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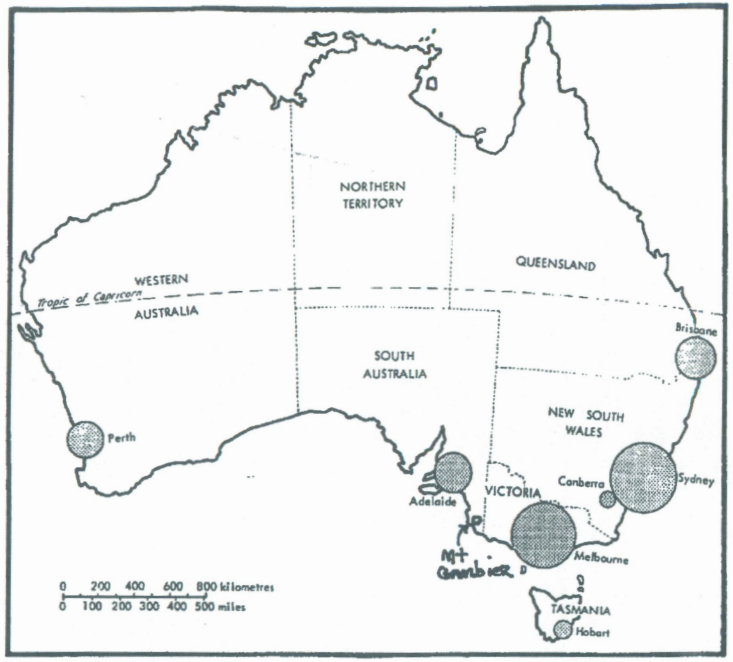
1. Introduction

A preliminary Goldvarb analysis of a sound change in progress in Australian English, the vocalization of /l/, was reported at NWAVE 24 (see Borowsky and Horvath 1997). The report was based on data collected in Adelaide, South Australia. In that report Optimality Theory is used to explain the variable linguistic patterns and in a paper delivered at the Australian Linguistic Society (Borowsky and Horvath 1996), we further argued that what variationists have called inherent variability can be represented as a struggle between faithfulness constraints, e.g., that consonant /l/ wants to remain a consonant, and markedness constraints, particularly syllable harmony constraints.

The overall aim of the /l/ vocalization project is to study the usual linguistic and social patterning of this change in progress but also to take a special look at the geographic patterns of variability. It is particularly important to examine the geographical spread of language change if only to present counterexamples to the widespread belief in Australian English studies that there is no or at best minimal geographical variation throughout the country. Our aim, however, is larger than that; we want to demonstrate that the study of the geolinguistics of sound change will yield interesting insights into the role that patterns of geography play in the spread of language change. To accomplish this task, the /l/ vocalization study has been extended in a number of ways: as a result of lessons learned from the pilot study, we have redesigned the data collection instrument to include /l/ in many more phonological environments and have collected data in many more places. We now have data from five new cities in Australia. The cities we have studied are: Brisbane, Sydney, Melbourne, Hobart and Mount Gambier; the map shows the location of these five cities and the size of the circles represents the relative size of the population. Table 1 shows the structure of the sample and the number of

speakers collected so far. The data consists of approximately 79 words for each speaker; the data have been coded—using the Language Coder—but we have only begun the variable rule analysis of the data and will be reporting on those results in the future.



Number of speakers by speech locality:

Mount Gambier (G)	46
Hobart (H)	27
Sydney (S)	28
Melbourne (M)	39
Brisbane (B)	31
Total	171

(Approx. 79 tokens per speaker (79x171=13509); 175 tokens excluded for variety of reasons, e.g., noise masking speaker, word omitted by speaker)

Table 1. Speaker Sample

Class	Gender	G	H	S	M	B
		29 Yrs and below				
Working	Female	10	5	5	8	9
	Male	9	3	1	3	5
Middle	Female	5	6	2	5	5
	Male	5	2	5	4	3
TOTAL		29	16	13	20	22
Class	Gender	G	H	S	M	B
		30 Yrs and over				
Working	Female	2	5	3	3	4
	Male	4	2	2	5	4
Middle	Female	4	1	5	4	1
	Male	7	3	5	7	0
TOTAL		17	11	15	19	9

In this paper we will would like to concentrate on the geographical aspects of the variability that we have observed. We call the approach 'geolinguistics' after the suggestion made by Chambers and Trudgill (1980). We begin by briefly contrasting our approach with the early work in dialect geography by researchers like Orton in England and Kurath in New England. Dialect geography primarily used maps to display relatively unanalyzed data and hoped that regional dialects would emerge from the maps: i.e., that either a single isogloss or bundles of isoglosses would emerge that would suggest where some dialect boundary could be located. Explanation for the patterns would then be found in terms of something like settlement history. This approach conforms with the practices of regional geography of the same era - the 1930's, '40s and '50s. With the advent of sociolinguistics in the '60's came a variety of criticisms of dialect geography, including sampling and data collection methods as well as methods of linguistic analysis. Since that time, sociolinguists following in Labov's footsteps have focussed on single speech localities and have all but abandoned geograpical variation in their determination to discover the social and linguistic patterns of variation in a single speech community. Geolinguistics seems to have been developed outside of sociolinguistics with the work of the geographer Colin Williams. In this paper we will argue for the return of geography to dialect studies with the proviso that the reinstatement needs to

take account of developments in both sociolinguistics and geography.

2. Geographical Patterns of /l/ Vocalization

Table 2 shows the number of tokens (words containing /l/) in the dataset; there are a total of 13,334 tokens in the dataset from all five cities with an overall rate of vocalization of just over 20%. However, as the 'Percent vocalized /l/' row shows, the five cities can be depicted as an implicational array, with Mount Gambier (in South Australia, where our pilot study was conducted) having the highest percentage of vocalizations followed in turn by Hobart, Sydney, Melbourne and Brisbane with the least amount of vocalization.

Table 2. Overall Statistics

	G	H	S	M	B	Total
number of tokens	3592	2127	2109	3073	2433	13,334
number of vocalized /l/	1197	545	495	366	181	2784
percent vocalized /l/	33.32	25.62	23.47	11.91	7.44	20.88

The linguistic coding of the dataset is given in Table 3(a); in the column labelled 'Linguistic Factors' there are some factors that were coded but whch have been left out here, e.g., whether or not the preceding or following consonants were voiced or voiceless, but in general these are the factors that we assume play some role in explaining the linguistic variability. Of course, we assume that the results of the Goldvarb analysis will be that only some of these factors end up accounting for the variation. In this preliminary report and for the purposes of looking at the geographical structure of the variation, we can see whether the implicational analysis can be maintained.

In an early paper on implicational analysis, Fasold (1973) made the distinction between 2-valued (presence/absence of a feature), 3-valued (presence/variable/absence of a feature) and n-ary implicational tables where a numerical value represents the frequency of a variable. The latter are more exacting because they require that the numerical values, in this case percentages, maintain

Table 3(a): Linguistic Factors x Speech locality

Linguistic Factors	Ex.	G	H	S	M	B
		Percentage Vocalized /l/				
/l/+dorsal	milk	78	48	51	33	33
dorsal+syll /l/	pickle	56	20	**30**	24	4
high/back V+/l/	cool	54	52	33	28	16
diphthong+/l/	boil	48	29	29	17	19
high V+/l/	field	46	43	32	21	13
/l/##C	feel sorry	43	35	30	18	6
/l/ is clustered	hulk	41	35	28	15	9
long V+/l/	hall	37	35	28	17	7
/l/##pause	foal	35	26	23	11	9
central V+/l/	girl	34	32	19	8	5
front V+/l/	feel	34	31	26	12	8
back V+/l/	cool	33	20	**27**	14	11
coronal+syll /l/	bottle	31	11	14	9	3
/l/ is syllabic	horrible	29	10	**16**	10	3
short V+/l/	fill	28	30	26	9	10
mid V+/l/	sell	26	20	21	7	6
low V+/l/	Mal	22	**29**	19	4	3
/l/ is coda	small	19	19	21	6	9
/l/##V	bottle of	19	8	12	6	1
/l/+labial	help	15	**41**	28	4	**21**
low/front V+/l/	Nile	14	**21**	13	2	1
labial+syll /l/	people	12	3	**10**	3	2
/l/+coronal	felt	11	10	15	2	3

Reproducibility measure: 1 - number of errors/number of cells (Miller 1991:178)

Measured across only and with ±5% tolerance: 1- 8/115 = .93

Table 3(b) Linguistic Factors x Speech Locality
(Total number of vocalizations/total number of tokens)

Linguistic Factors	Mt. Gambier	Hobart	Sydney	Melbourne	Brisbane
/l/+dorsal	71/91	26/54	28/55	26/79	20/61
dorsal+syll /l/	102/183	22/111	31/105	38/160	5/121
high/back V+/l/	196/366	111/215	73/218	87/310	41/251
diphthong+/l/	149/313	51/178	53/181	43/256	39/207
high V+/l/	497/1076	274/634	202/629	187/911	96/728
/l/##C	507/1177	246/707	208/684	179/1003	51/805
/l/ is clustered	803/1942	402/1149	315/1138	254/1648	116/1313
long V+/l/	311/851	179/511	139/499	126/731	39/583
/l/##pause	157/452	67/261	62/264	43/385	27/300
central V+/l/	201/596	72/356	64/354	43/516	22/403
front V+/l/	438/1307	31/771	196/761	135/1110	74/881

Table 3(b) continued

Linguistic Factors	Mt. Gambier	Hobart	Sydney	Melbourne	Brisbane
back V+/l/	327/1002	187/593	163/595	118/853	72/682
coronal+syll /l/	99/321	21/192	26/191	25/276	6/221
/l/ is syllabic	239/824	49/490	75/480	71/713	15/561
short V+/l/	286/1007	179/598	157/598	82/864	67/680
mid V+/l/	429/1645	193/981	204/975	103/1416	68/1114
low V+/l/	40/184	30/105	20/106	6/152	4/124
/l/ is coda	155/826	94/488	105/491	41/712	50/559
/l/##V	113/589	26/345	39/339	32/504	4/394
/l/+labial	21/137	33/81	23/82	5/119	18/86
low/front V+/l/	19/138	16/77	10/78	2/112	1/93
labial+syll /l/	38/320	6/187	18/184	8/277	4/219
/l/+coronal	63/598	35/353	54/354	10/514	12/412

an implicational ordering. Table 3(a) is an n-ary implicational table. The cells that do not fit the implicational pattern are underlined and even with the as yet unanalyzed list of linguistic factors, the reproducibility measure is a respectable .93, given 5% tolerance. This means that not only are the five cities ordered implicationally for the overall rate of vocalization but that that alignment is maintained even when we unpack the conditioning factors on /l/ vocalization to a quite delicate scale. Table 3(b) gives the number of tokens that the percentage figures represent.

Table 4 shows that the social factors also form an implicational array—with a reproducibility of .93. Once again, it is unlikely that all of these factors will be selected by Goldvarb as significant in accounting for the variability of /l/ vocalization, but it is nevertheless the case that the implications stand—speakers from Mount Gambier vocalize more than do speakers from Hobart, Sydney and so forth, no matter what the social category is—age, social class or gender.

Table 4. Social Factors x Speech Locality

Social Factors	G	H	S	M	B
	Percentage of Vocalizations				
29 or below	37	31	26	15	9
female	36	27	28	14	9
working class	35	25	**31**	11	8
30 or over	29	21	14	11	7
male	31	24	18	10	5
middle class	27	22	**34**	9	2

Reproducibility (5% tolerance): 1 - 2/30 = .93

Table 5 is an implicational table in which we extract a theoretically coherent dimension from the linguistic factors on Table 3(a). Sproat & Fujimura (1993) have shown in an articulatory study that English laterals are complex segments containing two gestures, a coronal and a dorsal one. Table 5 would indicate that some kind of place assimilation might account for the variability; /l/s are vocalized more often when in the context of back sounds (dorsal consonants and back vowels) than they are in the context of front sounds (coronal consonants and front vowels).

Table 5. Backness-Frontness Dimension x Speech Locality

Linguistic Dimension	Linguistic Factors	G	H	S	M	B
	Percentage of Vocalization					
BACK	/l/+dorsal	78	48	51	33	33
	high/back V+/l/	54	52	33	28	16
	dorsal+syll /l/	56	20	**30**	24	4
	coronal+syll /l/	31	11	14	9	3
	low/front V+/l/	14	**21**	13	2	1
FRONT	/l/+coronal	11	10	15	2	3

Reproducibility (5% tolerance): 1 - 3/30 = .90

Table 6. Following Environment (Word final /l/) x Speech Locality

/l/##X	G	H	S	M	B
	Percentage of Vocalizations				
Consonant	43	35	30	18	6
Pause	35	26	23	11	9
Vowel	19	8	12	6	1

Reproducibility (±5% tolerance): 1

Table 6 shows another linguistically coherent subset of the linguistic factors; /l/s vocalize everywhere more when followed by a consonant than when followed by a pause and least of all when followed by a vowel. Table 7 shows that vocalization occurs most often in every speech locality (with one exception) when /l/ is clustered (as in *milk*), followed by when it is syllabic (as in *people*) and least when it is a coda (as in *feel*). These facts differ from our earlier report on Adelaide where /l/ was categorically a consonant when followed by a vowel and syllabic /l/s were most frequently vocalized. A Goldvarb study just recently completed in Southend, Colchester and Norwich in England by Miriam Spero (1996) using the same data collection instrument found the following order: clustered (with a probability of .776), coda (.661) and syllabic (.554); this factor group is clearly going to prove interesting in any account of cross-dialectal comparison. Finally, Table 8 shows that the age factor holds in all speech localities, a good indicator that vocalization is a sound change in progress in all speech localities.

Table 7. Type of /l/: Clustered, Syllabic or Coda x Speech Locality

Type of /l/	G	H	S	M	B
	Percentage of Vocalizations				
Clustered	41	35	28	15	9
Syllabic	29	10	**16**	10	3
Coda	19	19	21	6	9

Reproducibility (±5% tolerance): 1-1/15 = .93

Table 8. Age x Speech Locality

Age	G	H	S	M	B
	Percentage of Vocalizations				
29 and below	37	31	26	15	9
30 and over	29	21	14	11	7

Reproducibility: 1

We have at least gained something from adding geography to sociolinguistics and that is another kind of evidence of language change in progress. But this addition is not the only or even the most important contribution we can expect of geolinguistics. Chambers and Trudgill correctly reject Bailey's statement that "Geographical dispersions can be so chaotic as to challenge the plausibility of any hypotheses about the orderliness of language." and they predict "...a fruitful interchange of hypotheses with geography," particularly concerning geographic models of diffusion (1980: 205). Colin Williams chides work in sociolinguistics for treating "...the spatial dimension of language contact and change... as either 'given' or assumed to be merely a context, a backdrop for more detailed inter-personal behavioural studies." He goes on to say: "As a reaction to this particular conceptualisation of space, a number of geographers have sought to analyze language (...) from an explicit spatial perspective." and "The most fundamental task of geolinguistics (is) the analysis of distribution patterns and spatial structure of languages ..." (1984:9). Let us now look at our results and examine how the geographical structure of the variability of the vocalization of /l/ in Australian English further contributes to our understanding of how language changes.

3. A Geographical Interpretation

In this section we discuss three of the most common models used by geographers to understand change. The first, the hierarchical model, traces changes from larger to smaller cities within an urban system. The second, the cultural hearth model, focuses upon the speech locality in which an innovation first appears and from which it spreads more widely. The third model, the core–periphery model, focuses upon changes spreading from the rapidly growing periphery to the more slowly growing older core. The question posed here is which of the three models best accounts for the patterns of the geographical variability of /l/.

Figure 1 is a highly stylised representation of the hierarchical model given the Australian urban system. For our purposes, we can think of the urban system as consisting of three levels:

1. Two primate cities (Sydney and Melbourne with populations of over three million people)
2. Four capital cities with populations between 250,000 and just over 1,000,000 people (Brisbane, Adelaide, Hobart, Perth and Canberra).
3. Many country towns that are not capital cities and have smaller populations than the higher order cities. Mt. Gambier is the only country town reported on here.

If /l/ vocalisation were spreading down the urban hierarchy from Sydney, Australia's only global city, and Melbourne to the second order capital cities and then to country towns, we would expect to see the following pattern on the implicational scale: 1. Sydney, 2. Melbourne, 3. Brisbane, 4. Adelaide, 5. Hobart, and 6. Mt. Gambier. Clearly, as the numbers on the figure show, the data do not follow the model involving change down the urban hierarchy. The hierarchical change model is not here as a strawman. The majority of the studies of change/spread of innovation have reported that important changes do move down the urban hierarchy and it is commonly believed in Australia that Sydney or Sydney and Melbourne together are the speech localities where changes begin.

Figure 2 presents the same implicational ordering discussed above using the stylised representation of the Australian urban system. The frequency of /l/ vocalization is highest in Mt. Gambier and Adelaide. The graphically represented implicational

order is as follows: (Adelaide—using evidence from the pilot study) Mt. Gambier, Hobart, Sydney, Melbourne, and last Brisbane. The implicational pattern appears similar to the cultural hearth model where a change begins in a specific speech locality or region (South Australia in this case) and spreads to other speech localities.

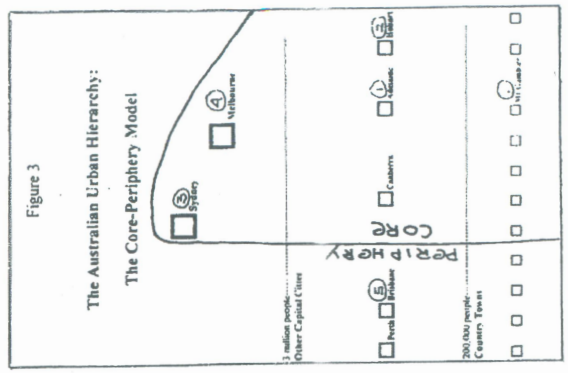
Figure 3 divides Australia into a rapidly growing periphery that includes Brisbane and Perth (Australia's Sun Belt) and the slowly growing older core (Southeastern Australia). Clearly, /l/ vocalisation is not spreading from the periphery to the core; in fact, the change is spreading from the most slowly growing parts of the older core, South Australia and Tasmania.

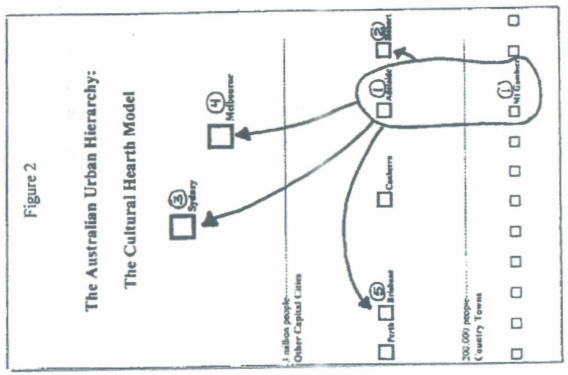
These results, would not meet the expectations of most Australians who would not imagine that innovations begin in South Australia and spread to the rest of Australia. As we have noted, most studies in fact do show that in general innovations in Australia move down the urban hierarchy rather that up from below. We now turn to a discussion of geolinguistics and its potential for adding to our ability to account for language change over time and space.

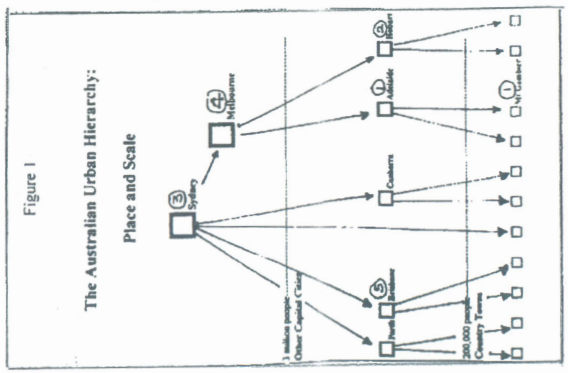
4. Conclusions

There are several conclusions that we can draw from the project as it has developed so far. There has been a tendency in Australian English studies to regard the Sydney dialect as the model for all of Australian English; the hierarchy of cities model is generally accepted by scholars and ordinary Australians alike. We have shown that Sydney is not the lead dialect for this sound change and one cannot just study the primate cities and know about the variability of Australian English. In fact there is a distinct advantage to studying the same sound change in a number of different speech localities: as we see the change beginning again and again and progressing through the linguistic system again and again, we can begin to innovations investigate innovations hypotheses about whether and to what degree the linguistic path of change is controlled by markedness considerations and whether and to what degree other contextual variables like social and geographical characteristics constrain the path of change.

What we want to focus on in this paper, however, is the fact that there is a geographical dimension to the variability of the vocalization of /l/ in Australia. In addition to having sufficient evidence from our Adelaide data to claim that /l/ vocalization is a







Circled numbers refer to implication order

change from below as sociolinguists understand that concept, our geographic analysis has indicated that it is also geographically a change from below, i.e., it is not proceeding down the urban hierarchy but rather seems to have originated in South Australia appearing in both a country town and Adelaide, the capital city. This leads us to further discussion of how we think geography ought to be reinstated in dialect studies.

We have used the term geolinguistics to describe an approach to the study of linguistic variability. We will now briefly characterize geolinguistics in two ways: 1) its relationship to sociolinguistics and 2) its relationship to dialect geography.

Geolinguistics adds a modern conception of geography to the field of sociolinguistics. Our current understanding of this project is to view geolinguistics as an approach to linguistic variation that takes into acount three structures: linguistic, social, and geographic. By linguistic we mean the analysis of language variation along the lines sociolinguists have been developing since Labov's earliest work. By social structure, we mean taking into account how social structures, especially gender, social class and age, constrain variation and change. By geographical structure, we are interested in investigating how the concepts of place, space and scale contribute to an understanding of linguistic variation and change. Recognizing the equal importance of geographic structure means that 'geography matters', i.e., that place, space and scale contribute in important ways to conditioning language change.

Let us once again compare geolinguistics with dialect geography. We suggest six important differences between them (Table 9). This table shows only two positions: what was in the past and what could be but is not yet. The table suggests that maps will need to reflect the sociolinguistic analysis and the patterns of variation and that we will need to look to geographic models before we can claim that the patterns are explained. Geography matters and it is up to future work in geolinguistics to show in what ways; in further work on the vocalizatiodialect n of /l/ in widely scattered speech localities we hope to address the question in detail. The current work linking sociolinguistics and geography by such people as Trudgill, Kretchmar and his associates, Bailey, Wikel and their associates or David Britain clearly shows that geolinguistics is rapidly becoming an important dimension in studies of sociolinguistic variation.

Table 9. Dialect Geography vs Geolinguistics

	Dialect Geography	Geolinguistics
1. SAMPLE	A very small number of speakers, often a single speaker, chosen according to predetermined selection criteria (older, rural, etc.)	A sample of speakers from a speech locality representing its gender, social class and age structure; of a sufficient number to allow tests of statistical significance to be used
2. TYPE OF ANALYSIS	Qualitative analysis	Quantitative and qualitative analysis
3. GEOGRAPHY	1930s-1950s Regional Geography framework	Geography matters, i.e., place, space, and scale become possible constraints on linguistic variation
4. MAPPING	Direct mapping of language features	Mapping of sociolinguistically analyzed features
5. RESEARCH OBJECTIVES	Use isoglosses for identifying dialects	Characterize the geographical dimension of language change in progress
6. INDIVIDUAL VS ECOLOGICAL FALLACY	Vulnerable to the individual fallacy	Both individuals and groups can be analysed and mapped

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