

Formant Study of 4 Male, 10 Female Voices

After receiving the two .wav files (one male, one female) from the Ling 201 class, I setup an Excel spreadsheet and made a data-capturing tool—basically, a simple form in which to enter the data. Given that we need to obtain F0, F1, and F2 for 14 individuals, that gives us 378 data points that we need to gather, so to expedite the process, I used Sony Sound Forge Studio 9.0 to further break up the files into just the content (“bead, bid, bed, bad, bud...” and so on), saving the individual files using the <name>.wav pattern.

Then, using Praat, I added a TextGrid to each of these files and first of all, obtained the F0 and manually logged the values in hard-copy, and then entered the data into another Excel spreadsheet.

With the F0’s all recorded, I then used Mietta Lennes’ `get_formant_mid_point` Praat script to get the values of F1 and F2, running the script against all the “male” voice files, and then changing the values for the “female” voices and ran the script again. Adjustments were made to some of the TextGrids by Reiko Kataoka and re-distributed to the class, and the files were processed again. Some of the values were suspect, so measurements were verified manually and corrected as needed. The final corrected values for “Male” data are shown in Table 1.

Table 1: Fundamental frequency (F0) and data for formants 1 and 2 (F1, F2), American English vowels, male speakers

		Vowel									
		i	ɪ	ɛ	æ	ʌ	ɑ	ɔ	ʊ	u	
F0	1	124	118	107	103	105	101	96	100	93	
	2	161	148	136	130	131	123	130	149	112	
	3	130	116	107	102	101	103	101	112	98	
	4	161	148	136	138	132	141	143	157	134	
F1	1	267	428	577	714	569	699	749	517	381	
	2	317	448	553	652	633	723	829	492	228	
	3	275	458	627	1006	911	702	668	376	346	
	4	243	480	753	954	902	762	715	1067	781	
F2	1	2219	1888	1844	1706	1418	1207	1278	1247	1297	
	2	2120	1775	1675	1746	1328	1168	1330	1109	1615	
	3	2524	2029	1916	1298	1494	1050	1046	1142	1184	
	4	2149	1909	1719	1556	2424	1762	1631	2301	2322	

The final verified values for all “Female” file data are shown in Table 2.

Table 2: Fundamental frequency (F0) and data for formants 1 and 2 (F1, F2), American English vowels, female speakers

		Vowel								
		i	ɪ	ɛ	æ	ʌ	ɑ	ɔ	ʊ	u
F0	1	277	256	242	142	229	235	110	229	218
	2	254	264	227	213	223	151	139	120	169
	3	238	229	224	190	207	167	188	191	301
	4	230	197	185	90	141	146	177	207	170
	5	189	167	152	143	145	137	127	254	123
	6	223	181	207	192	189	183	187	239	181
	7	219	245	234	203	248	199	241	205	197
	8	202	165	183	134	182	123	181	190	153
	9	239	223	210	195	199	189	188	234	187
	10	208	196	183	176	193	183	176	205	176
F1	1	301	547	756	935	777	960	989	616	1854
	2	429	586	735	1134	769	986	1090	733	1025
	3	376	529	759	915	680	857	860	562	1430
	4	267	595	1023	1000	1032	1129	1046	1170	1150
	5	289	513	652	886	712	992	1270	1152	1360
	6	354	583	571	836	1077	1244	820	692	1763
	7	502	427	720	931	988	1007	875	493	245
	8	282	576	610	968	805	939	1015	963	1758
	9	514	528	747	964	700	1061	1420	1390	1842
	10	370	414	523	905	501	667	797	420	373
F2	1	2726	2300	2099	1891	1809	1476	1594	1392	3131
	2	2941	2174	2070	1870	1756	1553	1477	1527	2852
	3	2628	2152	2061	1758	1897	1534	1693	1364	2295
	4	2800	2207	1884	1839	1626	1439	1649	2702	2687
	5	2555	2009	1895	1737	1662	1251	2638	2312	2564
	6	2830	2137	2073	1948	1456	1387	1699	2081	2738
	7	2706	2614	2185	1780	1750	1706	1603	1235	1643
	8	2728	2140	2146	1832	1649	3105	1955	1738	2791
	9	2414	2109	2084	1841	1865	1542	1451	2018	2784
	10	2607	2326	1956	1848	1824	1716	3164	1000	1125

Note that many speakers represented in this data are speakers of English as a second language, and that native languages include Farsi, Spanish, and Japanese. The female speakers outnumbered the male by 2.5 to 1.

Table 3 (next page) shows the mean and median for all Male and Female F1 and F2 values.

Table 3: Mean and median values for F1 and F2, American English vowels, 4 male and 10 female speakers

	Mean				Median			
	F1		F2		F1		F2	
	Female	Male	Female	Male	Female	Male	Female	Male
i	358	389	2497	2016	348	442	2539	1964
ɪ	530	482	2147	1963	547	564	2139	1880
ɛ	705	747	1982	1661	706	712	2012	1714
æ	936	813	1805	1596	902	753	1817	1573
ʌ	806	682	1640	1472	754	692	1660	1370
ɑ	918	526	1384	1706	932	479	1417	1840
ɔ	860	584	1339	1374	902	599	1433	1284
ʊ	567	632	1255	1452	568	606	1235	1223
u	412	570	1483	1431	393	514	1495	1240

Plotting the values using Praat did not result in a very readable image, but I include it nonetheless. Figure 1 is the best of several different attempts.

Figure 1: Formant Plot, Male and Female, with confidence ellipses (sigma ellipses set to 2.45)

