A Look at English [ow] and [ol]

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1 Introduction

The inspiration for this investigation was a particular person's pronunciation of a particular word. This was *both*, as pronounced by David Chudzicki. Instead of the expected [bowθ], it sounded as if he was producing [bolθ]. I was initially curious both as to whether this was a regular phonological change and to how he might come to have this variant.

It is possible that because [l] pulls the second formant down while [w] additionally pulls the first formant up that variations between [w] and [l] might be 'easier' in some fashion. Before trying to make an argument about this, though, I wanted to have some measured formant values to be basing claims on.

2 Methods and Materials

I recorded subjects on a word-list containing words in three categories. The first consisted of words that I believed were minimal pairs in American English. From these I hoped to get an idea of how [l] and [w] contrasted after [o]. They were,

[l]	[w]
bowl	bow
bolt	boat
knoll	know
gold	goad
soul	sew
mold	mode

The second category was smaller, and consisted of the words on which I expected variation. They were,

both folk yoke yolk moment poke Polk polka

The final category was filler words, included both to keep the subjects from getting suspicious and to prevent them from getting used to the vowel. All these words were then shuffled by a computer program that randomly arranged them into a list, with each word repeated three times. The list was then broken up into seven word segments and arrainged in columns on a page.

The subjects were instructed to read each block of seven words as if they were a sentence, pausing briefly after each block. This experimental paradigm was somewhat different from previous ones we'd used, lying somewhere between a list reading and a carrier sentence.[1]. I used this paradigm because I could get lots of examples in mostly natural positions without tremendously long recordings that would have annoyed my subjects and taken a long time to analyze.

For this paper I use data from four subjects. They were,

[1] In a list reading paradigm, to get examples of word X, the subject reads X several times, as in "X, X, X". Alternately, one can use a carrier sentence, in which the tested word is embedded in a sentence, as in "I said X to John.".

Name	Age	Gender	From
David German	20	male	St. Louis, Missouri
Venger Jamison	19	male	New Jersey
Michael Stone	21	male	Maryland
David Chudzicki	20	male	Upstate New York

While I could have varied age and gender, the sample is small and I didn't want additional, possibly confounding factors.

We recorded the subjects reading the lists with a Plaintronics DSP-400 noise canceling microphone and used the software program Praat to calculate formant values. For each word we recorded the values for the first and second formants at the point in the vowel at ther point where they were closest together. The charts below show the three repetitions of each word with their first two formant values (F_1 and F_2), in addition to both their difference and the average of their difference.

3 Data

3.1 David German

	1			2			3			Avg.
Word	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	$F_2 - F_1$
bow	432	1181	749	405	952	547	326	765	439	578
bowl	371	577	206	458	513	55	446	514	68	110
boat	351	977	626	345	1025	680	318	988	670	659
bolt	426	491	65	336	522	186	464	530	66	106
know	599	1319	720	353	928	575	402	1264	862	719
knoll	413	548	135	407	570	163	471	564	93	130
goad	348	955	607	365	1337	972	324	937	613	731
gold	422	441	19	351	500	149	388	530	142	103
so	368	1120	752	414	1090	676	543	1226	683	704
soul	455	520	65	464	536	72	433	672	239	125
mode	334	1135	801	462	1142	680	374	1124	750	744
mold	427	488	61	331	585	254	522	568	46	120
poke	405	1032	627	412	1212	800	401	1000	599	675
Polk	322	430	108	376	500	124	458	536	78	103
polka	421	581	160	406	689	283	511	643	132	192
yoke	375	832	457	375	1126	751	398	789	391	533
yolk	480	510	30	457	584	127	579	721	142	100
folk	451	523	72	463	646	183	416	509	93	116
moment	523	1065	542	447	789	342	436	790	354	413
both	379	1187	808	368	1263	895	373	1192	819	841

3.2 Venger Jamison

	1			2			3			Avg.
Word	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	$F_2 - F_1$
bow	–	–	–	–	–	–	–	–	–	–[2]
bowl	465	623	158	526	587	61	477	597	120	113
boat	502	1139	637	369	1143	774	417	1260	843	751
bolt	587	623	36	441	501	60	538	597	59	52
know	535	1079	544	448	874	426	519	1183	664	545
knoll	599	659	60	514	648	134	526	745	219	138
goad	479	1348	869	446	1207	761	393	1101	708	779
gold	487	516	29	533	755	222	496	716	220	157

	1			2			3			Avg.
Word	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	$F_2 - F_1$
so	501	916	415	380	1042	662	519	1271	752	610
soul	578	627	49	472	558	86	538	611	73	69
mode	394	1175	781	402	1078	676	524	952	428	628
mold	566	656	90	472	656	184	–	–	–	137
poke	432	1005	573	351	929	578	485	1111	626	592
Polk	502	624	122	456	737	281	570	608	38	147
polka	478	884	406	503	865	362	476	733	257	342
yoke	392	904	512	548	1186	638	430	1115	685	612
yolk	696	818	122	459	692	233	574	680	106	154
folk	523	739	216	562	661	99	529	785	256	190
moment	581	1333	752	535	1029	494	602	964	362	536
both	443	1188	745	516	779	263	520	653	133	380

3.3 Michael Stone

	1			2			3			Avg.
Word	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	$F_2 - F_1$
bow	416	1020	604	539	1050	511	606	838	232	449
bowl	502	679	177	586	733	147	497	615	118	147
boat	482	1130	648	487	993	506	249	1084	835	663
bolt	613	698	85	430	546	116	592	698	106	102
know	725	949	224	507	983	476	356	1156	800	500
knoll	558	626	68	387	782	395	586	736	150	204
goad	445	1036	591	408	1093	685	343	1121	778	685
gold	530	617	87	549	759	210	343	541	198	165
so	–	–	–	289	963	674	334	864	530	602
soul	526	645	119	517	607	90	551	642	91	100
mode	472	1074	602	459	992	533	504	1117	613	583
mold	598	692	94	401	699	298	336	732	396	263
poke	462	827	365	627	1038	411	546	975	429	402
Polk	495	902	407	594	704	110	531	860	329	282
polka	512	968	456	514	854	340	504	841	337	378
yoke	515	1136	621	430	1012	582	509	974	465	556
yolk	518	763	245	699	819	120	580	1024	444	270
folk	522	913	391	330	717	387	575	932	357	378
moment	389	847	458	353	848	495	432	1034	602	518
both	478	1074	596	495	1069	574	448	802	354	508

3.4 David Chudzicki

	1			2			3			Avg.
Word	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	$F_2 - F_1$
bow	624	1280	656	507	1228	721	680	1069	389	589
bowl	505	828	323	650	699	49	–	–	–	186
boat	540	1225	685	563	987	424	505	1248	743	617
bolt	540	669	129	563	745	182	524	725	201	171
know	670	1421	751	646	1202	556	648	1408	760	689
knoll	593	678	85	560	786	226	558	687	129	147
goad	527	1409	882	550	1203	653	614	1259	645	727
gold	493	649	156	527	682	155	452	592	140	150

[2]The speaker pronounced the ambiguously written *bow* as the action rather than the knot, and so the resulting measurements wouldn't be useful to compare with *bowl* and the others.

	1			2			3			Avg.
Word	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	F_1	F_2	$F_2 - F_1$	$F_2 - F_1$
so	535	1466	931	521	1204	683	640	1329	689	768
soul	557	763	206	535	706	171	598	646	48	142
mode	555	1203	648	543	1242	699	663	1179	516	621
mold	–	–	–	609	721	112	518	760	242	177
poke	626	1249	623	532	1296	764	606	1228	622	670
Polk	556	1228	672	562	1212	650	588	1086	498	607
polka	550	1242	692	576	1144	568	529	1281	752	671
yoke	570	1564	994	735	1696	961	614	1376	762	906
yolk	561	1265	704	597	1290	693	626	1294	668	688
folk	587	1158	571	648	1266	618	624	1127	503	564
moment	590	1051	461	607	1029	422	403	892	489	457
both	693	750	57	667	714	47	527	839	312	139

4 Discussion

For the minimal pairs, the words with [l] consistently had substantially closer F_1 and F_2 values than those with [w]. In the table below, we have the minimum average difference for words with no [l] and the maximum for words with an [l], by speaker.

Speaker	Min [w] diff	Max [l] diff
David German	578	125
Venger Jamison	545	157
Michael Stone	449	263
David Chudzicki	589	186

This data suggests that the cutoff for hearing an [l] instead of a [w] is somewhere between 450 Hz and 250 Hz. Nearly every recorded sample from the minimal pairs section classified properly under this criteria, with the exception of about five distributed words which are likely errors.

We can then apply this filter to the test words to see which speakers use [l] and which use [w]. The table below has 'x' for each word that had an apparent [l], and '?' for those that are in the middle.

Speaker	poke	Polk	polka	yoke	yolk	folk	moment	both
German	-	x	x	-	x	x	-	-
Jamison	-	x	?	-	x	x	-	?
Stone	-	?	-	-	?	?	-	-
Chudzicki	-	-	-	-	-	-	-	x

Both German and Jamison appear to be putting [l] in words that are spelled with *l* while Chudzicki doesn't. Stone is somewhere in between. Because this was a formal setting and people were reading, I would expect this [l] inclusion frequency to be higher than normal. *Yolk* and *yoke* are often listed as homophones, and there are on-line guides telling people when to write one and when the other. This suggests that there are large numbers of people who no longer make this distinction. English orthography is nice in some ways because it preserves distinctions that people do not always make, such as *wh*/*w* or, in this case, *ol*/*o*. While I would want to do further testing, it seems likely that a sound change has turned /l/ to /w/ in the environment /o_k/, and that this change has not get gone to completion.

As for *both*, it is clear that Chudzicki pronounces it with an [ol] in place of an [ow], but it is not clear why. It may have to do with some sort of hypercorrection, either on his part or the part of someone he heard as a child. He is not the only one that does it, and *bolth* is more common a spelling than you would expect as a typo.[3] Now that the phonetic distinction between *both* and *bolth* is clear, it would be interesting to do further testing to find out where it is common and where not.

[3]Searches with the search engine Google on April 27 turned up 71,000 hits for *bolth*, as opposed to 632 for *bopth* and 627 for *bokth*.