Second Formant Relationship to Adduction: An Airflow Study

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Introduction

Recent research, however, is now suggesting that the larynx and the vocal tract are interactive with each other, meaning that a change of muscular function in the larynx will create a change of resonator function in the vocal tract, and vice versa. This conclusion is drawn mainly on the work of Titze, Story, Laukkanen, et. al. They have found that a relationship exists between laryngeal function and the first vowel formant (F1). When examining research on the second vowel formant (F2), this author discovered that there may be a relationship between F2 and adduction.

Therefore, based on present evidence, it was hypothesized that an elevated frequency of F2 corresponded to an increase in adduction. The hypothesis is examined by comparing the resonance output and glottal closure between F1 similar vowels where F2 was elevated. The paper reports the findings of a study conducted at the University of Nebraska – Lincoln. Subjects are asked to sing [u] and then while maintaining their lip position were to move their tongue to the position of an [i] creating [y]. This process was done using the Glottal Enterprises MS-110 Transducer UBS Interface and the WaveviewPro software, and then repeated using a microphone signal that was inverse-filtered. Airflow, pitch, intensity, and formant data were collected and compared.

Conclusion

The correlation analysis of the airflow data, a negative correlation between Qo and F2, does suggest the hypothesis is valid, that in increase in F2 frequency results in increased adduction, however, the average change value for Qo indicates the opposite. The microphone data shows a strong correlation positive correlation between Qo and F1. This may be due to the inverse-filtration process since the waveform is most affected by the filtering of F1. Furthermore, since singing is different from speaking, and given the source-filter interaction, the filtering model may not accurately estimate Qo as suggested by Henrich *et. al.* (2001). Further study is needed.

Correlations

		Avg Air	Peak Air	dB	Qo	F0	F1	F2
Avg Air	Pearson Correlation	1	.899**	.452*	-.364	-.167	-.182	.322
	Sig. (2-tailed)		.000	.023	.074	.424	.384	.116
	N	25	25	25	25	25	25	25
Peak Air	Pearson Correlation	.899**	1	.364	-.588**	-.090	-.147	.408*
	Sig. (2-tailed)	.000		.074	.002	.667	.483	.043
	N	25	25	25	25	25	25	25
dB	Pearson Correlation	.452*	.364	1	-.226	.063	.407*	.274
	Sig. (2-tailed)	.023	.074		.278	.765	.044	.186
	N	25	25	25	25	25	25	25
Qo	Pearson Correlation	-.364	-.588**	-.226	1	-.236	-.012	-.429*
	Sig. (2-tailed)	.074	.002	.278		.256	.953	.032
	N	25	25	25	25	25	25	25
F0	Pearson Correlation	-.167	-.090	.063	-.236	1	.209	.271
	Sig. (2-tailed)	.424	.667	.765	.256		.315	.191
	N	25	25	25	25	25	25	25
F1	Pearson Correlation	-.182	-.147	.407*	-.012	.209	1	-.048
	Sig. (2-tailed)	.384	.483	.044	.953	.315		.818
	N	25	25	25	25	25	25	25
F2	Pearson Correlation	.322	.408*	.274	-.429*	.271	-.048	1
	Sig. (2-tailed)	.116	.043	.186	.032	.191	.818	
	N	25	25	25	25	25	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Group 1 Airflow Mask

Correlations

		AvgOfF0	AvgOfF1	AvgOfF2	AvgOfdB	AvgOfQo
AvgOfF0	Pearson Correlation	1	.337	-.337	.191	.263
	Sig. (2-tailed)		.100	.100	.359	.205
	N	25	25	25	25	25
AvgOfF1	Pearson Correlation	.337	1	-.176	.228	.723**
	Sig. (2-tailed)	.100		.400	.273	.000
	N	25	25	25	25	25
AvgOfF2	Pearson Correlation	-.337	-.176	1	-.157	-.338
	Sig. (2-tailed)	.100	.400		.452	.099
	N	25	25	25	25	25
AvgOfdB	Pearson Correlation	.191	.228	-.157	1	.351
	Sig. (2-tailed)	.359	.273	.452		.085
	N	25	25	25	25	25
AvgOfQo	Pearson Correlation	.263	.723**	-.338	.351	1
	Sig. (2-tailed)	.205	.000	.099	.085	
	N	25	25	25	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

Group 2 Microphone

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