David Bolter
Dissertation Defense
May 3, 2022

Liquid Enhancement, Liquid Polarization And Bavarian German L-Rounding

1. Introduction

- This dissertation presents a phonetically-informed phonological analysis of vowel + lateral sequences in the Southeastern region of Bavarian German, covering much of Southeast Austria.
- Terminological note: *Bairisch* 'Bavarian' ≠ *Bayerisch* 'Bavarian (region of Germany)'.
- In these dialects, front vowel + lateral sequences i.e. /il el ɛl/ are realized as [y⌊ ø⌊ œ⌊], with a rounded vowel and a retroflex lateral. I call this phenomenon L-ROUNDING.
- For example, the vowel in the Standard German word [fiːl] *viel* 'many' is realized as [fy⌊].
- Specifically, this dissertation is geared towards the Region A dialects, described in the table in (1).

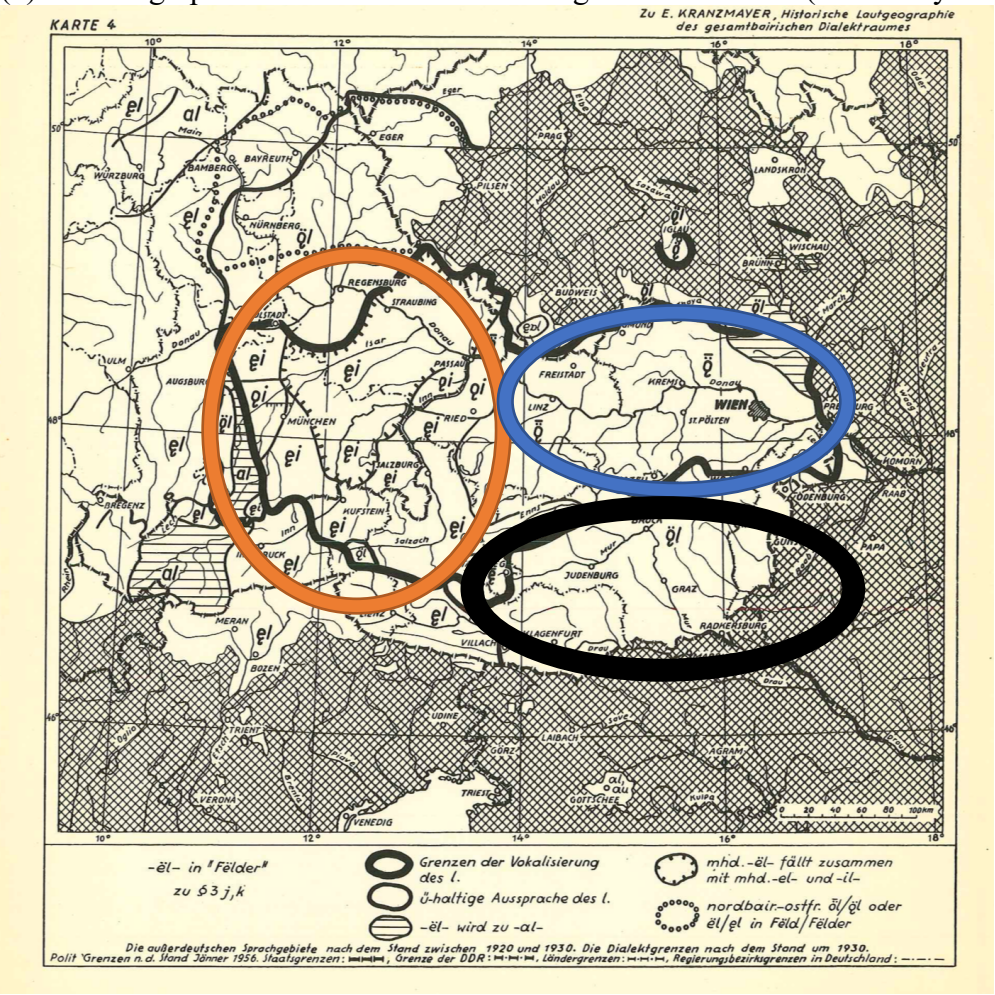
(1) Data for three different Austrian German varieties of vowels before /l/[1]

Environment	MSG	Gloss	Region A	Region B	Region C
/il/	*Spiel*	'game'	[ʃpy⌊]	[ʃpyː]	[ʃpui]
/el/	*stellt*	's/he plays'	[ʃtø⌊t]	[ʃtøːt]	[ʃtoit]
/ɛl/	*Feld*	'field'	[fœ⌊d]	[fœːd]	[fɔid]
/al/	*Weile*, *weil*	'a while, while'	[waː⌊]	[wæ̂ɣ]	[wæɪ̯]
/ɔl/	*alt*	'old'	[ɔ⌊t]	[ɔit]	[ɔit]
/ol/	*Holz*	'wood'	[hu⌊ts]	[hoits]	[hoits]
/ul/	*Schuld*	'guilt'	[ʃu⌊d]	[ʃuid]	[ʃuid]

[1] Similar data can be found in Rein (1974) and the sources in the descriptions cited below. In Rein's work, the lateral is transcribed as a palatal lateral approximant [ʎ], a transcription which I reject in this work. Kranzmayer (1956: 120, Map 4), describes the lateral in virtually all varieties of Bavarian as *ü-haltig* and uses the transcription [ʎ], although it is not clear what type of lateral that symbol represents. I argue extensively below that this sound should be understood as a retroflex lateral, transcribed below as [⌊].

David Bolter
Dissertation Defense
May 3, 2022

(2) Geographic distribution of l-Rounding / l-Vocalization (Kranzmayer 1956: Map 4)



- Key: Region A (black circle), Region B (blue circle), Region C (orange circle).

- Although these data are well-known, there is no clear consensus on a phonetic motivation for l-Rounding.
- For example, Schmid et al. (2017: 104) write that "the phonetic motivation for the rounding of vowels before laterals, which has taken place in all but a few West Central Bavarian varieties, is unknown".[2] [3]
- I hope to demonstrate here that there is a clear phonetic/ phonological motivation.
- **Namely, l-Rounding is to be understood as an acoustically-driven assimilation that occurs in order to enhance the underlying contrast between /l/ and /r/.**
- In this defense, I concentrate on Chapters 2, 3 and 5.

2. Phonemic Inventory and Theoretical Background of Bavarian German

[2] Unless otherwise noted, all German quotes in this dissertation were translated by myself.
[3] German original: „die phonetische Motivation der Rundung von Vokalen vor Lateralen, die nur noch in einigen westmitteldeutschen Varietäten nicht durchgeführt wird, ist ungeklärt".

- In this section, I discuss the underlying phonemic of Bavarian German.
- Of course, Bavarian German is a collection of dialects that are not identical, but there are many commonalities across the various systems.
- Indeed, there are traditional subclassifications: North, Central, South Bavarian (cf. Russ 1989).
- In particular, the consonant system does not differ much across the varieties of Bavarian. See the figure in (3).

(3) Bavarian German Consonant System

	LABIAL		CORONAL		DORSAL		
	Bilabial	Labio-dental	Alveolar	Post-alveolar	Velar	Uvular	Glottal
Plosive	pᵘ p		tᵘ t		kᵘ k kʰ		
Fricative		fᵘ f	sᵘ s	ʃᵘ ʃ	xᵘ x		h
Affricate		p͡fᵘ p͡f	t͡sᵘ t͡s	(t͡ʃᵘ) t͡ʃ	(k͡xᵘ) (k͡x)		
Nasal	mᵘ m		nᵘ n		ŋᵘ ŋ		
Lateral			lᵘ l				
Rhotic			(r)			(ʀ)	

- An important hallmark of Bavarian German phonology is the system of ISOCHRONY, whereby short vowels are obligatorily followed by long (fortis) consonants and long vowels by short (lenis) consonants (see Pfalz 1913, Bannert 1976, Hinderling 1980, Kleber 2020 among others).[4]
- The system of Isochrony is also found in Swedish (cf. Riad 2014) / Norwegian (Kristoffersen 2000).

(4) Bavarian German Phonemic Vowel System: Monophthongs

		front	back
high		i	u
mid	[+ATR]	e	o
	[-ATR]	ɛ	ɔ
low		a	(ɑ)

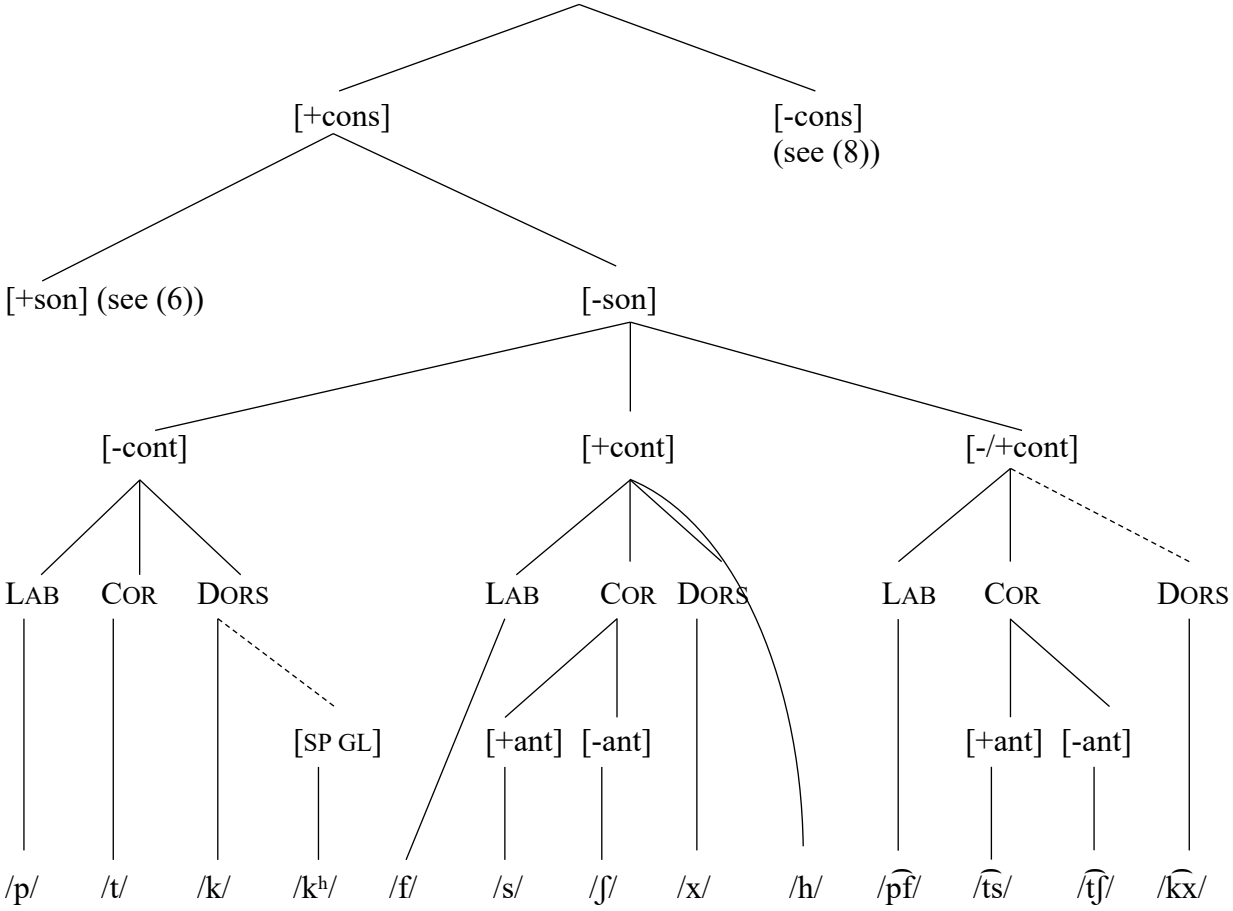
- Notably differences from Standard German: lack of front rounded vowels (=ENTRUNDUNG i.e. *Stückchen* 'little piece' with [y] and *hören* 'to hear' with [ø] would be realized with [i] and [e])
- Lack of high tense-lax contrast e.g. *bieten* 'to offer' [iː] vs. *bitten* 'to ask' [ɪ].

- We now turn to discuss the distinctive features for the phonological system of Bavarian outlined above.
- I accomplish using the CONTRASTIVE HIERARCHY framework of Dresher (2009).

[4] In contrast to North and Central Bavarian, South Bavarian (see Seiler 2005 for an analysis) has been argued to have contrastive vowel length in addition to contrastive consonantal length. For a a dialect description that falls into this category see Leitinger (1939), who describes the South Bavarian variety spoken in Sulm Valley of Southern Styria, Austria.

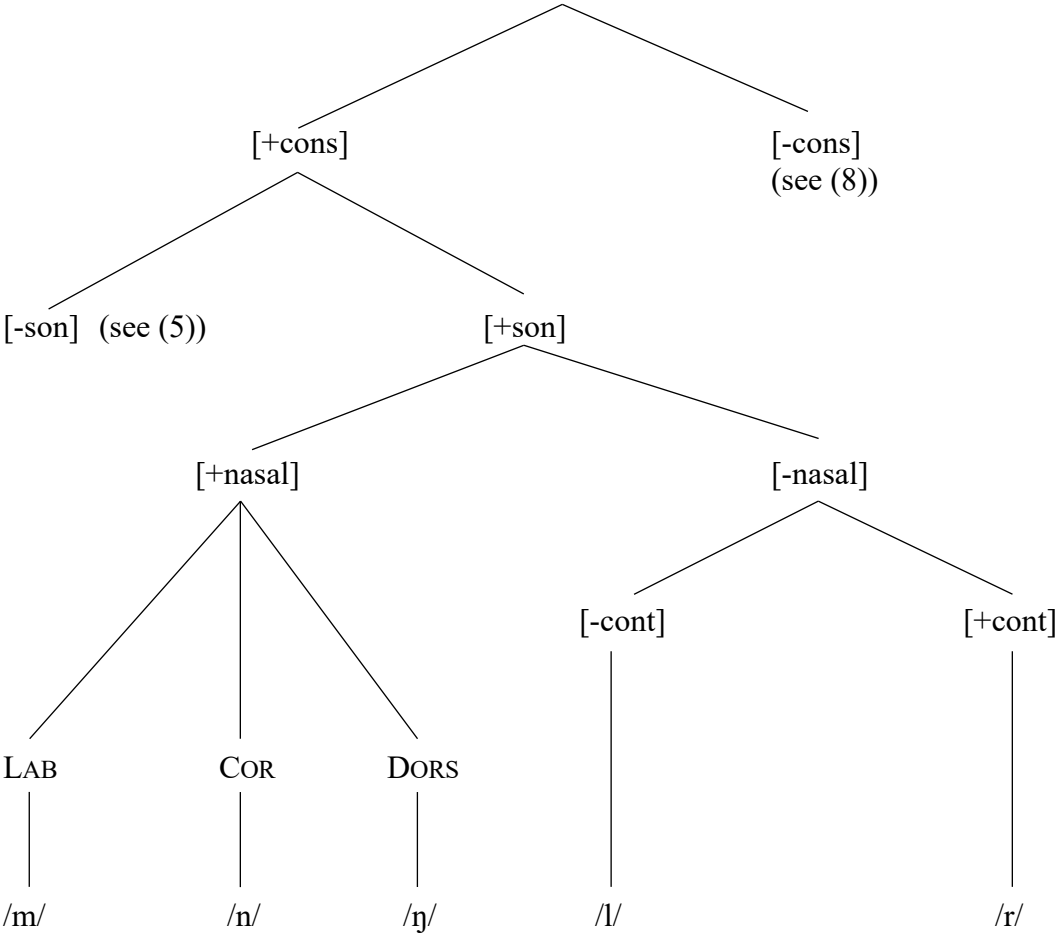
- In this framework, features are organized into a hierarchy based on the principle of phonological activity.

(5) Contrastive Hierarchy: Bavarian German obstruents[5]
[consonantal] > [sonorant] > [continuant] > LABIAL, CORONAL, DORSAL > [anterior], [spread glottis]



[5] In (5), there are two dotted lines relating to the occurrence of /kʰ/ and /k͡x/. Since no dialect has both, this means that the hierarchy differs slightly from dialect to dialect.

(6) Contrastive Hierarchy: Bavarian German sonorants
[consonantal] > [sonorant] > [nasal] > [continuant] > LABIAL, CORONAL, DORSAL

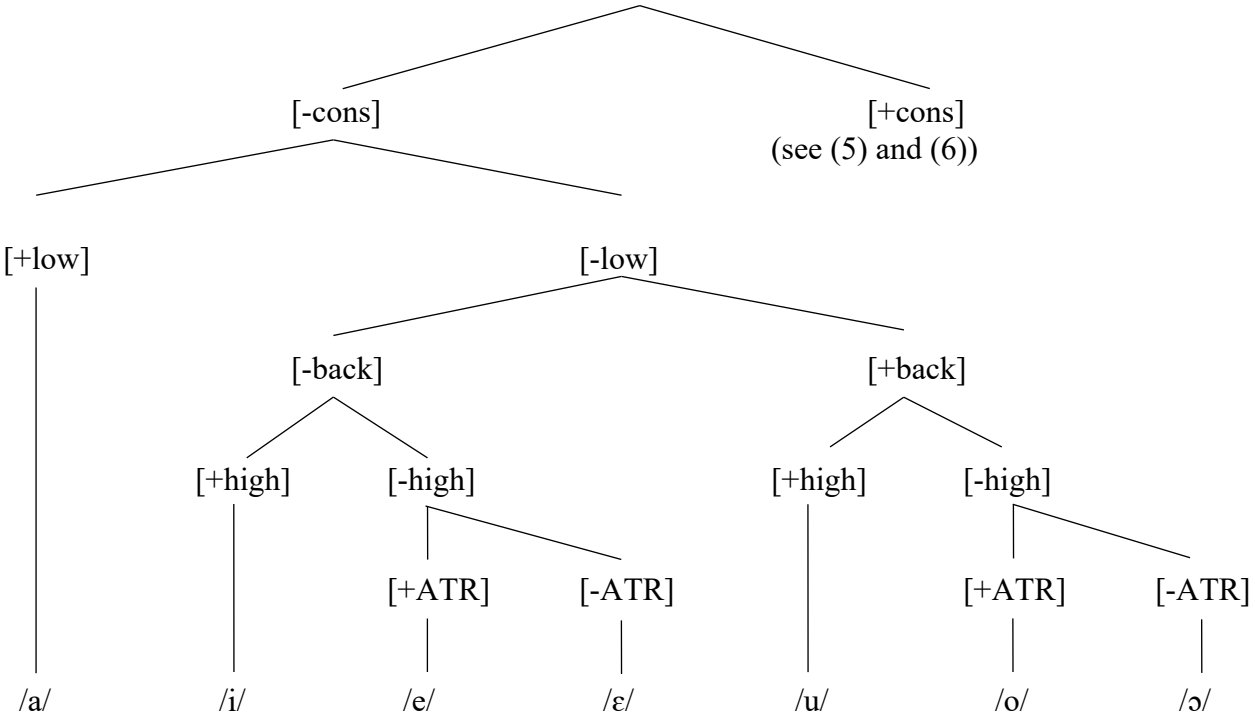


(7) Underlying Featural Specification: Bavarian German Consonants

	/p/	/t/	/kʰ/	/k/	/p͡f/	/t͡s/	/t͡ʃ/	/k͡x/	/f/	/s/	/ʃ/	/x/	/h/[6]	/m/	/n/	/ŋ/	/l/	/r/
[cons]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
[son]	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+
[nas]														+	+	+	-	-
[cont]	-	-	-	-	-/+	-/+	-/+	-/+	+	+	+	+	+				-	+
SP GL			✓															
LAB	✓				✓				✓					✓				
COR		✓				✓	✓			✓	✓				✓			
[ant]						+	-			+	-							
DOR			✓	✓				✓				✓				✓		

[6] Throughout this dissertation, I assume that /h/ is classified as an obstruent i.e. [- sonorant] rather than as a sonorant i.e. [+ sonorant]. See de Lacy (2006: 94-96 and references therein) for some discussion of this debate in the literature. The decision to classify /h/ as an obstruent does not affect my analysis in any way.

(8) Contrastive Hierarchy: Bavarian German vowels
[consonantal] > [low] > [back] > [high] > [ATR]



(9) Underlying Featural Specification: Bavarian German Vowels

	/i/	/e/	/ɛ/	/a/	/ɑ/	/ɔ/	/o/	/u/
[consonantal]	-	-	-	-	-	-	-	-
[low]	-	-	-	+	+	-	-	-
[back]	-	-	-	(-)	(+)	+	+	+
[high]	+	-	-			-	-	+
[ATR]		+	-			-	+	

- However, in addition to underlying segments given above in (3) and (4), there are also allophones that bear discussion here.

- These include the allophones of /l/ ([l ɫ]) as well as the surface allophones of /r/ ([r ʁ ɐ]).
- To account for these segments, I introduce two more features: [flat] and [grave].
- These two features are taken from Jakobson et al. (1951) and can be defined acoustically.
- Jakobson et al. (1951: 31), who write: “Flattening manifests itself by a downward shift of a set of formants or even of all the formants in the spectrum”.
- Jakobson et al. (1951: 30) on [grave]: “The position of the second formant in relation to that of the other formants in the spectrum is the most characteristic index of this feature: when it is closer to the first formant the phoneme is grave [...]”

(10) Featural specifications for liquids and their allophones

	/l/		/r/		
	[l]	[l̪]	[r]	[ʁ]	[ɐ]
[consonantal]	+	+	+	+	-
[sonorant]	+	+	+	+	+
[nasal]	-	-	-	-	-
[continuant]	-	-	+	+	+
[flat]	**-**	**+**	**-**	**-**	**-**
[grave]	**-**	**-**	**-**	**+**	**+**

(11) Featural Specification: Front Vowels

	[i]	[y]	[e]	[ø]	[ɛ]	[œ]
[consonantal]	-	-	-	-	-	-
[high]	+	+	-	-	-	-
[low]	-	-	-	-	-	-
[back]	-	-	-	-	-	-
[ATR]			+	+	-	-
[flat]	**-**	**+**	**-**	**+**	**-**	**+**

- In the remainder of this talk, I focus on the phonology of /l/ and /r/.

3. Liquid Enhancement – The Phonological Account of l-Rounding
   - Featural enhancement, as defined by Stevens et al. (1986: 426), occurs when "redundant features [=non-distinctive features] strengthen the acoustic representation of distinctive features and contribute additional properties that help the listener to perceive the distinction".
   - This is particularly likely to occur "when the perceptual distinctions signalled by distinctive features are weak" (Stevens et al. 1986: 426).
   - Using the previous section as a basis, the section introduces the data for l-Rounding dialects of Bavarian German.
   - Let us now consider some relevant data sets from the dialect description of Pilz (1938).
   - Monophthongs in Semriach Basin dialect include: /i e ɛ a ɔ o /.
   - The diphthongs (not given here) include: /aɪ̯ aʊ̯ ɛɐ̯ ɔɐ̯ eɪ̯ iɐ̯ uɐ̯/.

(12) Vowels of the dialect of Semriach Basin (Pilz 1938, page as indicated)[7]

	Vowel	Example	IPA	MSG	Gloss	Page
a.	/i/	wissn̥	[wisːn̩]	*wissen*	'to know'	p. 66, §28

[7] Data sets are simplified as compared to the full versions found in the dissertation manuscript.

b.	/e/ (=[e̯ɪ̯])	nə̄its	[ne̯ɪ̯ːt͡s]	*Netz*	‘net’	p. 48, §24
c.	/ɛ/	lē·m	[lɛː.m̩]	*leben*	‘to live’	p. 39, §19
d.	/a/	lāfn̥	[laːfn̩]	*laufen*	‘to walk, run’	p. 39, §19
e.	/ɔ/	mo̥χχɒn	[mɔxːɐn]	*machen*	‘to make’	p. 40, §21
f.	/o/ (=[oʊ̯])	fōukl̥	[foʊ̯ːkl̩]	*Vogel*	‘bird’	p. 41, §21
g.	/u/	fuks	[fuks]	*Fuchs*	‘fox’	p. 77, §32

- However, before /l/ the surface vowels are: [y ø œ a ɔ u].
- The /l/ in this position is described by Pilz (1938) as *zerebral* ‘cerebral’ and transcribed |ɬ|.

(13) Vowels before /l/ in the dialect of the Semriach Basin (Pilz 1938, page as indicated)

	Context	Example	IPA	MSG	Gloss	Page
a.	/il/ (=[y˽])	pült	[py˽t]	*Bild*	‘picture’	p. 67, §28
b.	/el/ (=[øʏ̯˽])	höül	[høʏ̯˽]	*Hölle*	‘hell’	p. 49, §24
c.	/ɛl/ (=[œː˽])	kχö̥ɬɒ	[kxœ˽ːɐ]	*Keller*	‘cellar’	p. 61, §26
d.	/al/ (=[a˽])	štał	[ʃta˽]	*Ställe*	‘stables’	p. 55, §24
e.	/ɔl/ (=[ɔ˽])	wō̥ɬt	[wɔː˽t]	*Wald*	‘forest’	p. 45, §24
f.	/ol/ ~ /ul/ (=[u˽])	wuł	[wu˽]	*Wolle*	‘wool’	p. 71, §30

- The pattern that emerges from (13) is the following:
  - front vowel + lateral sequences surface with a front rounded vowel followed by a retroflex lateral.
  - back vowel + lateral sequences surface a back vowel followed by a retroflex lateral.
  - Furthermore, in Pilz (1938), both /ol/ and /ul/ sequences surface as [u˽]. **We will return to this observation later.**
- Note that syllable constituency does not matter with regard to l-Rounding i.e. *Bild* (monosyllabic) and *Keller* (disyllabic) both show the l-Rounding pattern in the same manner.

- Let us also compare the vowel outputs preceding /l/ to those preceding /r/.
- See the data in (14) and (15).

(14) /r/-Vocalization in the dialect of the Semriach Basin (Pilz 1938, page as indicated)

	Context	Example	IPA	MSG	Gloss	Page
a.	/ir/ (=[iɐ̯])	hiɒšš	[hiɐ̯ʃː]	*Hirsch*	'stag'	p. 68, §28
b.	/ɛr/ (=[ɛɐ̯])	tẹɒffɒ	[tɛɐ̯fːɐ]	*Dörfer*	'towns'	p. 74, §30
c.	/ar/ (=[a])	lā	[laː]	*leer*	'empty'	p. 57, §25
d.	/ɔr/ (=[ɔɐ̯])	wǭɒ	[wɔɐ̯ː]	*wahr*	'true'	p. 56, §25
e.	/ur/ (=[uɐ̯])	pūɒk	[puɐ̯ːk]	*Burg*	'castle'	p. 155, §55

(15) Vowels before heterosyllabic /r/ in the Semriach Basin (Pilz 1938, page as indicated)

	Context	Example	IPA	MSG	Gloss	Page
a.	/ir/ (=[ir])	pɒ(n)īrɒ	[pɐ.(n)iː.rɐ]	*bei ihr* (*sich*)	'with her(self)'	p. 36, §16
b.	/ɛr/ (=[ɛɐ̯r])	mē̩ɒrɒ	[mɛɐ̯ː.rɐ]	*mehrere*	'several, various'	p. 156, §55
c.	/ar/ (=[ar])	nārìš	[naː.rɪʃ]	*närrisch*	'foolish, silly'	p. 156, §55
d.	/ɔr/ (=[ɔɐ̯r])	pfǭ̩ɒrɒ	[p͡fɔɐ̯ː.rɐ]	*Pfarrer*	'minister'	p. 156, §55

- Note that according to Pilz (1938), the syllable onset (= consonantal r) realization is always the tongue tip [r]. **In my speaker recordings, I also found the uvular [ʁ].**

- In order to account for the data given in (12) through (15), I propose the following phonological rules.

(16) Liquid Enhancement 1 (abbreviated as LE 1):
[+ son, + cons, - nas, α cont] → [-α flat] / [- cons] _____

Equivalent to:
/l/ → [l̝] / Vowel _____
/r/ → [r] / Vowel _____

(17) Liquid Enhancement 2 (abbreviated as LE 2):
[+ son, + cons, - nas, + cont] → [+ grave]

Equivalent to: /r/ → [ʁ]

(18) Flat Assimilation:
[- cons, -low] → [α flat] / ___ [α flat]

Equivalent to: /i e ɛ/ → [y ø œ] / _____ [l̰]

(19) r-Vocalization:
[+ son, + cons, - nas, + cont, - flat] → [- cons] / ____]$_{\sigma}$

(20) Derivations in four words

	/pilt/ ‘picture’	/kxɛlᵘr/ ‘cellar’	/mɛr/ ‘more’
LE 1	pi̯lt	kxɛ̯l̰r	mɛr
LE 2	----	kxɛ̯l̰ʁ	mɛʁ
Flat assimilation	py̯lt	kxœ̯l̰ʁ	----
r-Vocalization	----	kxœ̯l̰ɐ̯	mɛɐ̯
	[py̯lt]	[kxœ̯l̰ːɐ̯]	[mɛɐ̯ːˑ]

4. Liquid Polarization – The Phonetic Motivation for l-Rounding
   - The term Liquid Polarization, which I borrow from (Carter & Local 2007, McDougall & Jones 2011), refers to the generalization that all other things being equal, surface allophones of /r/ and /l/ are as acoustically distinct as possible.
   - In the l-Rounding dialects of Austrian German, the surface allophones of /l/ include [l] and [l̰], whereas /r/ has the surface allophones [r], [ʁ] and [ɐ]. This is summarized in (21).

(21) Distribution of liquid allophones

	Word-Initial Position	Word-medial Onset Position	Coda Position
/r/	[r] / [ʁ]	[r] / [ʁ]	[ɐ]
/l/	[l]	[l̰]	[l̰]

- I argue in this section that the pattern of l-Rounding follows straightforwardly from Liquid Polarization.
- Consider the table in (22), which presents the formant values of /r/ and /l/ allophones.

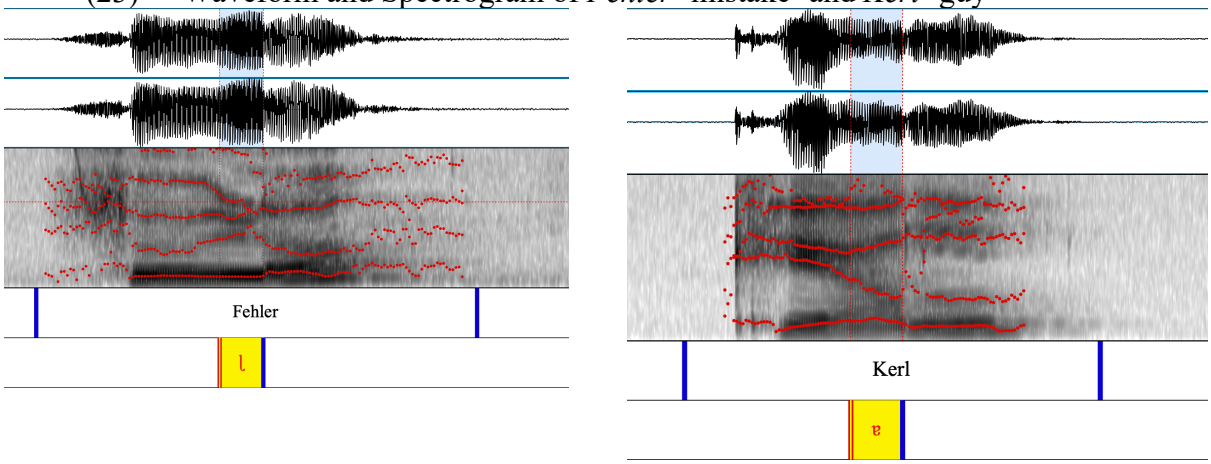
(22) Acoustic summary of /r/ vs. /l/

		F1	F2	F3	F4	F3-F2	F2-F1	
/r/	#rV	475	1707	2739	3779	1032	1232	n=65
	#ʁV	471	1421	2855	3742	1434	949	n=139

	Vɐ]$_{\sigma}$	586	1643	2734	3950	1091	1057	n=118
	V.r	476	1771	2764	3706	993	1295	n=33
	V.ʀ	477	1551	2793	3731	1242	1075	n= 69
	Average	505	1575	2786	3801	1211	1070	n=424
/l/	#lV	376	1787	2815	3855	1028	1411	n=185
	V]$_{\sigma}$	459	1665	2301	3272	635	1206	n=88
	V.l	407	1683	2244	3124	561	1275	n=102
	Average	404	1730	2539	3520	809	1326	n=375

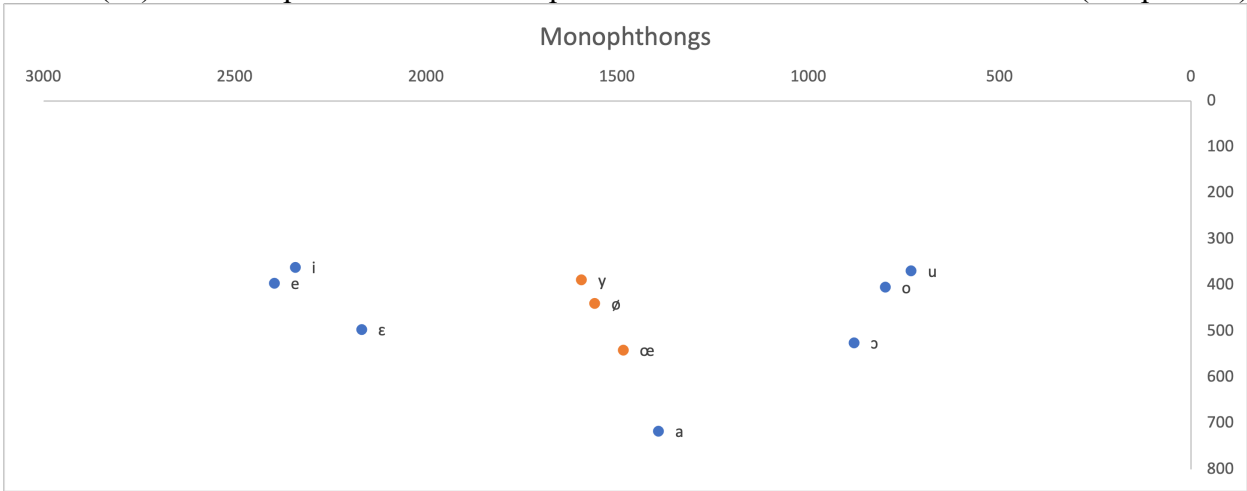
- In (22), it can be seen that the post-vocalic allophones of /l/ (= 'V]$_{\sigma}$' and 'V.l') have significantly lower F3 values than all allophones of /r/.
- Therefore, the [l] meets the definition of [flat] provided earlier, in the sense that [l] has comparatively low values of F3 and F4.
- Consider also the waveforms and spectrograms given in (23).

(23) Waveform and Spectrogram of *Fehler* 'mistake' and *Kerl* 'guy'



- Next, we may turn to Flat Assimilation. Can we find evidence for this in the phonetics of Austrian German?
- In order to substantiate this claim, I collected data with 16 speakers from in and around Graz, Austria.
- The procedures used for obtaining these data are described in Chapter 4 and the appendix provides a list of all stimuli.

(24) Scatterplot of F2 vs. F1 for phonemic vowels and l-Rounded vowels (15 speakers)



(25) Monophthong Inventory

	F1	F2	F3	F4	F3-F2	F2-F1	
[i]	361	2342	3034	3999	692	1981	n=183
[e]	395	2397	3013	3924	617	2001	n=139
[ɛ]	496	2169	2809	3960	640	1672	n=94
[a]	717	1392	2610	3884	1219	675	n=271
[ɔ]	525	880	2664	3716	1784	355	n=127
[o]	405	799	2625	4018	1826	394	n=79
[u]	369	731	2533	3657	1802	363	n=183
[y]	389	1593	2249	3540	656	1205	n=44
[ø]	440	1559	2463	3646	904	1119	n=39
[œ]	541	1484	2470	3697	985	943	n=46

- Note here that [o] has the highest F4 value of all vowels.
- I suggest in Chapter 5 that this could be the motivation for /ol/ sequences to be realized as [u[].

(26) Retroflex Lateral in comparison to high vowels

	F1	F2	F3	F4	F3-F2	F2-F1	
[i]	361	2342	3034	3999	692	1981	n=183
[y]	389	1593	2249	3540	656	1205	n=44
[[]	431	1675	2270	3193	595	1243	n=190
[i] – [[]	-70	667	764	806			
[y] – [[]	-42	-82	-21	347			

(27) Retroflex Lateral in comparison to high-mid vowels

	F1	F2	F3	F4	F3-F2	F2-F1	
[e]	395	2397	3013	3924	617	2001	n=139

[ø]	440	1559	2463	3646	904	1119	n=39
[l̠]	431	1675	2270	3193	595	1243	n=190
[e] – [l̠]	-36	722	743	731			
[ø] – [l̠]	9	-116	193	453			

(28) Retroflex Lateral in comparison to low-mid vowels

	F1	F2	F3	F4	F3-F2	F2-F1	N
[ɛ]	496	2169	2809	3960	640	1672	n=94
[œ]	541	1484	2470	3697	985	943	n=46
[l̠]	431	1675	2270	3193	595	1243	n=190
[ɛ] – [l̠]	65	494	539	767			
[œ] – [l̠]	110	-191	200	504			

- Kranzmayer (1956) refers to the realization of /l/ as *ü-haltiges l* 'a ü-colored l sound'. This is very much what we find in the phonetic data that I have presented here.

5. Conclusion
   - I have argued that the pattern of l-Rounding in Region A is an acoustically-driven assimilation that occurs in order to enhance the contrast between /r/ and /l/.
   - It is important that this is understood acoustically, rather than articulatorily, because the relationship between lip rounding and retroflexion would not be apparent otherwise.
   - This point about the feature [flat] was also recognized by Ohala (1985).
   - Ohala (1985: 224):
     - "[*flat*] demonstrates in an even more dramatic fashion than is possible with *grave*, another acoustically defined feature with discontinuous articulatory correlates … how essential it is to keep not only the articulatory but also the acoustic correlates of speech sounds in mind when trying to figure out why speech sounds behave the way they do."

David Bolter
Dissertation Defense
May 3, 2022

References

Bannert, R. (1976). *Mittelbairische Phonologie auf akustischer und perzeptorischer Grundlage.* Lund: CWK Gleerup.

Carter, P. & Local, J. (2007). F2 variation in Newcastle and Leeds English liquid systems. *Journal of the International Phonetic Association* 37(2), 183–199.

De Lacy, P. (2006). *Markedness: Reduction and preservation in phonology* (Vol. 112). Cambridge: Cambridge University Press.

Dresher, B. E. (2009). *The Contrastive Hierarchy in Phonology*. Cambridge: Cambridge University Press.

Hinderling, R. (1980). Lenis und Fortis im Bairischen. Versuch einer morphophonemischen Interpretation. *Zeitschrift für Dialektologie und Linguistik*, 25-51.

Jakobson, R., Fant, G., & Halle, M. (1951). *Preliminaries to speech analysis : the distinctive features and their correlates.* Cambridge, Mass.: M.I.T. Press.

Kleber, F. (2020). Complementary length in vowel–consonant sequences: Acoustic and perceptual evidence for a sound change in progress in Bavarian German. *Journal of the International Phonetic Association*, *50*(1), 1-22.

Kranzmayer, E. (1956). *Historische Lautgeographie des gesamtbairischen Dialektraumes*. Vienna: Verlag der Österreichischen Akademie der Wissenschaften.

Kristoffersen, G. (2000). *The phonology of Norwegian.* New York: Oxford University Press.

Leitinger, G. (1939). *Die Mundart des oberen Sulmtales:(Lautlehre)*. Doctoral dissertation. Graz: Universität Graz.

McDougall, K. & Jones, M.J. (2011). Liquid polarisation in Australian English. *17th International Congress of Phonetic Sciences* (ICPhS XVII), 1358–1361.

Noelliste, E. (2017). *The Phonology of Sonorants in Bavarian German.* Doctoral Dissertation. Bloomington: Indiana University.

Ohala, J. (1985). Around flat. Victoria Fromkin (ed.) *Phonetic Linguistics*, *Essays in Honor of Peter Ladefoged*. Orlando: Academic Press, 223-241.

Pilz, F. (1938). *Die Mundart des Semriacher Beckens in der Mittelsteiermark*. Doctoral dissertation. Graz: Universität Graz.

Rein, K. (1974). Die mittelbairische Liquiden-Vokalisierung. *Zeitschrift für Dialektologie und Linguistik*, 21-37.

Seiler, G. (2005). On the development of the Bavarian quantity system. *Interdisciplinary Journal for Germanic Linguistics and Semiotic Analysis*, *10*(1), 103-129.

Schmid, C., Moosmüller, S., & Kasess, C. H. (2017). Geschlechtsspezifische Realisierung des velarisierten Laterals im Wiener Dialekt. *Phonetik in und über Osterreich, S. Moosmller, M. Sellner, C. Schmid, Eds. Wien: Verlag der Osterreichischen Akademie der Wissenschaften*, 99-122.

Stevens, K. N., Keyser, S. J., & Kawasaki, H. (1986). Toward a phonetic and phonological theory of redundant features. In: Joseph S. Perkell and Dennis H. Klatt (eds.), *Invariance and variability in speech processes*, 426-449.

Riad, T. (2014). *The phonology of Swedish.* Oxford, United Kingdom: Oxford University Press.

Russ, C. V. J. (1989). *The Dialects of modern German : a linguistic survey.* Stanford, California, USA: Stanford University Press.