Supplemental Tables

Table S1

Speaker demographics for the neurologically healthy control (HC) speaker group.

	Group	Age	Intelligibility (%)[1]
Female Speakers			
HCF01	HC	66	90.74
HCF02	HC	54	83.33
HCF03	HC	68	82.15
HCF04	HC	56	93.36
HCF05	HC	68	83.71
HCF06	HC	65	84.74
HCF07	HC	49	86.74
HCF08	HC	65	80.29
HCF09	HC	72	91.77
M	—	62.56	86.31
SD	—	7.68	4.62
Male Speakers			
HCM01	HC	55	86.59
HCM02	HC	49	63.64[2]
HCM03	HC	51	81.91
HCM04	HC	85	58.70[3]
HCM05	HC	47	79.14
HCM06	HC	68	84.32
HCM07	HC	70	91.40
HCM08	HC	53	81.05
HCM09	HC	74	76.75
M	—	61.33	78.17
SD	—	13.29	10.60

[1] The reported intelligibility (%) scores are aggregated from the Visual Analog Scale (VAS) ratings made for conversational speech samples in the current study.

[2] The HCM02 speaker, while healthy and intelligible, had a Spanish accent that likely influenced his intelligibility ratings. Further discussion about this speaker and the implications for his intelligibility ratings can be found in the limitations section.

[3] The HCM04 speaker, presented with a perceptually rough voice quality consistent with healthy aging. This voice quality likely influenced his intelligibility ratings.

Table S2
Speaker demographics for the neurologically healthy control (HC) speaker group.

	Group	Age	Time Since Diagnosis (Years)	Intelligibility (%)[1]	Severity[2]
Female Speakers					
PDF01	PD	51	12	86.98	Mild
PDF02	PD	73	2	88.02	Mild
PDF03	PD	80	4	89.90	Mild
PDF04	PD	61	12	68.75	Severe
PDF05	PD	63	3	85.19	Mild
PDF06	PD	69	3	82.55	Moderate
M	—	66.17	5.92	83.56	—
SD	—	10.13	4.78	7.68	—
Male Speakers					
PDM01	PD	63	8	17.69	Profound
PDM02	PD	77	9	37.17	Profound
PDM03	PD	73	2	59.72	Severe
PDM04	PD	67	6	62.36	Severe
PDM05	PD	49	12	25.43	Profound
PDM06	PD	67	1	63.87	Severe
PDM07	PD	68	7	9.74	Profound
PDM08	PD	60	15	44.09	Profound
PDM09	PD	80	13	4.36	Profound
PDM10	PD	50	7	91.62	Mild
PDM11	PD	79	6	63.73	Severe
PDM12	PD	65	6	81.84	Moderate
PDM13	PD	82	10	72.47	Moderate
PDM14	PD	78	3	53.43	Severe
PDM15	PD	82	2	74.91	Moderate
PDM16	PD	74	2	78.49	Moderate
M	—	69.62	6.80	52.56	—
SD	—	10.46	4.30	26.79	—

[1] The reported intelligibility (%) scores are aggregated from the Visual Analog Scale (VAS) ratings made for conversational speech samples in the current study.

[2] Severity labels were determined based on the intelligibility measures using the surrogate-severity measures outlined in Stipancic et al. (2022). Specifically, intelligibility values > 94% are `Normal`, 85% - 94% are `Mild`, 70% - 84% are `Moderate`, 45% - 69% are `Severe`, and < 45% are `Profound`.

Table S3

The target measures across the speaking conditions, presented for male, female, and all speakers.

	Conversational				Less Clear				More Clear			
	HC		PD		HC		PD		HC		PD	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
All Speakers												
Intelligibility (VAS)	82.31	26.98	61.06	38.45	70.88	33.86	54.49	39.33	87.68	22.59	66.25	37.48
Articulatory Precision (VAS)	76.09	27.10	53.34	35.58	57.70	33.02	42.92	35.34	84.19	23.14	60.40	35.89
Acoustic VSA (kHz²)	238.44	132.84	140.22	77.97	243.83	189.49	129.82	114.25	335.81	192.62	178.75	146.81
Acoustic Distance (Hz)	532.94	224.19	518.58	254.01	609.13	362.49	490.95	338.06	839.04	369.38	681.48	339.54
F2 Slope (Hz/ms)	4.11	1.71	3.48	1.91	4.16	2.07	3.35	1.90	3.31	1.15	2.91	1.16
Kinematic VSA (mm²)	50.96	22.96	55.75	32.07	46.55	23.79	44.07	25.99	67.18	36.84	65.04	36.87
Kinematic Distance (mm)	11.64	3.80	10.24	5.93	11.71	4.83	9.07	5.28	15.63	4.64	13.91	7.12
Kinematic Speed (mm/s)	97.90	42.59	77.57	54.11	100.24	56.05	69.96	47.97	74.37	36.10	64.82	37.55
Female Speakers												
Intelligibility (VAS)	86.31	23.34	83.51	25.39	72.43	32.99	77.73	29.46	91.17	19.36	89.91	19.68
Articulatory Precision (VAS)	83.51	21.10	77.77	24.36	59.50	32.59	67.00	29.01	87.72	20.77	84.87	21.69
Acoustic VSA (kHz²)	350.01	91.60	220.67	73.73	384.85	170.77	222.94	172.19	483.87	165.42	332.19	192.78
Acoustic Distance (Hz)	649.28	241.91	732.90	211.90	804.25	378.90	846.39	360.57	1123.95	252.68	1031.16	259.59
F2 Slope (Hz/ms)	4.45	1.91	4.70	1.67	4.67	2.07	5.03	2.10	3.58	1.08	3.57	1.02
Kinematic VSA (mm²)	43.82	15.36	54.88	20.79	38.25	17.81	43.68	14.04	58.93	31.09	72.63	37.88
Kinematic Distance (mm)	11.45	4.21	13.09	3.64	12.01	4.32	12.70	3.78	15.90	4.96	17.90	3.51
Kinematic Speed (mm/s)	85.13	41.76	90.49	39.26	89.31	56.03	87.22	42.51	59.30	34.35	68.42	23.19
Male Speakers												
Intelligibility (VAS)	78.24	29.71	52.54	39.14	69.29	34.69	45.67	39.02	84.13	24.98	57.27	38.71
Articulatory Precision (VAS)	68.85	30.19	44.32	34.83	55.94	33.37	34.03	33.27	80.74	24.78	51.36	35.88
Acoustic VSA (kHz²)	126.86	33.11	110.05	56.03	102.81	48.89	94.90	60.17	187.75	46.39	121.21	69.54
Acoustic Distance (Hz)	419.12	128.56	440.17	221.60	414.01	210.58	360.48	214.22	554.12	214.69	553.55	268.34
F2 Slope (Hz/ms)	3.78	1.43	3.03	1.80	3.65	1.96	2.73	1.39	3.05	1.17	2.67	1.11
Kinematic VSA (mm²)	58.11	27.74	56.09	36.26	54.84	27.03	44.23	29.91	75.44	42.00	62.01	37.35
Kinematic Distance (mm)	11.81	3.38	9.13	6.29	11.41	5.32	7.63	5.12	15.36	4.34	12.31	7.58
Kinematic Speed (mm/s)	110.39	40.01	72.54	58.35	111.17	54.50	63.11	48.56	89.79	31.28	63.38	41.99

Table S4
The Model Building Process for Predicting Intelligibility Using the Point-Based Spatial Measures

	Model 1		**Final Model**	
Predictors	*Estimates*	*p*	*Estimates*	*p*
(Intercept)	49.32	**<0.001**	48.39	**<0.001**
aVSA	0.10	**<0.001**	0.13	**<0.001**
Sex [F]	17.41	0.018	27.69	**<0.001**
kVSA	0.07	0.199		
aVSA × Sex [F]	-0.08	**0.004**	-0.10	**<0.001**
Sex [F] × kVSA	0.14	0.107		
Random Effects				
σ^2	44.78		49.86	
τ_{00}	186.37 $_{SpeakerID}$		202.90 $_{SpeakerID}$	
ICC	0.81		0.80	
N	40 $_{SpeakerID}$		40 $_{SpeakerID}$	
Observations	117		120	
Marginal R^2 / Conditional R^2	0.353 / 0.875		0.371 / 0.876	

Note. Bold values indicate significance at $\alpha < .008$.

Table S5
The Model Building Process for Predicting Intelligibility Using the Transition-Based Spatial Measures

	Model 1		**Final Model**	
Predictors	*Estimates*	*p*	*Estimates*	*p*
(Intercept)	53.41	**<0.001**	54.56	**<0.001**
acoDistance	0.01	0.212		
Sex [F]	16.63	**0.001**	14.15	**0.001**
kinDistance	1.04	**<0.001**	1.15	**<0.001**
acoDistance × Sex [F]	-0.01	0.273		
Sex [F] × kinDistance	0.03	0.908		
Random Effects				
σ^2	90.19		90.14	
τ_{00}	156.32 $_{SpeakerID}$		159.35 $_{SpeakerID}$	
ICC	0.63		0.64	
N	39 $_{SpeakerID}$		39 $_{SpeakerID}$	
Observations	581		581	
Marginal R^2 / Conditional R^2	0.318 / 0.750		0.314 / 0.752	

Note. Bold values indicate significance at $\alpha < .008$.

Table S6
The Model Building Process for Predicting Intelligibility Using the Spatiotemporal Measures

	Model 1		**Model 2**		**Final Model**	
Predictors	*Estimates*	*p*	*Estimates*	*p*	*Estimates*	*p*
(Intercept)	64.12	**<0.001**	68.42	**<0.001**	65.98	**<0.001**
F2 Slope	0.64	0.300	-0.60	0.210		
Sex [F]	29.24	**<0.001**	17.75	**<0.001**	18.67	**<0.001**
kinSpeed	19.38	0.331	12.98	0.458		
F2 Slope × Sex [F]	-2.25	0.021				
Sex [F] × kinSpeed	-41.96	0.288				
Random Effects						
σ^2	106.59		110.28		110.53	
τ_{00}	174.70 $_{\text{SpeakerID}}$		177.57 $_{\text{SpeakerID}}$		218.84 $_{\text{SpeakerID}}$	
ICC	0.62		0.62		0.66	
N	39 $_{\text{SpeakerID}}$		39 $_{\text{SpeakerID}}$		40 $_{\text{SpeakerID}}$	
Observations	581		581		600	
Marginal R^2 / Conditional R^2	0.212 / 0.701		0.194 / 0.691		0.199 / 0.731	

Note. Bold values indicate significance at $\alpha < .008$.

Table S7
The Model Building Process for Predicting Articulatory Precision Using the Point-Based Spatial Measures

	Model 1		**Final Model**	
Predictors	*Estimates*	*p*	*Estimates*	*p*
(Intercept)	28.40	**<0.001**	28.64	**<0.001**
aVSA	0.17	**<0.001**	0.20	**<0.001**
Sex [F]	23.88	0.011	38.27	**<0.001**
kVSA	0.10	0.165		
aVSA × Sex [F]	-0.14	**<0.001**	-0.17	**<0.001**
Sex [F] × kVSA	0.20	0.083		
Random Effects				
σ^2	92.92		102.40	
τ_{00}	222.33 $_{\text{SpeakerID}}$		220.73 $_{\text{SpeakerID}}$	
ICC	0.71		0.68	
N	40 $_{\text{SpeakerID}}$		40 $_{\text{SpeakerID}}$	
Observations	117		120	
Marginal R^2 / Conditional R^2	0.426 / 0.831		0.443 / 0.824	

Note. Bold values indicate significance at $\alpha < .008$.

Table S8
The Model Building Process for Predicting Articulatory Precision Using the Transition-Based Spatial Measures

	Model 1		**Final Model**	
Predictors	*Estimates*	*p*	*Estimates*	*p*
(Intercept)	37.09	**<0.001**	39.49	**<0.001**
acoDistance	0.00	0.590		
Sex [F]	24.29	**<0.001**	17.38	**0.001**
kinDistance	1.65	**<0.001**	1.54	**<0.001**
acoDistance × Sex [F]	-0.00	0.561		
Sex [F] × kinDistance	-0.38	0.283		
Random Effects				
σ^2	126.64		128.02	
τ_{00}	239.88 $_{SpeakerID}$		248.29 $_{SpeakerID}$	
ICC	0.65		0.66	
N	39 $_{SpeakerID}$		39 $_{SpeakerID}$	
Observations	581		581	
Marginal R^2 / Conditional R^2	0.349 / 0.775		0.333 / 0.773	

Note. Bold values indicate significance at $\alpha < .008$.

Table S9
The Model Building Process for Predicting Articulatory Precision Using the Spatiotemporal Measures

	Model 1		**Model 2**		**Final Model**	
Predictors	*Estimates*	*p*	*Estimates*	*p*	*Estimates*	*p*
(Intercept)	57.43	**<0.001**	61.05	**<0.001**	59.23	**<0.001**
F2 Slope	-0.46	0.530	-1.27	0.022	-1.32	**0.003**
Sex [F]	33.36	**<0.001**	23.30	**<0.001**	24.85	**<0.001**
kinSpeed	0.01	0.751	-0.01	0.777		
F2 Slope × Sex [F]	-1.20	0.298				
Sex [F] × kinSpeed	-0.07	0.112				
Random Effects						
σ^2	147.72		150.23		149.78	
τ_{00}	299.91 $_{SpeakerID}$		293.07 $_{SpeakerID}$		331.36 $_{SpeakerID}$	
ICC	0.67		0.66		0.69	
N	39 $_{SpeakerID}$		39 $_{SpeakerID}$		40 $_{SpeakerID}$	
Observations	581		581		600	
Marginal R^2 / Conditional R^2	0.217 / 0.742		0.210 / 0.732		0.214 / 0.755	

Note. Bold values indicate significance at $\alpha < .008$.