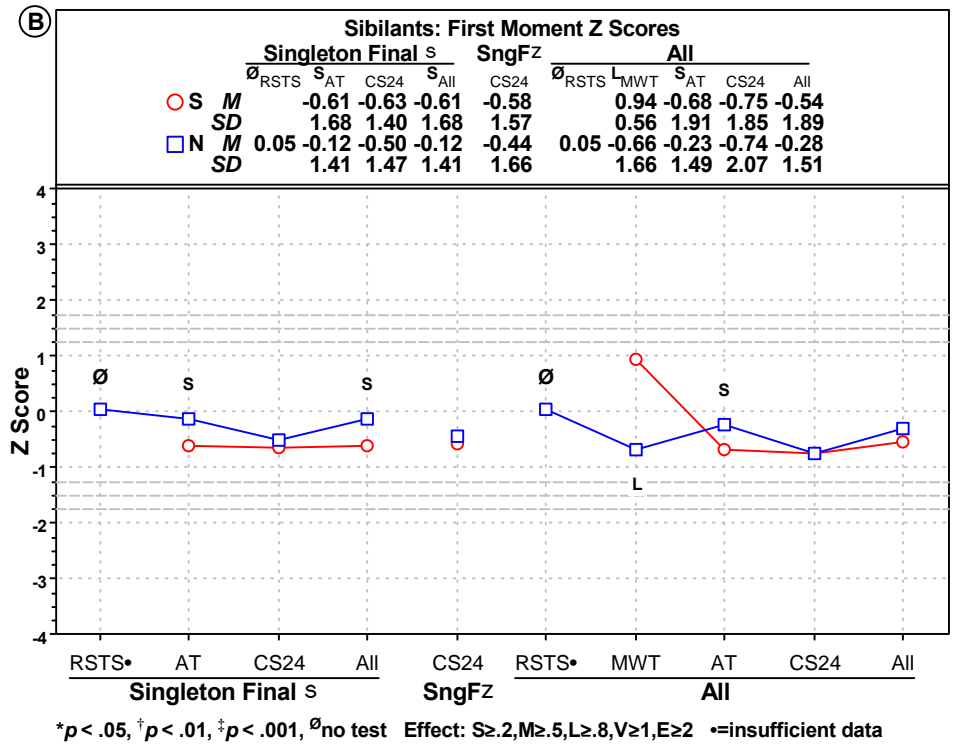
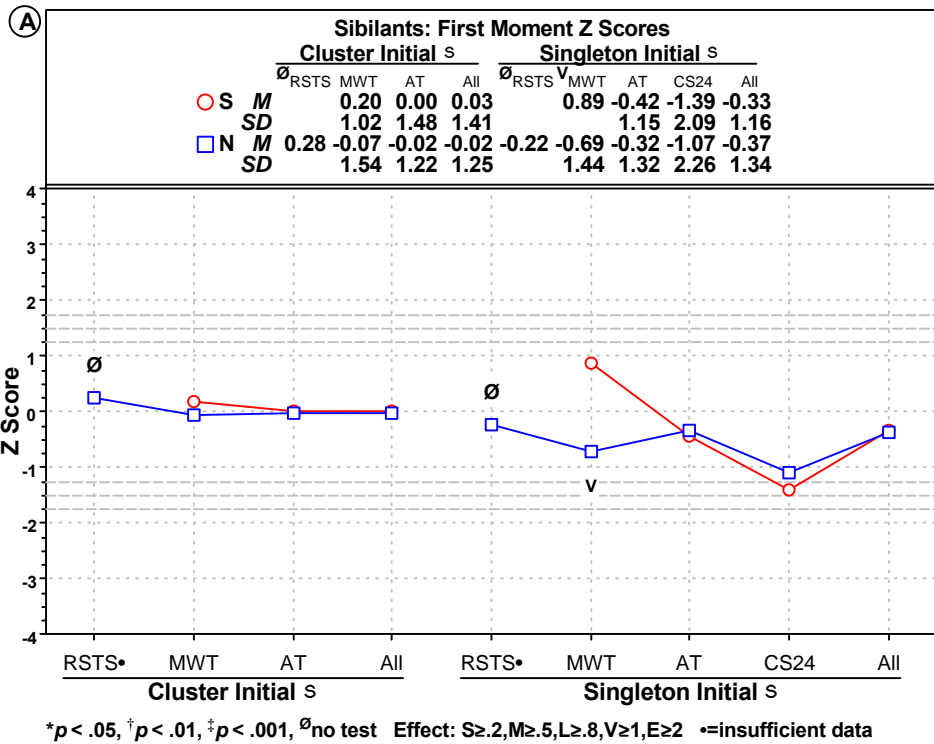


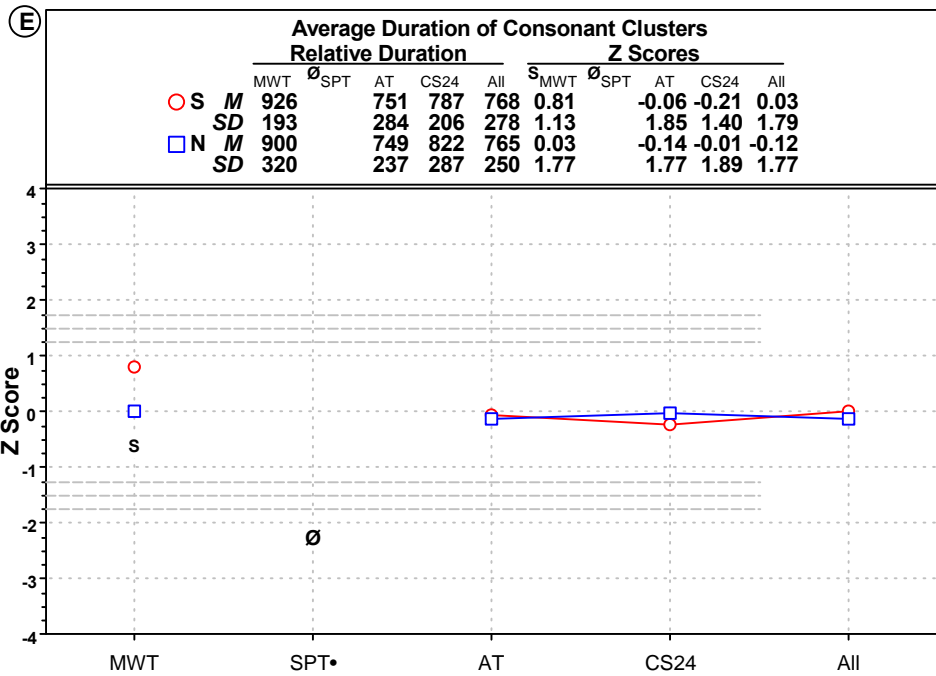




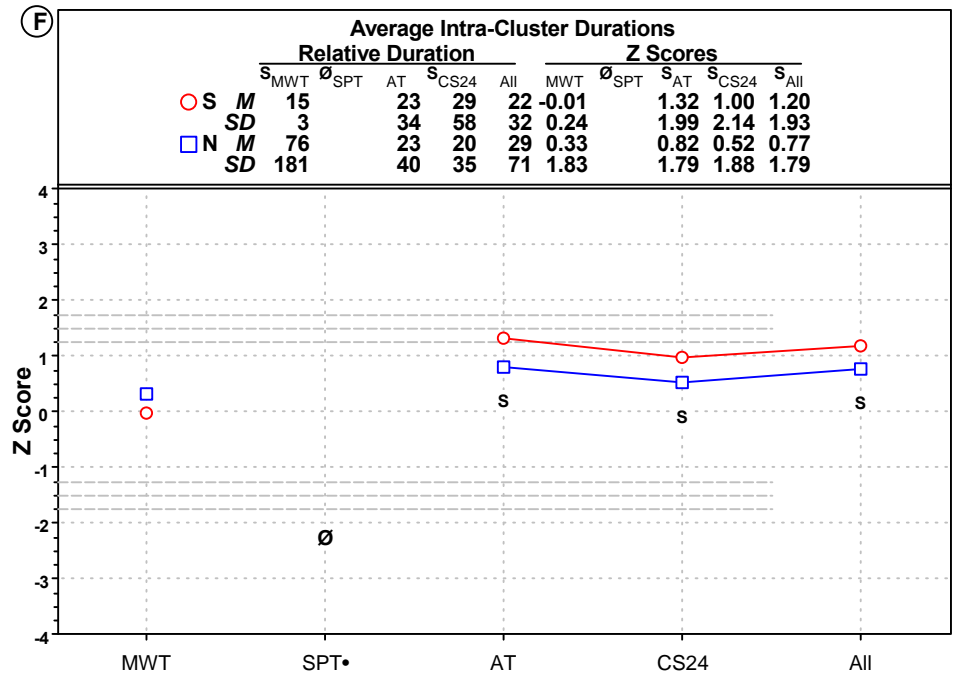




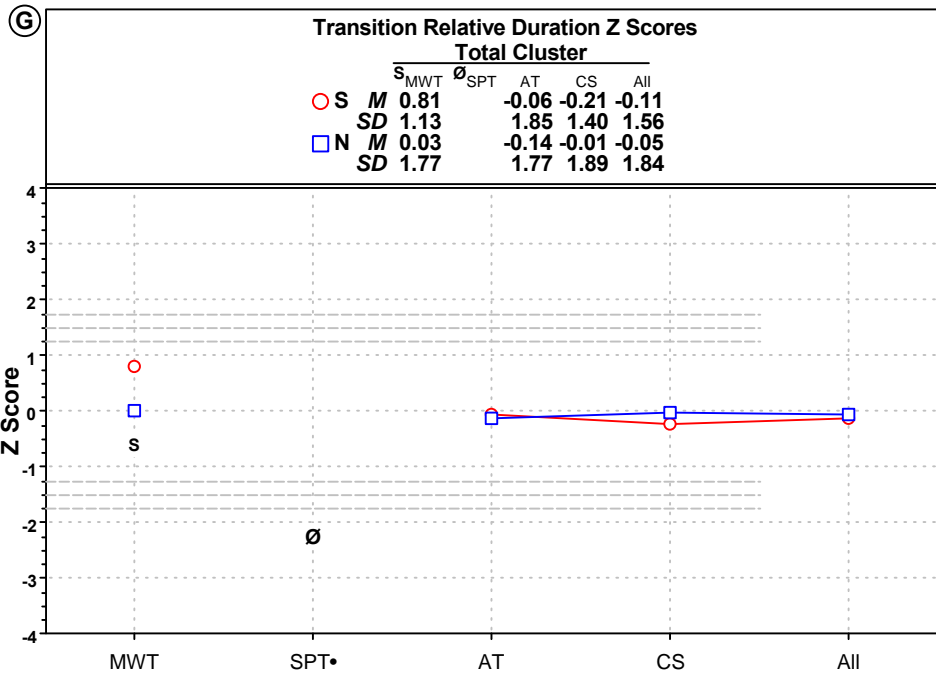




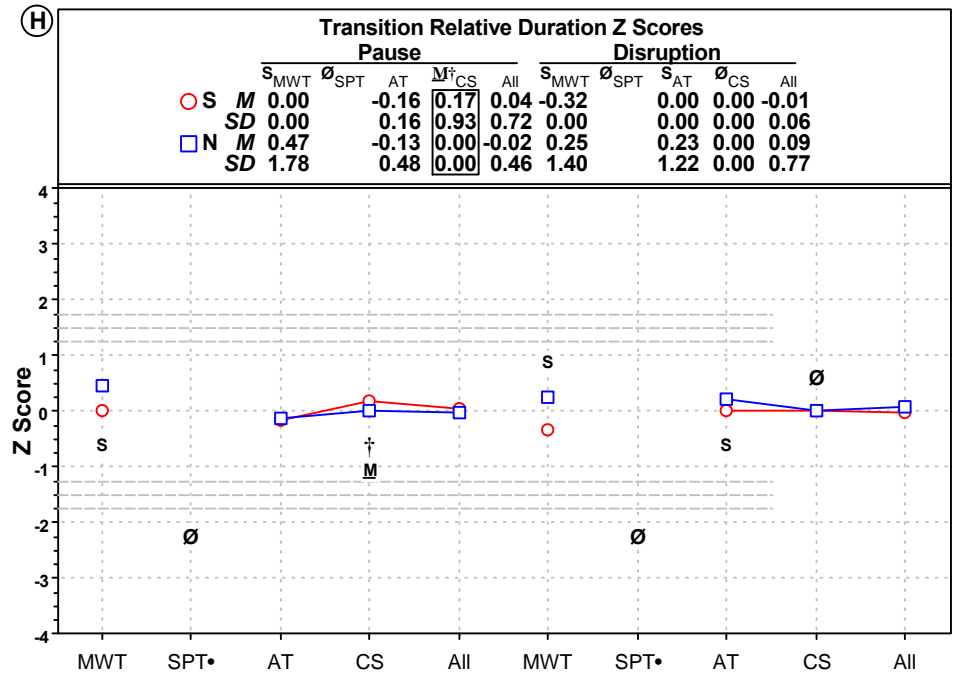
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$  •=insufficient data



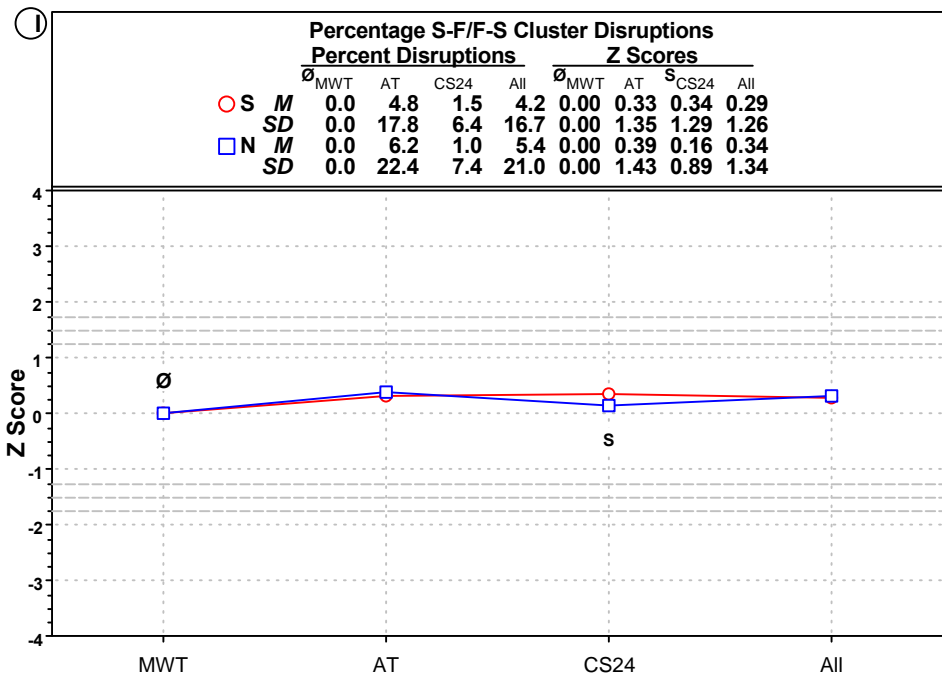
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$  •=insufficient data



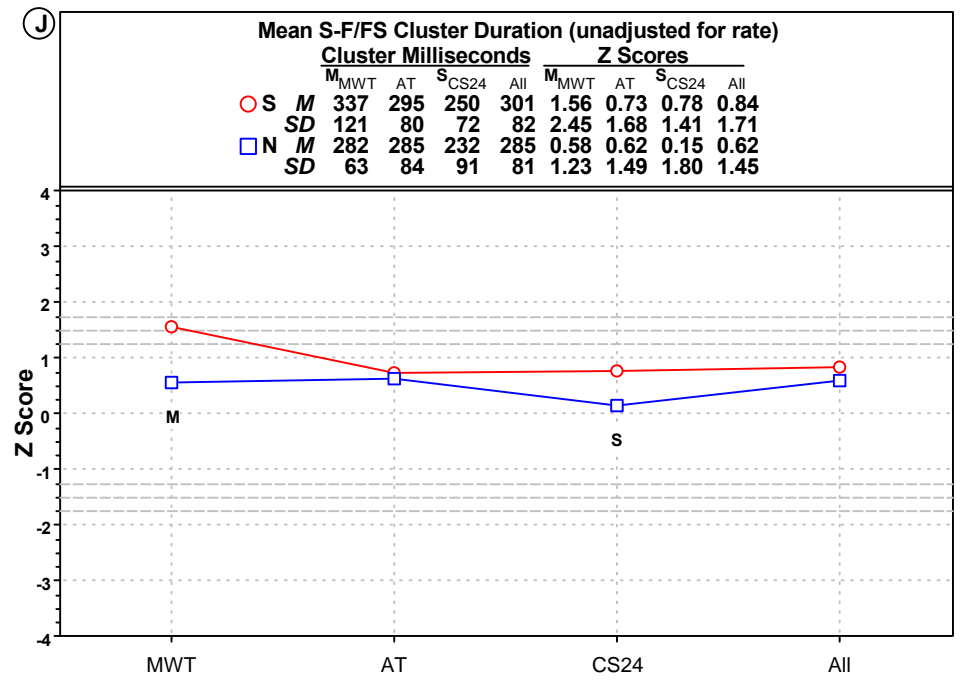
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$  •=insufficient data



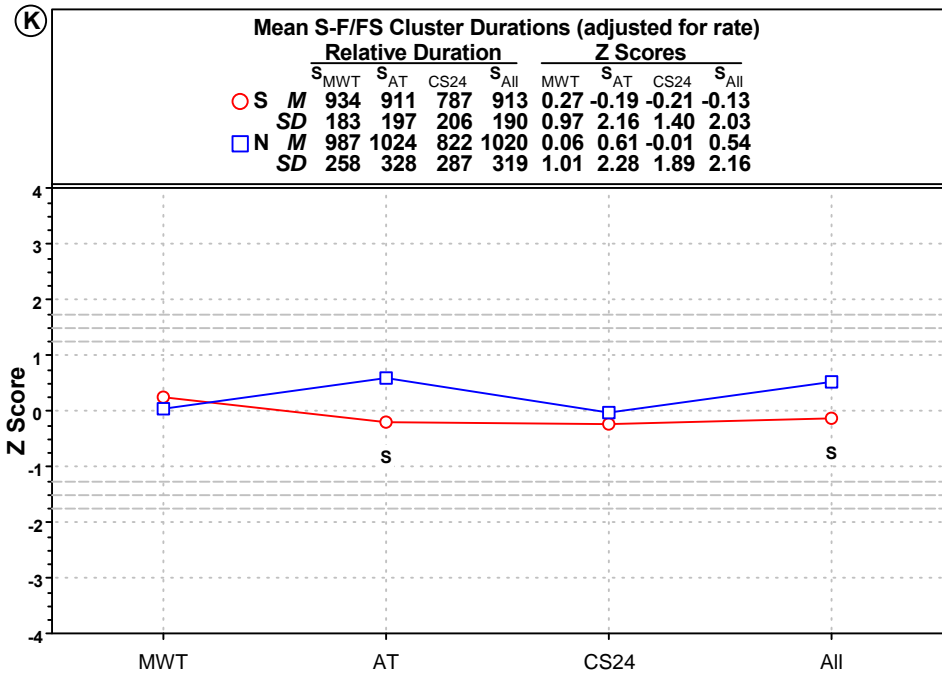
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$  •=insufficient data



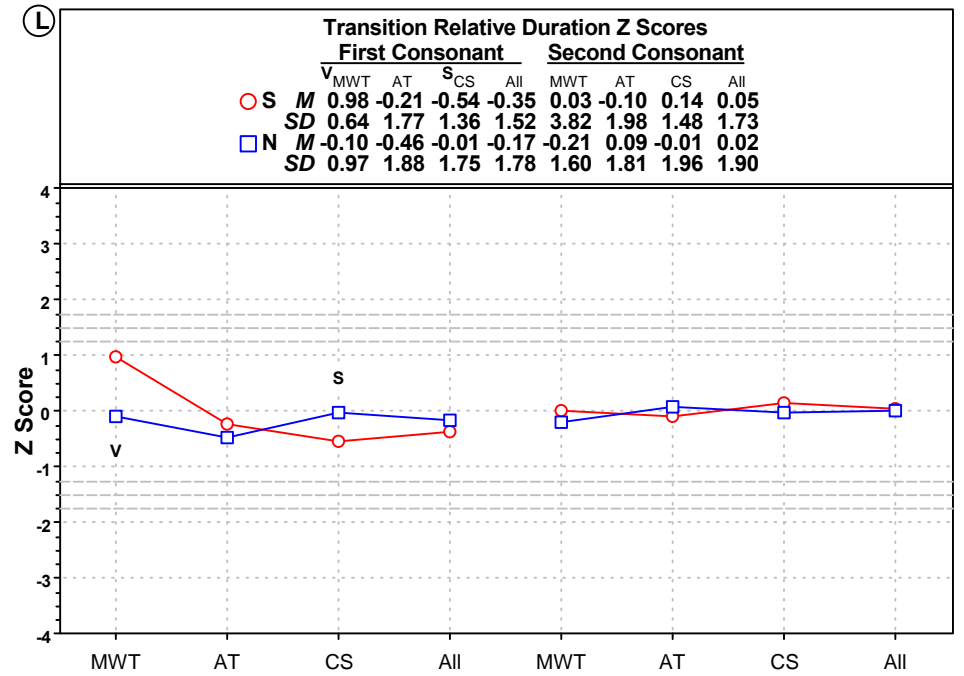
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ ,  $\emptyset$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



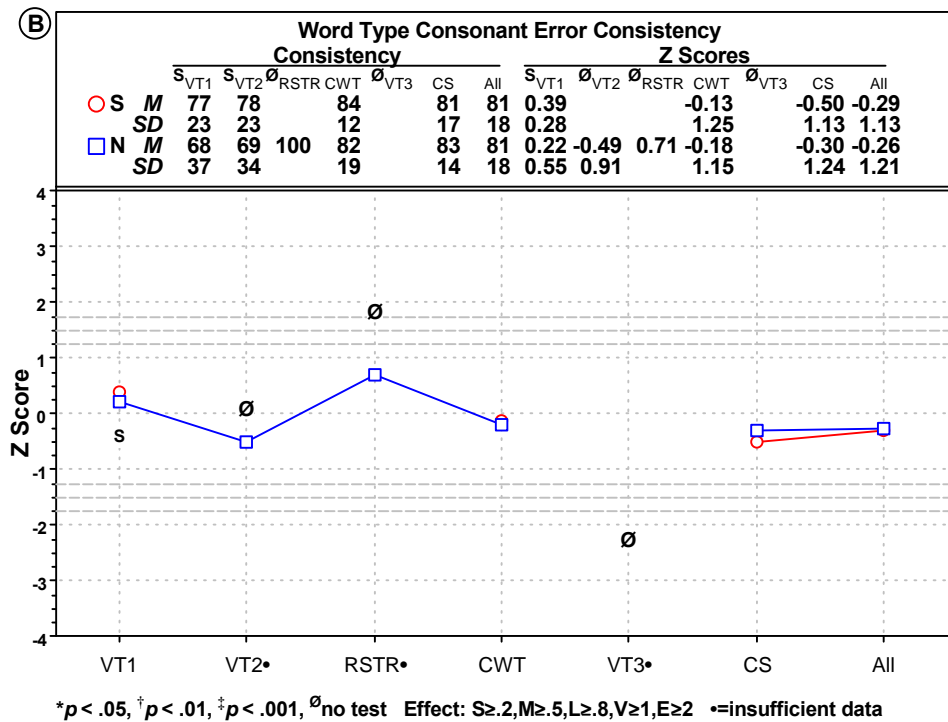
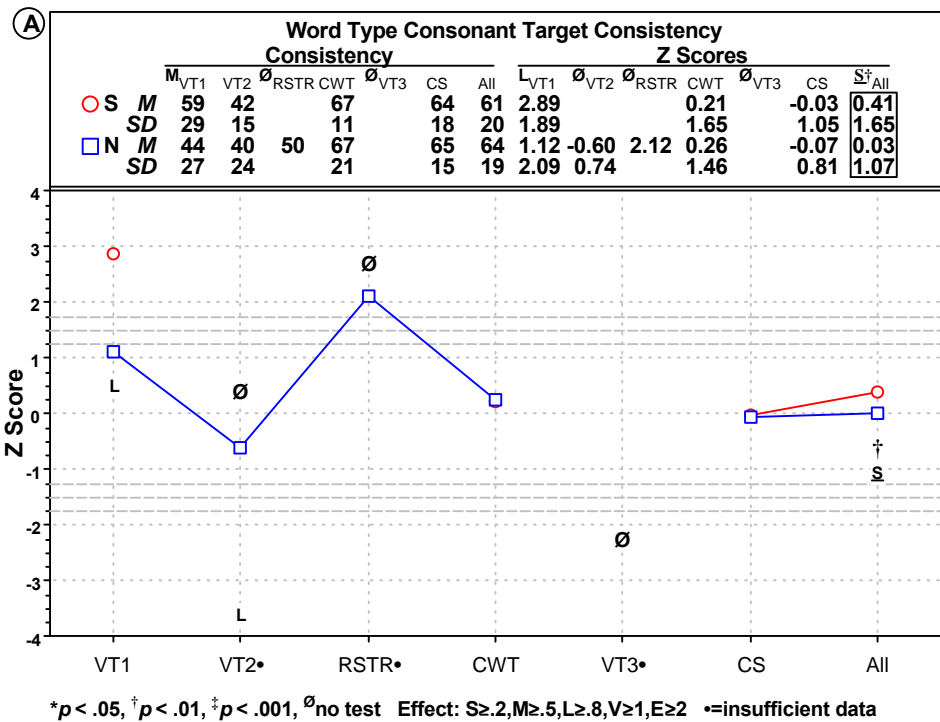
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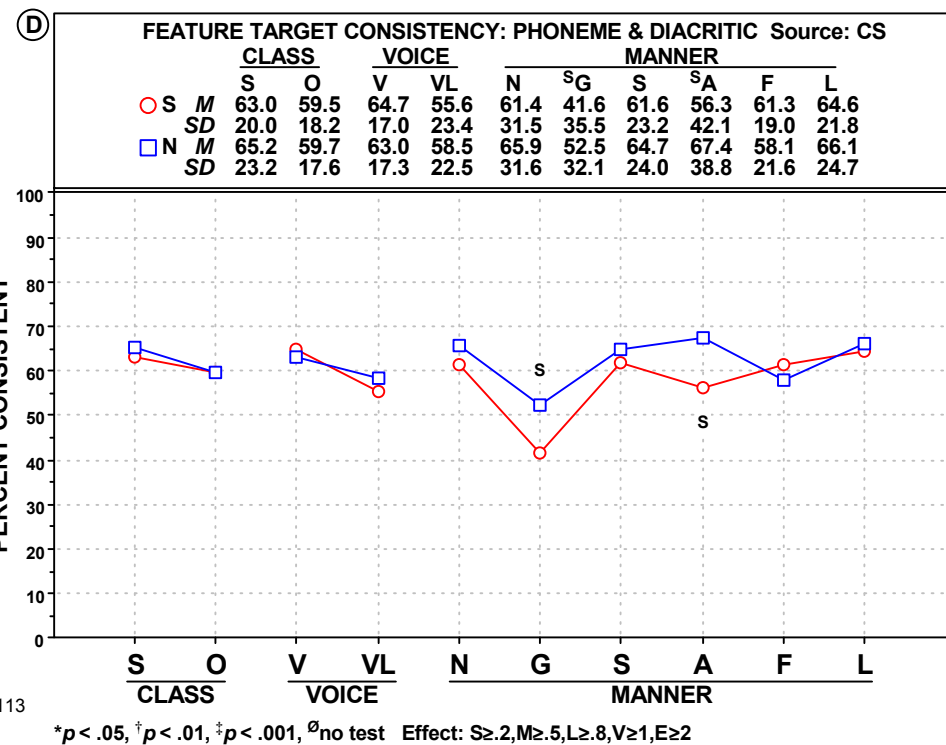
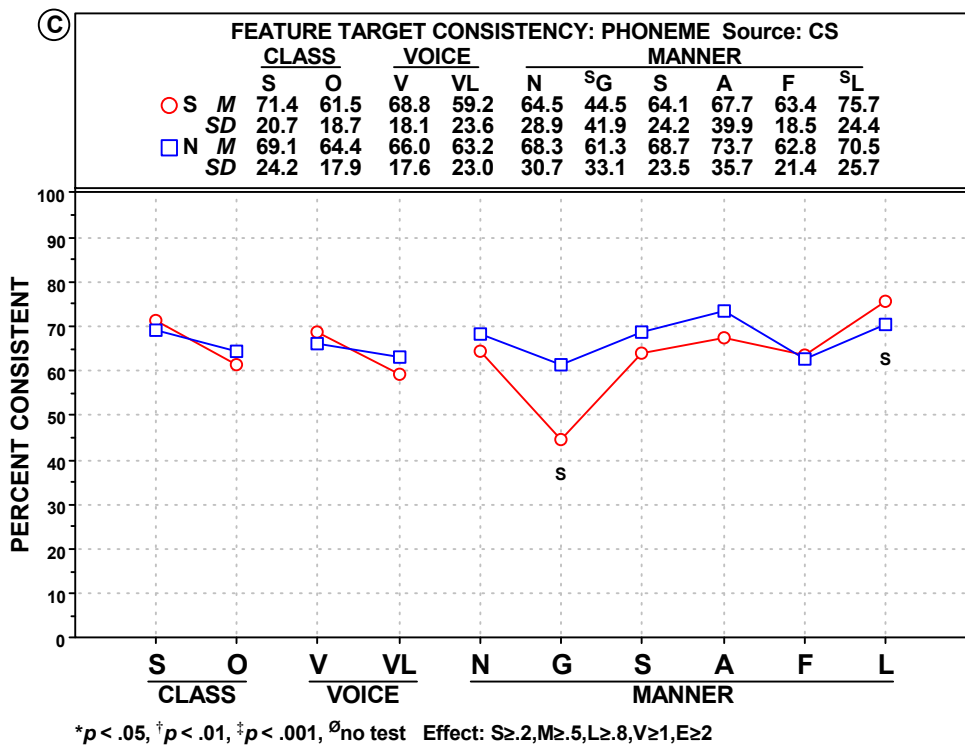
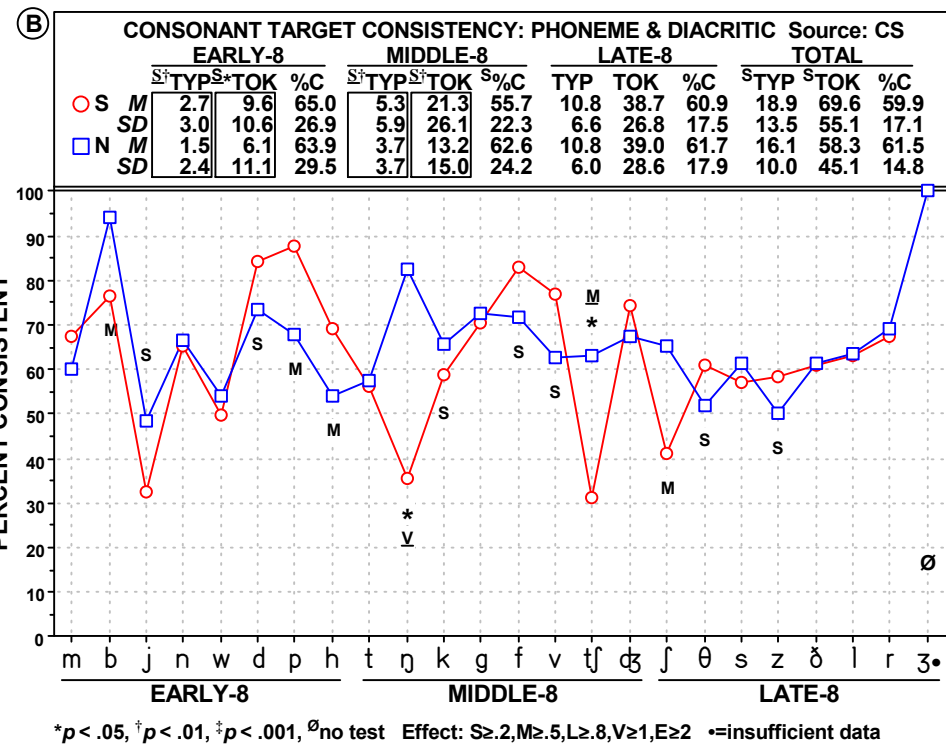
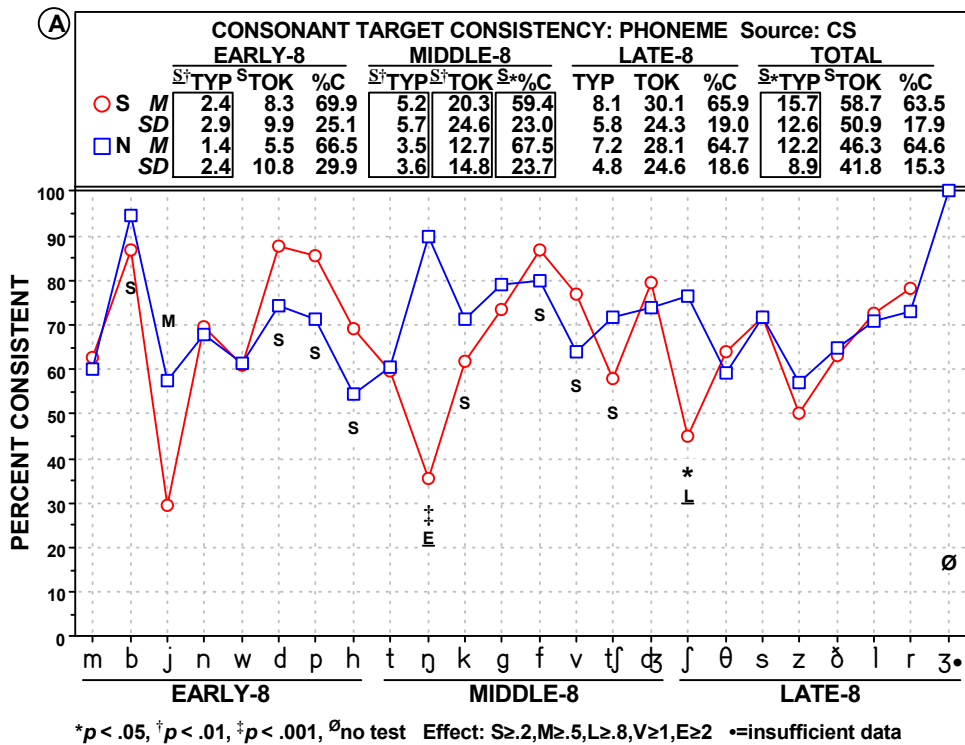


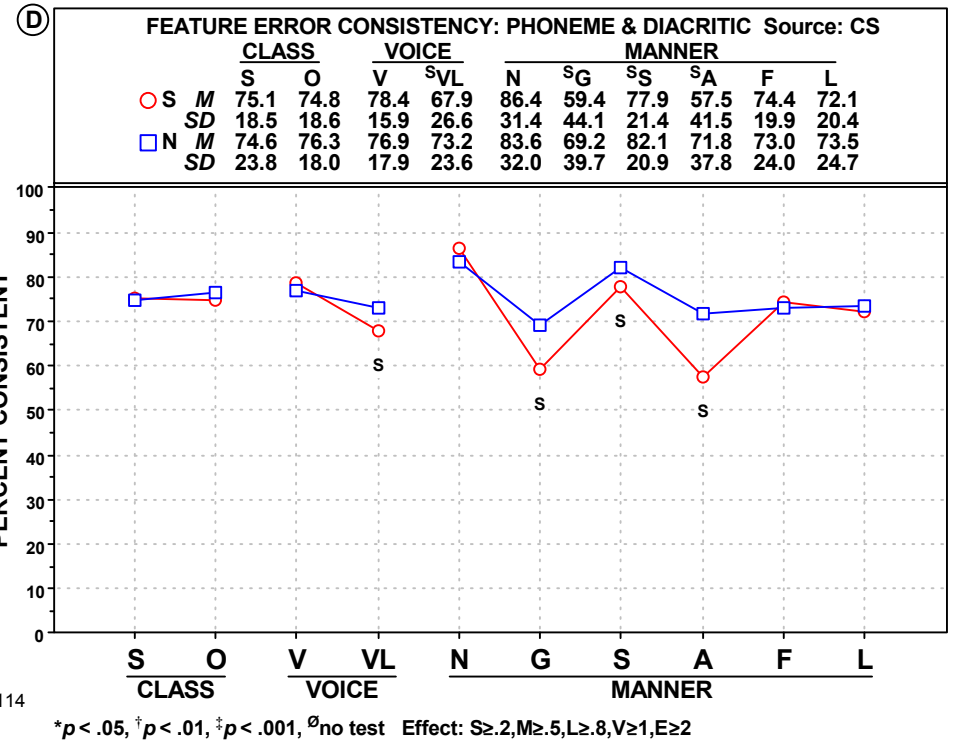
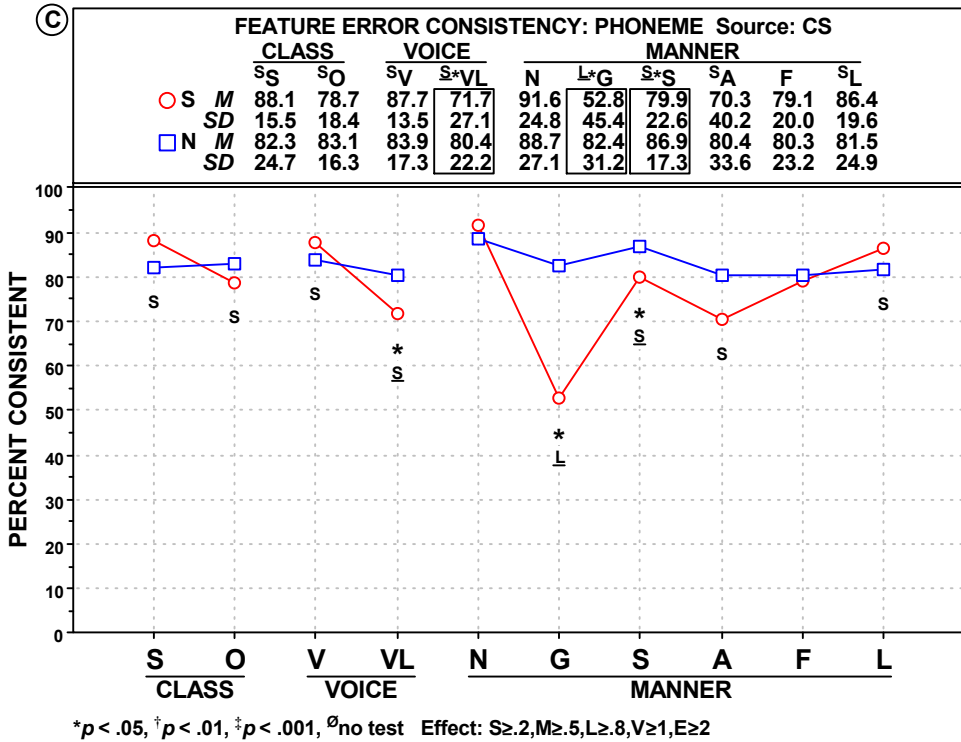
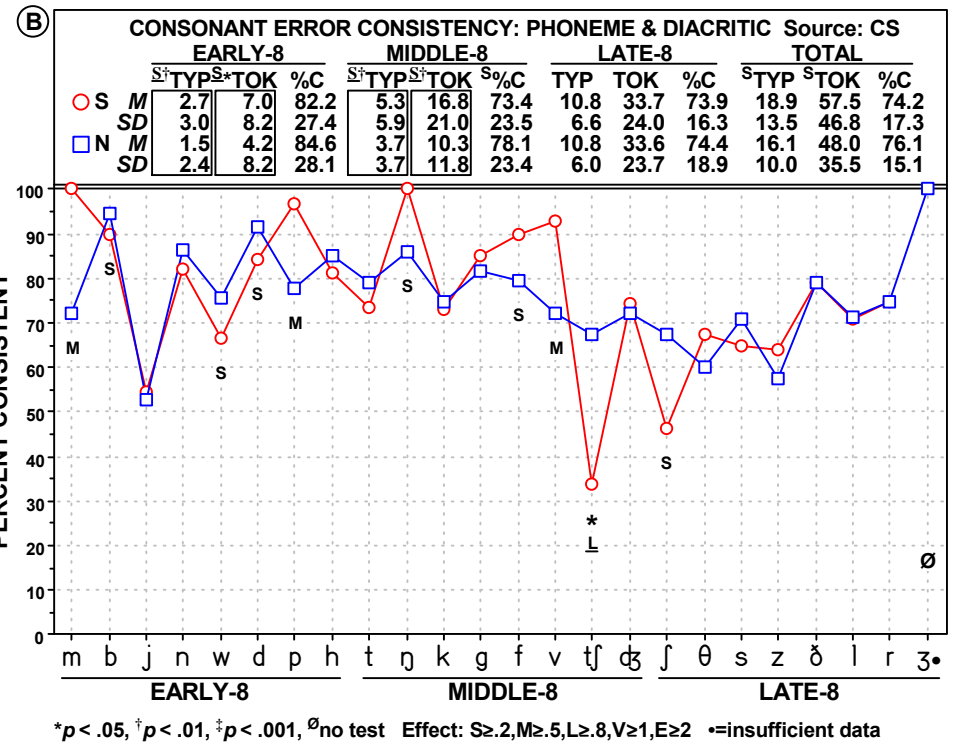
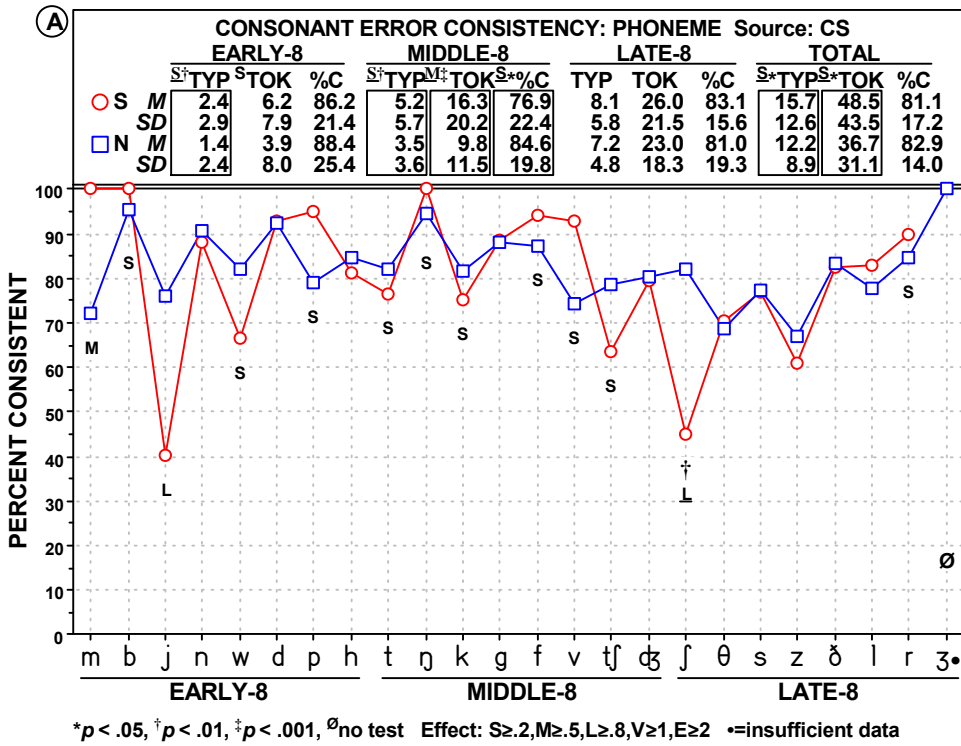
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ ,  $\emptyset$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

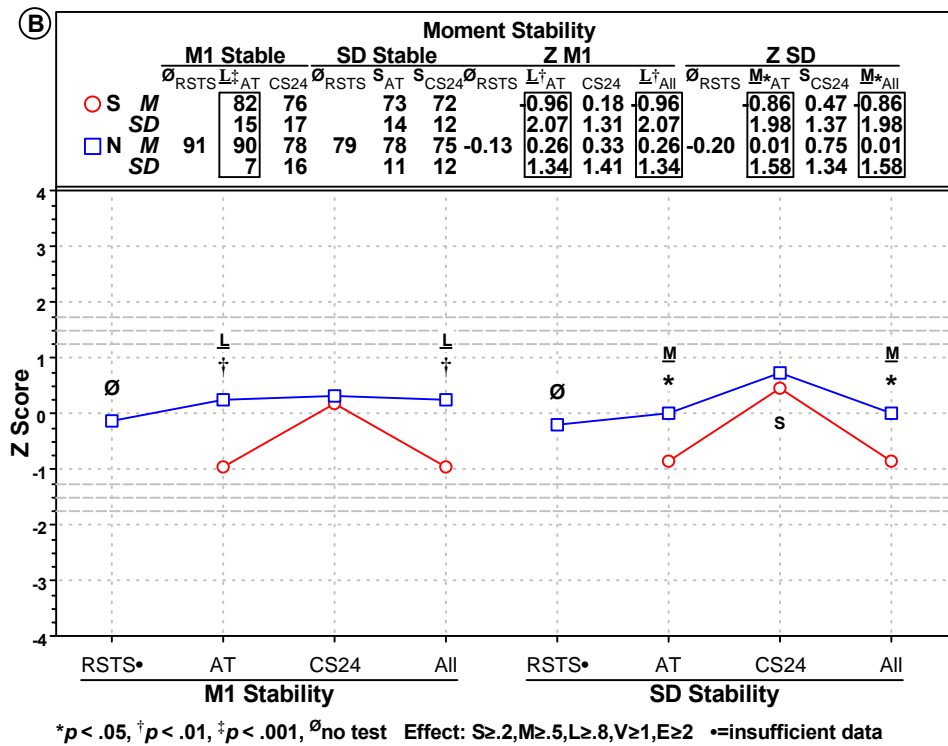
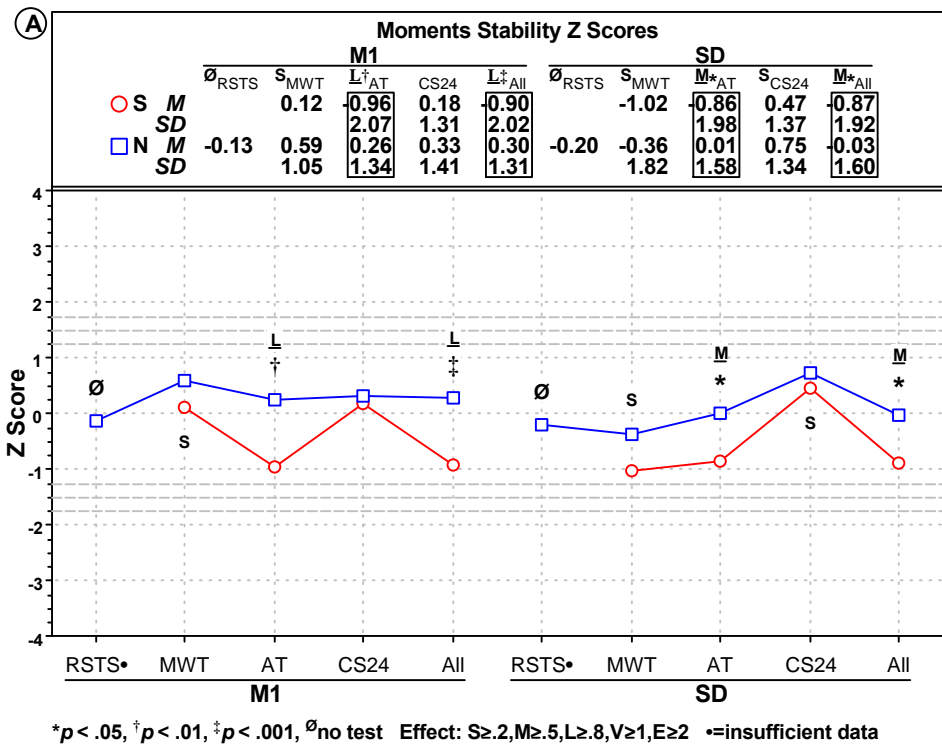


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ ,  $\emptyset$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$





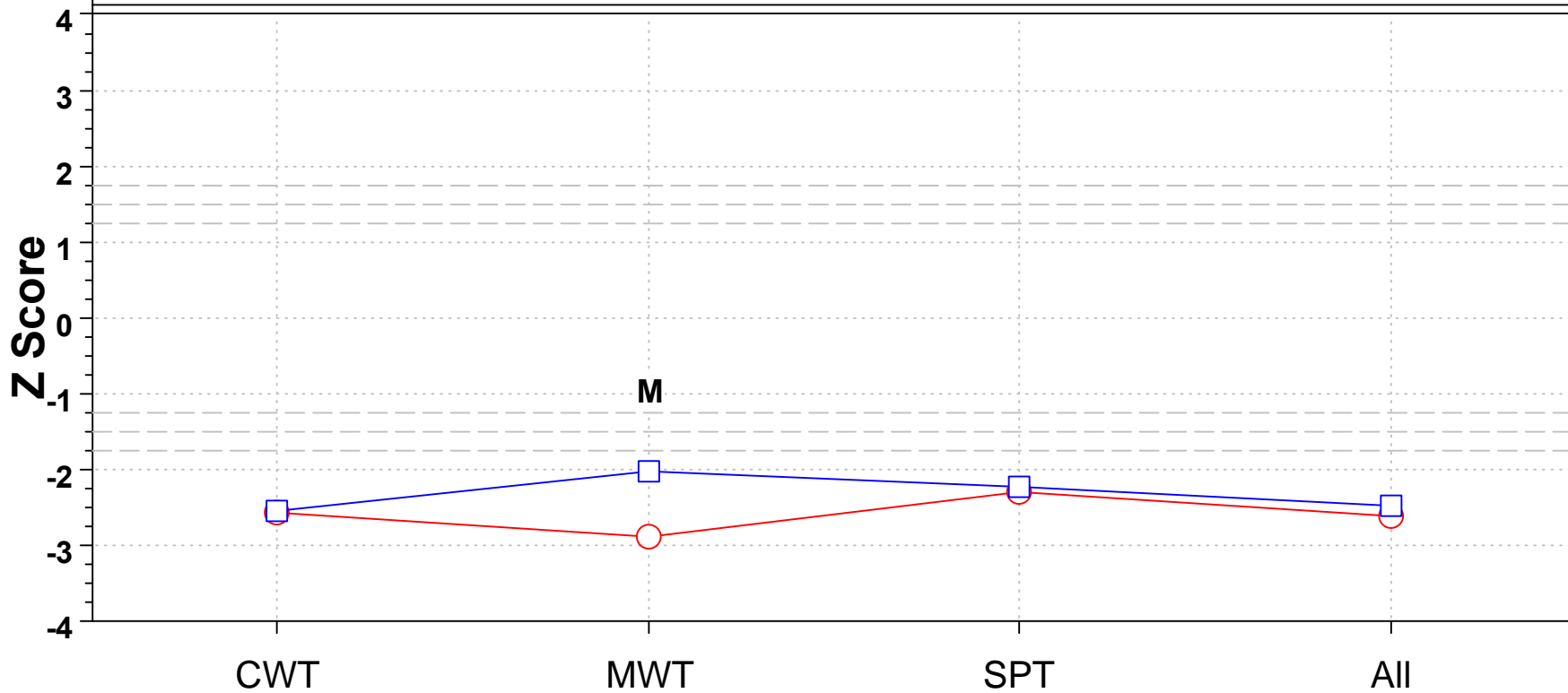




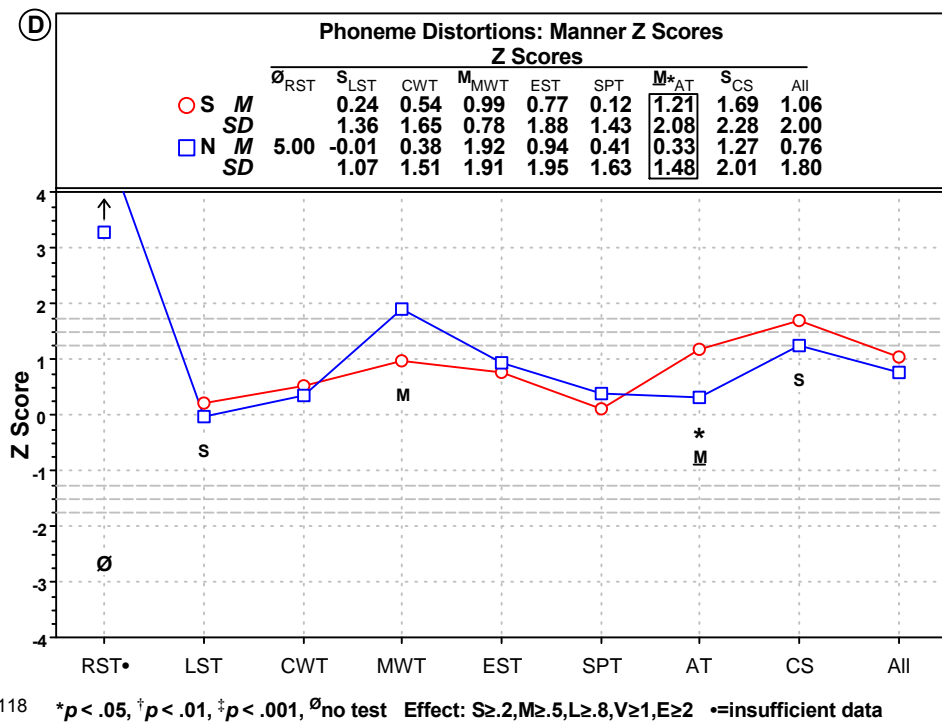
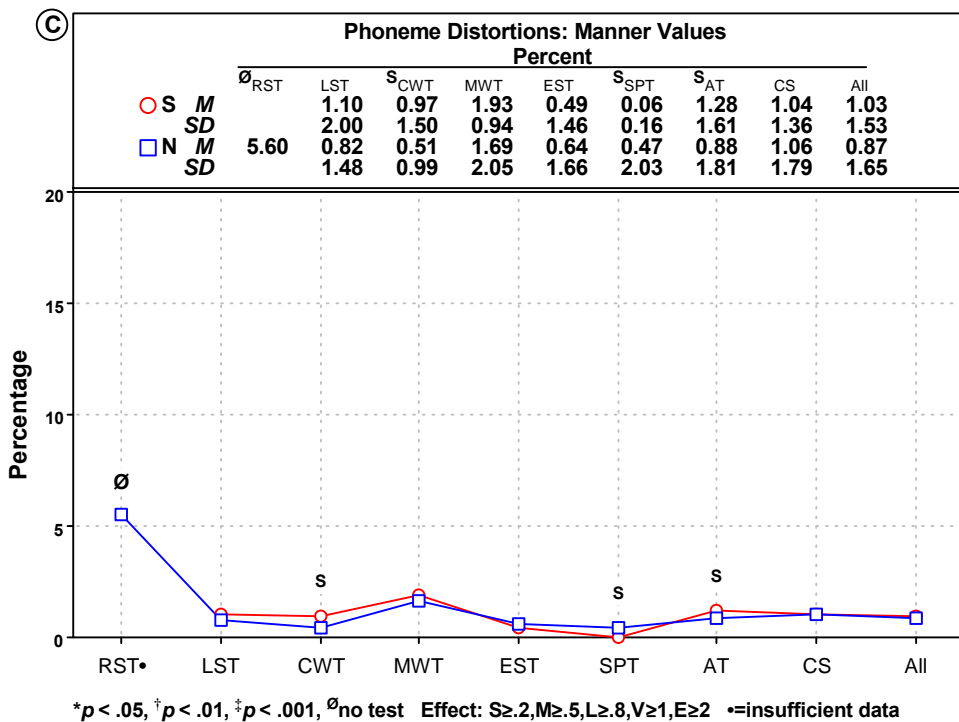
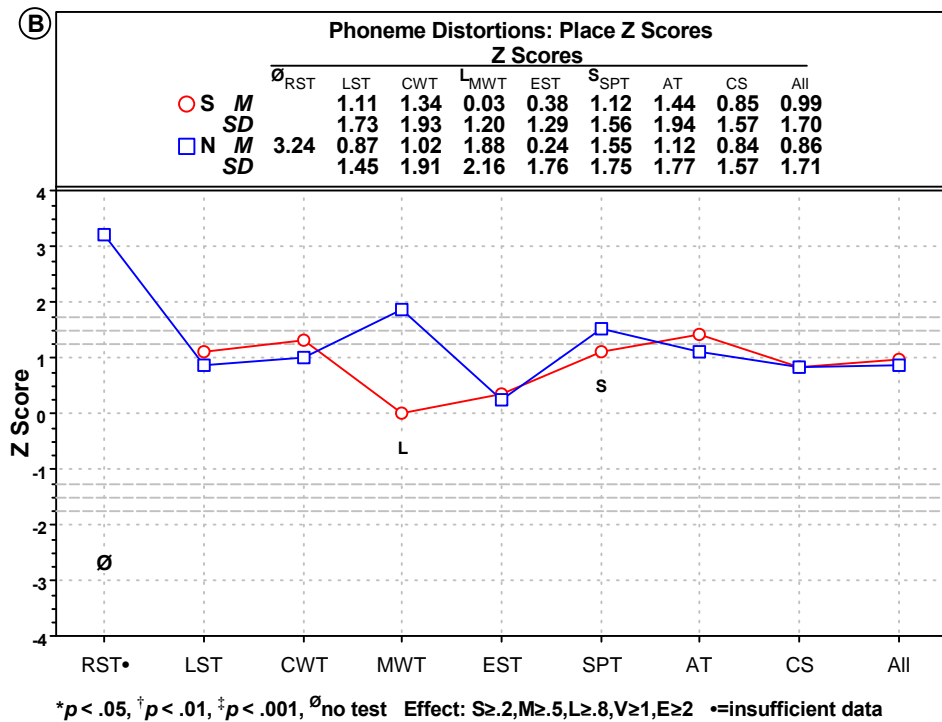
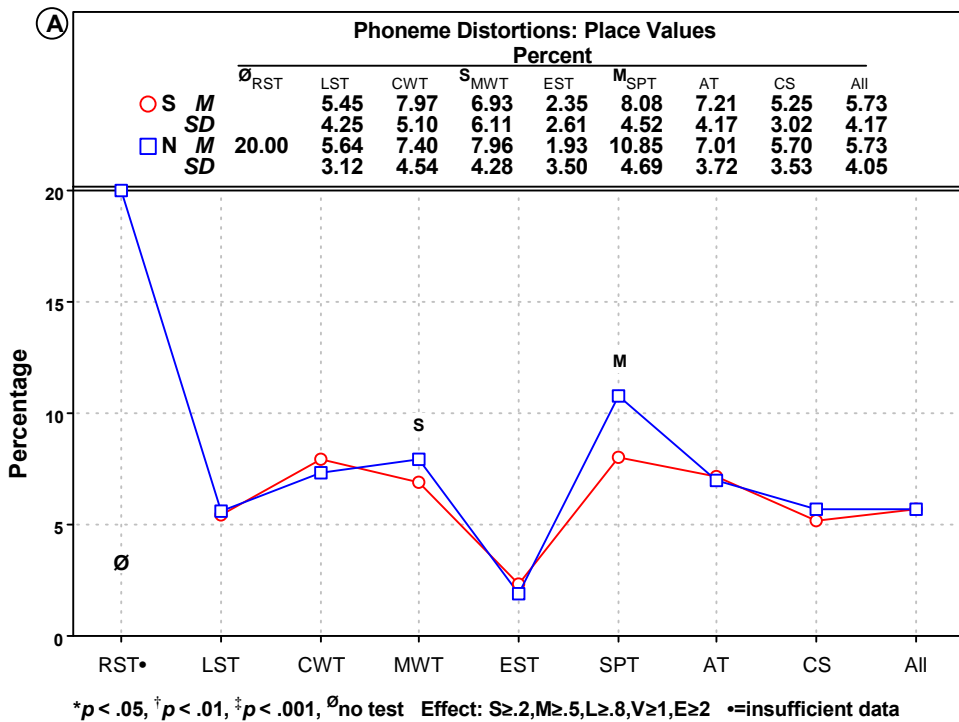
## **VOWEL & CONSONANT PROFILES**

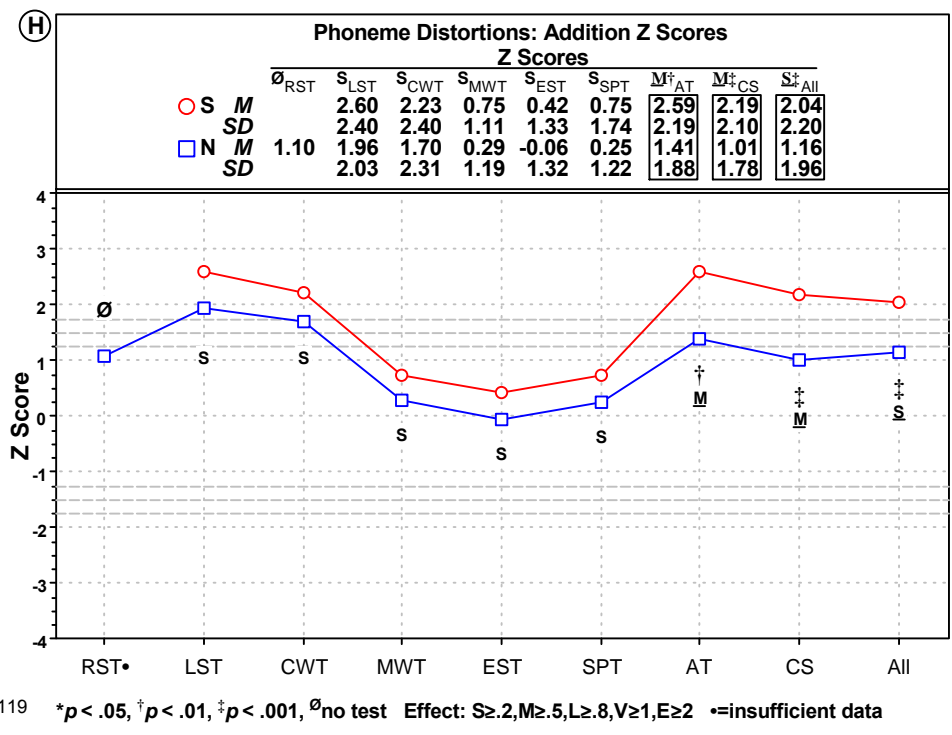
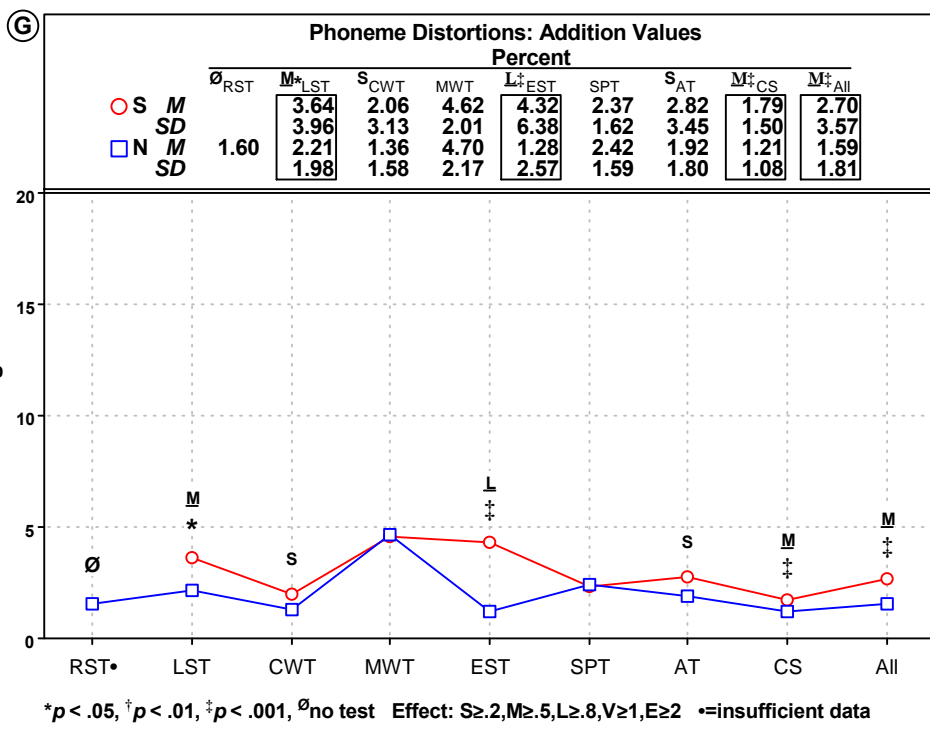
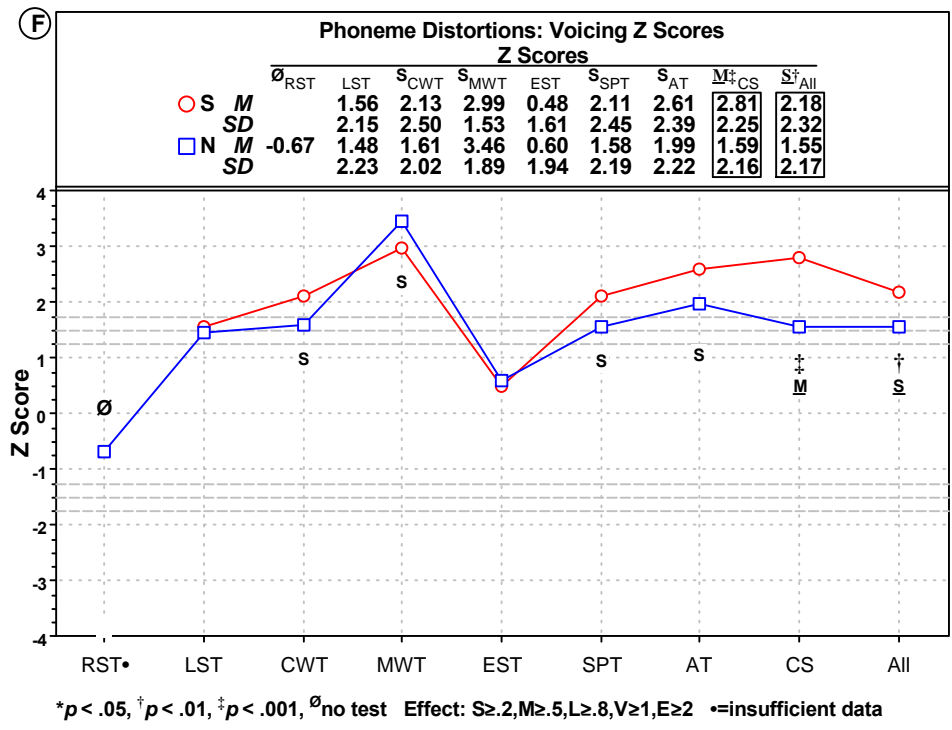
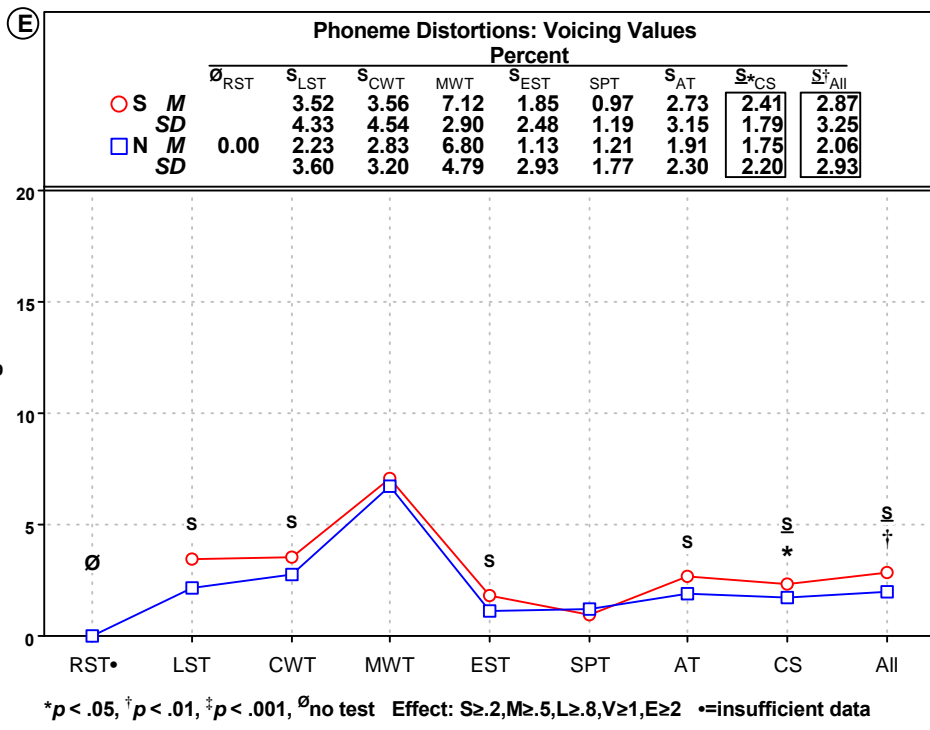
**Percent of Phonemes Correct in Complex Words**

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

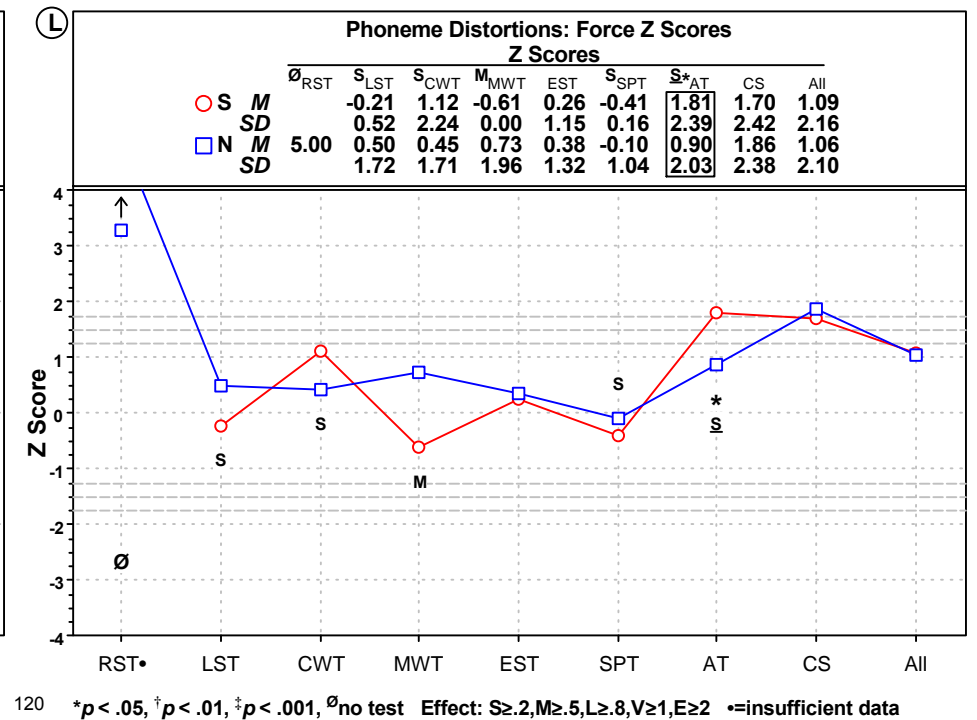
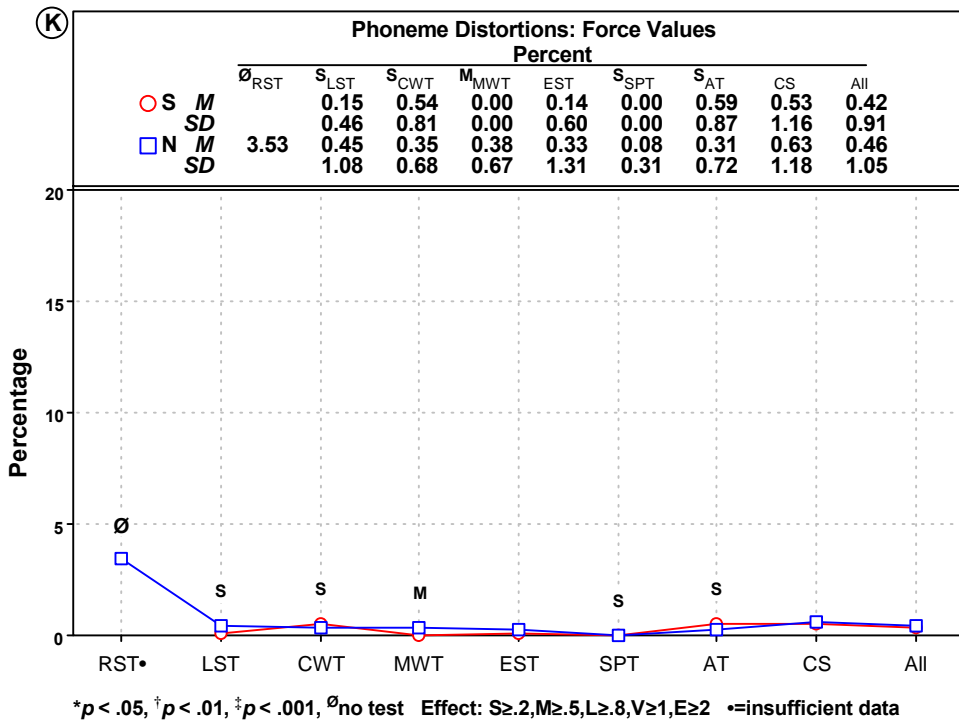
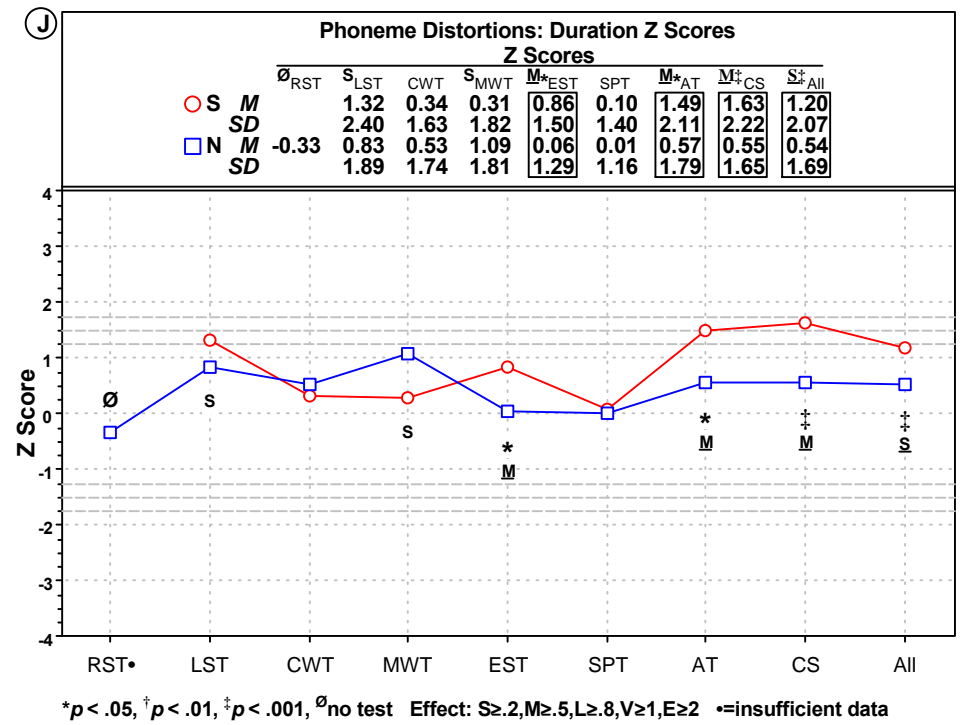
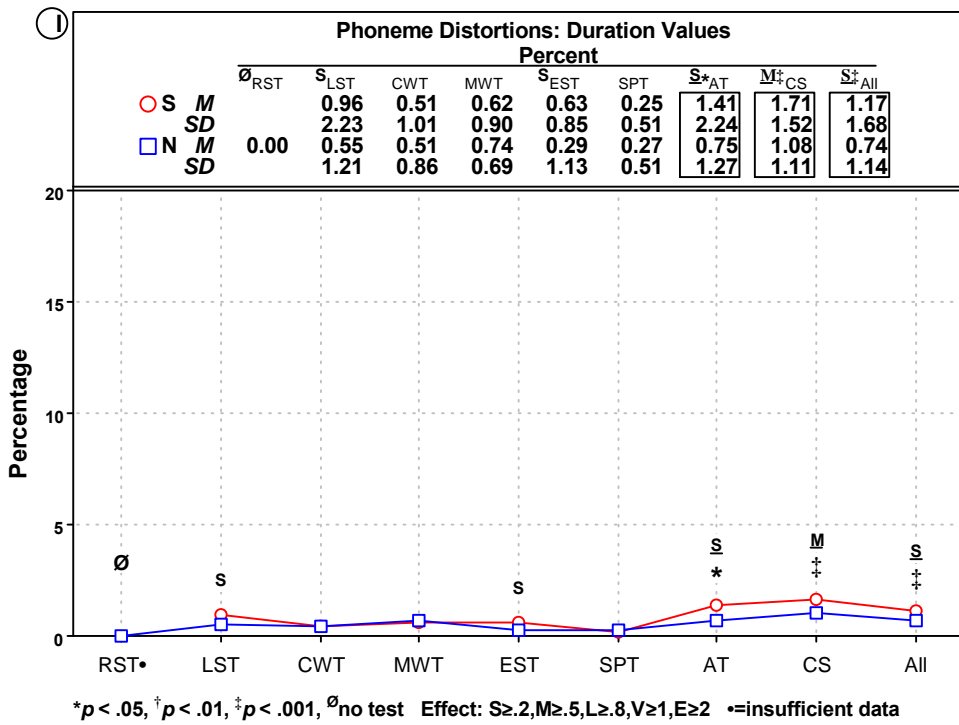


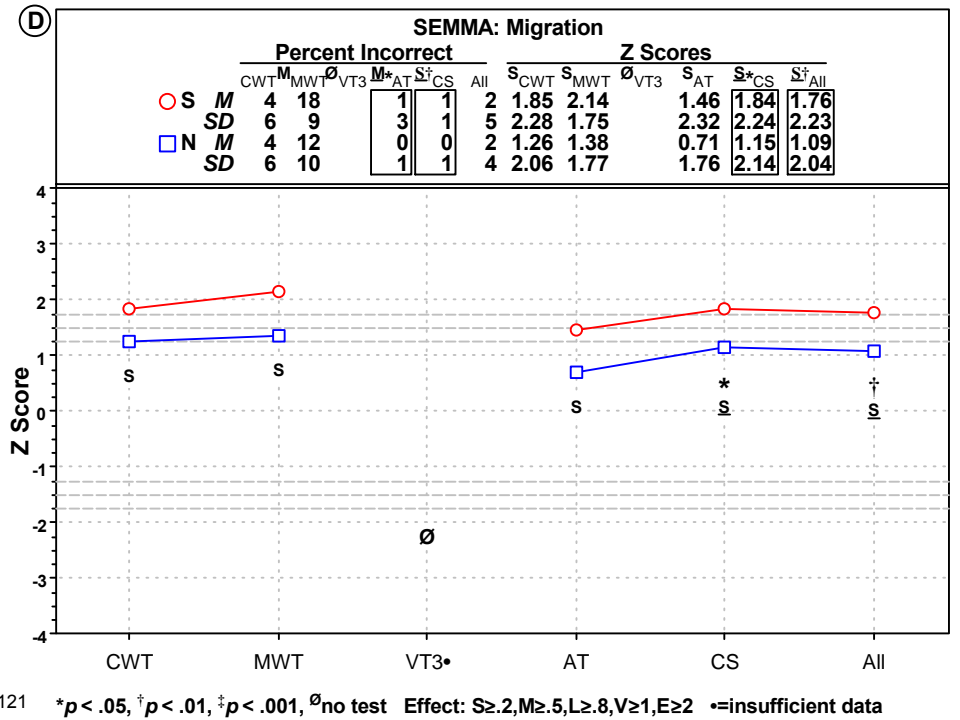
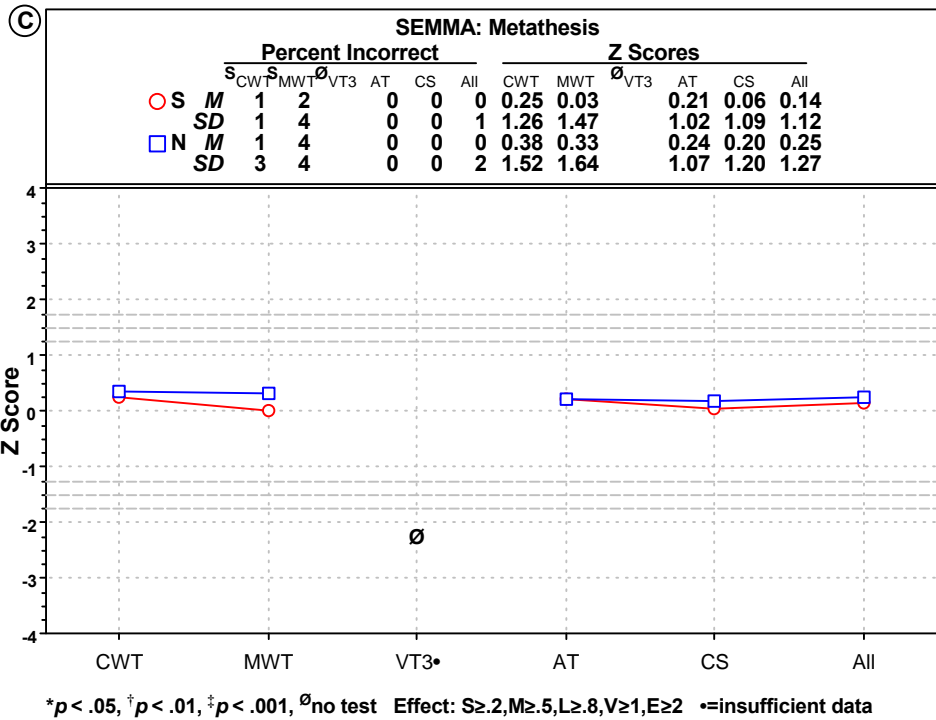
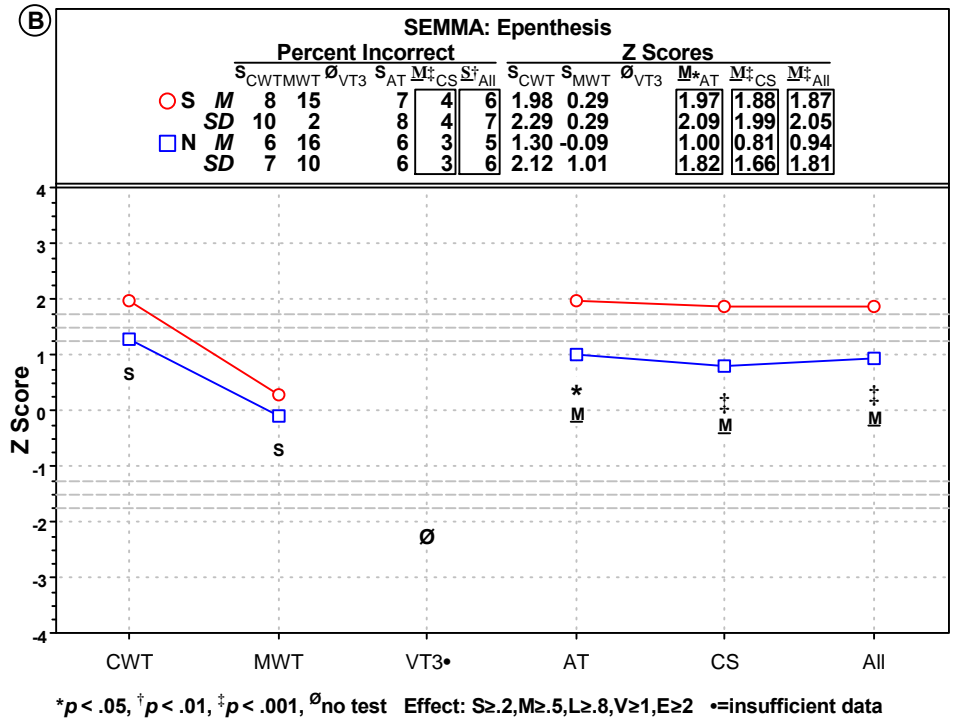
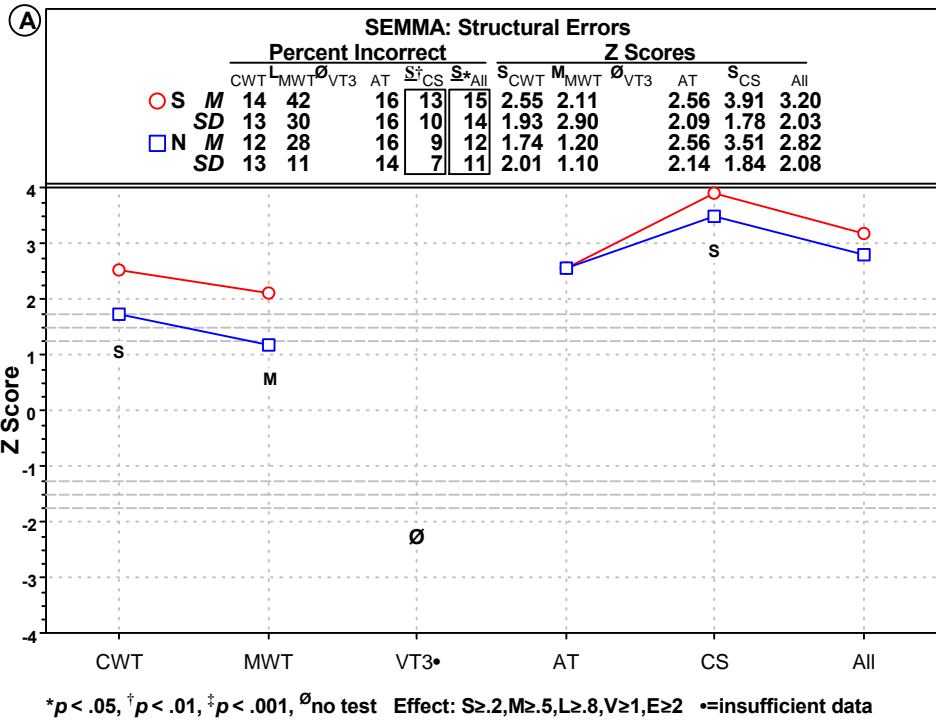
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅ no test Effect:  $S \geq .2, M \geq .5, L \geq .8, V \geq 1, E \geq 2$

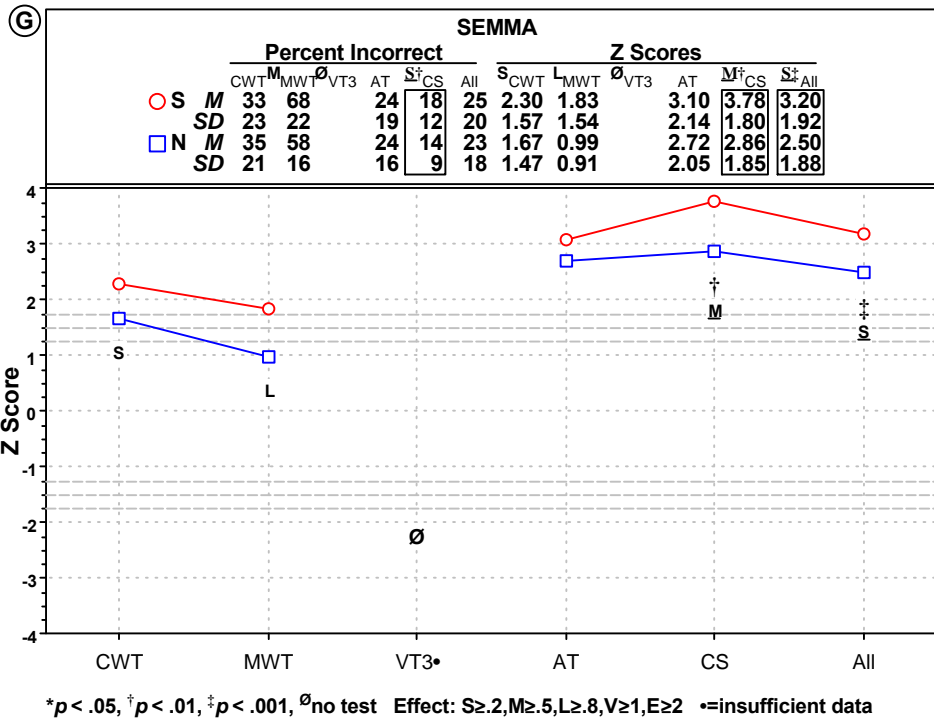
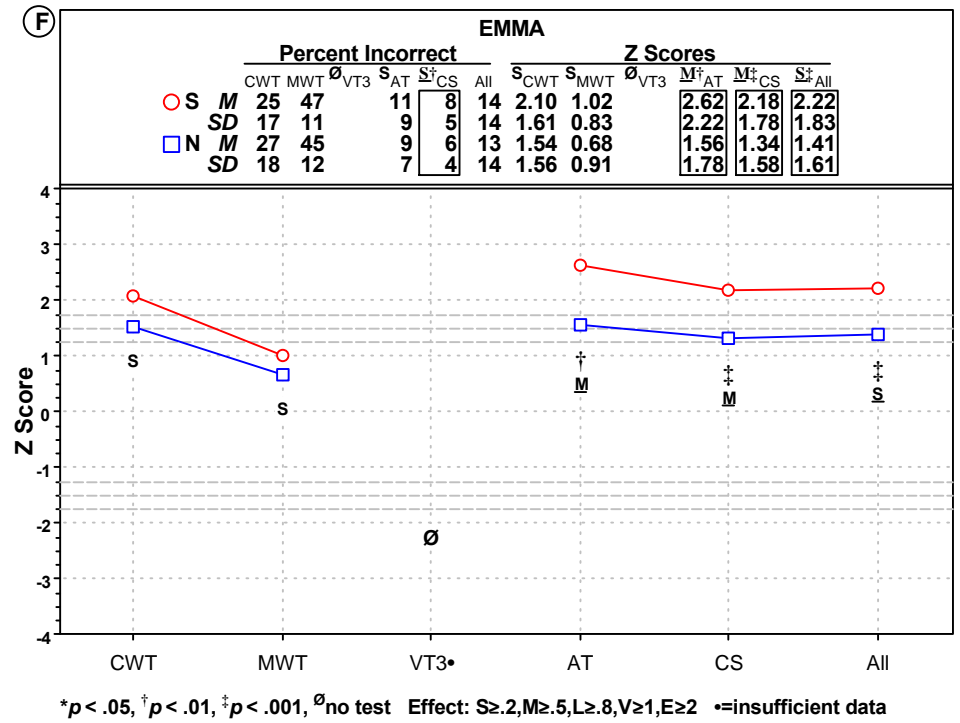
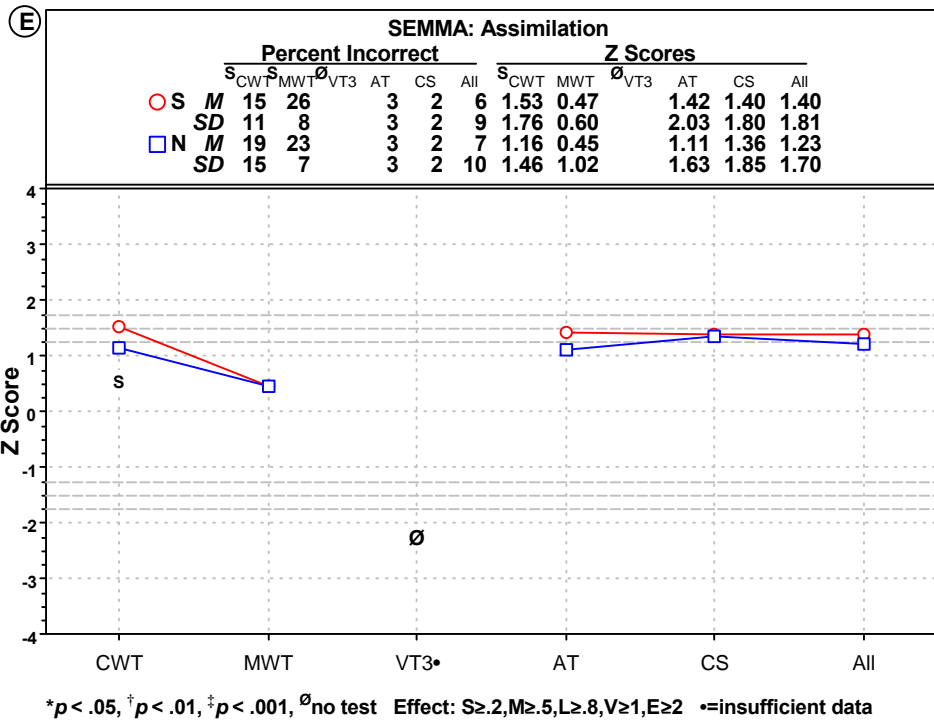


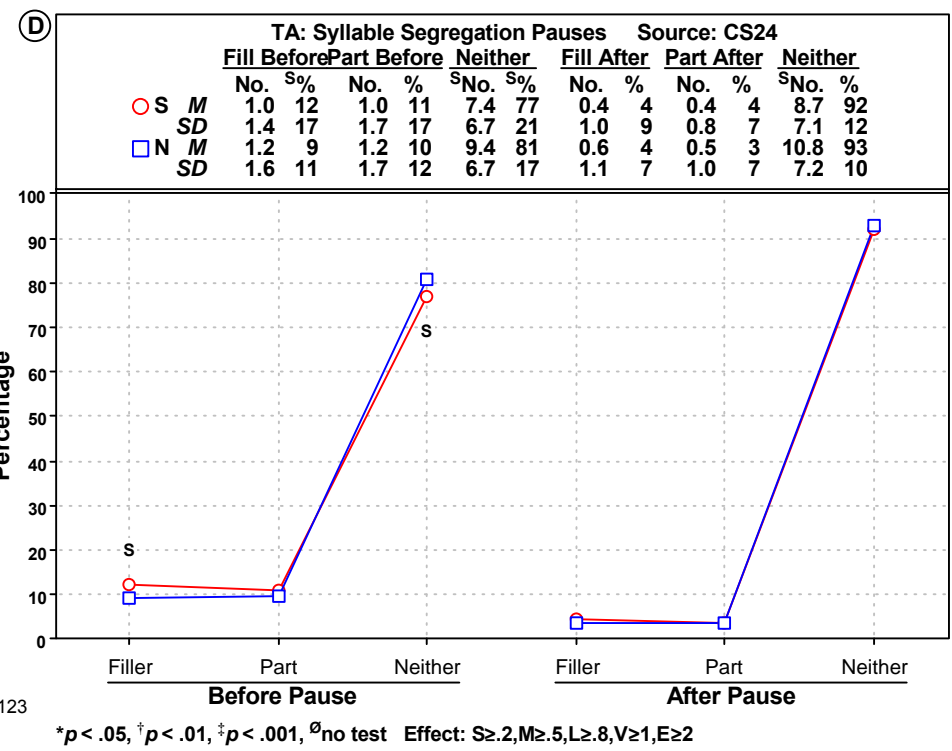
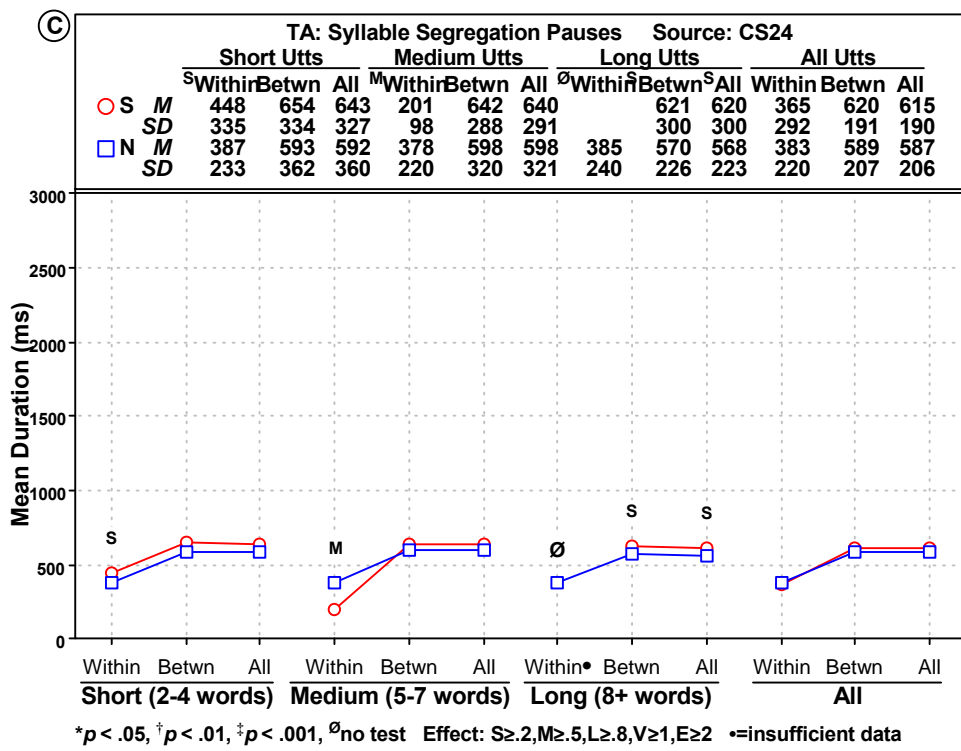
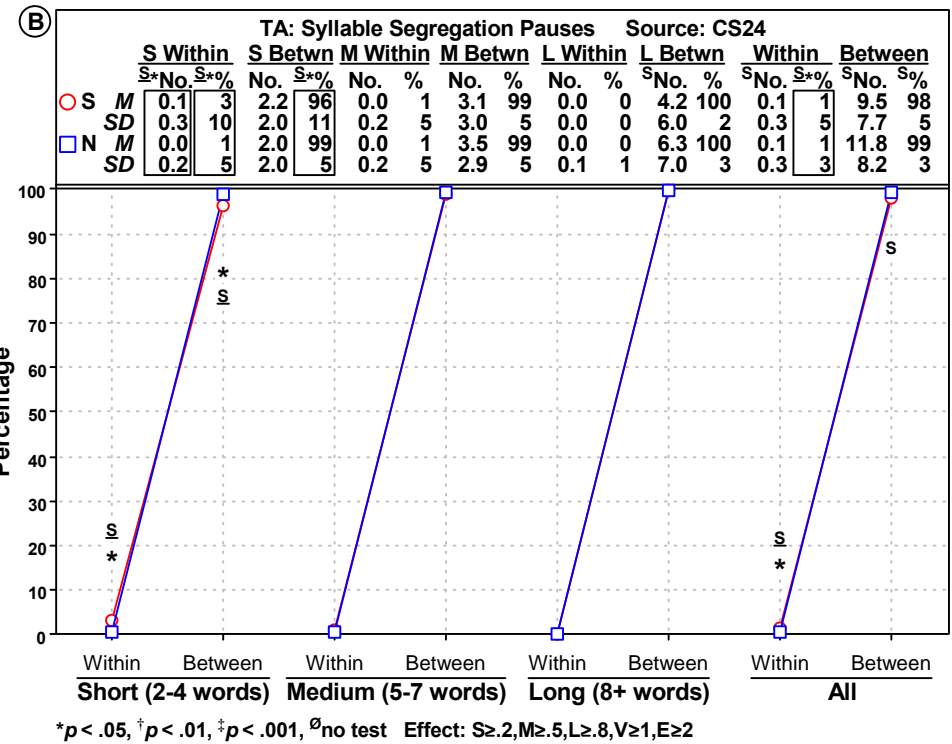
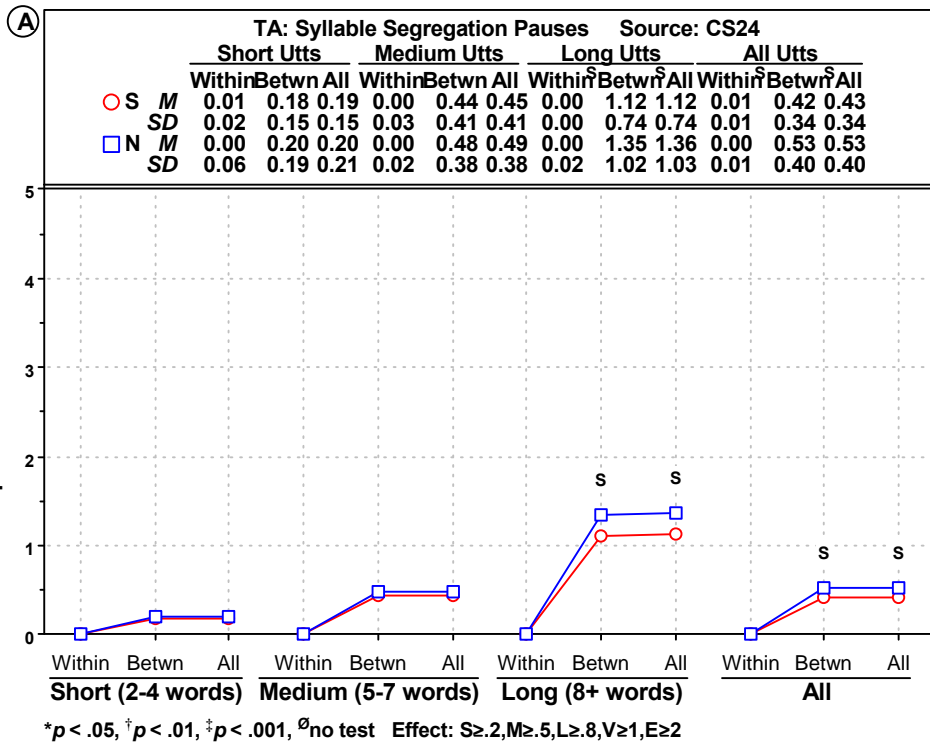


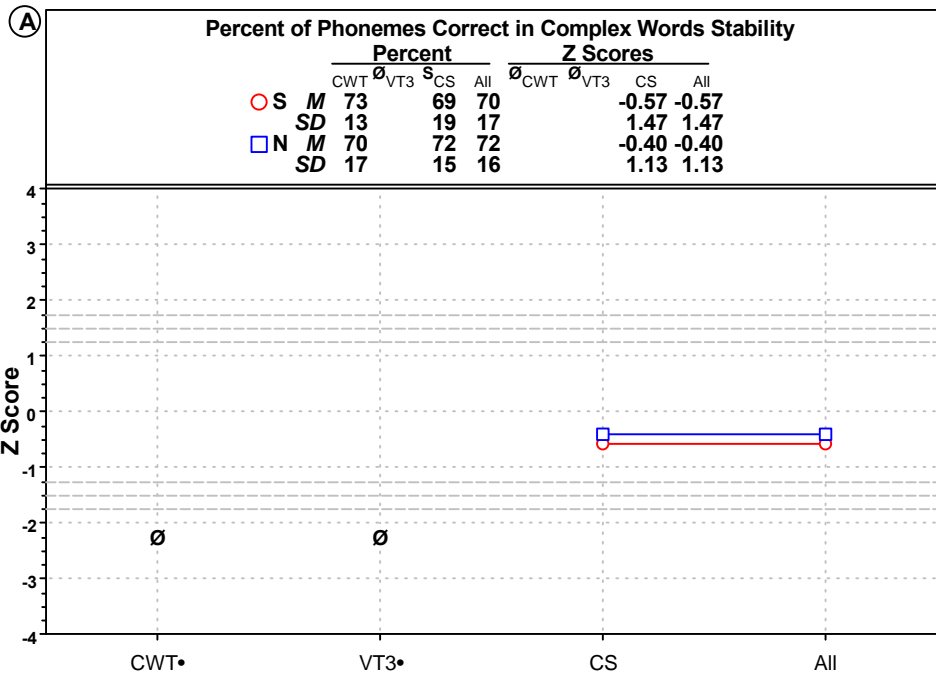
Vowels & Consonants Profile 2, S and N



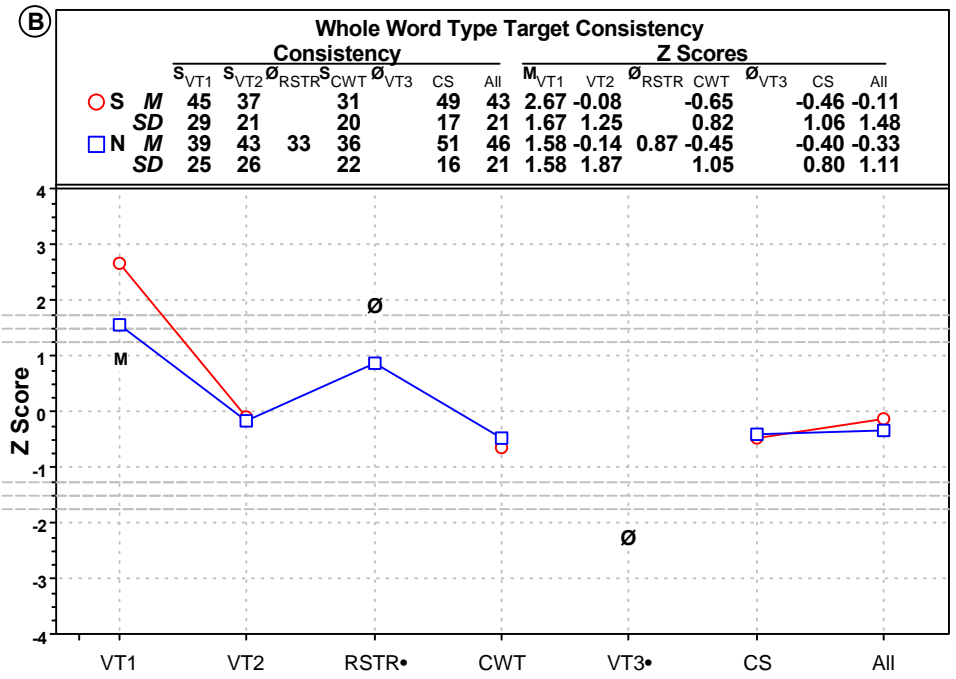




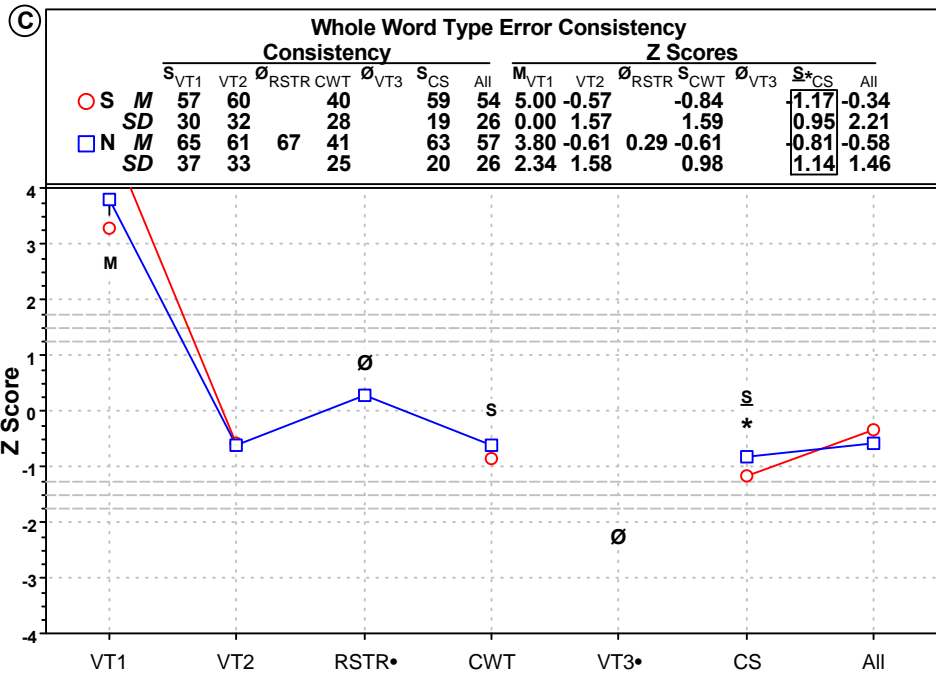




\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq 2$ , M $\geq 5$ , L $\geq 8$ , V $\geq 1$ , E $\geq 2$  •=insufficient data

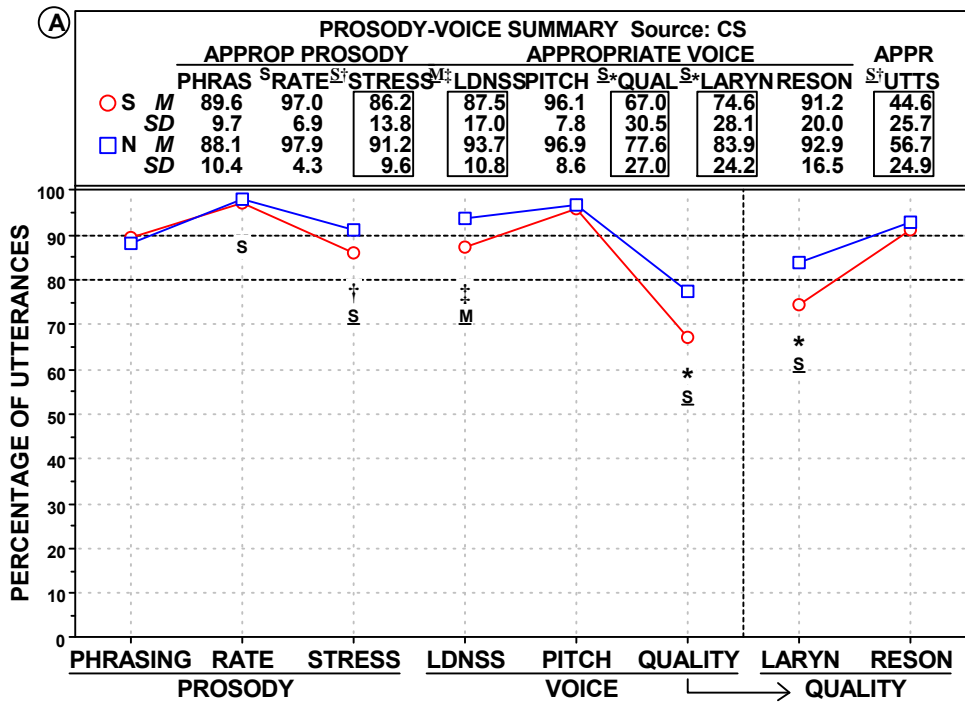


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq 2$ , M $\geq 5$ , L $\geq 8$ , V $\geq 1$ , E $\geq 2$  •=insufficient data

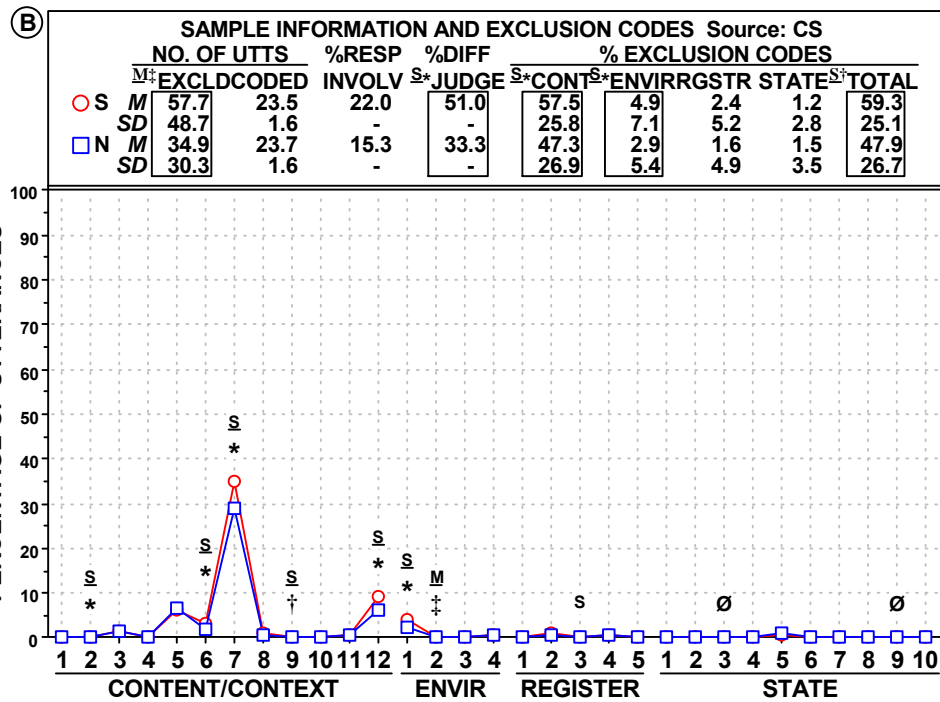


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq 2$ , M $\geq 5$ , L $\geq 8$ , V $\geq 1$ , E $\geq 2$  •=insufficient data

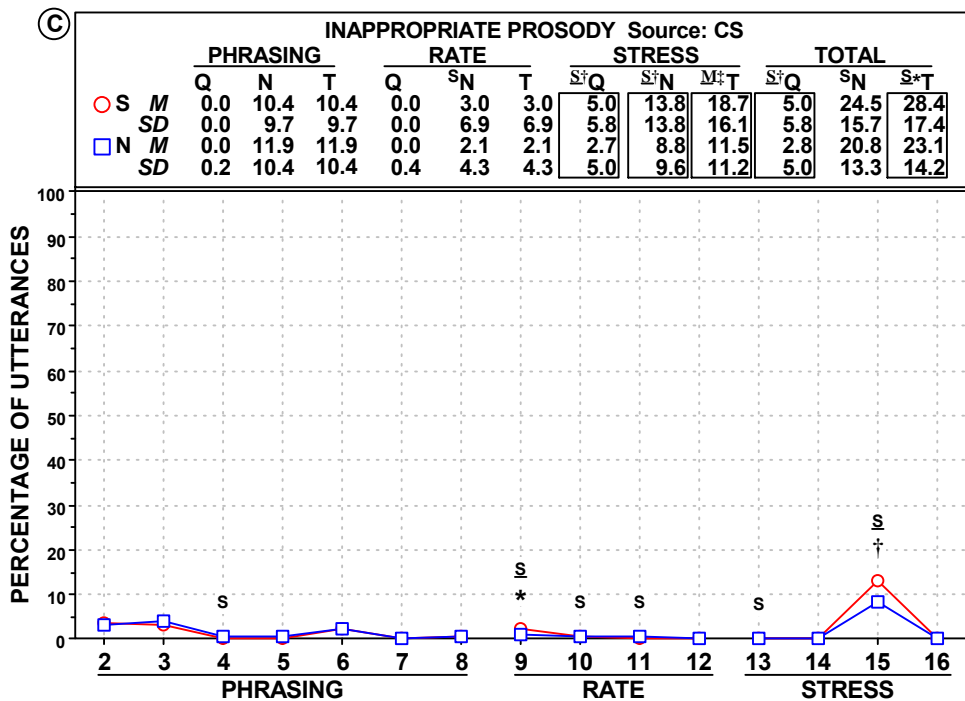
**PROSODY-VOICE SCREENING PROFILE**



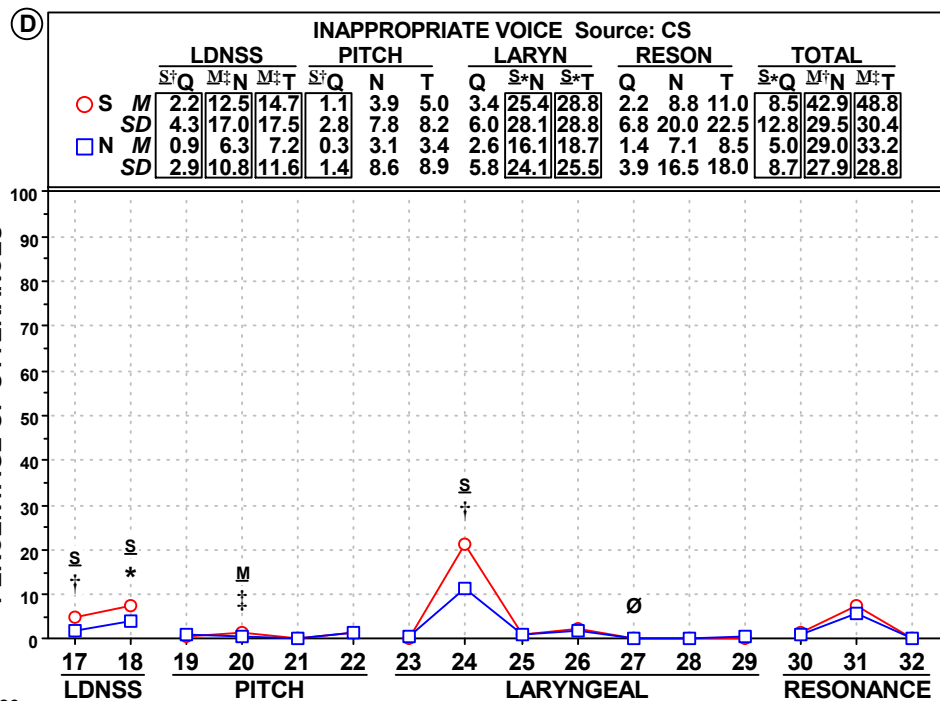
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2

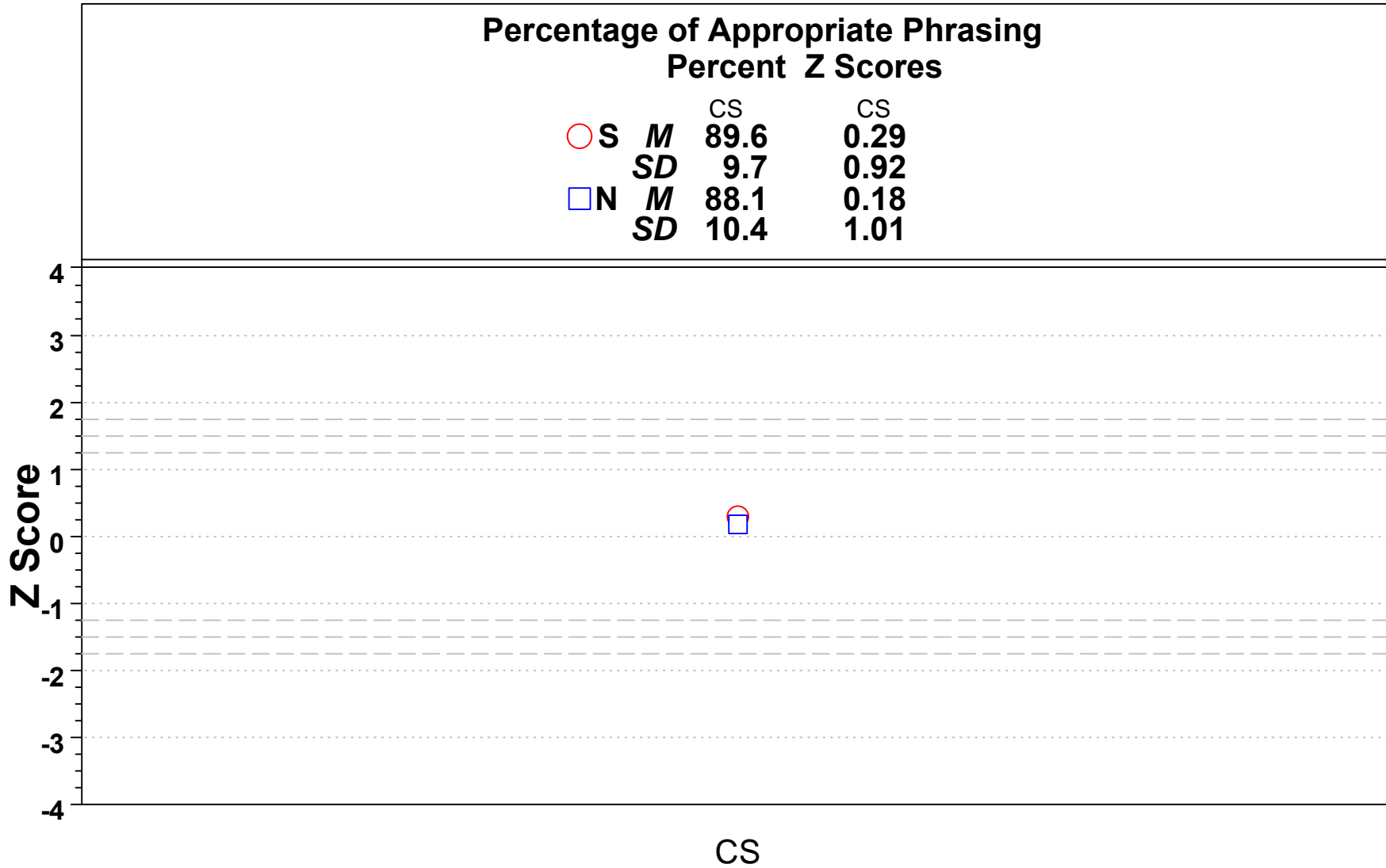


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>a</sup>no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2

## **PHRASING PROFILES**

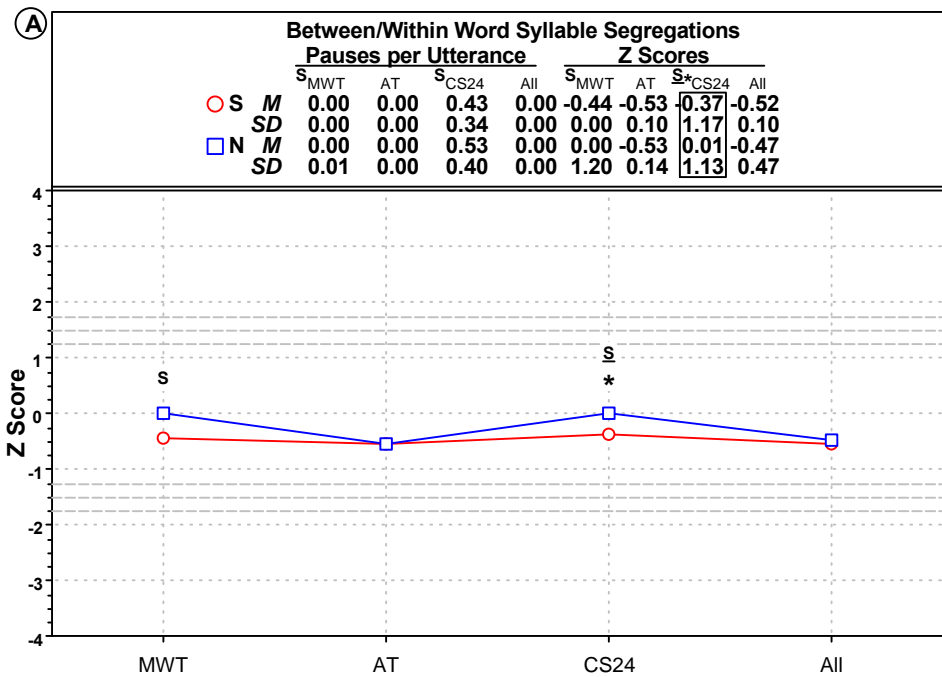
**Percentage of Appropriate Phrasing  
Percent Z Scores**

			CS	CS
○	<b>S</b>	<i>M</i>	<b>89.6</b>	<b>0.29</b>
		<i>SD</i>	<b>9.7</b>	<b>0.92</b>
□	<b>N</b>	<i>M</i>	<b>88.1</b>	<b>0.18</b>
		<i>SD</i>	<b>10.4</b>	<b>1.01</b>

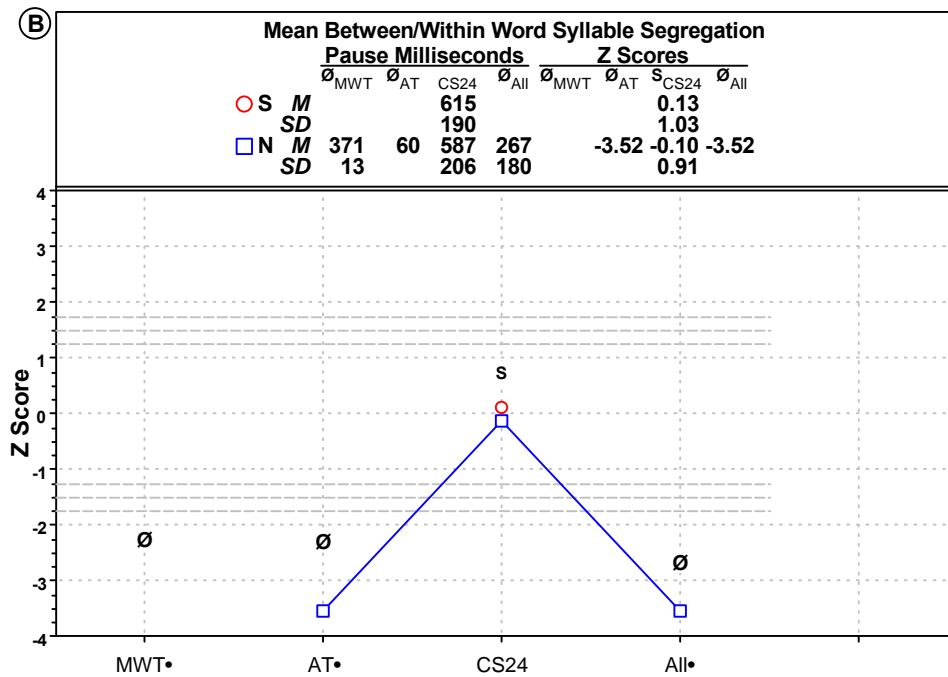


Phrasing Profile 1, S and N

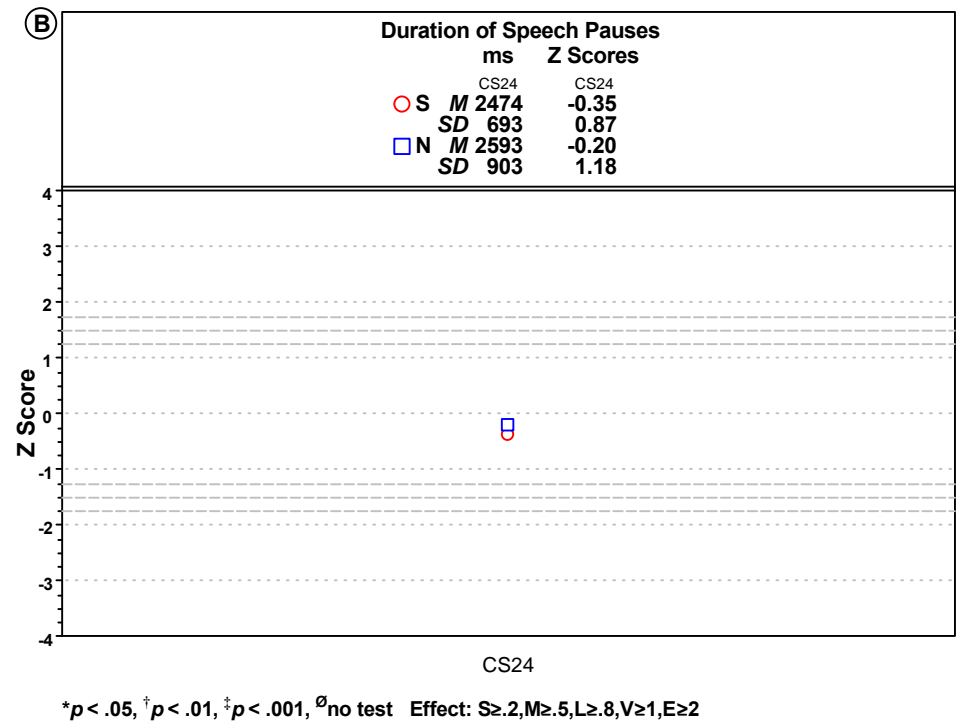
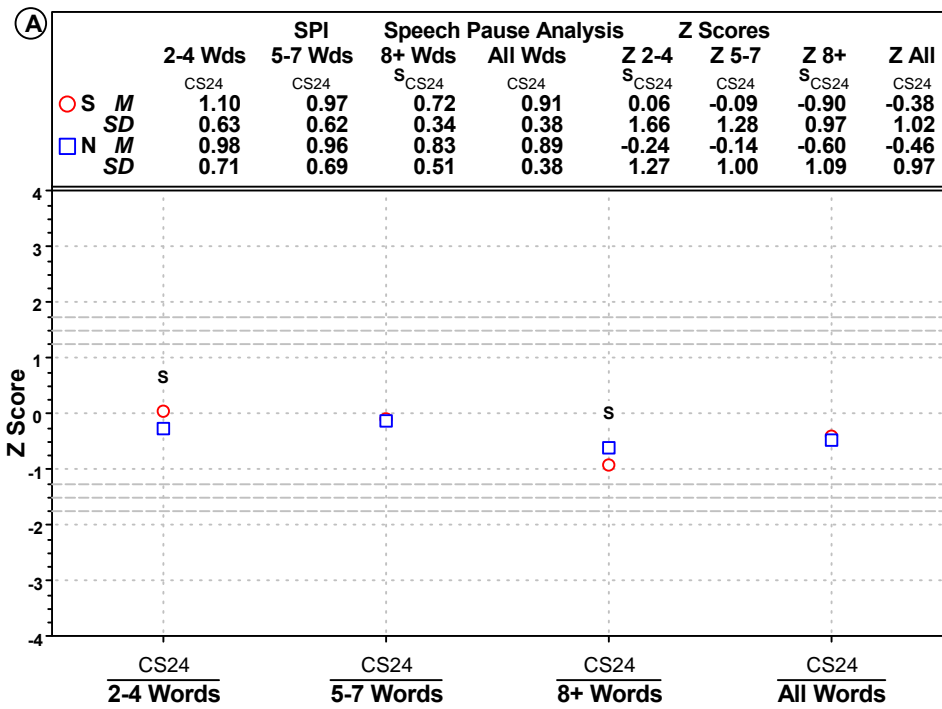
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅ no test    Effect:  $S \geq .2, M \geq .5, L \geq .8, V \geq 1, E \geq 2$



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

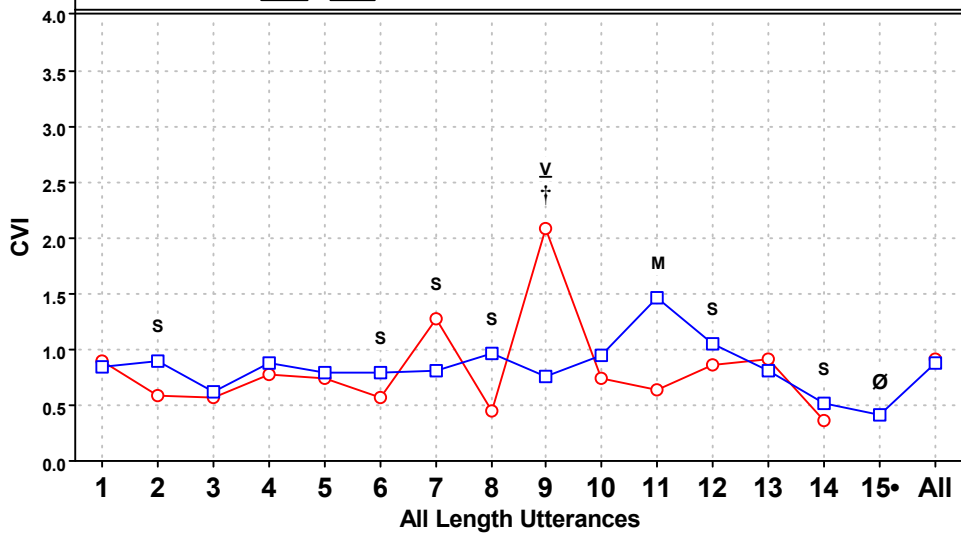


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2 •=insufficient data



**(A) Phrasing Analysis: All Utts. Source: CS24**

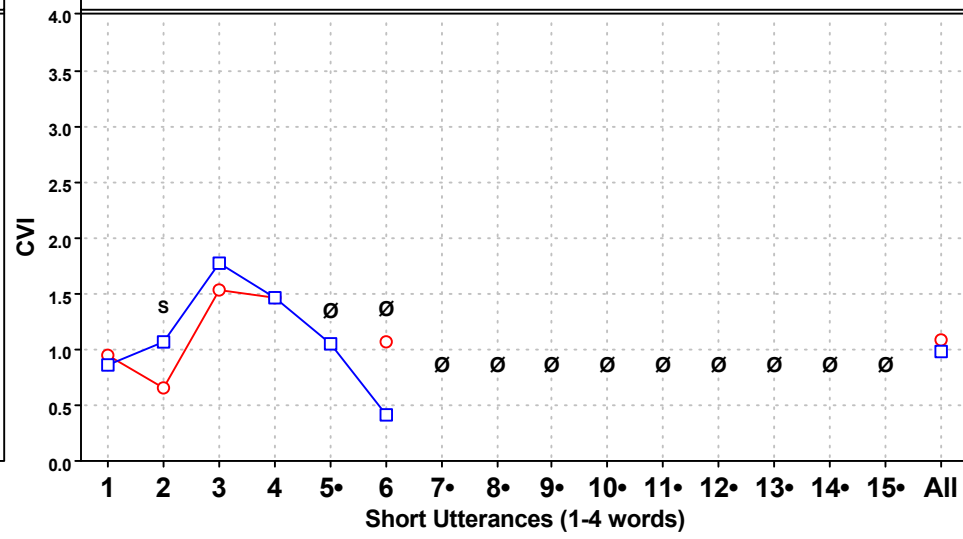
	No. Utts	Events		Percent		Duration		CV		CVI
		Pause	Speech	Pause	Speech	Pause	Speech	Pause	Speech	
○ S	6.62	1.39	2.39	24.77	75.23	830	2474	0.571	0.653	0.912
SD	3.89	0.36	0.36	5.69	5.69	261	693	0.220	0.165	0.381
□ N	7.35	1.53	2.53	24.97	75.03	904	2593	0.580	0.676	0.885
SD	3.75	0.47	0.47	7.22	7.22	421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



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

**(B) Phrasing Analysis: Short Utts. Source: CS24**

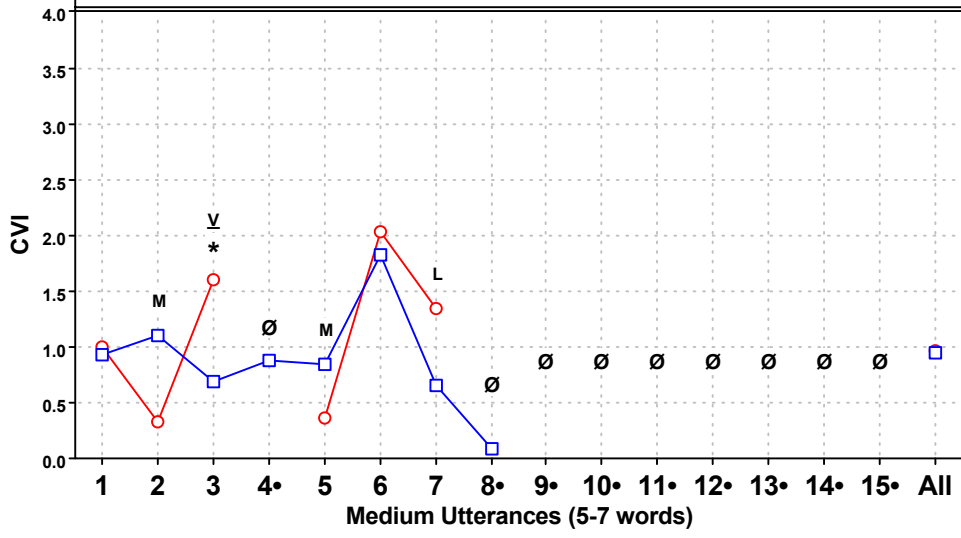
	No. Utts	Events		Percent		Duration		CV		CVI
		Pause	Speech	Pause	Speech	Pause	Speech	Pause	Speech	
○ S	2.08	1.12	2.12	30.28	69.72	720	1491	0.535	0.536	1.098
SD	1.84	0.27	0.27	9.68	9.68	464	351	0.291	0.192	0.632
□ N	1.82	1.10	2.10	30.18	69.82	664	1400	0.509	0.555	0.979
SD	1.70	0.25	0.25	11.43	11.43	448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



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

**(C) Phrasing Analysis: Medium Utts. Source: CS24**

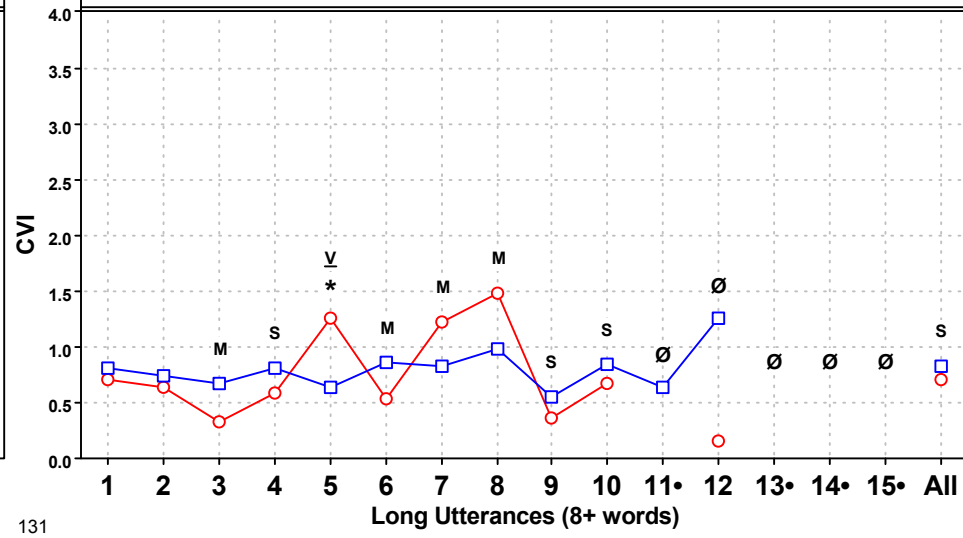
	No. Utts	Events		Percent		Duration		CV		CVI
		Pause	Speech	Pause	Speech	Pause	Speech	Pause	Speech	
○ S	2.32	1.34	2.34	23.75	76.25	841	2432	0.476	0.553	0.968
SD	1.98	0.48	0.48	7.89	7.89	439	436	0.245	0.221	0.621
□ N	2.60	1.36	2.36	24.89	75.11	836	2176	0.507	0.581	0.955
SD	1.94	0.53	0.53	9.89	9.89	601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



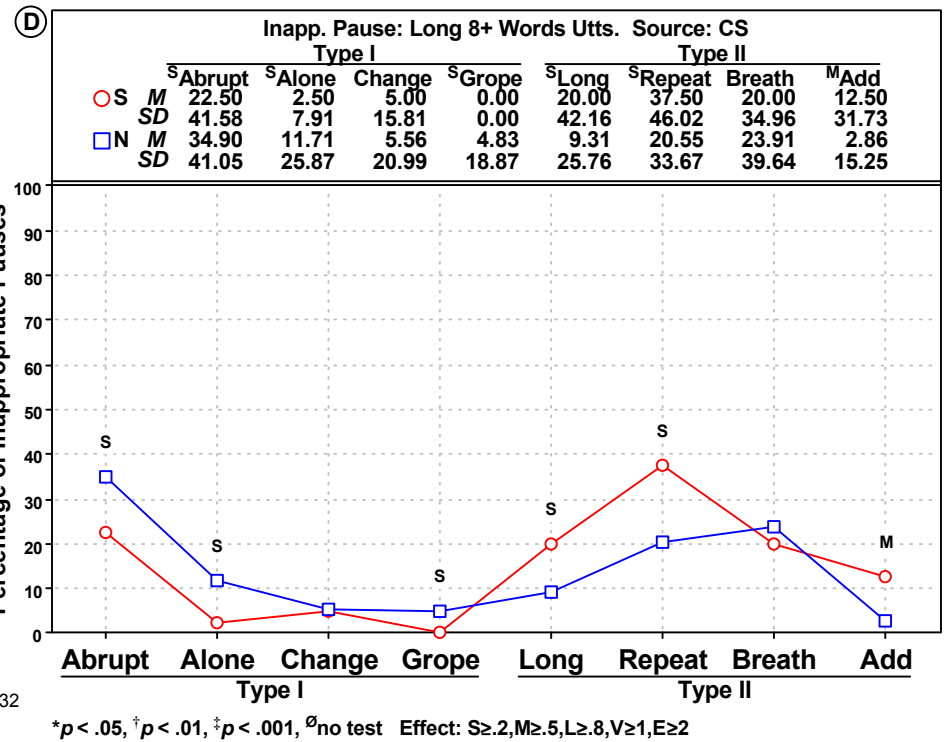
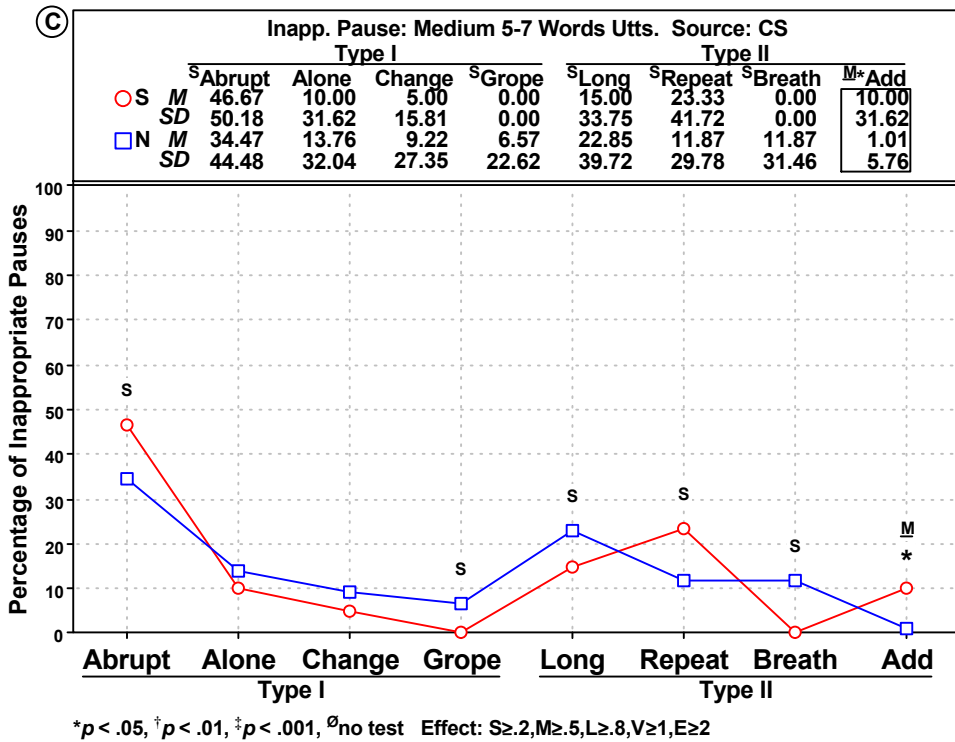
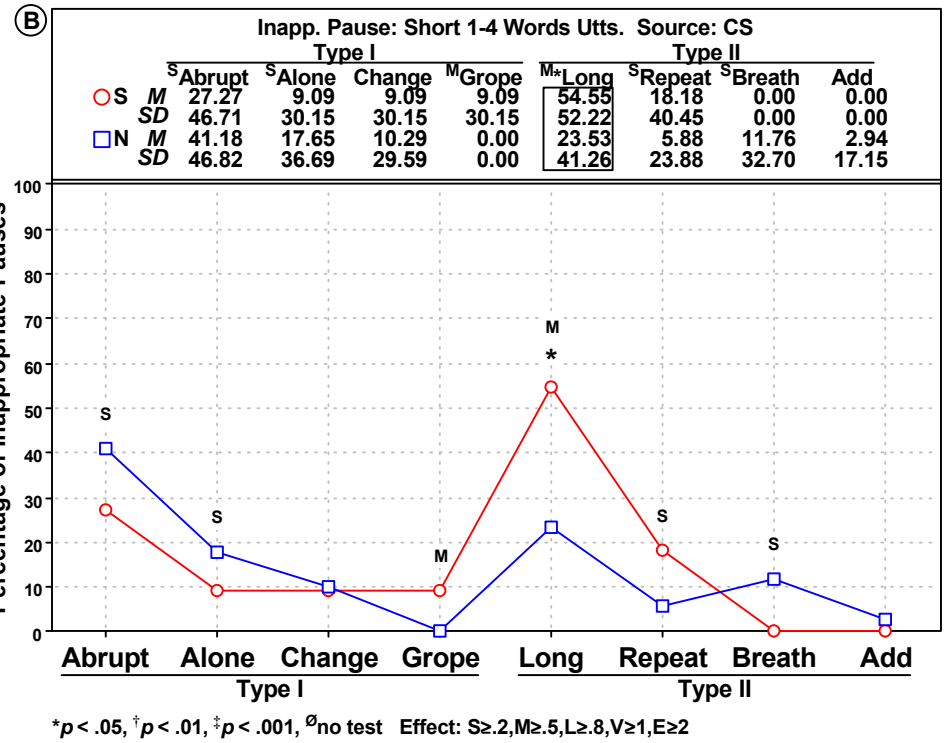
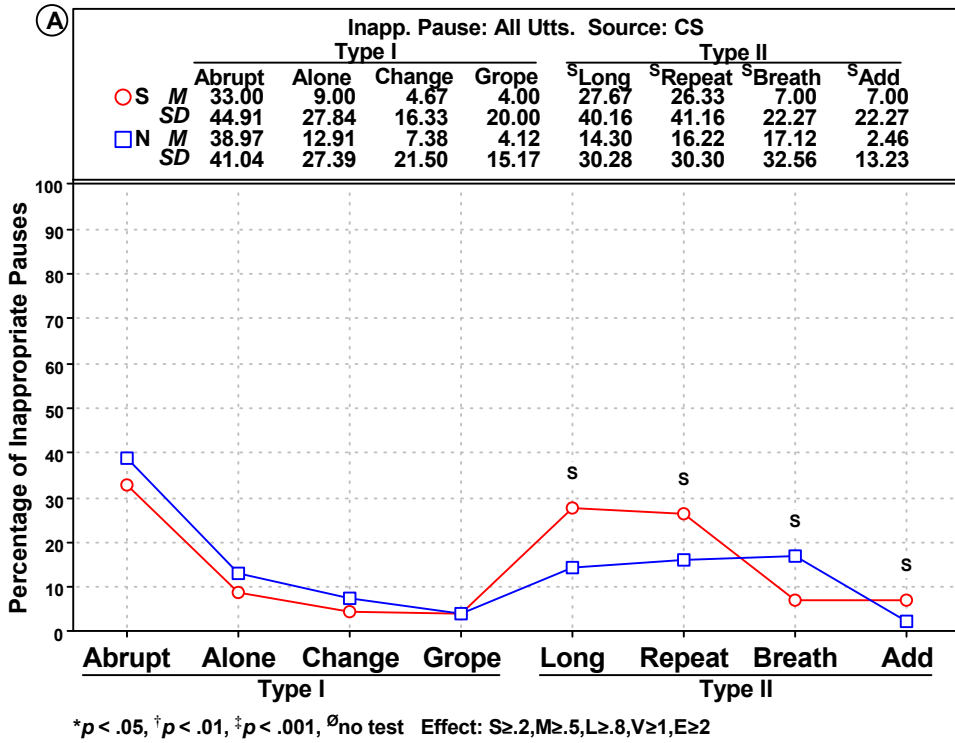
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>∅</sup>no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2 •=insufficient data

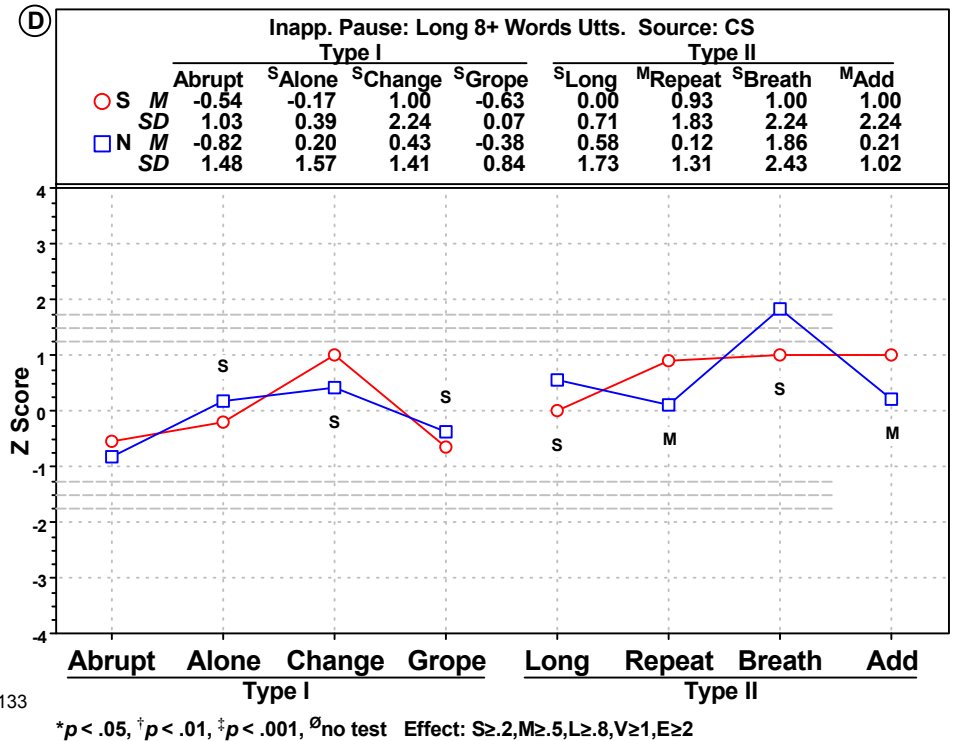
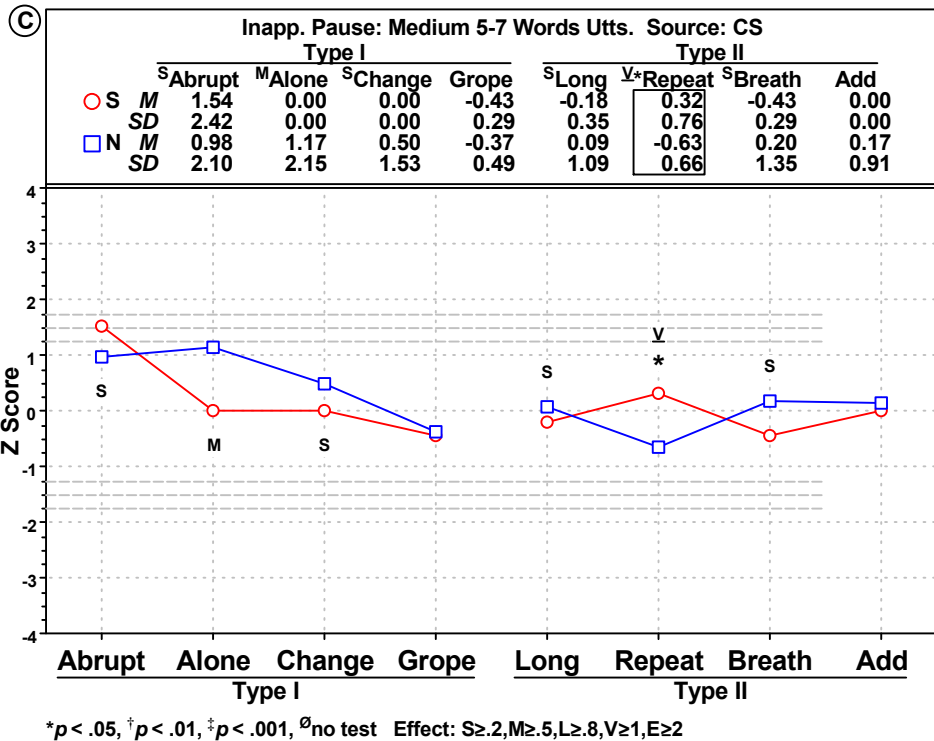
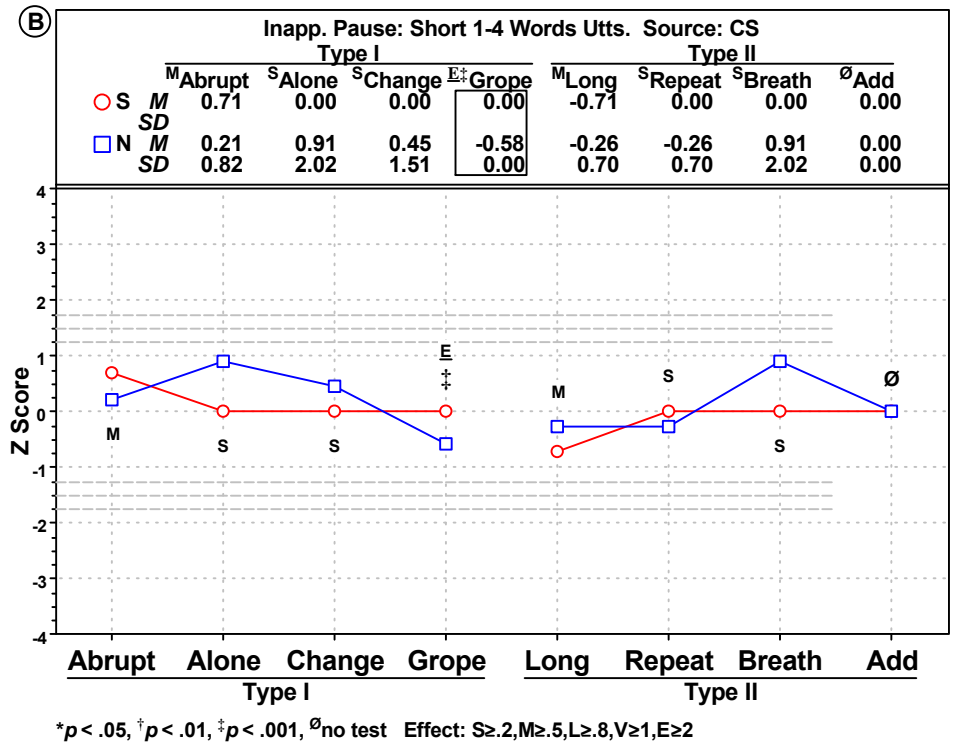
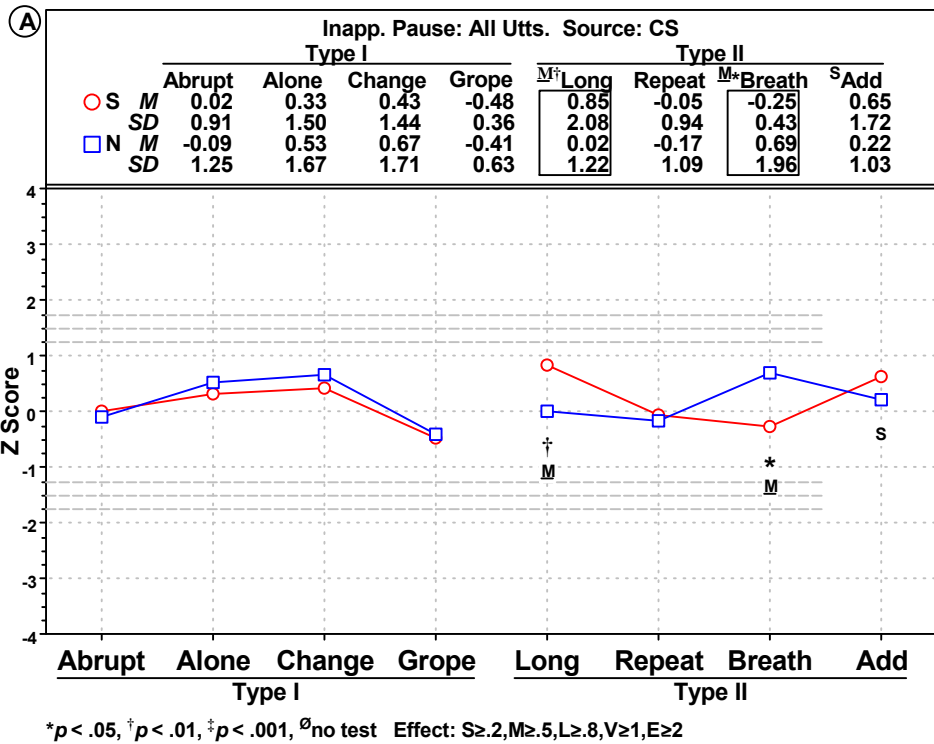
**(D) Phrasing Analysis: Long Utts. Source: CS24**

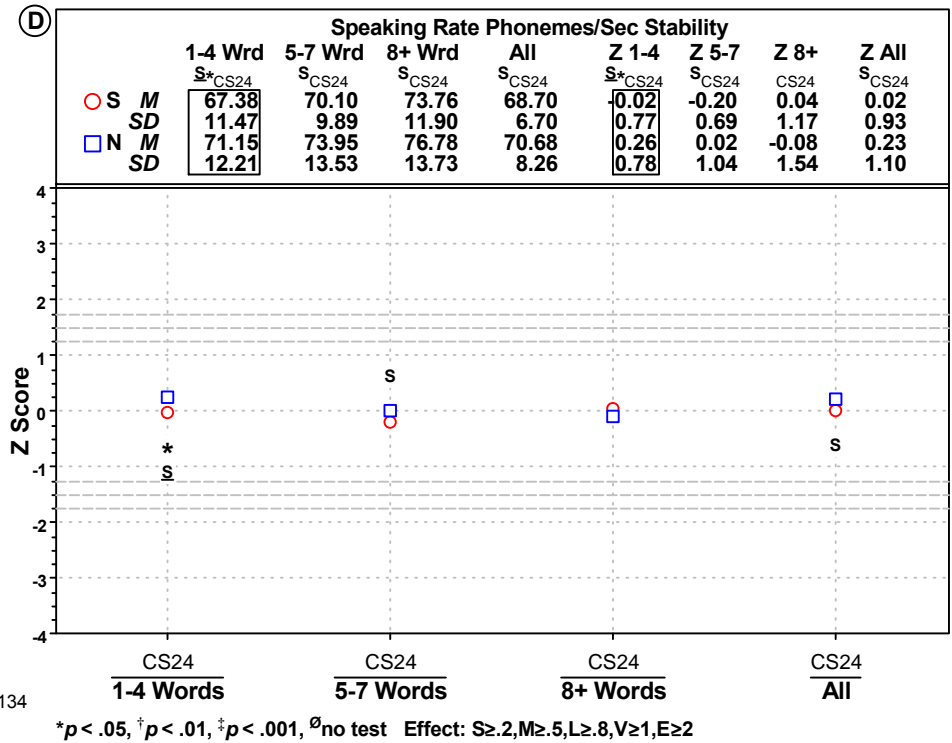
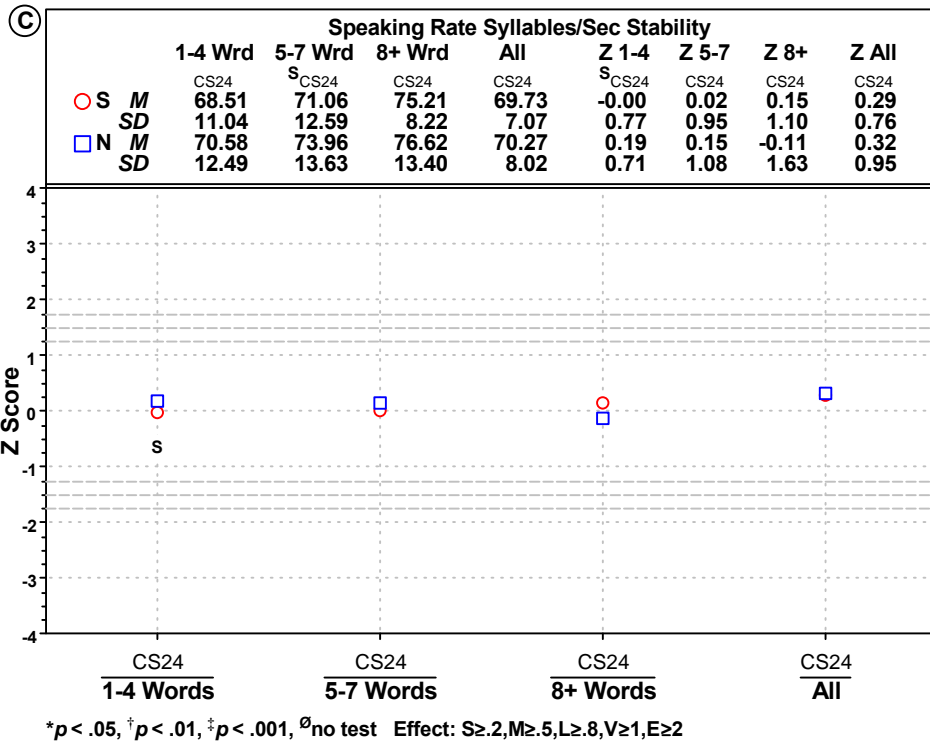
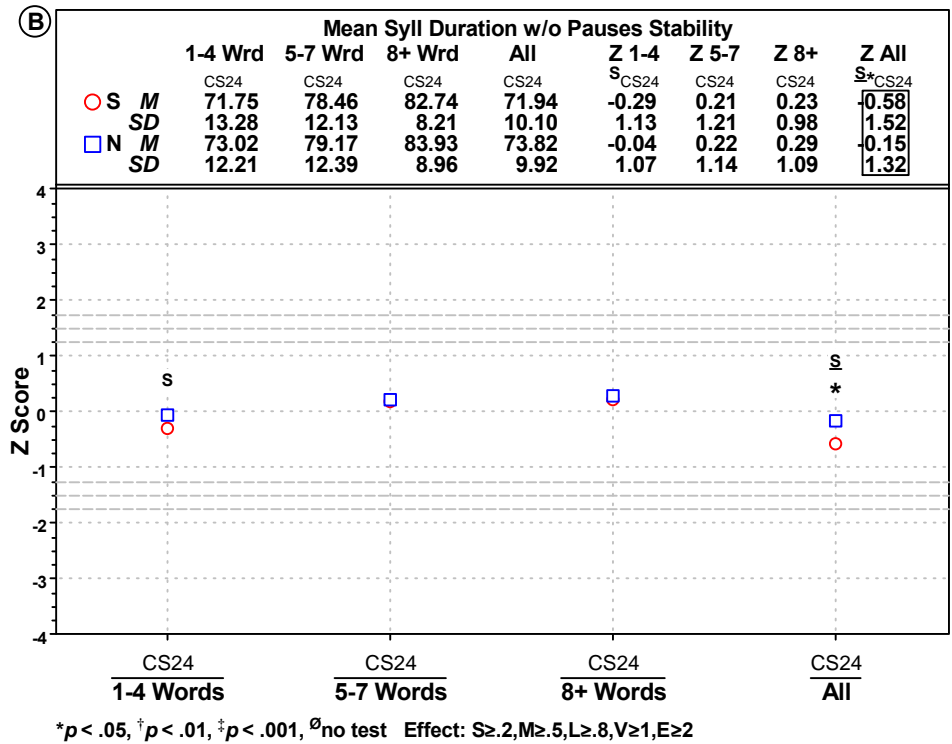
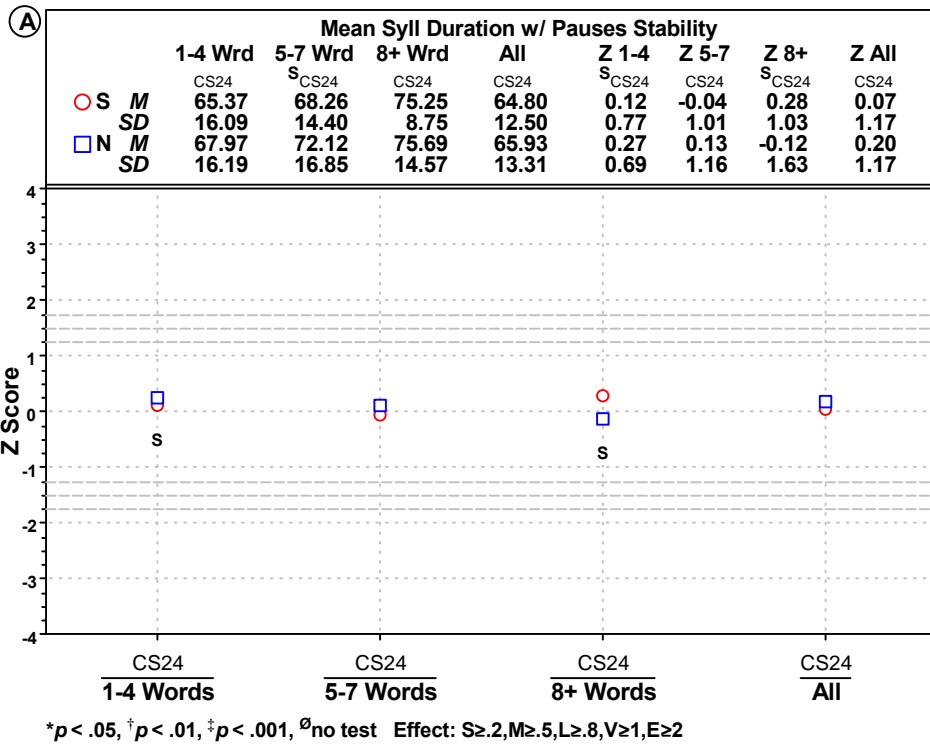
	No. Utts	Events		Percent		Duration		CV		CVI
		Pause	Speech	Pause	Speech	Pause	Speech	Pause	Speech	
○ S	2.22	1.83	2.83	22.07	77.93	1071	3639	0.482	0.682	0.717
SD	2.80	0.53	0.53	7.78	7.78	480	742	0.207	0.228	0.341
□ N	2.93	3.07	3.07	22.14	77.86	1201	3727	0.514	0.665	0.833
SD	2.72	0.98	0.98	9.16	9.16	854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



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



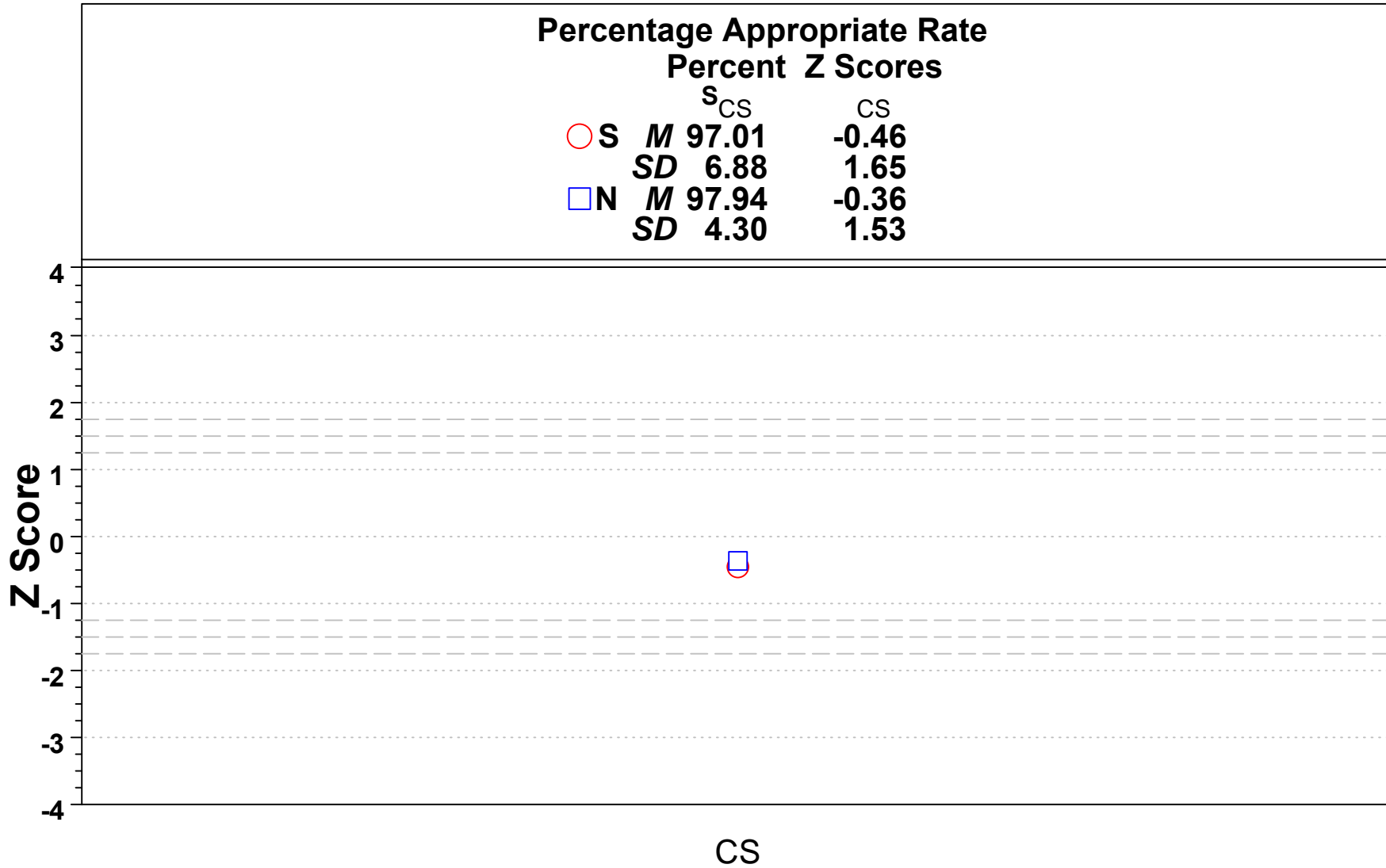




## **RATE PROFILES**

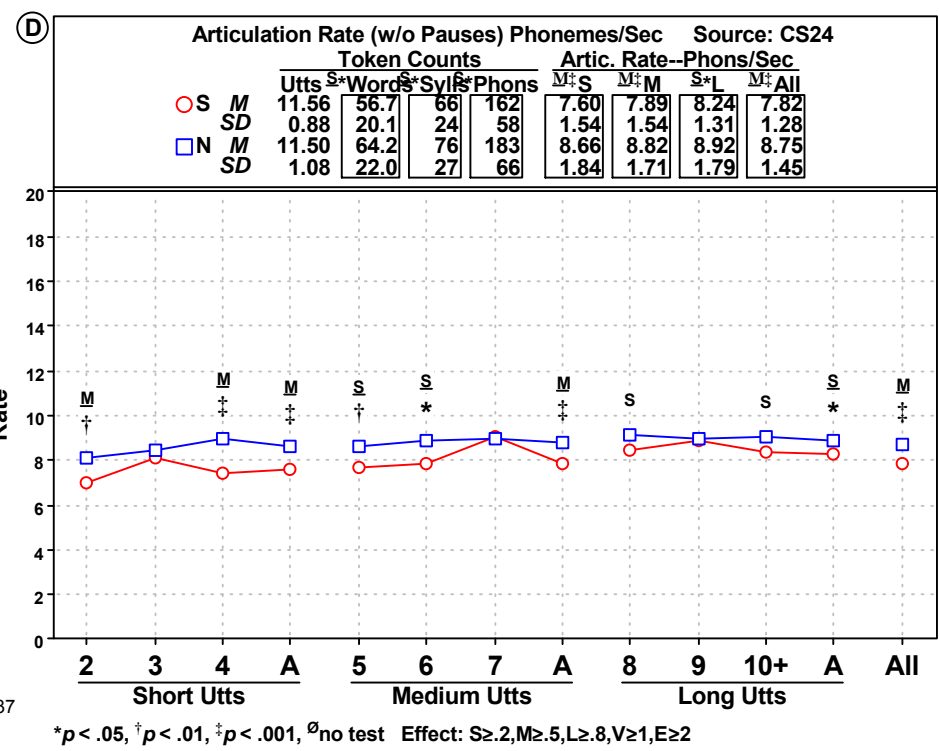
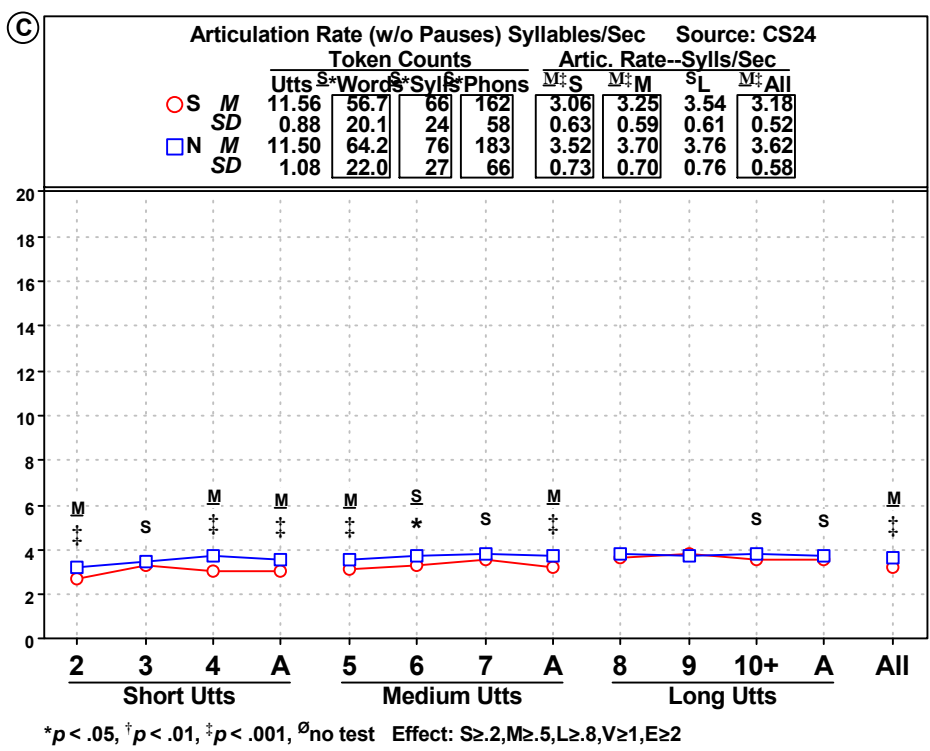
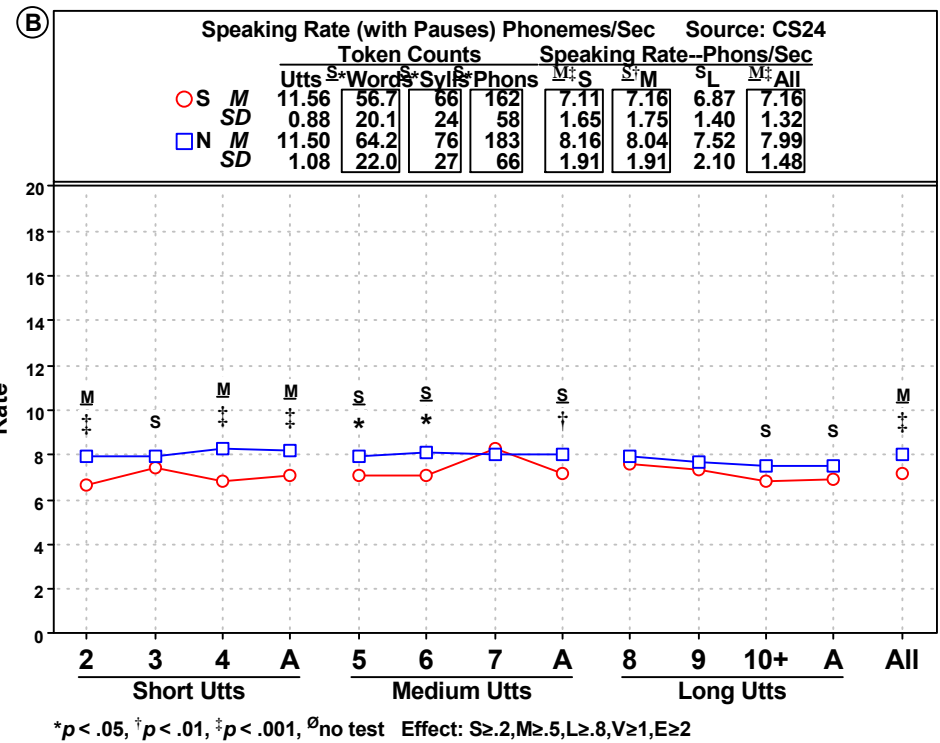
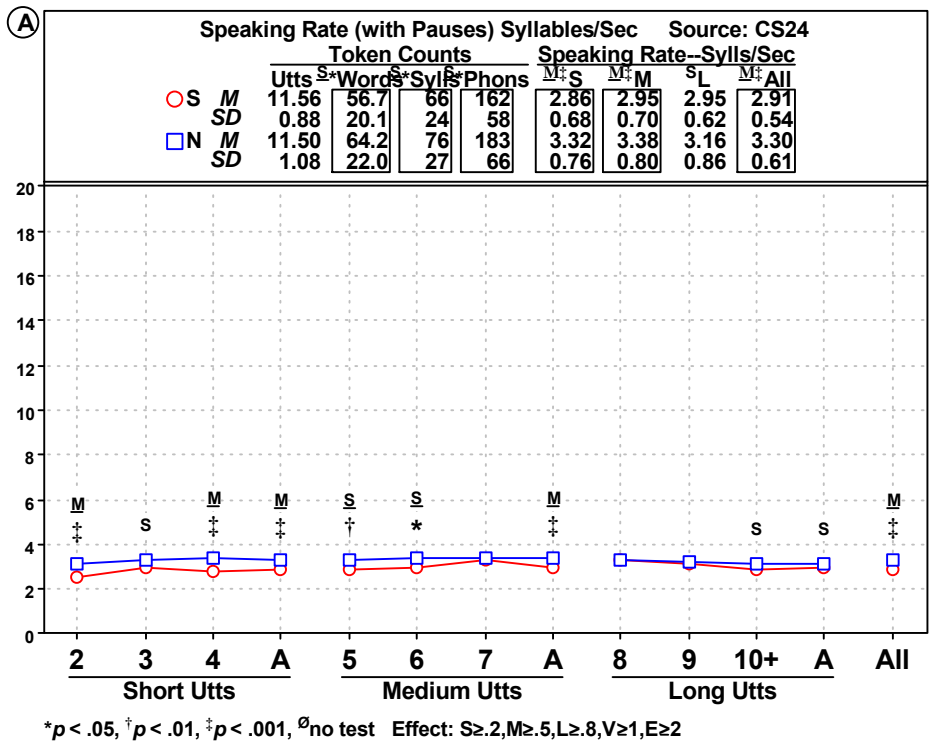
**Percentage Appropriate Rate  
Percent Z Scores**

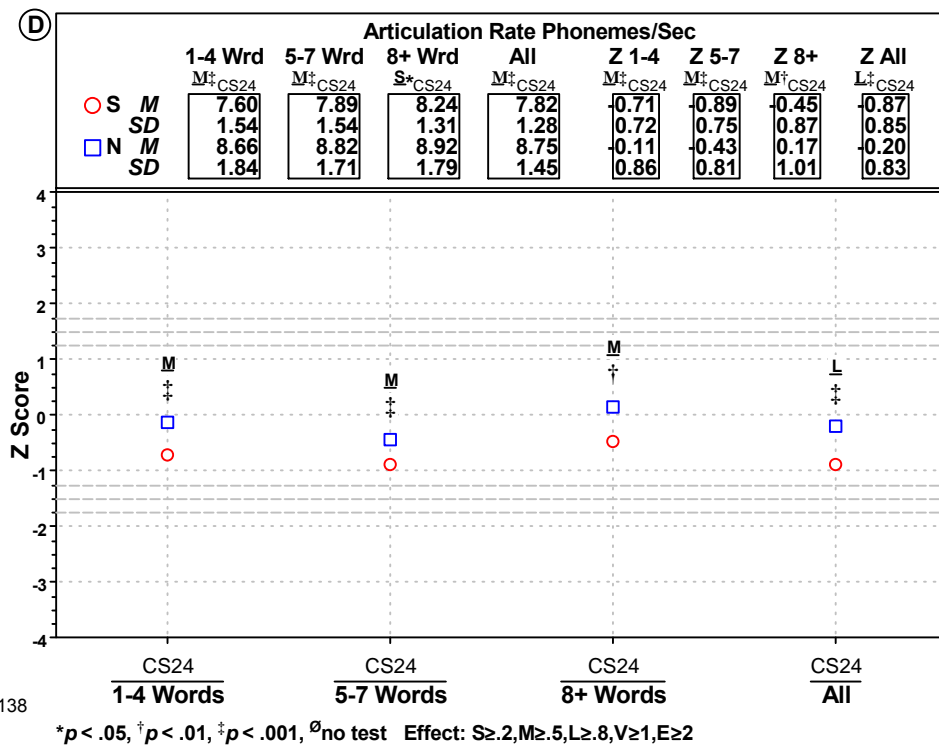
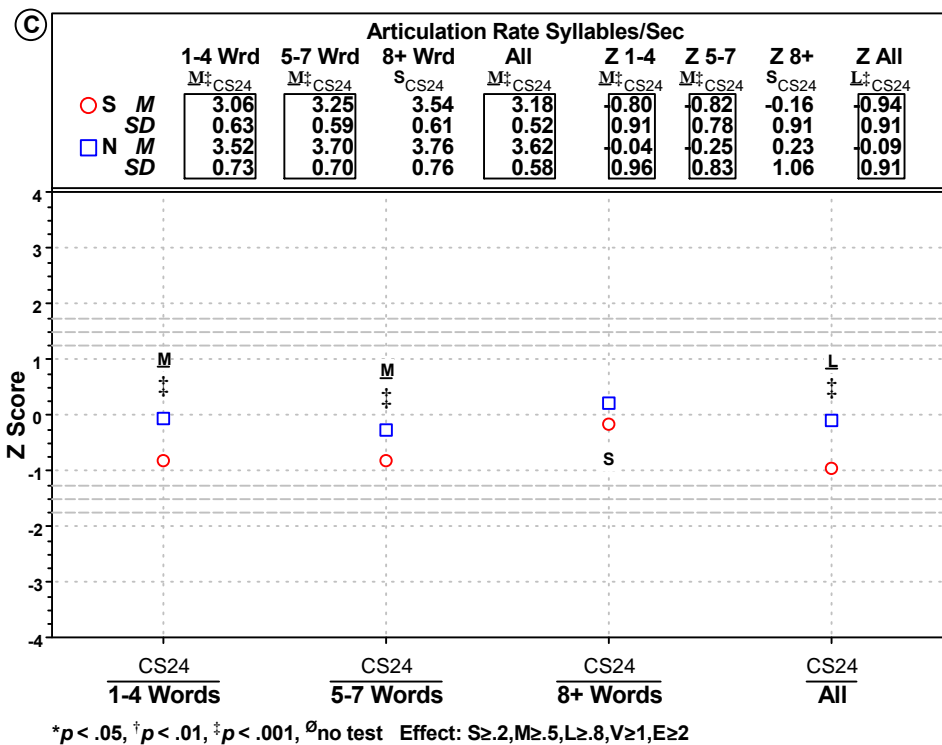
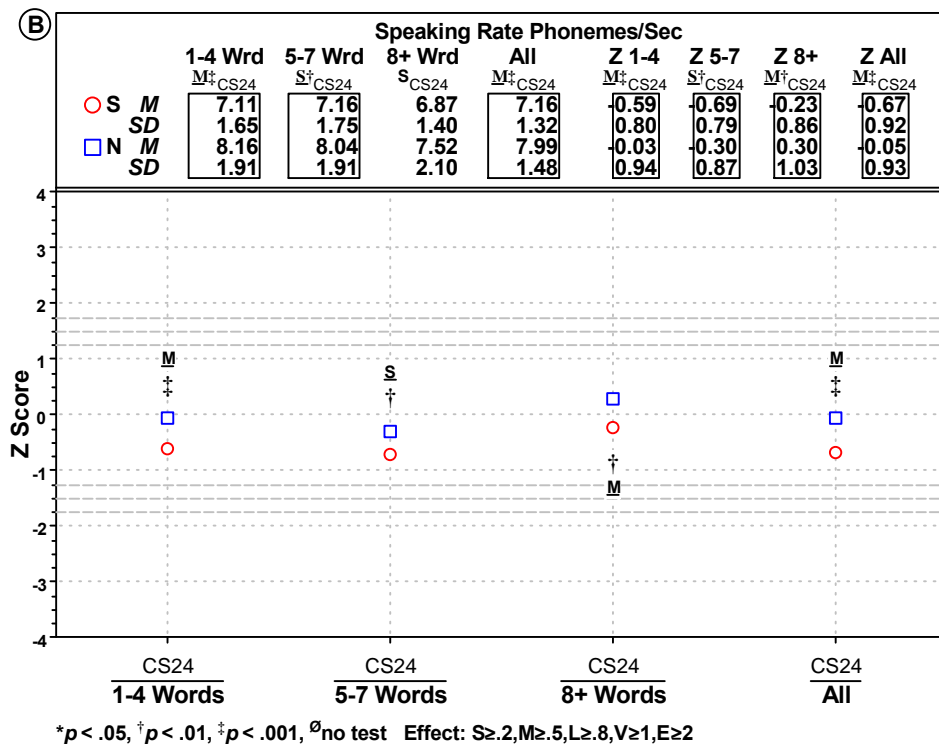
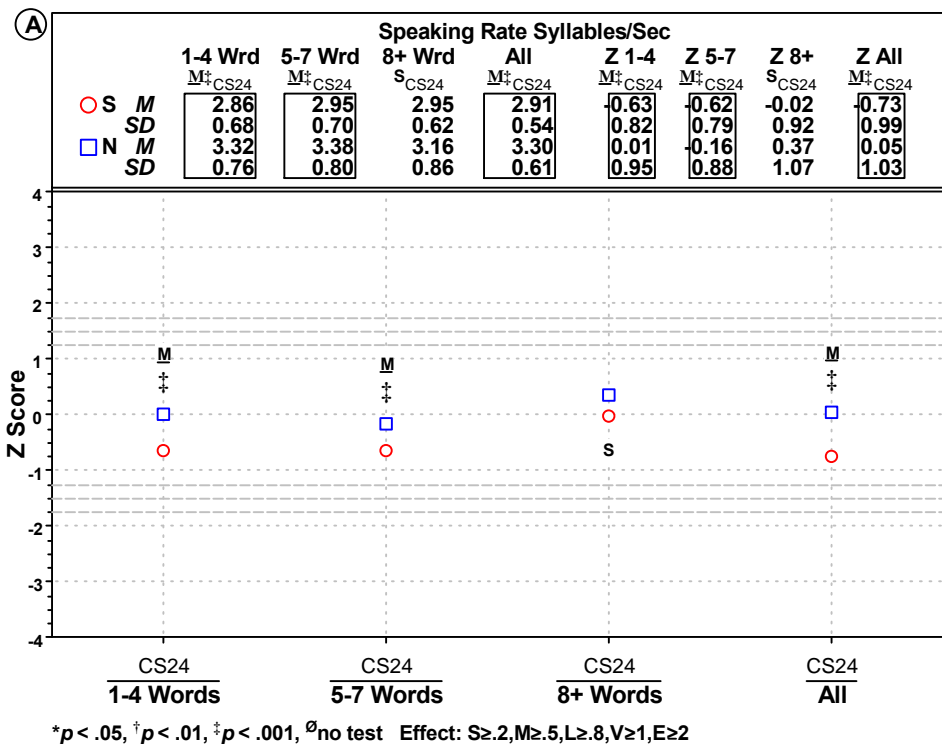
	$S_{CS}$	CS
○ S	M 97.01	-0.46
	SD 6.88	1.65
□ N	M 97.94	-0.36
	SD 4.30	1.53

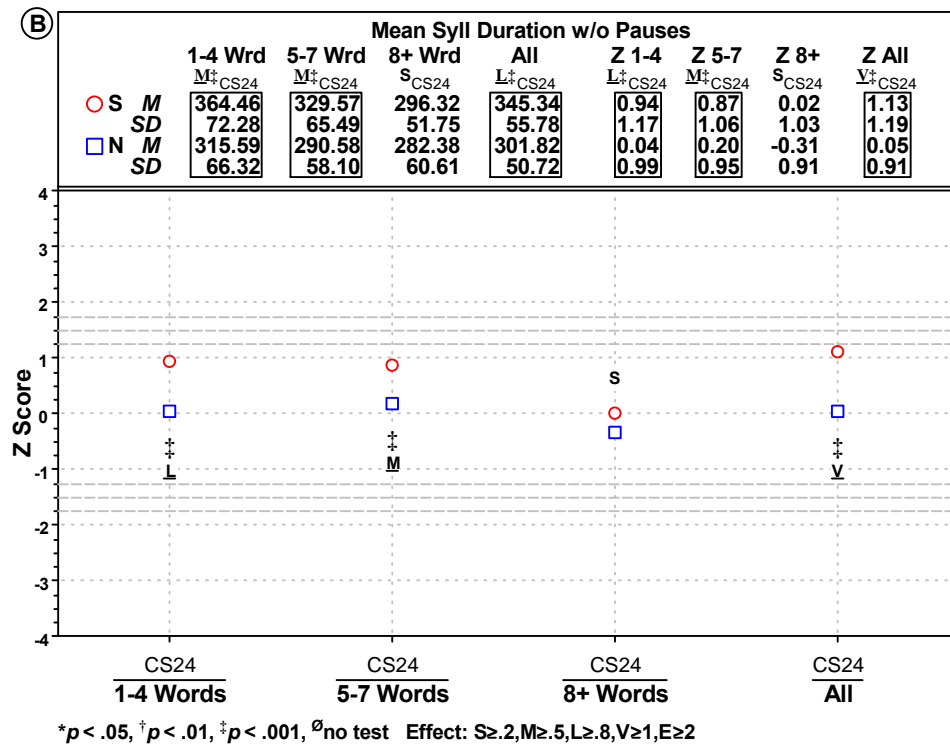
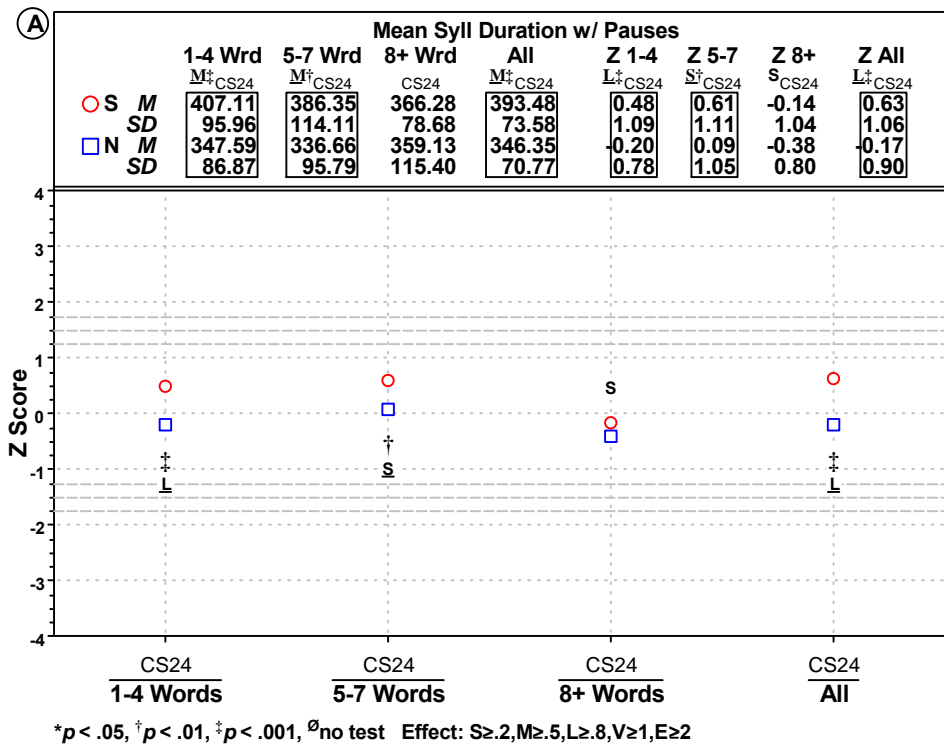


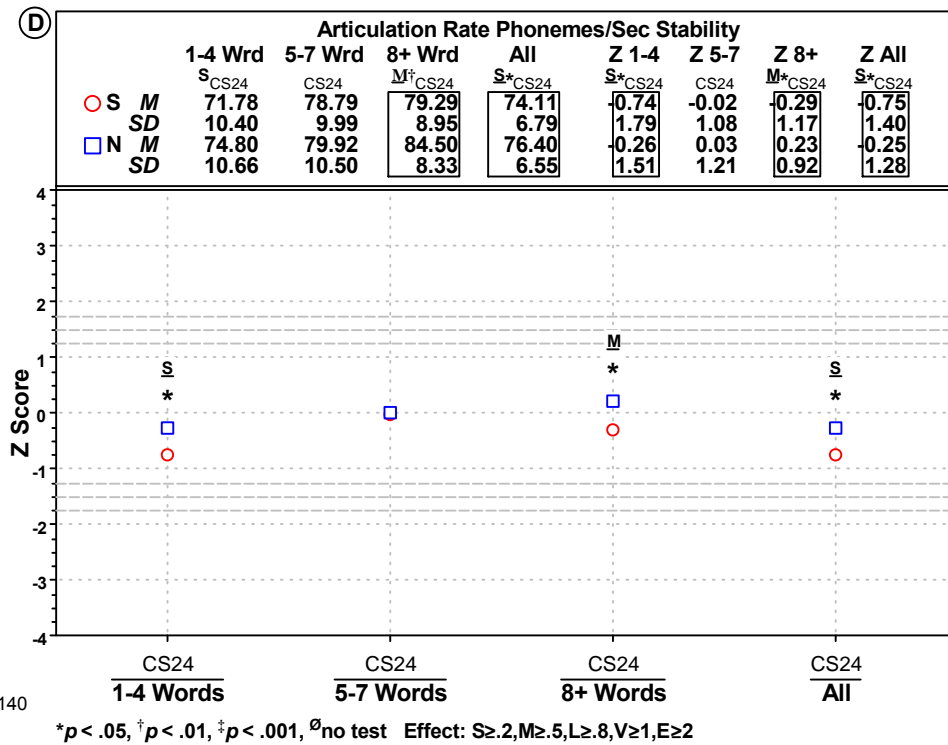
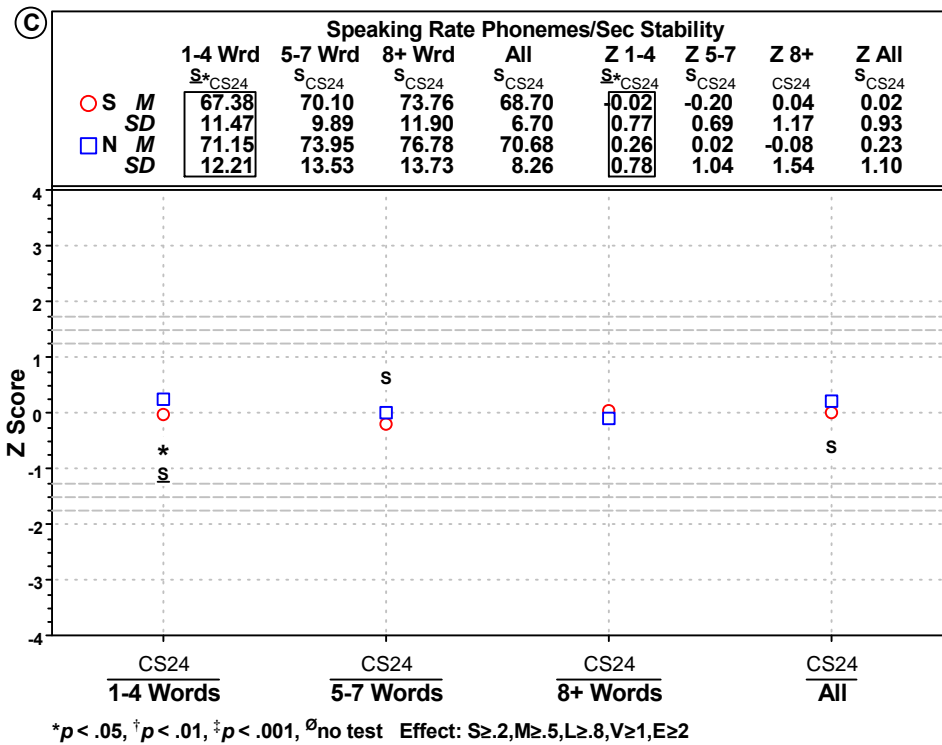
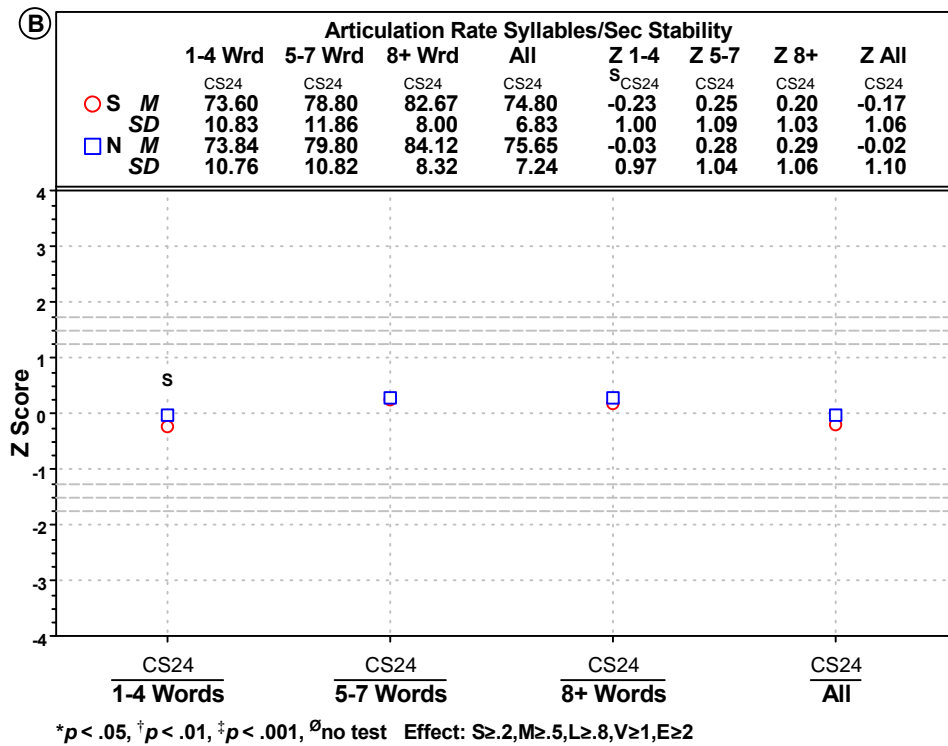
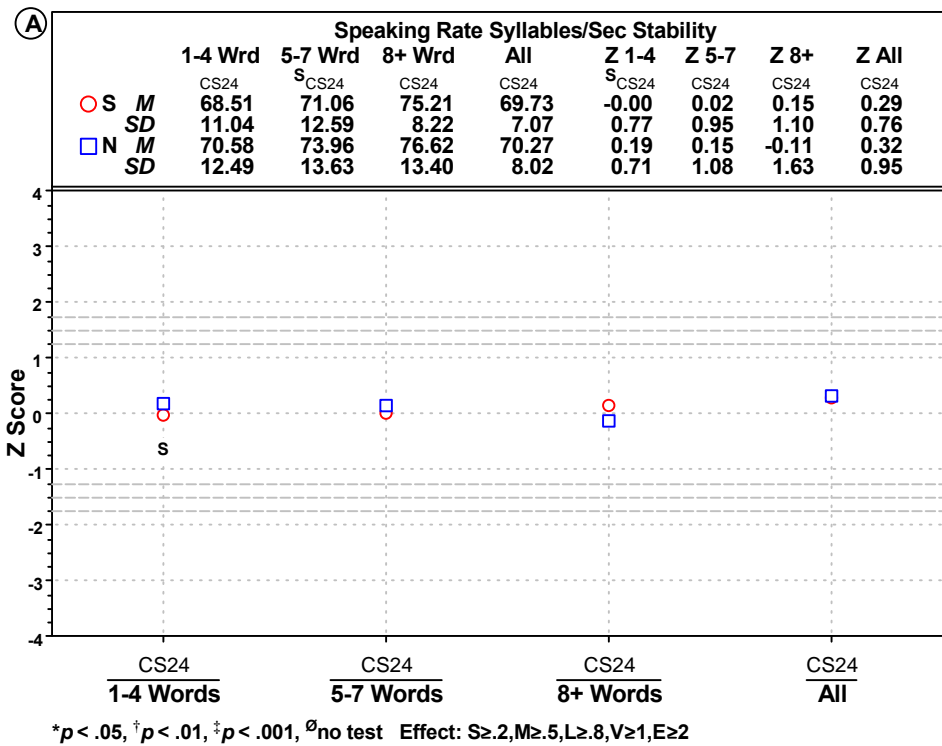
Rate Profile 1, S and N

\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅ no test Effect:  $S \geq .2, M \geq .5, L \geq .8, V \geq 1, E \geq 2$

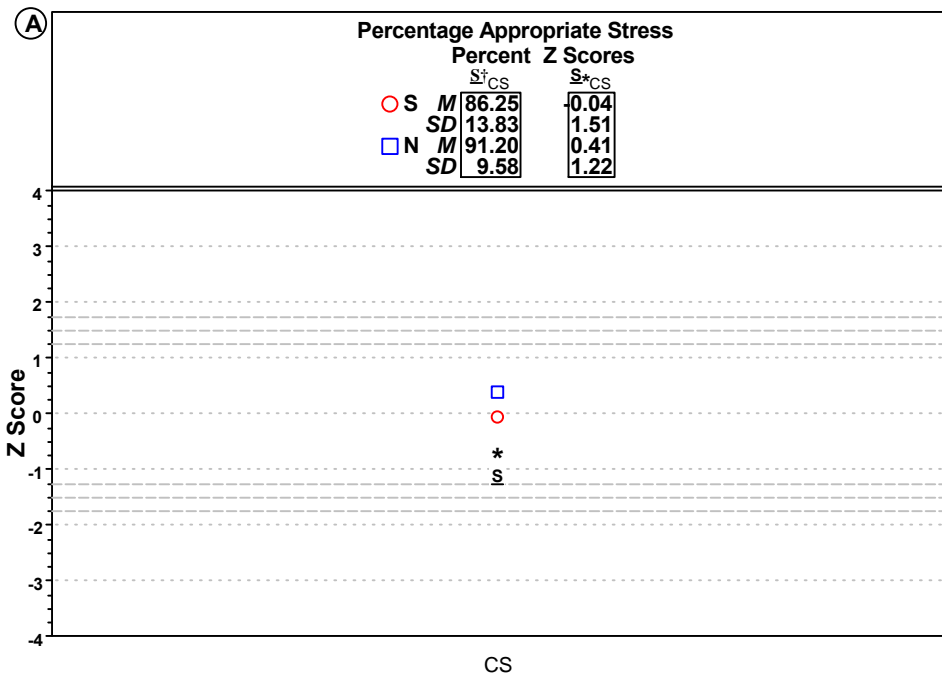




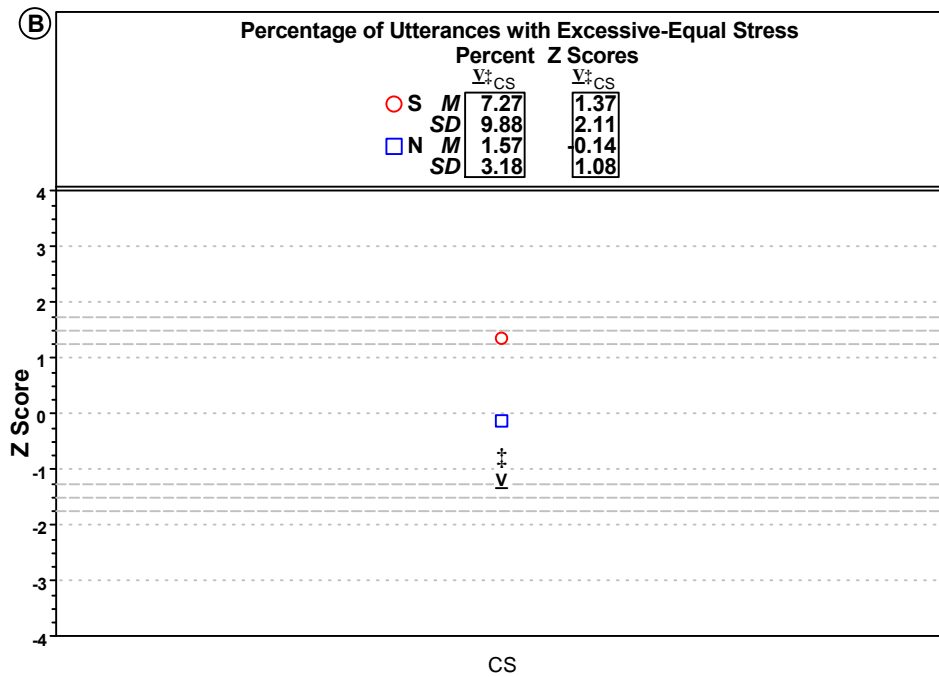




## **STRESS PROFILES**



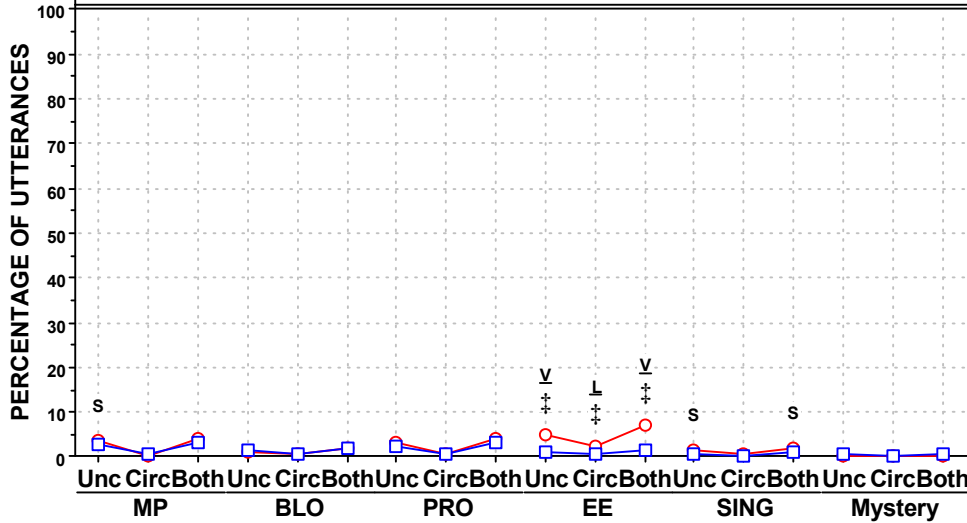
\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\emptyset}$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



\* $p < .05$ ,  $^{\dagger}p < .01$ ,  $^{\ddagger}p < .001$ ,  $^{\emptyset}$ no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

**(A) PV15/16 CODE PERCENTAGES OF CODED, NOT ACCEL UTTERANCES** Source: CS

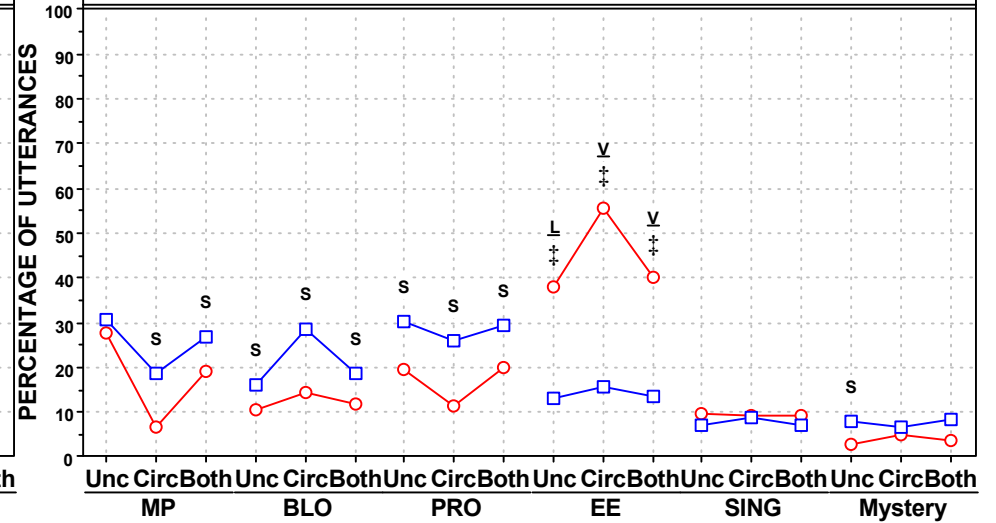
		MP		BLO		PRO		EE		SING		Mystery	
		Unc	Both	Unc	Both	Unc	Both	Unc	Both	Unc	Both	Unc	Both
		<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>
○ S	M	3.8	4.0	1.1	1.8	3.2	3.9	5.1	7.3	1.3	2.0	0.2	0.4
	SD	6.5	6.6	2.7	4.1	6.2	6.5	8.5	9.9	3.4	4.9	0.8	1.5
□ N	M	2.7	3.2	1.4	2.0	2.4	3.1	1.1	1.6	0.7	1.0	0.7	0.8
	SD	4.7	5.1	3.2	3.8	4.2	4.9	2.7	3.2	2.8	3.6	4.0	4.1



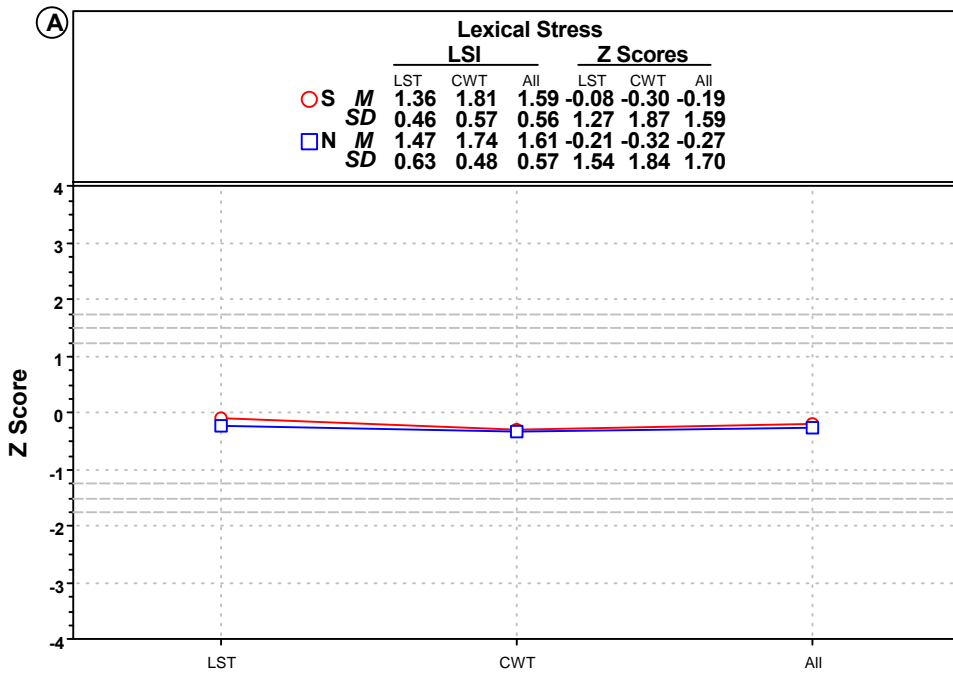
\* $p < .05$ , <sup>†</sup> $p < .01$ , <sup>‡</sup> $p < .001$ , <sup>§</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

**(B) PV15/16 CODE PERCENTAGES OF PV15/16 UTTERANCES** Source: CS

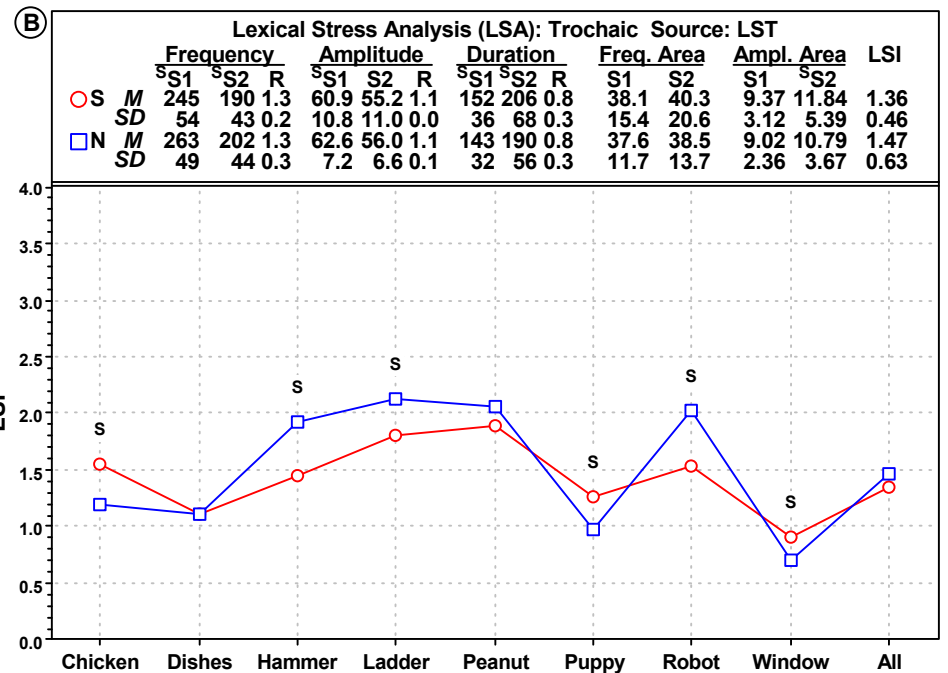
		MP		BLO		PRO		EE		SING		Mystery	
		Unc	Both	Unc	Both	Unc	Both	Unc	Both	Unc	Both	Unc	Both
		<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>	<sup>s</sup>
○ S	M	27.8	19.1	10.5	11.7	19.4	20.1	38.0	40.2	9.5	9.2	2.8	3.8
	SD	35.4	25.9	25.7	24.7	29.4	29.8	37.7	36.8	23.6	21.3	15.9	16.7
□ N	M	30.7	26.9	16.3	18.8	30.0	29.4	13.3	13.7	7.1	7.0	8.0	8.3
	SD	35.9	32.2	27.2	28.5	36.9	34.4	25.9	23.9	19.3	17.3	26.5	25.7



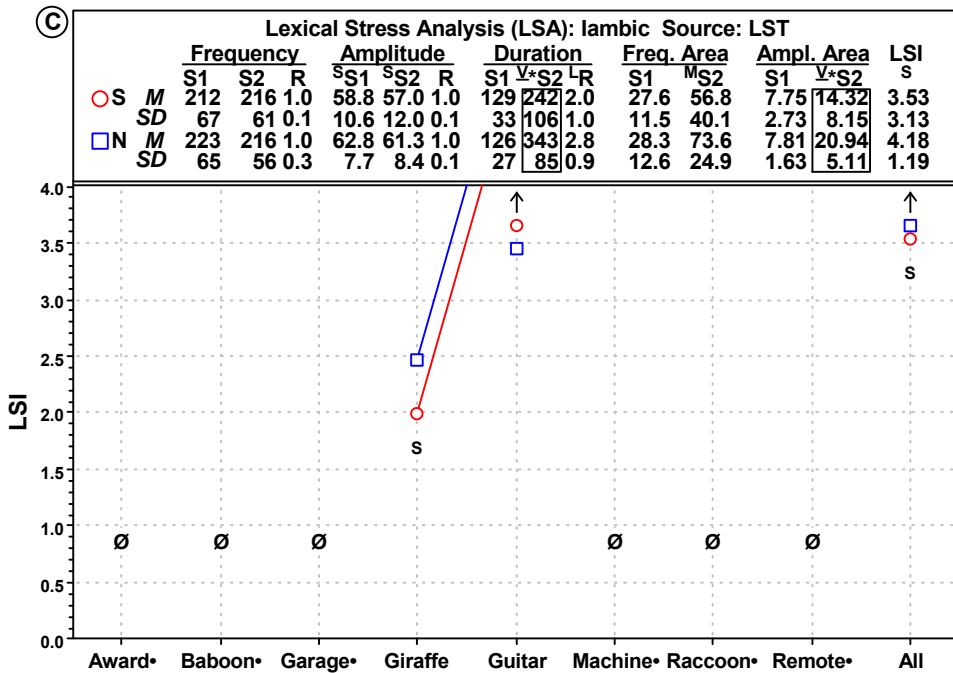
\* $p < .05$ , <sup>†</sup> $p < .01$ , <sup>‡</sup> $p < .001$ , <sup>§</sup>no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2



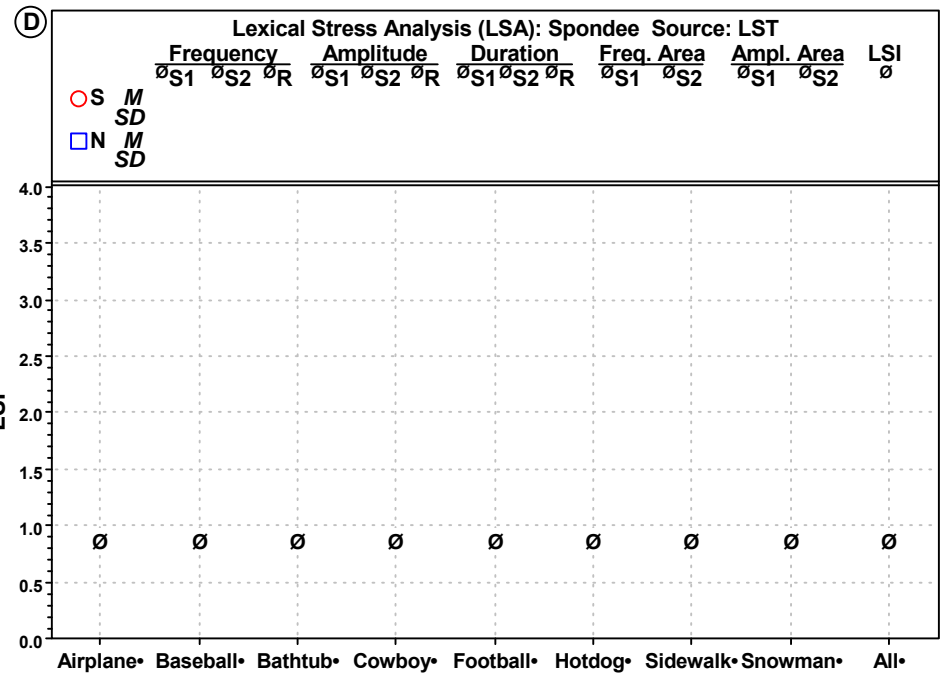
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



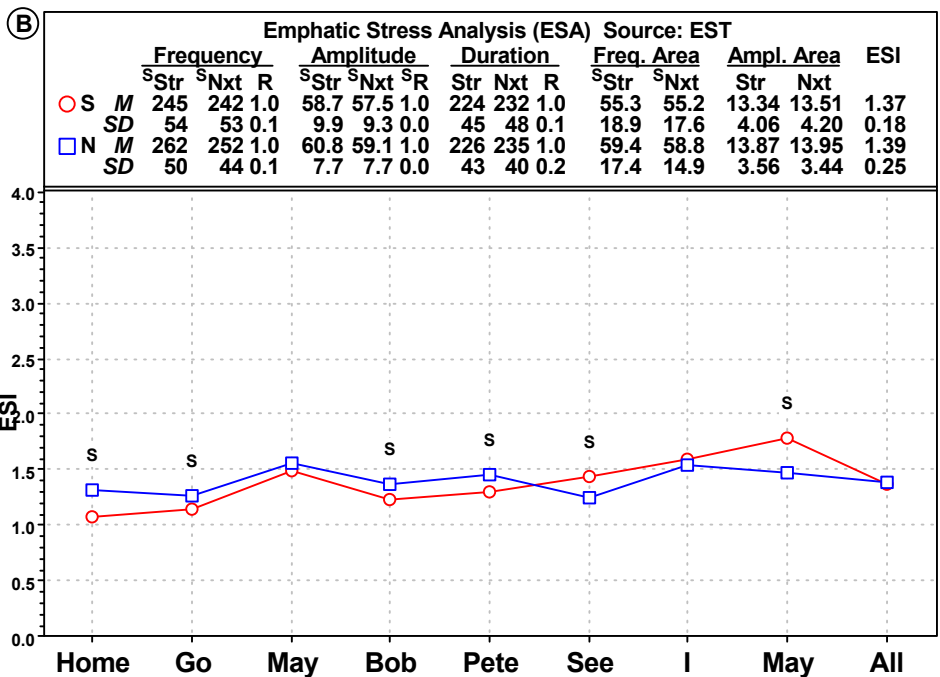
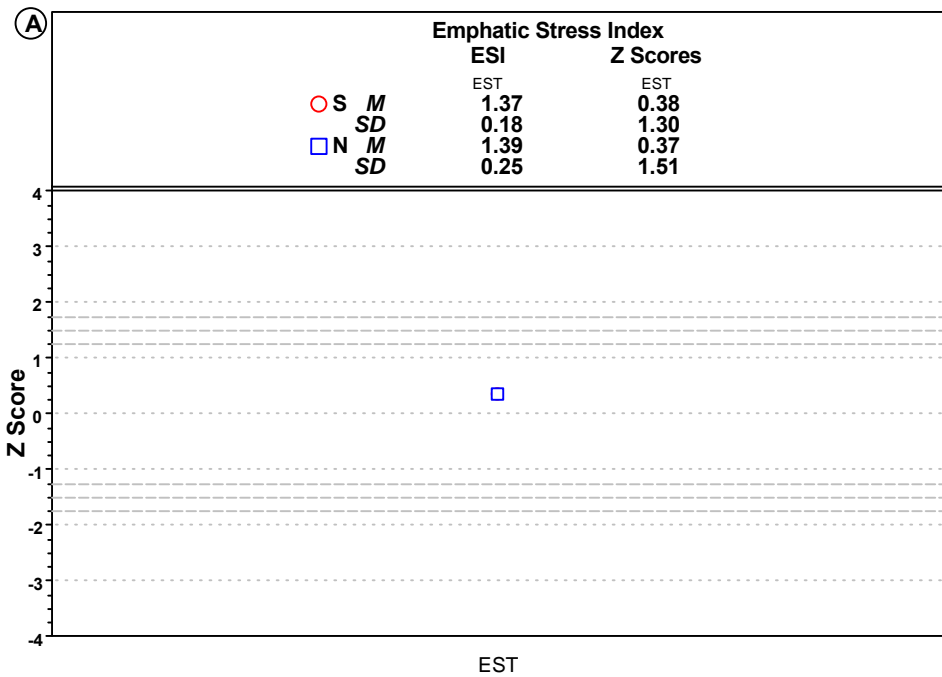
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$  ∅=insufficient data

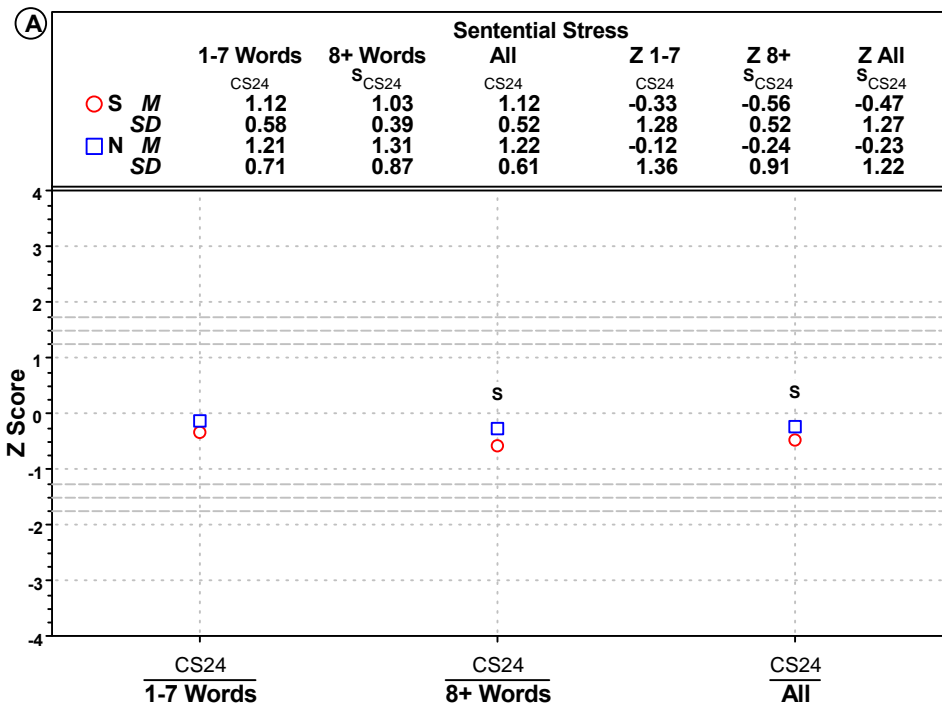


∅ = insufficient data

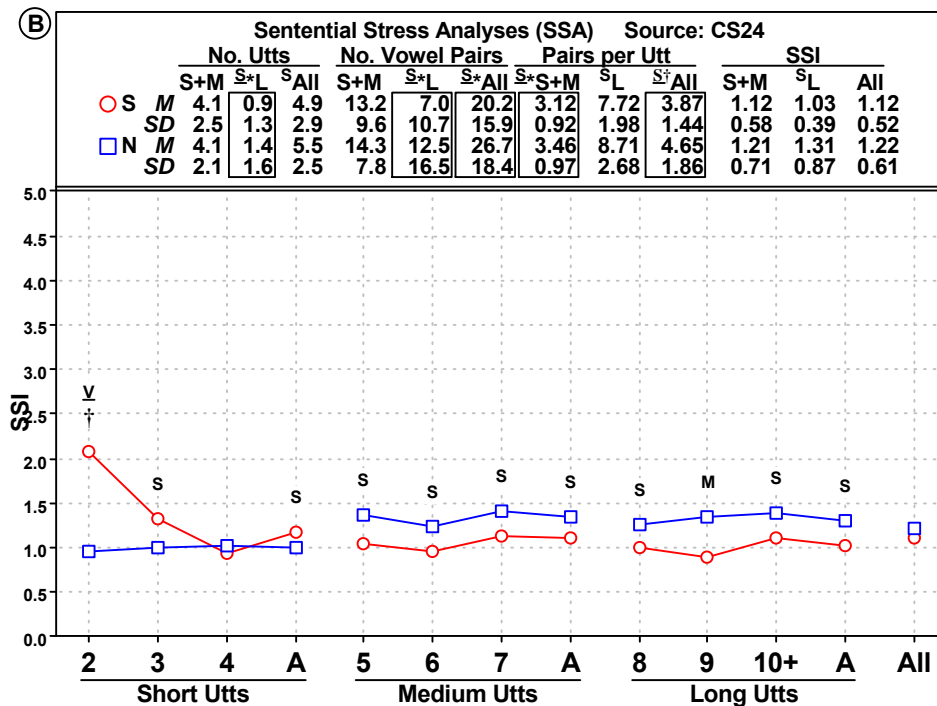


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2

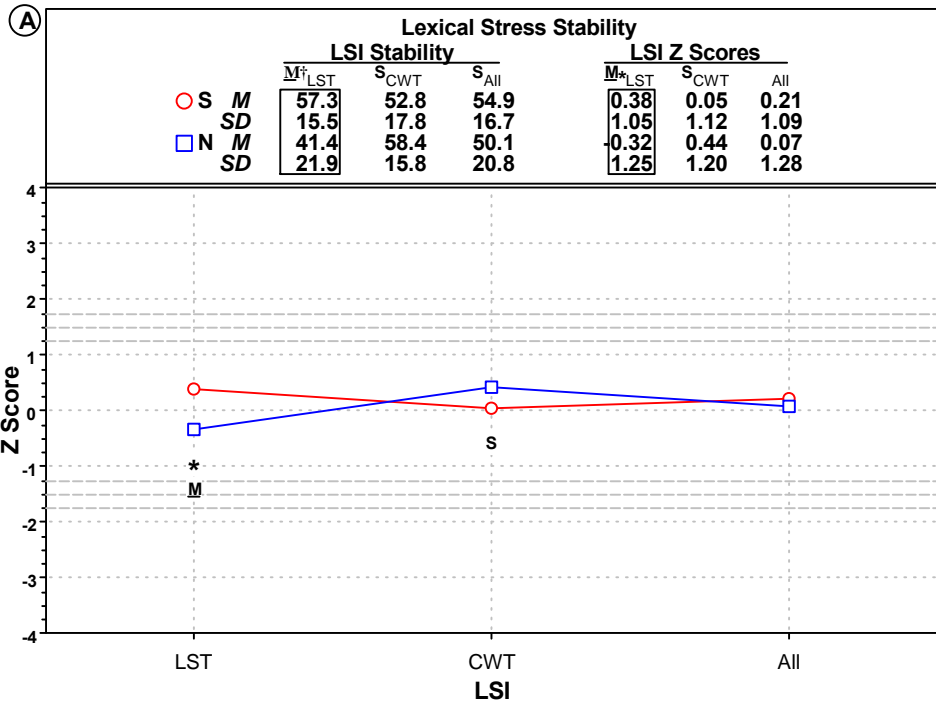
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S≥.2, M≥.5, L≥.8, V≥1, E≥2



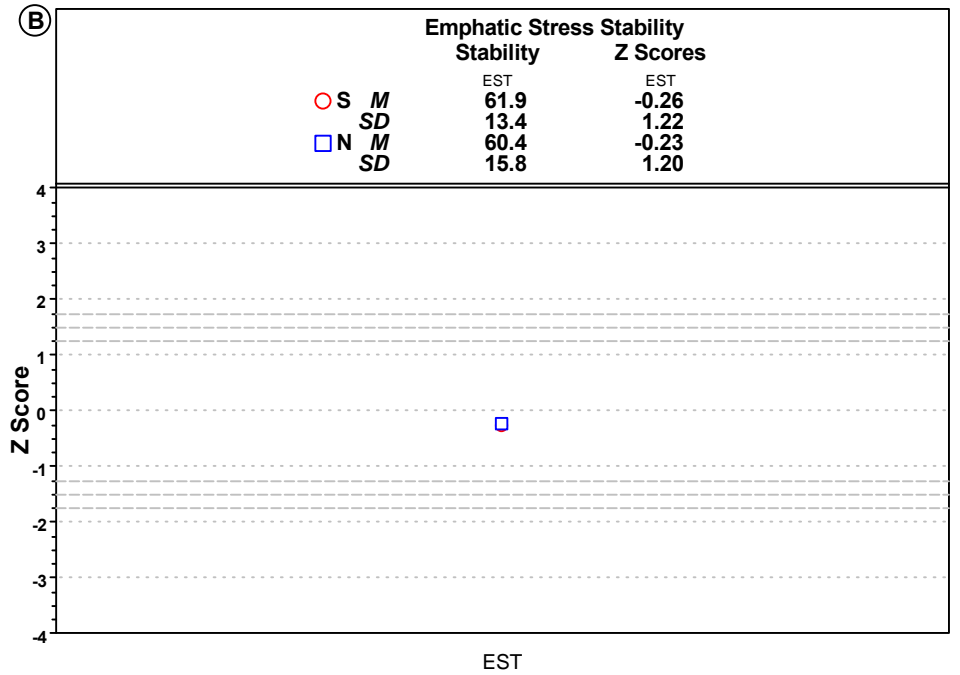
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



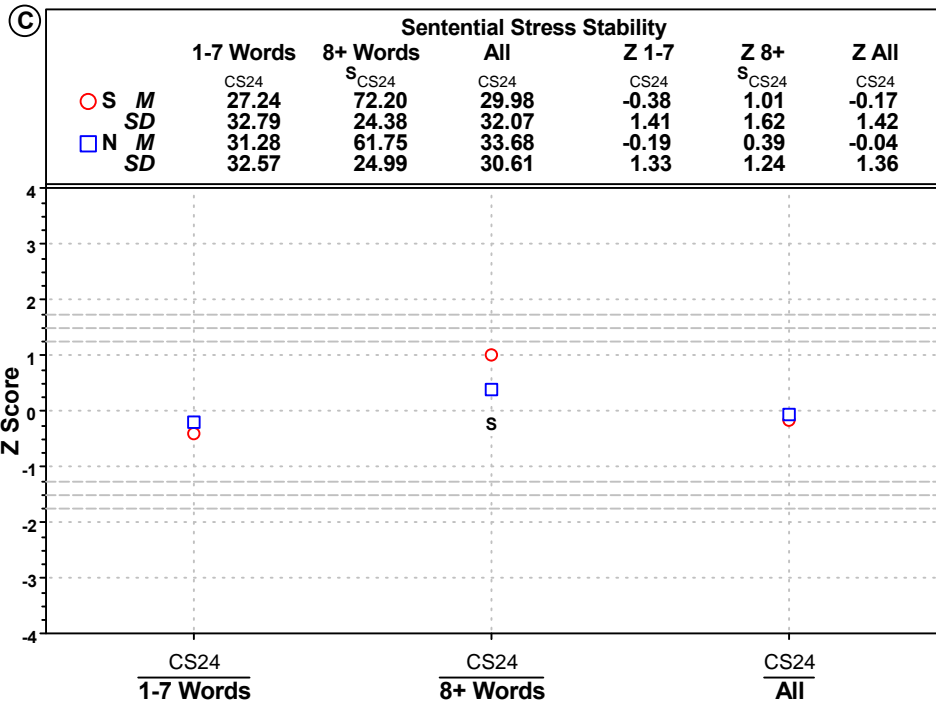
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>θ</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>∅</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>∅</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2

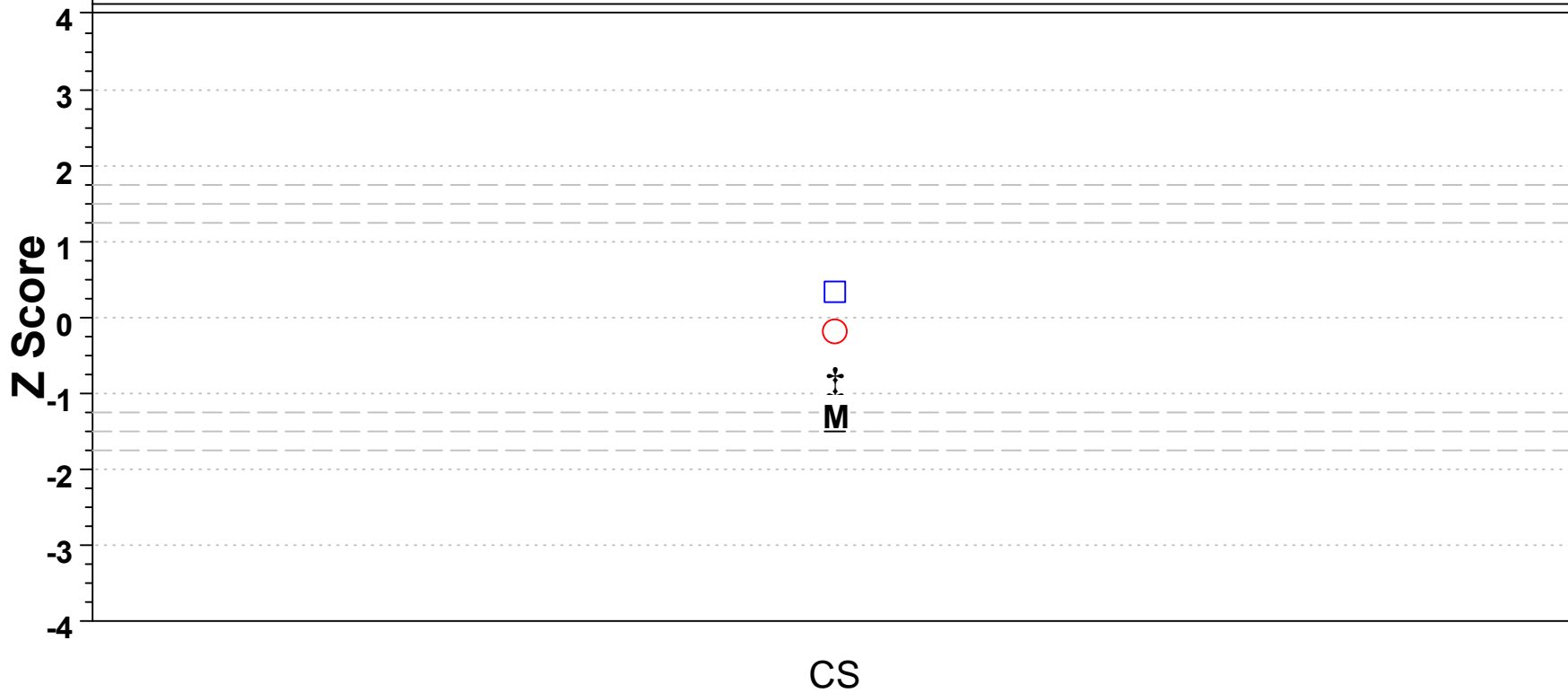


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>∅</sup>no test Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2

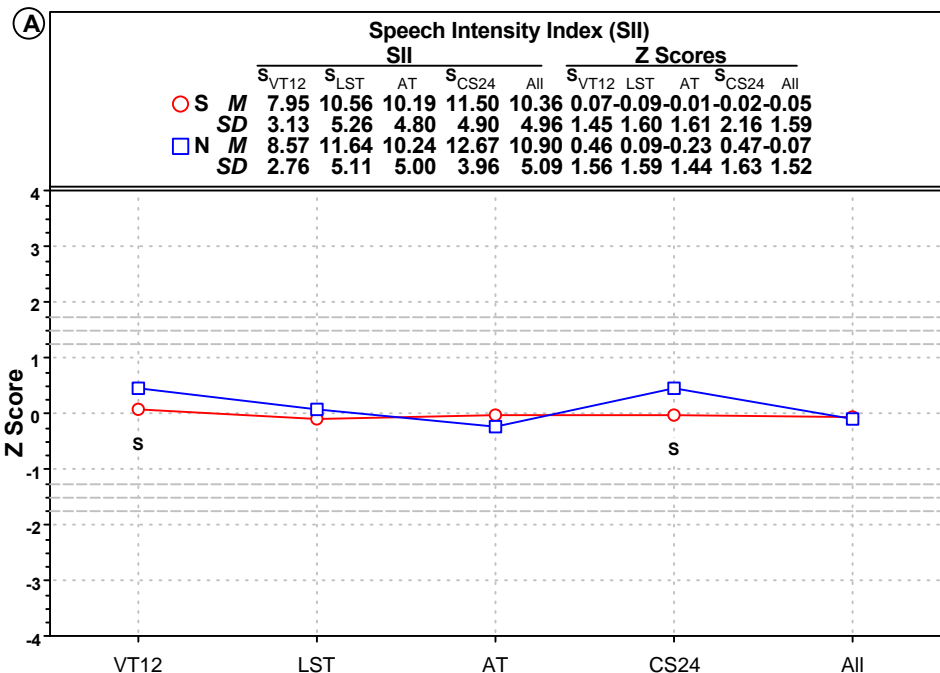
## **LOUDNESS PROFILES**

**Percentage Appropriate Loudness  
Percent Z Scores**

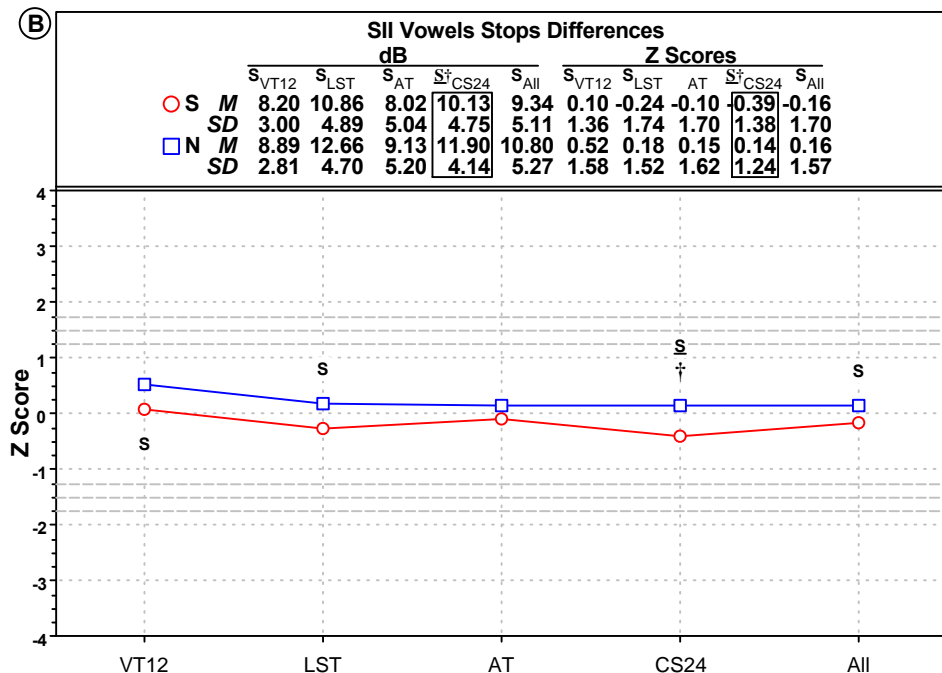
		$\overline{M}^{\ddagger}_{CS}$	$\overline{M}^{\ddagger}_{CS}$
○ S	M	87.52	-0.18
	SD	16.98	1.14
□ N	M	93.71	0.33
	SD	10.80	0.70



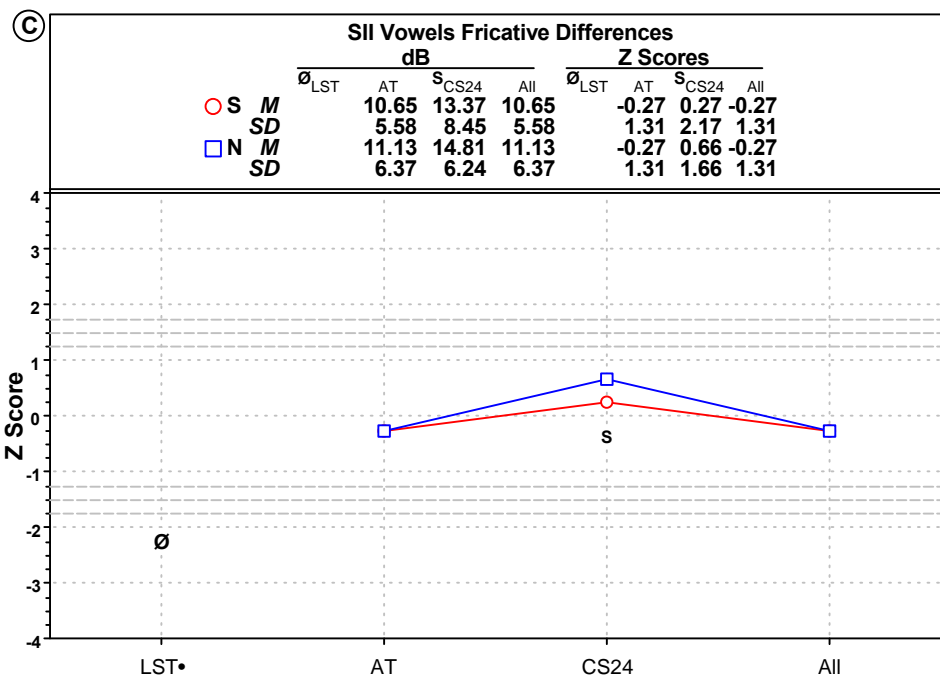
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅ no test Effect:  $S \geq .2, M \geq .5, L \geq .8, V \geq 1, E \geq 2$



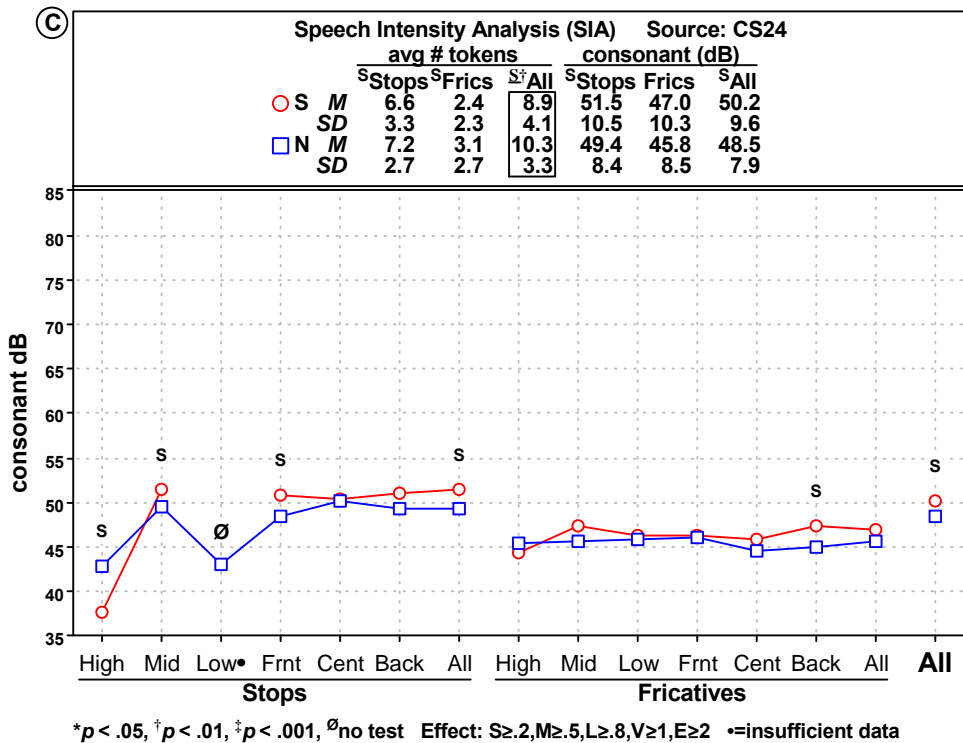
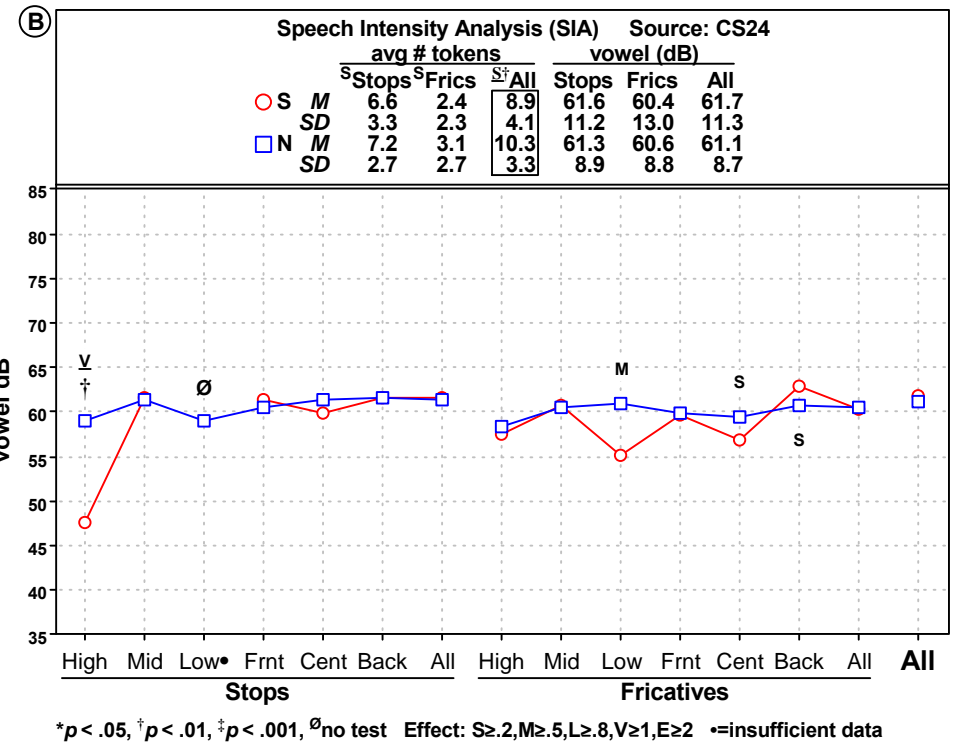
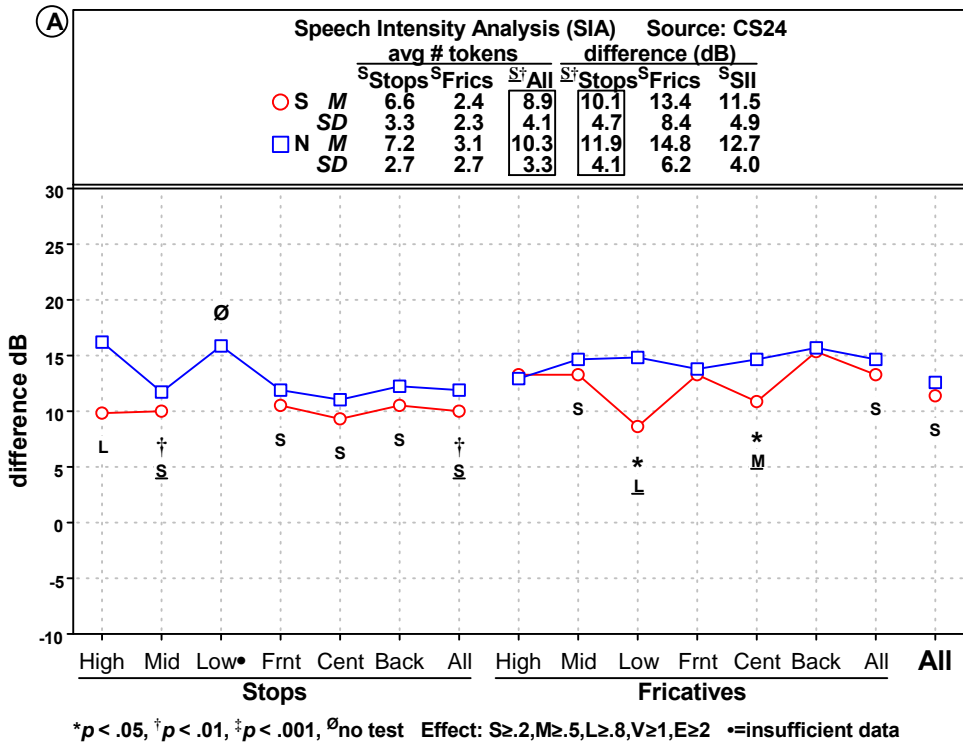
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

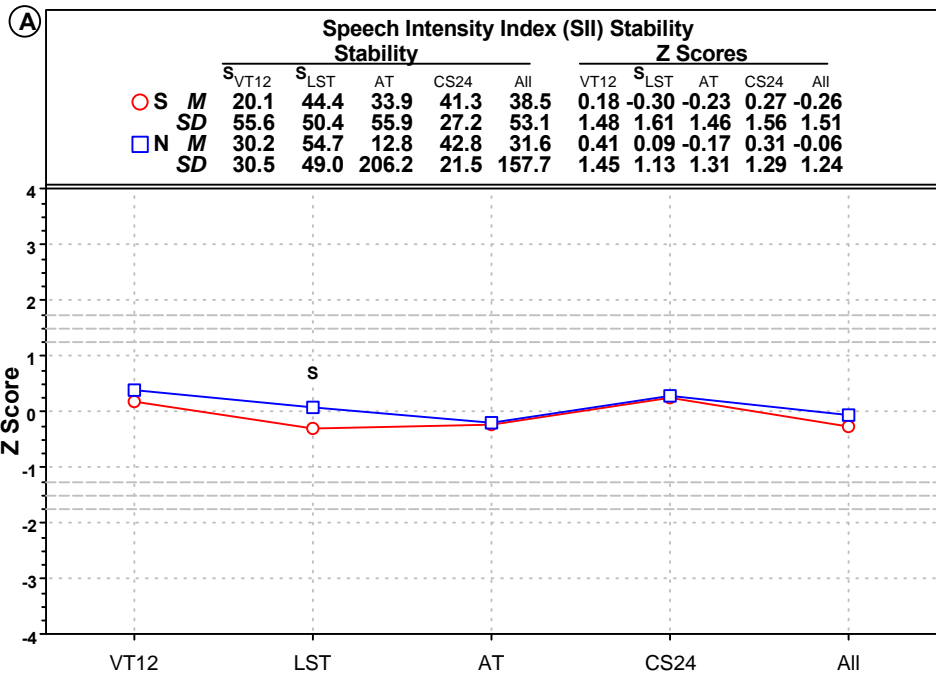


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2

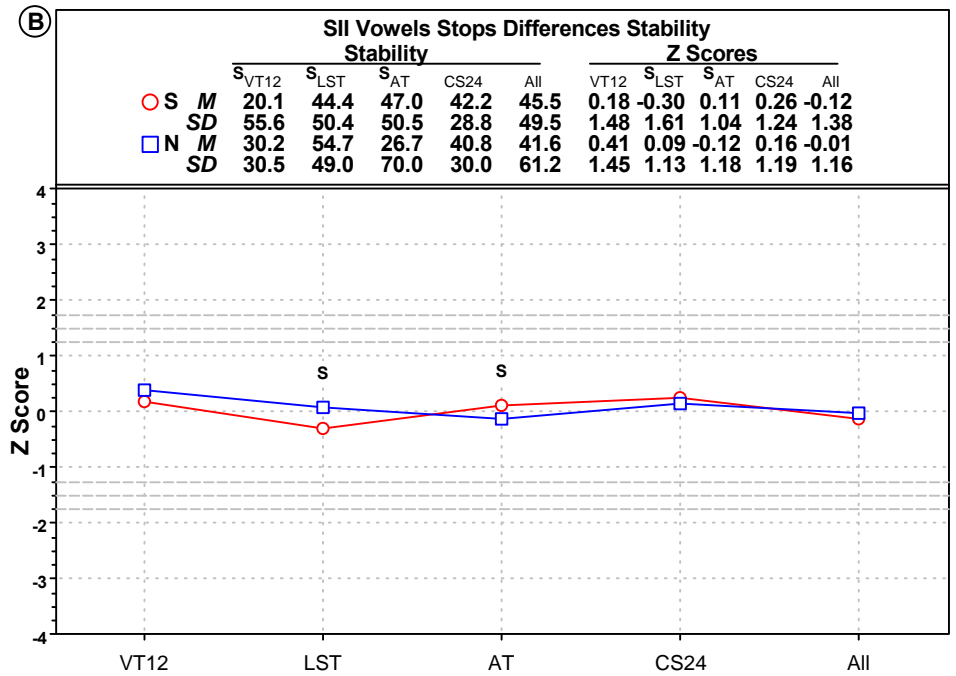


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ .2, M $\geq$ .5, L $\geq$ .8, V $\geq$ 1, E $\geq$ 2 ∅=insufficient data

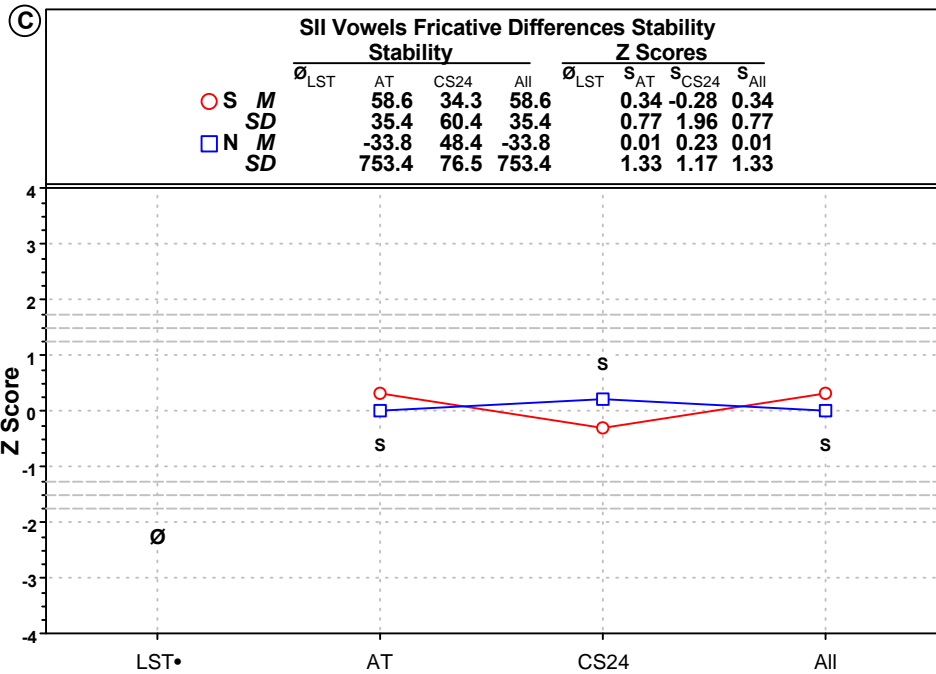




\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ 2,M $\geq$ 5,L $\geq$ 8,V $\geq$ 1,E $\geq$ 2



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ 2,M $\geq$ 5,L $\geq$ 8,V $\geq$ 1,E $\geq$ 2

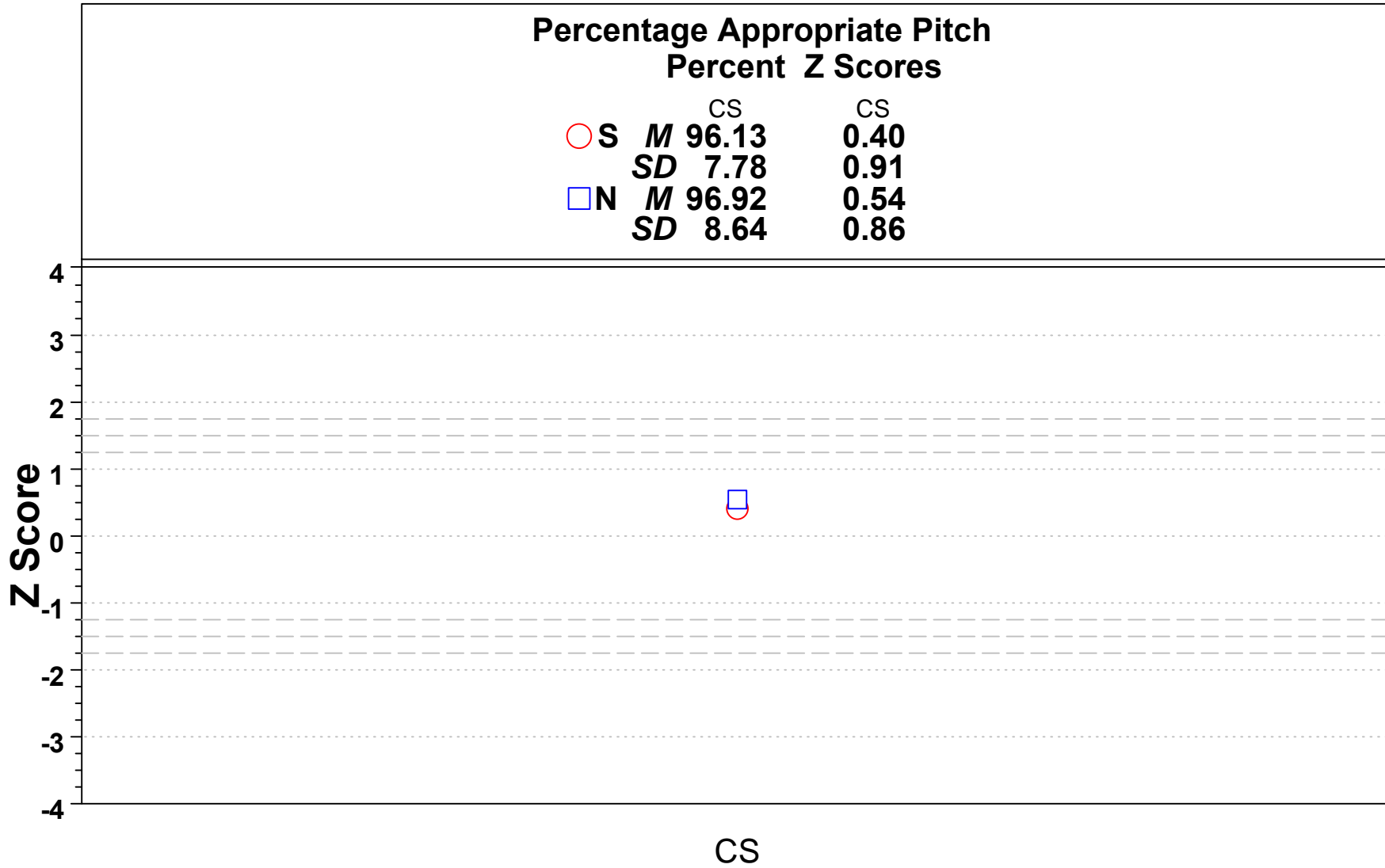


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq$ 2,M $\geq$ 5,L $\geq$ 8,V $\geq$ 1,E $\geq$ 2 ∅=insufficient data

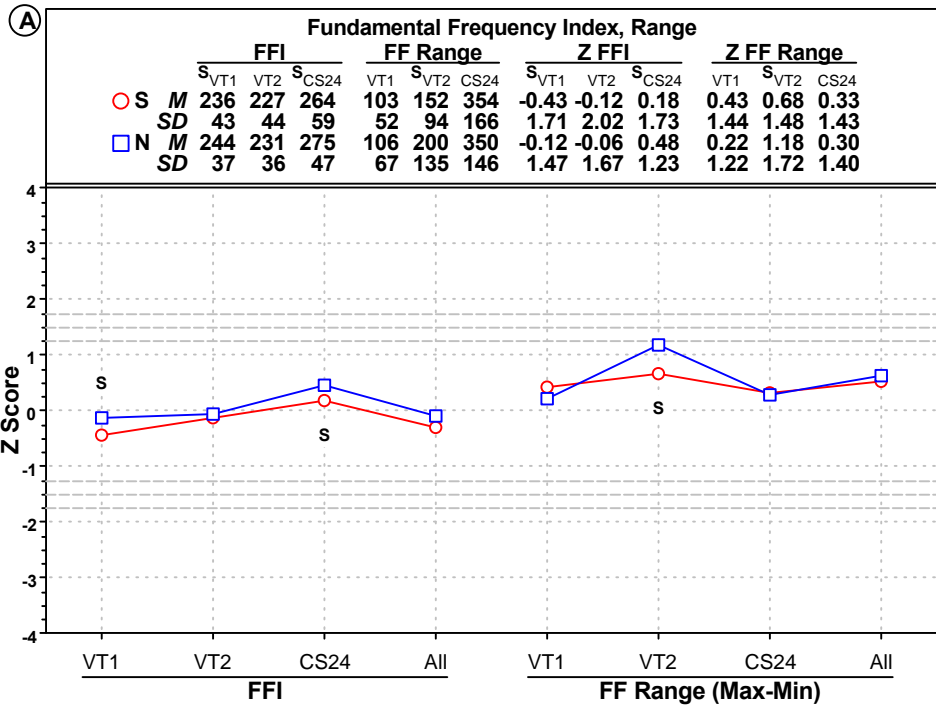
## **PITCH PROFILES**

**Percentage Appropriate Pitch  
Percent Z Scores**

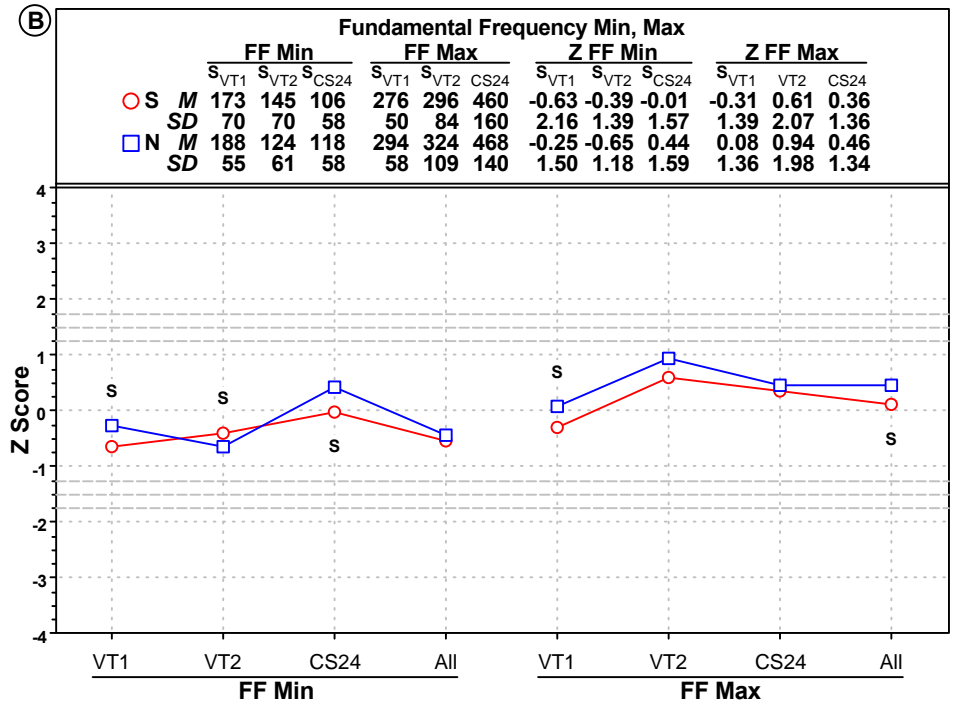
		CS	CS
○ S	<i>M</i>	<b>96.13</b>	<b>0.40</b>
	<i>SD</i>	<b>7.78</b>	<b>0.91</b>
□ N	<i>M</i>	<b>96.92</b>	<b>0.54</b>
	<i>SD</i>	<b>8.64</b>	<b>0.86</b>



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅ no test Effect:  $S \geq .2, M \geq .5, L \geq .8, V \geq 1, E \geq 2$



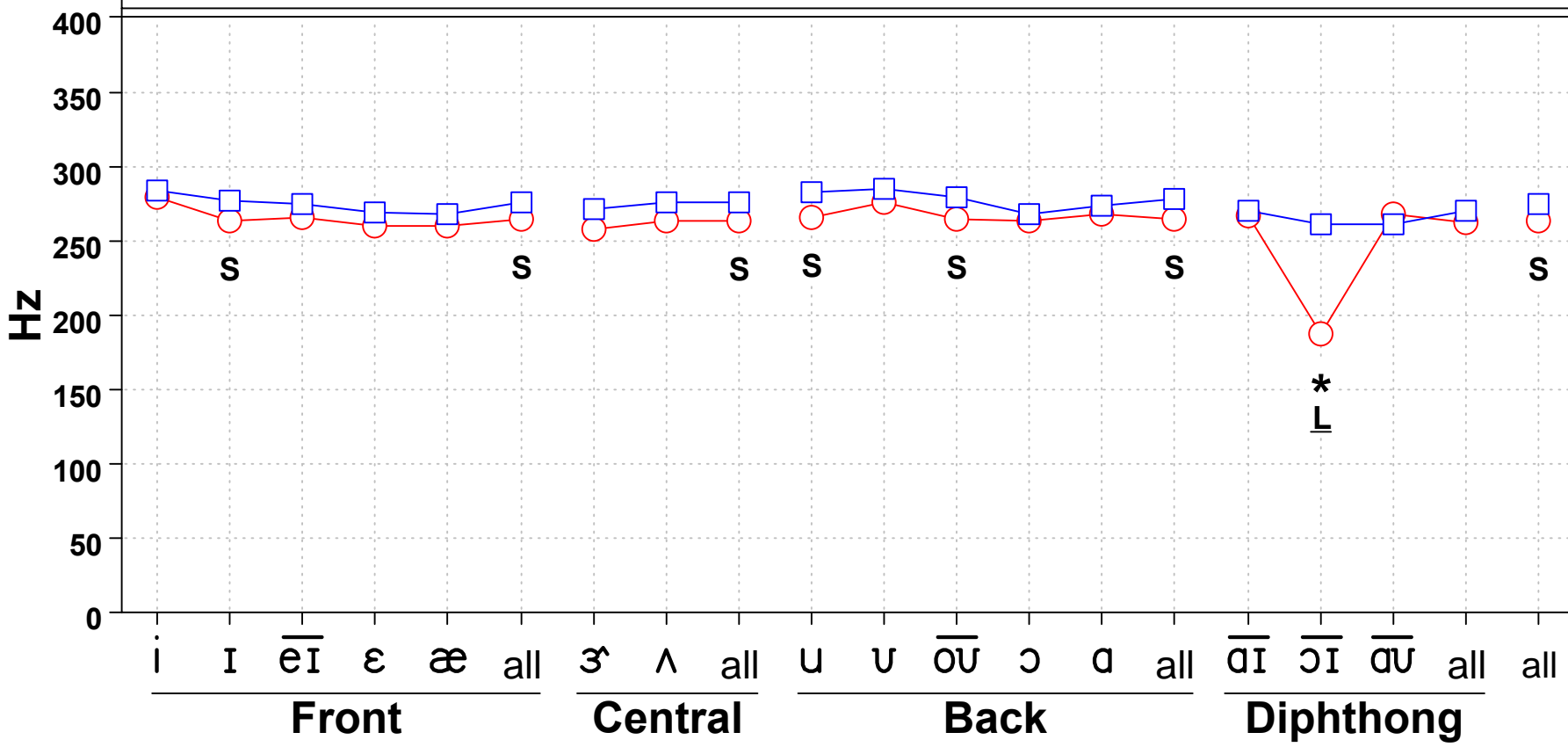
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>o</sup>no test    Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2



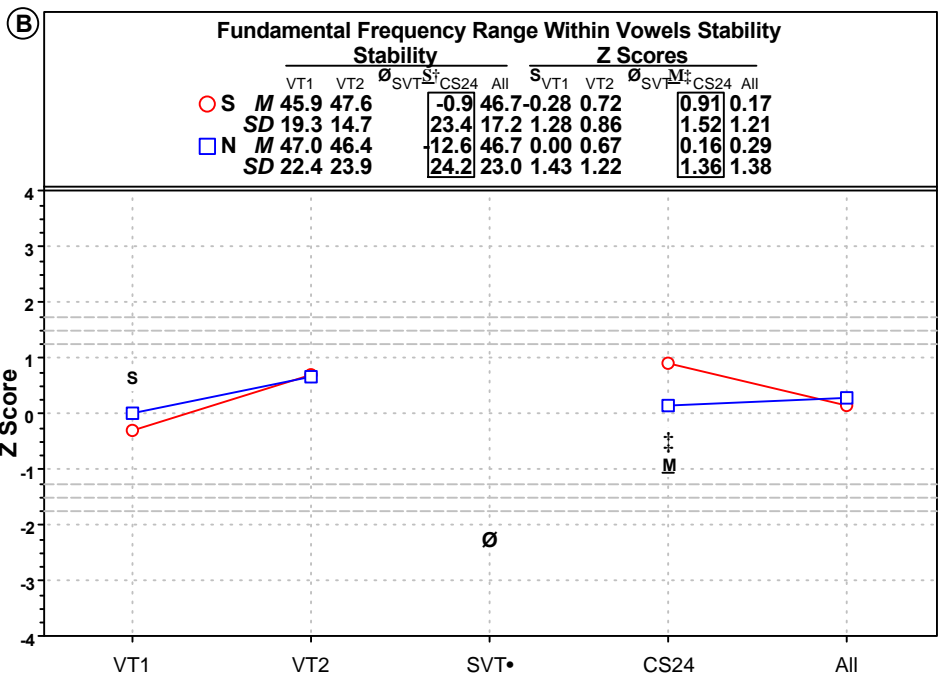
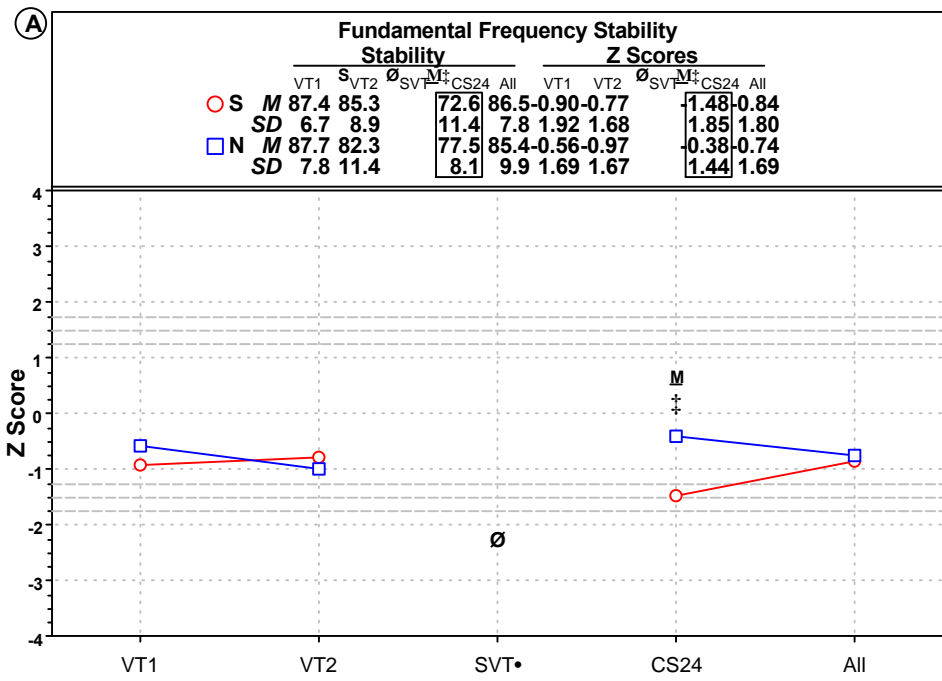
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , <sup>o</sup>no test    Effect: S $\geq$ 2, M $\geq$ 5, L $\geq$ 8, V $\geq$ 1, E $\geq$ 2

Fundamental Frequency Analyses (FFA) Source: CS24  
 avg # tokens F0 (Hz) All

		$S^{\dagger}$ frnt	$S^{*}$ cent	$S^{\circ}$ back	diph	$S^{\dagger}$ all	$S^{\circ}$ frnt	$S^{\circ}$ cent	$S^{\circ}$ back	diph	$S^{\circ}$ mean	$S^{\circ}$ 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



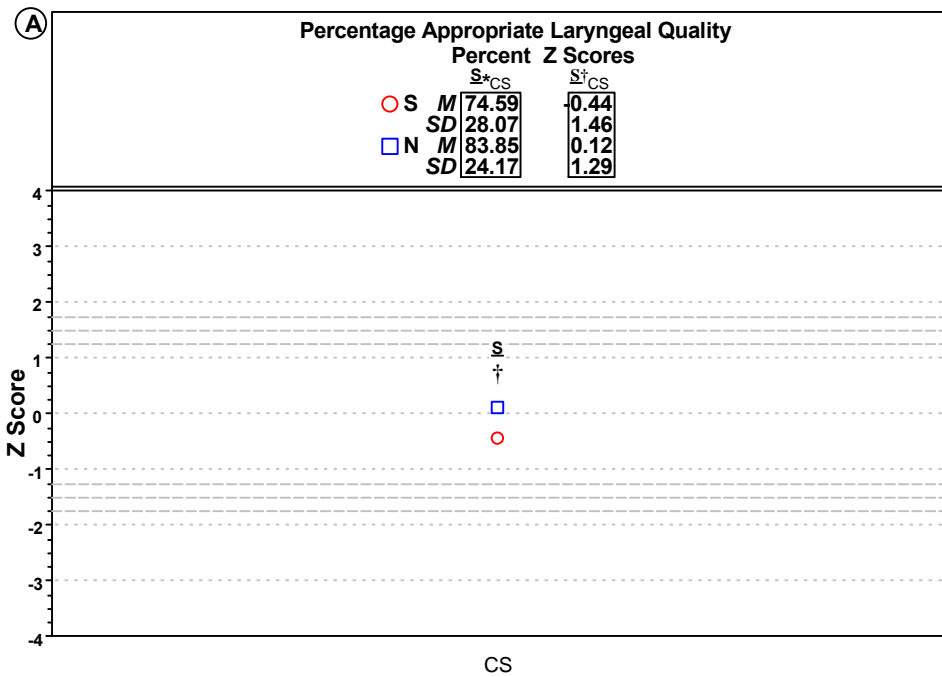
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅ no test Effect:  $S \geq .2, M \geq .5, L \geq .8, V \geq 1, E \geq 2$



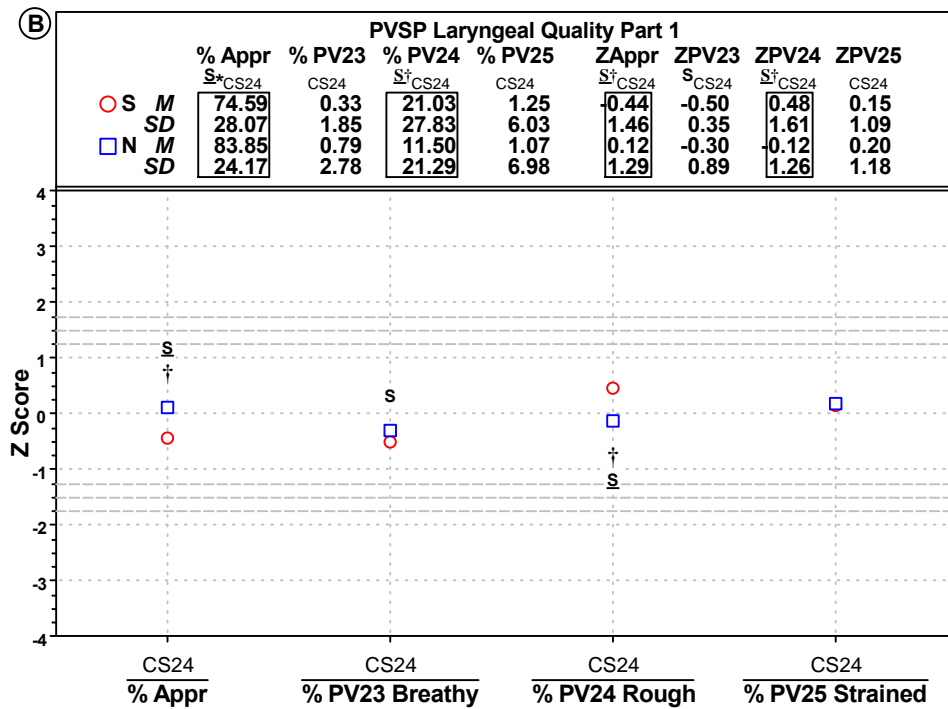
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect: S $\geq 2$ , M $\geq 5$ , L $\geq 8$ , V $\geq 1$ , E $\geq 2$  •=insufficient data

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

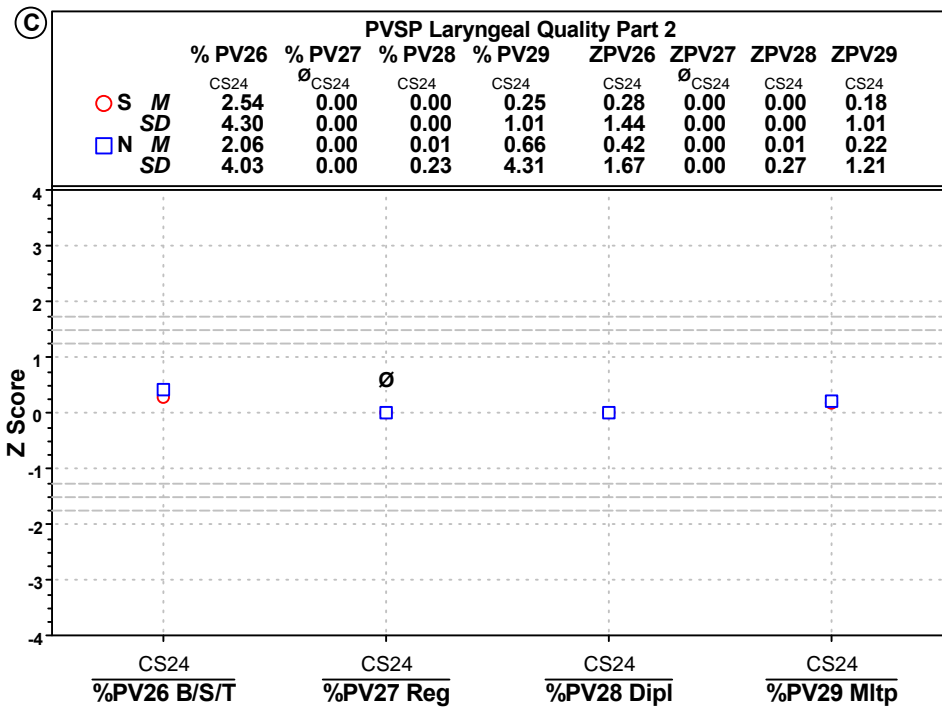
## **LARYNGEAL QUALITY PROFILES**



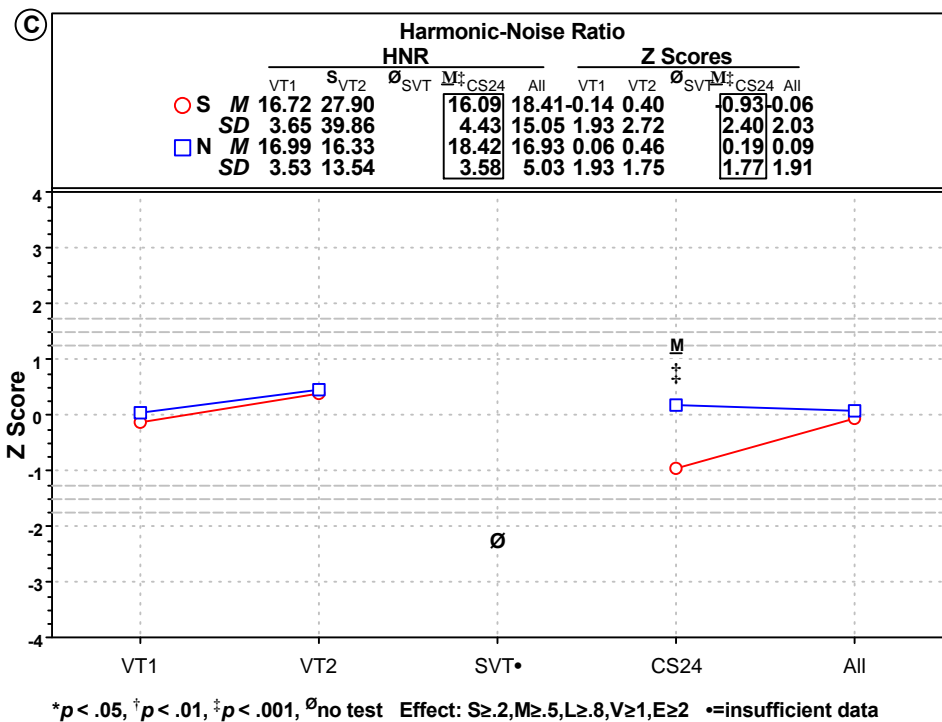
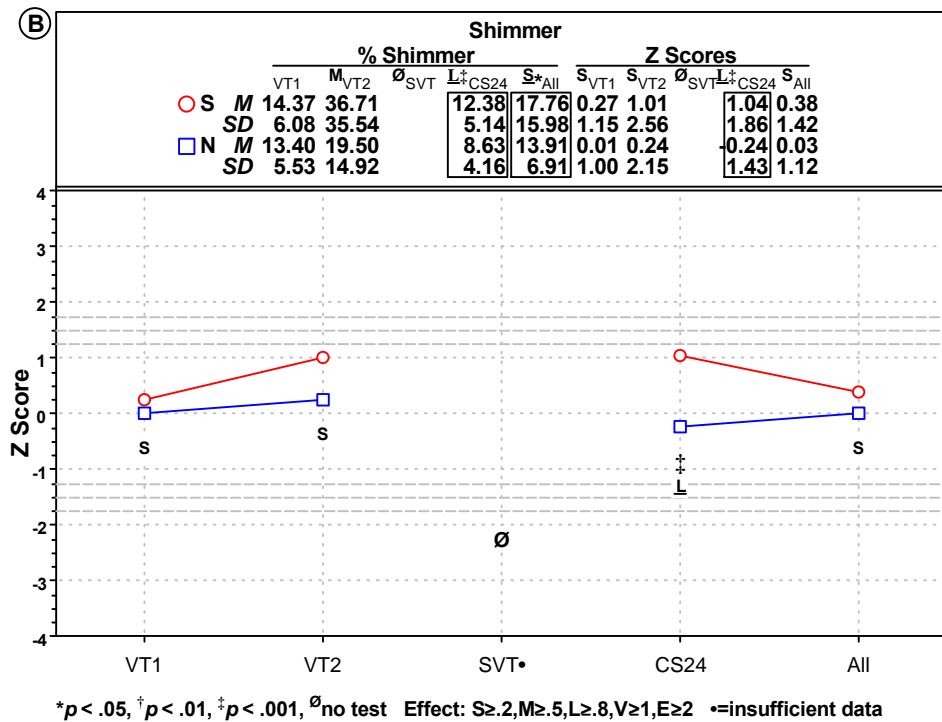
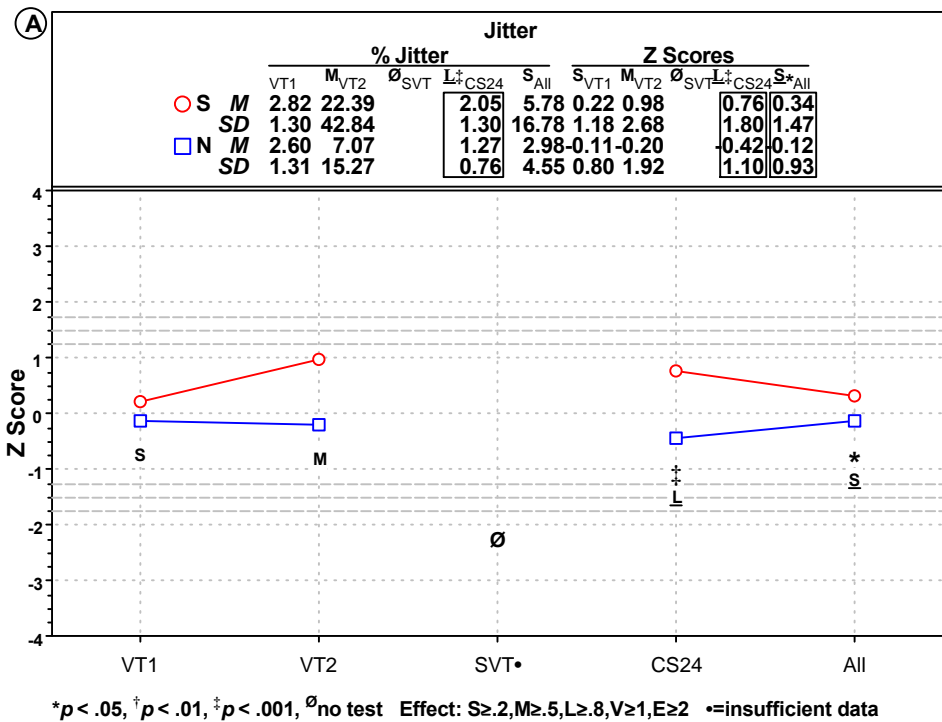
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

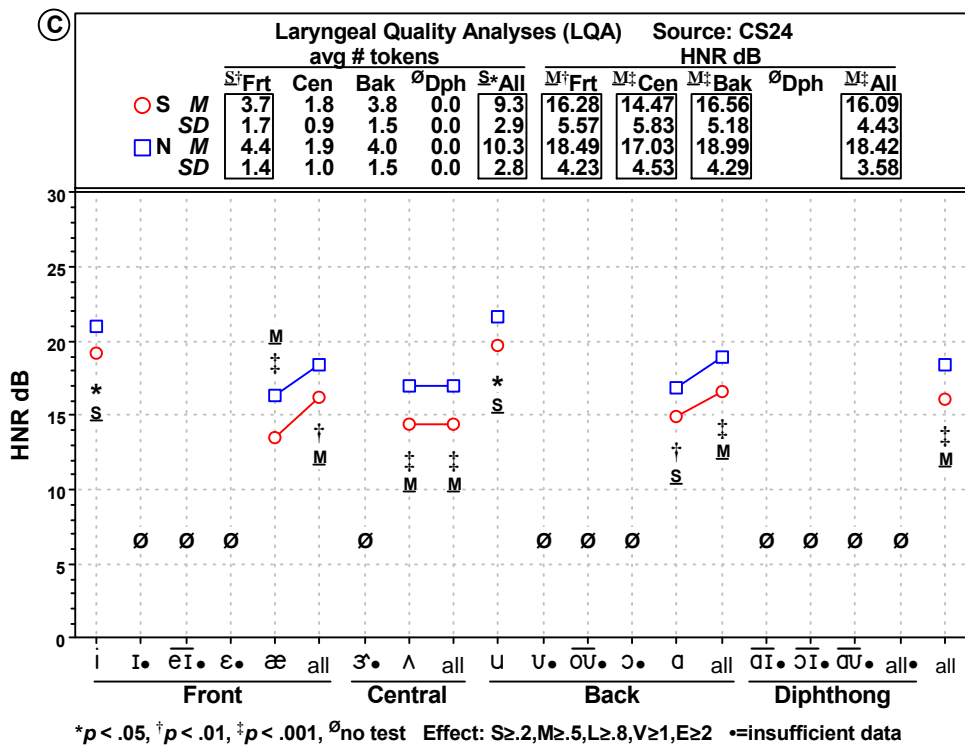
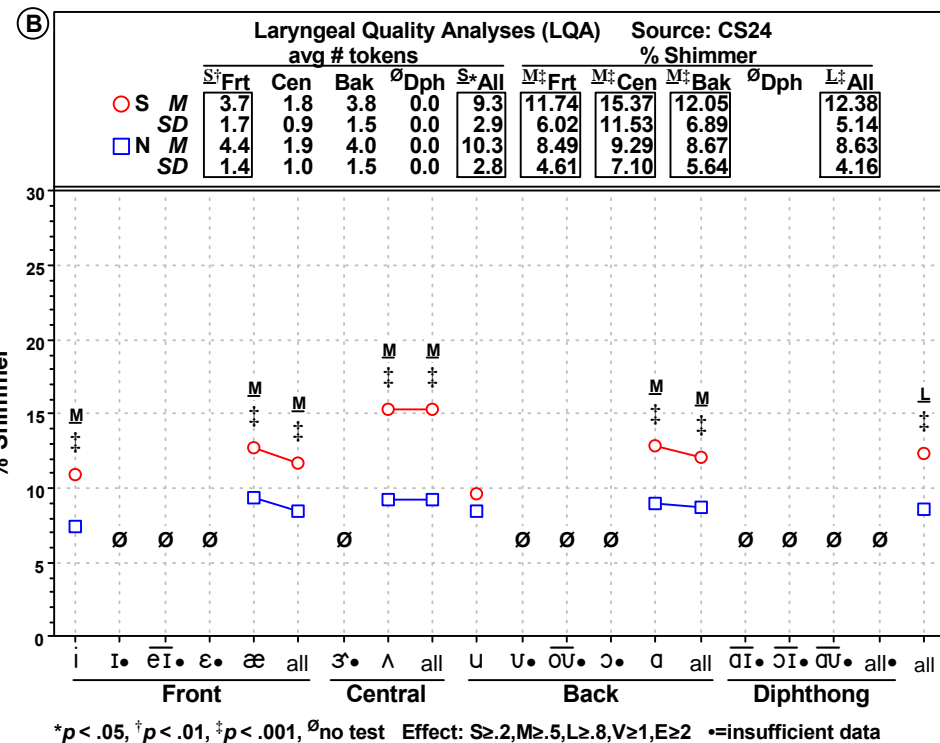
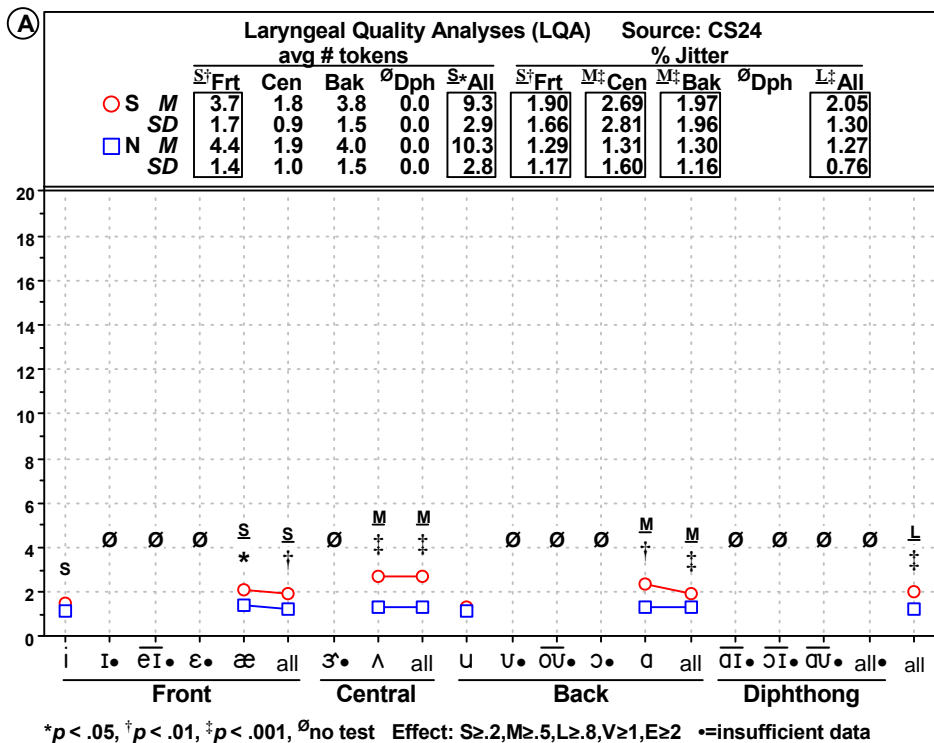


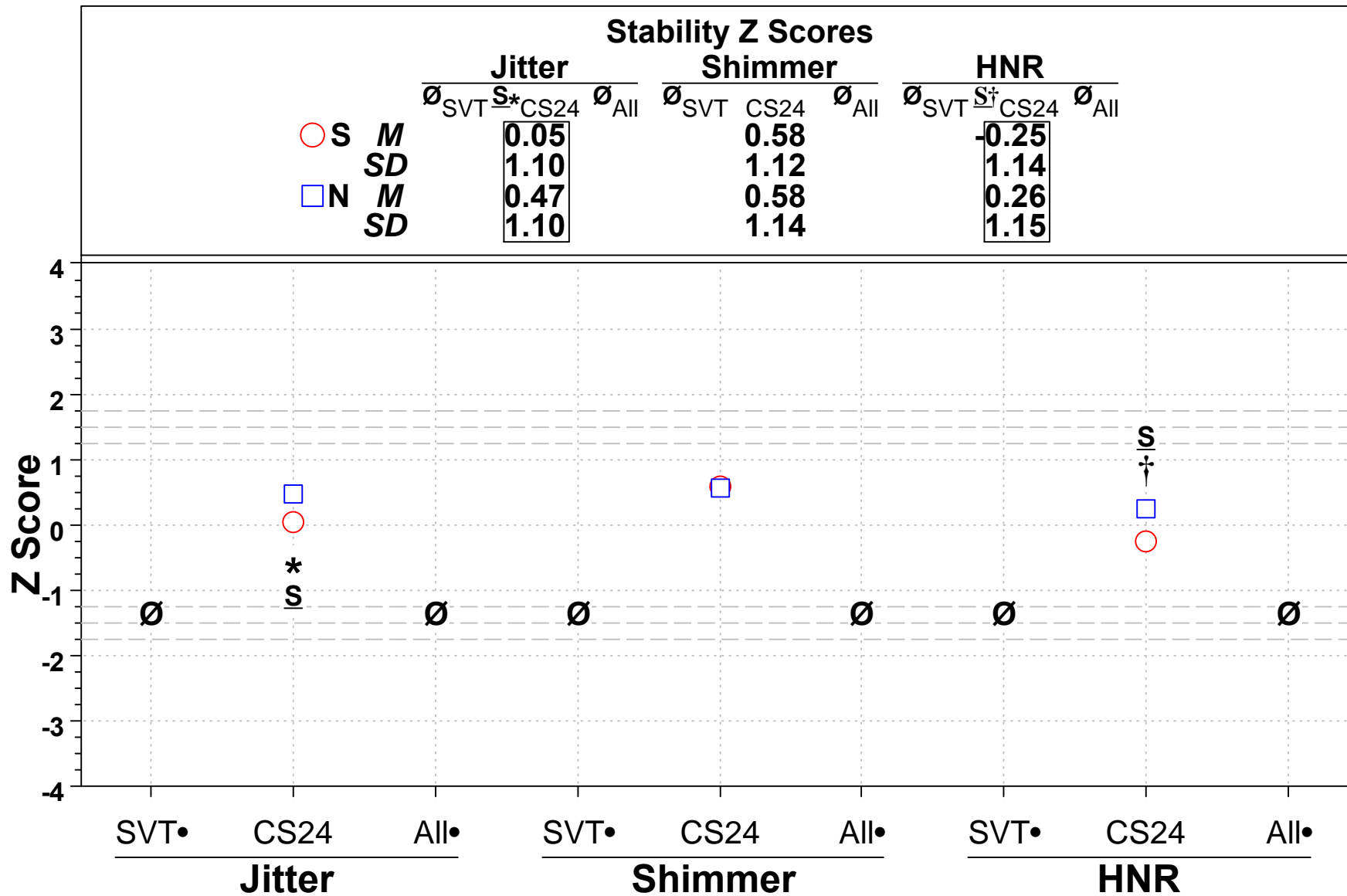
\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$



\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅no test Effect:  $S \geq 2, M \geq 5, L \geq 8, V \geq 1, E \geq 2$

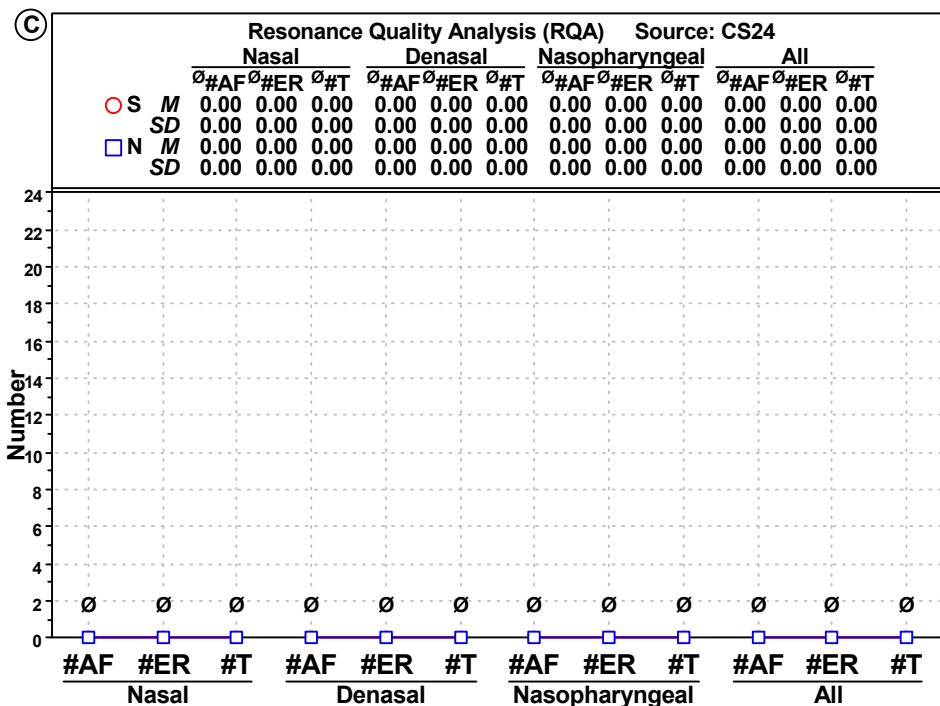
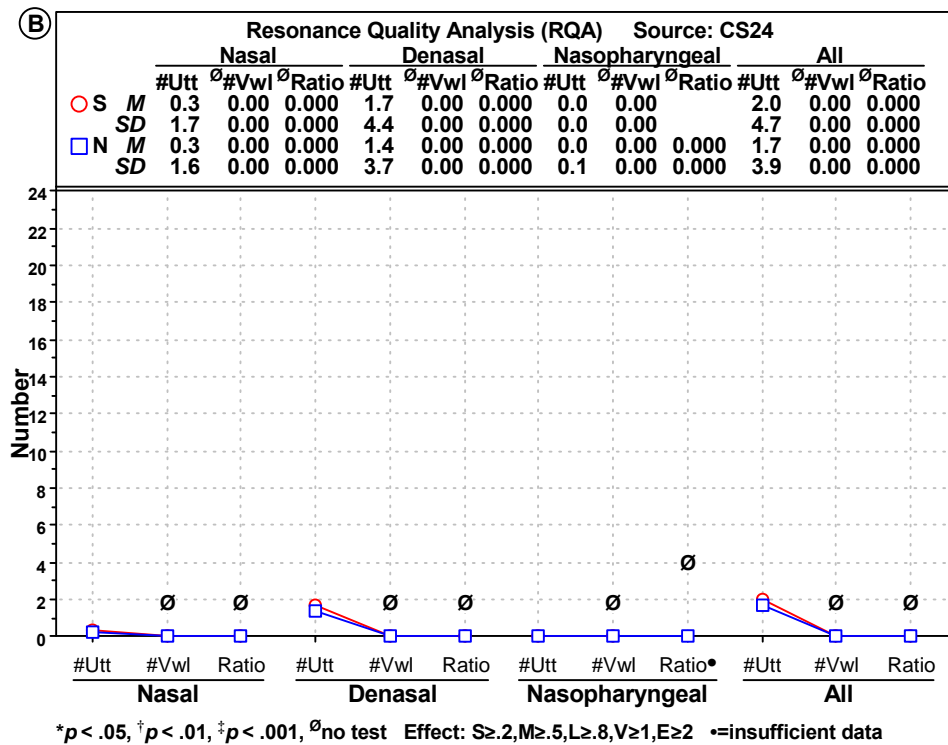
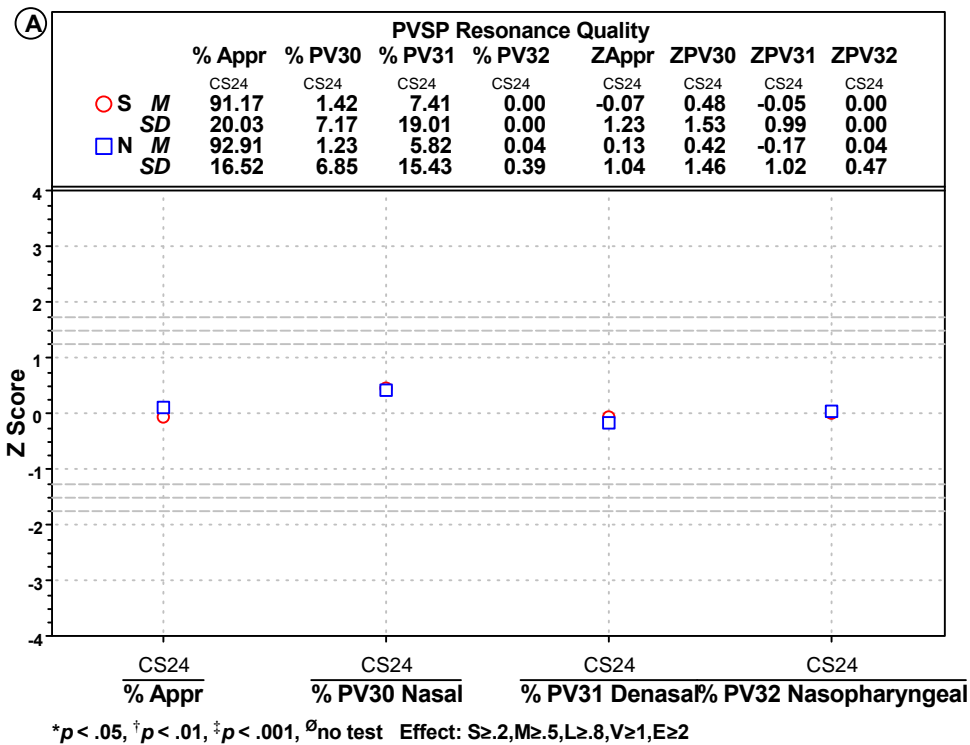


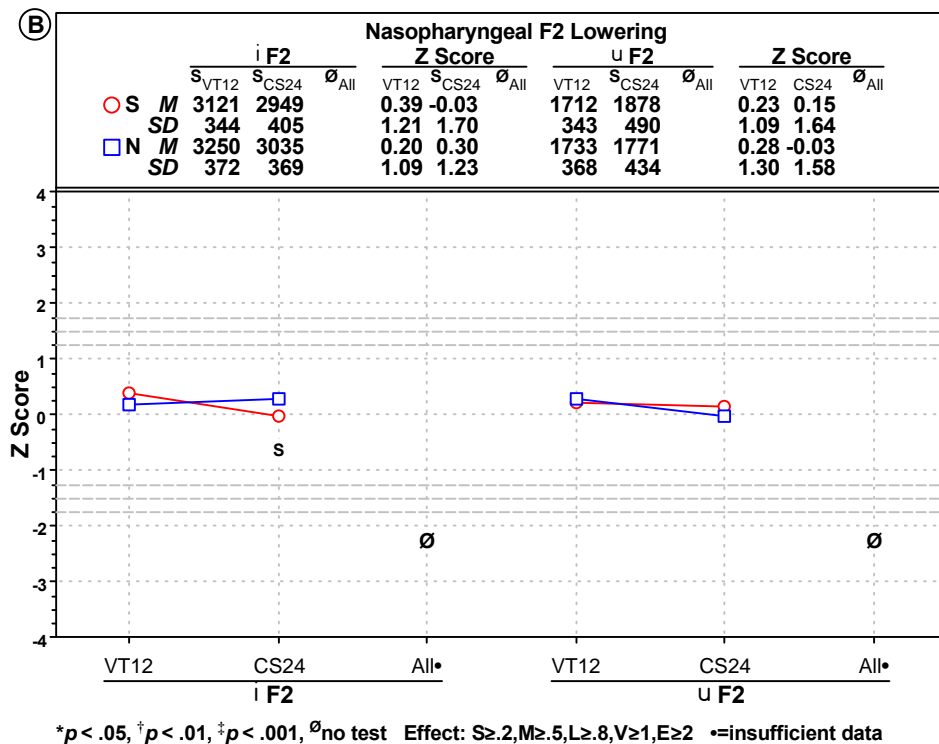
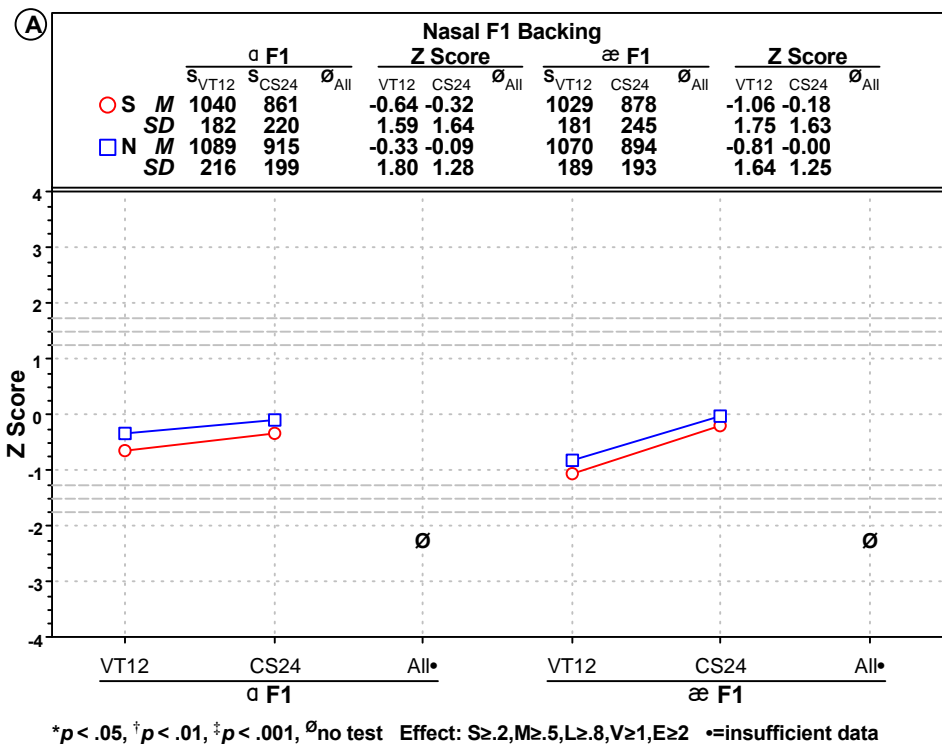


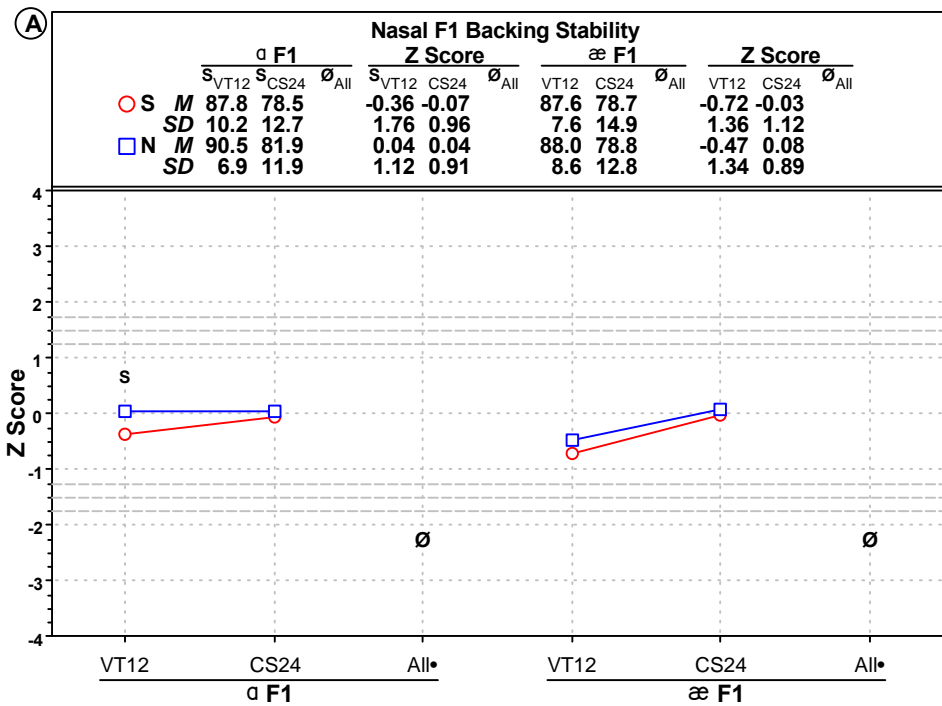


\* $p < .05$ , † $p < .01$ , ‡ $p < .001$ , ∅ no test    Effect: S $\geq .2$ , M $\geq .5$ , L $\geq .8$ , V $\geq 1$ , E $\geq 2$     ∅=insufficient data

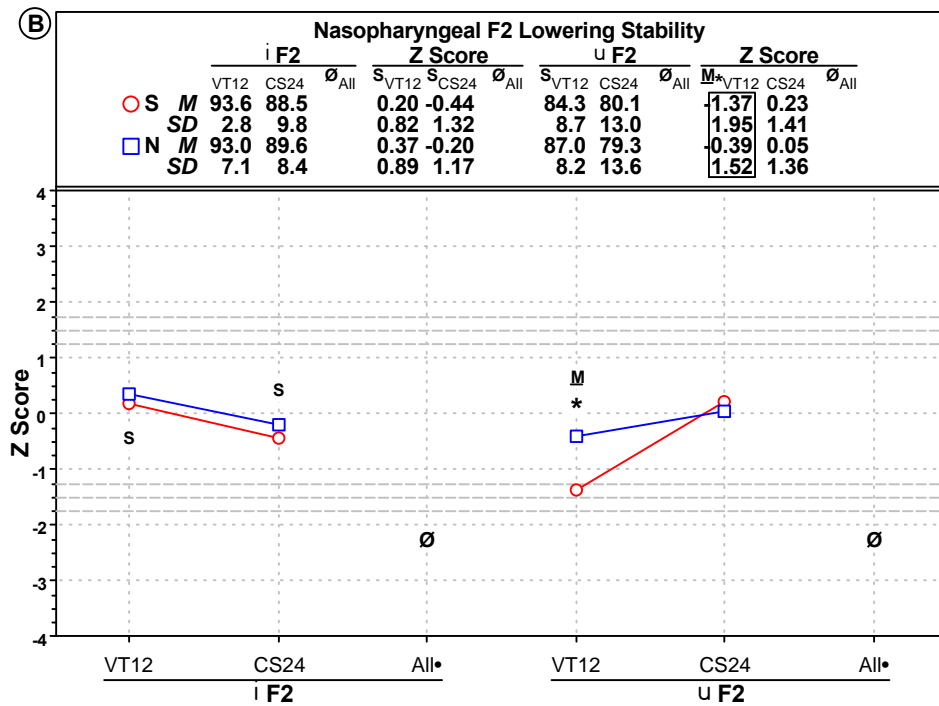
## **RESONANCE QUALITY PROFILES**







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



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

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