An Optimality-Theory-Based Analysis of Variable /l/-Vocalization in Australian English

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1. Introduction

While much of formal, theoretic linguistics today concerns itself with finding analyses of languages that ignore variability within an individual speaker's production, language variation is a very important topic for linguists to study. Most obviously, any complete study of language will explain as many of its features as possible, including the fact that language sometimes varies. Furthermore, analyses of language variability can help to shed light on other issues. Studies of phonological variation, for example, can suggest facts about phonological rules and what kind of pressures might cause a language to change. In fact, the study of language variation is inherently necessary to any study of language change, for languages tend to change gradually, going through periods of variation.

In all likelihood, most of the phonologists who have adopted Optimality Theory (OT), probably the current most popular framework for phonological analysis, did so without considering the theory's implications for the study of phonological variation. However, OT has a very interesting feature that makes it a particularly fertile system for analyses of variation within a language. This feature is the possibility of partial ranking of constraints, or "crucial nonranking" (Anttila 1997, 48). Recently, several phonologists have explored the possibility that a framework involving partial ranking may be useful for analyzing cases where variation seems to be intrinsic to a language. In fact, such a framework may even help lead to quantitative predictions about the relationship between different phonological environments and the extent to which a given variation occurs in each of them.

In a 1997 paper, Toni Borovsky and Barbara Horvarth make use of Optimality Theory to develop an analysis of the variable vocalization of /l/ in the Australian English of Adelaide. In this paper, they propose that an OT-based analysis can successfully explain their findings and make some suggestions about how to develop an analysis to do this. However, their analysis is flawed in a couple of ways. Firstly, most of the constraints that they use are not stated according to express principles of constraint development. Secondly, on account of their failure to take into account certain potential candidates, they fail to provide a unified analysis for the three different situations in which they claim /l/ can be vocalized, instead choosing to look at each situation separately.

In what follows, I will basically accept Borowsky and Horvarth's claim that Optimality Theory can play a role in analyzing the data they have gathered. In fact, their analysis will be my starting point. However, I aim to rectify the problems that I described above. I intend to provide an analysis stated in more appropriate OT-terminology that looks at /l/-vocalization as a whole. I also intend to make a serious attempt to link my analysis to the actual statistics about the differences between these three situations, examining issues of quantitative analysis as explored in Arto Anttila's 1997 paper, "Deriving Variation from Grammar," and William Thomas Reynolds' 1994 dissertation, "Variation and Phonological Theory." In summary, my hope is to provide an analysis that deals with some of the interesting facts about this data and demonstrates the phonological factors involved in this variation.

2. Borowsky and Horvarth's Data on L-Vocalization in Adelaide English

In their 1997 paper, "L-Vocalization in Australian English," Toni Borowsky and Barbara Horvarth make the proposal that OT can be used to explore the case of variation that they have been studying. In particular, this paper deals with variation in /l/-vocalization in the South Australian city of Adelaide (Borowsky & Horvarth 101). Some of this variation is caused by sociolinguistic factors, but Borowsky and Horvarth's analysis also clearly demonstrates that some of it is caused by purely linguistic factors.

The actual definition of /l/-vocalization is not completely clear in this paper. Basically, vocalization means that /l is replaced by a vowel, but Borowsky and Horvarth do not specify a single vowel that replaces /l/. In fact, in their tableaux, they represent it variously as [_], [u], and [w] (115-18). Readers can surmise that vocalized /l/ becomes a high back rounded vowel or semivowel of some sort. It is not clear from the paper whether or not the quality of this vowel actually varies systematically; in what follows, I follow Borowsky and Horvarth's example on the whole, varying their representation only slightly.

The authors used a "Quick and Anonymous Survey" to collect their data, as well as adding other (mostly working class speakers) to fill out the data. In total, 63 speakers were examined. The survey involved reading both a wordlist and a reading passage, both of which were designed to elicit pronunciations of /l/ in various phonological positions. The survey elements were as follows (Borowsky & Horvarth 103):

1) Table 1. The Wordlist and Reading Passage for the Adelaide Survey

WORDLIST		**READING PASSAGE**
Dance	Hold	**Nelson** went to the movies last night with his mate who **sells** cars. That morning he'd **sold** a Ford **Falcon** to an **old fool** for a **lot** more than it was worth. **Well,** to **celebrate** they bought some beer. In the **middle** of the **film Nel** dropped his **bottle** and **spilt** his beer **all** over his **clothes**. He **yelled, "Bloody hell,"** cursing and shouting **aloud**. A woman turned round and said, "Shut up mate. No use crying over **spilt milk."**
noodle	mask	
cool	school	
advance	skillful	
feel	plant	
help	foolish	
grasp	giraffe	
silk	Melbourne	
needle	Wooloomooloo	

From this wordlist, the authors removed *Melbourne* and *Wooloomooloo* from consideration because of complicating factors. Of the remaining words in both the wordlist and reading passage, variable pronunciation of /l/ appeared in the following words (Borowsky & Horvarth 104-5):

2) Table 2. Words with variable /l/

WORDLIST	**READING PASSAGE**
noodle	sells
cool	sold
feel	old
help	fool (for)
silk	well (pause)
needle	film
hold	Nel (dropped)
school	bottle (and)
skillful	yelled
	hell (pause)
	spilt (milk)
	milk

The remaining words, which had a categorical pronunciation of /l/, were:

3) Table 3. Words with categorical /l/

WORDLIST	**READING PASSAGE**
foolish	Nelson
	Falcon
	middle (of)
	spilt (his)
	lot
	celebrate
	all (over)
	clothes
	bloody
	aloud

What Table 2 demonstrates is that there are only certain linguistic environments that allow for variable /l/ pronunciation. /l/ is never vocalized in an onset, whether at the beginning of a word or intervocalically within one (eg, *lot, clothes,* and *foolish* all have categorical consonantal pronunciations). Therefore, /l/ only has the possibility of taking a vocalized form in cases where it appears in a coda, whether simple (eg, *cool, feel, skillful*) or complex (eg, *milk*), or in the nucleus as a syllabic consonant (eg, *bottle*) (Borowsky & Horvarth 106-107).

Borowsky and Horvarth collected precise data on how frequently L-vocalization occurred within each of these separate cases. Their results are summarized in their Table 6, as depicted in my Table 4 below (109-110). Note that, as the probabilities were calculated using a statistical method, the Goldvarb binomial step-up/down procedure (106), there is in fact evidence for a statistical difference between the three cases. Also note that the case that the authors describe as "breaking" includes words with /l/ in a simple coda:

4) Table 4. The Three Classes of L-Vocalization

Class	Probability	Phonological Environment	Examples

Class 1 (most vocalization)	.630	Cl# i.e. nuclear	noodle, bottle
Class 2 (intermediate)	.553	VVl# i.e. breaking	feel, cool
Class 3 (least)	.417	VlC# i.e. post-nuclear cluster	milk, silk

Is it possible that phonologists can explain this pattern of variation using OT? Borowsky and Horvarth believe that it is and develop a set of constraints that they use to set up an exploration of this variation. In my next section, I will attempt to explain their analysis, before describing some of my problems with this analysis.

3. Borowksy and Horvarth's OT Analysis of the Data

3.1 Background on Optimality Theory and Variation

Borowsky and Horvarth analyze /l/-vocalization using OT, attempting to make use of variable constraints to explain the vocalization phenomenon: both how it happens and why it does not happen categorically. Since OT explanations will be the focus of all of the following material, it would be useful to explore the theory briefly here, as well as to give a quick explanation of the principles behind variable analysis.

According to OT, a phonological grammar has three main components. There is a single generation function, called GEN. When an underlying form is used as input for GEN, the output is an infinite set of possible candidate surface forms. Secondly, there is a set of universal constraints on this output, called CON. Finally, there is also a ranking of the constraints, called EVAL, which evaluates the candidates from GEN, using CON, and resolves conflicts between the constraints in CON as they affect the candidates. The rankings are generally considered to be language-specific and are the reason for the differences between the phonology of different languages (Anttila 45).

Theoretically, there are two main types of constraints in OT. Markedness constraints aim at well-formed structures; an example is a constraint ruling out syllables with a coda, which would help to explain languages without codas. Faithfulness constraints, meanwhile, rule out output forms that diverge too heavily from the original input. Constraints can conflict, both within the markedness category and, in particular, between the two categories (Borowsky & Horvarth 108-9).

The key insight of OT is that a form can violate constraints and yet still be the correct form. EVAL, the ranking of constraints, ensures this – OT rejects those forms which incur higher violations. Thus, if the highest constraint that a candidate violates is ranked lower than the highest constraints that all the other candidates violate, that candidate is chosen as correct, Furthermore, if two candidate forms both violate the same constraint, this constraint does not successfully distinguish between the two, and other constraints must be used to pick out the correct form (Anttila 45). Anttila's Tableau 1a illustrates an abstract example of how the theory works:

5) Tableau 1: output = *cand*$_2$

input	A	B	C
cand$_1$	*	*!	
☞*cand*$_2$	*		*

Since both candidates violate constraint A, it does not play a role in deciding between them, and it is *cand*$_1$'s violation of the highly-ranked constraint B that decides in favor of *cand*$_2$. *Cand*$_2$'s violation of constraint C is unimportant in this case, because there is no other proposed candidate to test and *cand*$_1$ has already violated the higher-ranked constraint B (Antillla 46).

In OT as it was originally proposed, the set of universal constraints, which all apply to every language, is totally ordered for each language. Thus, each grammar corresponds to only one EVAL. Refinements in OT have led to proposals that, in fact, one grammar might in fact have several different rankings for CON, differentiating between different types of words (for example, native words and loan words in Japanese). Nonetheless, these proposals do not contradict the basic principle that every given word has only one corresponding tableau.

However, the theory does not directly rule out the possibility that the set of universal constraints is actually only partially ranked within each grammar. In other words, some of the constraints might not have a set ranking with respect to certain other constraints. This would mean that every grammar would consist of several possible rankings, each one providing its own favored output for certain words. I will go into more detail later about different proposals for partially-ranked grammars.

Borowsky and Horvarth, however, explicitly avoid making a decision about whether to use a method based on unranked or floating constraints. For their purposes, all that is important is that, within a single OT grammar, constraints can vary with respect to each other, allowing for a multiplicity of possible output forms (108). Therefore, in looking at their analysis, we do not need any sort of detailed theoretical background on how the constraints are varying.

3.2 Borowksy and Horvarth's Data on L-Vocalization in Adelaide English

Borowsky and Horvarth propose nine constraints, although they only actually make use of five of them in their tableaux (111-118). However, I will describe all nine constraints. The reader should note in advance that these authors do not stick strictly to well-accepted principles of OT constraint formation; this is one of the flaws with their proposal. I will deal with this issue in developing my own constraints, after describing theirs.

Firstly, the authors examine the role of syllabification in the vocalization of /l/. They assume that the pressure to vocalize may come from the presence of /l/ in a position, such as the coda or nucleus, where sounds of a higher sonority are preferred. Thus, they propose a family of constraints on sonority, based on the Sonority Sequencing Principle, which states that the sonority of segments in a syllable increases towards the nucleus. Therefore, these are markedness constraints which help describe the nature of a well-formed syllable. The sonority marking scale, in an abstract fashion, is as follows:

6) V > Gl > r > l > nas > fric > stop

The least important of these sonority constraints for their purposes, given that /l/ is categorically non-vocalized in onset position, is:

7) HONS**:** a lower sonority onset is more harmonic than a higher sonority onset.

The other two general sonority constraints are:

8) HNUC: a higher sonority nucleus is more harmonic than one of lower sonority

and

9) HCOD: a higher sonority coda is more harmonic than a lower sonority coda.

Note that constraint (10) proposes that the most harmonic coda is a vowel, and consequently no coda at all (Borowsky and Horvarth 111-112).

For the purposes of their discussion, Borowsky and Horvarth develop two more specific constraints based on constraint (9) and constraint (10). Since, according to (9), the most harmonic nucleus is a vowel, they propose:

10) N=V: the most harmonic nucleus is a vowel

Furthermore, since, according to (10), a vowel or a glide is a more harmonic coda than /l/ (remember, a vowel in the coda actually means no coda at all. This is potentially true of glide codas as well, as long as we assume that glides are syllabified in the nucleus.), they propose:

11) Co = Gl/V: the most harmonic coda is a vowel or glide

In actuality, the authors make use of these constraints in their tableaux rather than the more general ones proposed above (112).

Secondly, Borowsky and Horvarth suggest that syllable shape plays a role in the vocalization. Therefore, they propose markedness constraints based on the shape of syllables. These constraints are as follows (113):

12) ONSET: the most harmonic syllable has an onset

13) NOCODA: the most harmonic syllable does not have a coda

14) *COMPLEX: the most harmonic syllable has no consonant clusters

15) *___: the most harmonic syllable is bimoraic

16) *__: the most harmonic syllable is monomoraic.

The final constraint that the authors propose is a faithfulness constraint:

17) /l/=[l]: input /l/ corresponds to output [l]

This constraint is necessary to explain the variability of the system; if it did not exist, then there would be no reason for input /l/ ever to be expressed as output [_] in the cases which are actually variable, and /l/-vocalization would occur categorically (Borowsky & Horvarth 114).

3.3 Borowsky and Horvarth's Tableaux

Borowsky and Horvarth use some of these constraints to provide a separate analysis for each of their three classes; however, as one might be able to guess from the constraints that they choose, all of their analyses are based on issues of syllable structure. Their analysis of the Class 1 words is the simplest. Recall that these are the words, like *noodle* and *bottle,* which have an /l/ in the nucleus. Therefore, the pressure to vocalize can be explained simply through the prohibition on consonants in the nucleus (N=V), whilst the pressure to keep the /l/ can be explained through the faithfulness constraint (/l/=[l]) (115).

In order to provide an analysis that permits variation, Borowsky and Horvarth propose the existence of variable constraints. Therefore, they explain that these two constraints are not ranked with respect to each other. What this means is that there are two potential tableaux generated by the grammar. In one of these tableaux, N=V is ranked higher than /l/=[l], so the pressure to vocalize is more significant than the pressure to keep the /l/. The opposite is true in the other tableaux. The two tableaux, Borowksy and Horvarth's (9) and (10), look as follows:

18) Tableau 2a: output = *b_.t_*

/botl/	/l/=[l]	N=V
☞b_.t_		*
b_t_	*!	

19) Tableau 2b: output = *b_t_*

/botl/	N=V	/l/=[l]
b_.t_	*!	
☞ b_t_		*

This example clearly shows how the variation in constraint ranking can lead to, and potentially help explain, variation in output (115).

Borowsky and Horvarth's explanation of the variation in Class 2, which consists of words with /l/ in a simple coda, such as *feel* and *cool*, is slightly more complicated. They attempt to explain the variation itself with the same two constraints that they used for Class 3. However, since the /l/ is in a coda in this case, they need to come up with an explanation for why the /l/ would be placed in the nucleus in the first place. Their explanation makes use of the *___ constraint and the claim that the vowel in words like *feel* or *cool* is long in English. If the most harmonic syllables have fewer than three morae, then a syllable like [fi:l], with both a long vowel and a coda, would be ruled out by this constraint (note that Borowsky and Horvarth do not use dark /_/ in these situations, and I follow them in this section, despite the fact that the sound is clearly /_/, even in Borowsky and Horvarth's own description). If that constraint is ranked higher than the other two, the only possible solutions would be to pronounce the word as bisyllabic [fi:.l], placing the /l/ in the nucleus of the second syllable, or to vocalize the /l/ and pronounce the word as bisyllabic [fi:.u]. This decision is made depending on whether /l/=[l] or N=V is ranked higher (116). Thus, Borowsky and Horvarth basically attempt to explain their Class 1 and Class 2 in the same fashion.

Just as there were two tableaux for Class 1, there are two similar tableaux for Class 2, Borovksy and Horvarth's (11) and (12) (117):

20) Tableau 3a: output = *fi:.l*

/fi:l/	*___	/l/=[l]	N=V
fi:l	*!		
☞fi:.l			*
fi:.u		*!	

21) Tableau 3b: output = *fi:.u*

/fi:l/	*___	N=V	/l/=[l]
fi:l	*!		
☞fi:.l		*!	
fi:.u			*

The variation here works just as it did above. Very briefly, it is worth pointing out that Borowksy and Horvarth make the argument that while words with a high front vowel before [_] can only be pronounced bisyllabically, other words, like *cool*, do have a monosyllabic option (116). They suggest in passing that this can be potentially explained by ranking *___ below the other constraints, but they are not clear on why *cool* would then also have a bisyllabic pronunciation (117). Possibly, they mean to suggest that with words like *cool*, *___ is also variable with respect to both of the other constraints, but they do not explore this in depth.

The final situation is that of Class 3 words, like *milk* and *silk*, which feature /l/ in a complex coda. Borowsky and Horvarth do not try to explain these words by placing /l/ in the nucleus and using the N=V constraint, as they did with the other two classes. Instead, they turn to their coda constraint, Co=G/V, which basically plays the same role as N=V, ruling out consonants, only for codas. They also include the constraint *COMPLEX, which rules out complex codas, in their tableaux, but it is not clear why, since they rank it categorically below the two varying constraints, disqualifying it from playing any actual role. They describe the variation in Class 3 entirely through the variation between Co=G/V and /l/=[l]. When the former is ranked higher, the pressure to avoid having a consonantal coda is greater than the pressure to keep the /l/, and the /l/ is vocalized. When the latter is ranked higher, the opposite is the case. The tableaux, Borowksy and Horvarth's (13) and (14), are as follows (117-118):

22) Tableau 4a: output = *milk*

/milk/	/l/=[l]	Co=G/V	*COMPLEX
☞milk		*	*
miwk	*!		

23) Tableau 4b output = *miwk*

/milk/	Co=G/V	/l/=[l]	*COMPLEX
milk	*!		*
☞miwk		*	

Note that in this discussion, just as with *feel* and *cool*, Borowksy and Horvarth do not explain that the /l/ in [mi_k] is specifically dark [_].

4. Some Problems With Borowksy and Horvarth's Analysis

Borowsky and Horvarth's key insight about the cause for /l/-vocalization seems valuable. They argue that the pressure to vocalize /l/ comes from sonority sequencing restrictions; the less sonorant a segment is, the less desirable it is in the nucleus or coda. Replacing /l/ with a vocalic segment thus solves the problem; however, there is also pressure against this solution, stemming from the faithfulness constraint. On the whole, I accept this argument and would agree with the authors that this seems like a logical explanation for the vocalization.

However, Borowsky and Horvarth's actual analysis is flawed. Not only do their constraints fail to conform to general principles of Optimality Theory, but they also ignore certain potential candidates, and consequently do not really deal with the interaction between the constraints they set up for the three cases. Once one sets up more reasonable constraints, I think that their analysis of the Class 1 words, like *bottle,* is essentially correct. On the other hand, they fail to realize that constraints on the formation of codas will also affect the results of the tableaux for their Class 2 words, like *feel*. Similarly, they ignore the effect of the constraints on nuclei on the Class 3 words, like *milk*. In fact, I think that they excessively complicate their analysis of Classs 2 words, depending upon resyllabification of /l/ rather than allowing the coda constraints to play a role there.

First of all, let us examine the more superficial problem of Borowsky and Horvarth's constraint set. A first point is that the authors themselves do not even make use of all of their proposed constraints in developing their analysis. For example, they never once mention ONSET, NOCODA, or *__ again after their initial introduction of the constraints. While they do make use of *COMPLEX in some of their tableaux, it never actually affects the output in any way. On the whole, this is somewhat irrelevant to their actual analysis; neither ONSET nor *COMPLEX seems to affect the results one way or another. While NOCODA or *__ might theoretically play a role in the absence of *___, the latter constraint basically rules out the same forms that NOCODA or *__ otherwise would. These two constraints, therefore, seem equally irrelevant. However, that being the case, the inclusion of these constraints in the paper in the first place seems somewhat unnecessary. While constraints like ONSET and NOCODA seem somewhat logical assumptions, based on analyses of the languages of the world in general, I fail to see what they add to this particular analysis.

A more serious issue is that these constraints do not, in fact, match the appropriate way of stating OT constraints. For example, a faithfulness constraint such as /l/=[l] might be better described as FAITH/l/. Borowsky and Horvarth claim that their use of this constraint is meant as a simplification of "the complex formalisms of correspondence theory" (114), but it is not clear to me why such an unconventional constraint form is necessary for this type of simplification. As for the sonority constraints, these should really be stated in terms of actual constraints, or prohibitions against forbidden outcomes, as opposed to being stated in terms of general principles that do not, technically, specifically rule out any candidates.

Another problem is that Borowsky and Horvarth mostly avoid the issue of epenthesis. Remember that their proposal is that /l/ is vocalized in order to avoid its appearance in a nucleus or coda. However, another potential solution to this problem, in all three cases, is adding in an epenthetic /_/ (this will be explored further below). Therefore, in order to explain why vocalization occurs, all possible candidates that include a /_/ should be ruled out by a high-ranked DEP constraint, which stands for dependence. This constraint rules out any candidate outputs that include a new segment not present in the input. It is worth pointing out that, in a footnote, Borowsky and Horvarth also argue that such an epenthetic /_/ would probably not occur in English (122). Borowksy and Horvarth nonetheless ignore this requirement.

Borowsky and Horvarth also are somewhat confusing in their discussion of their Class 2 words. The problem with these words is clear when we look at Tables 2 and 3. The words with a variable /l/ that do not fit into the other two classes all have /l/ appearing in a simple coda. However, not all of the words that have /l/ in this position have variable pronunciation. Words like *Nelson* and *Falcon*, which also have /l/ in a coda position, have a categorically non-vocalized pronunciation. One might argue that the distinction between *Nelson* and *Nel (dropped)*, the latter having variable pronunciation, is that there is a word boundary after the /l/ in the latter case. Perhaps the variation is only triggered in a coda before a word boundary. However, this proposal does not explain why the /l/ in a word like *skillful* is variable. In their Table 4, Borowsky and Horvarth specifically tell us that it is the first /l/, which comes before a morpheme boundary, that varies here (106).

Borowsky and Horvarth themselves describe this class, in their Table 6, as "breaking," and depict the phonological environment as "VVl#" (110). Problematically, the authors are collapsing the distinction between the /l/ that appears before a morpheme boundary, as in *skillful*, and one that appears before a word boundary, as in *feel*. This is a difficulty for their analysis, because it is not entirely clear that these two cases can be analyzed as a single situation.

Even if this were not the case, Borowsky and Horvarth's analysis of the words is problematic in other ways. They attempt to make a distinction between words in this class that have a high front vowel and those with other types of vowels. They claim that the former type of word, such as *feel*, *hail*, or *file*, cannot be pronounced monosyllabically. Other words, such as *coal* and *cool*, can be pronounced monosyllabically or bisyllabically (116).

Unfortunately, no available phonological analysis supports this claim. Any obvious explanation would be based on feature geometry. However, the /l/ in Australian English is distributed just like the /l/ in RP; it is always dark in coda position (Turner 105). A dark [_] theoretically has the feature [+back], just as the vowels in *coal* and *cool* do. The vowels in *feel*, *hail*, and *file* all have the feature [-back]. One might argue that the [+back] of the dark [_] and the [+back] of the vowels in *cool* and *coal* could not both appear in the same syllable because of an obligatory contour principle, but this is exactly the opposite of the desired result. There is certainly no obvious reason why the [-back] feature attached to the vowels in *feel*, *hail*, and *file* could not appear with the [+back] of the dark [_]. Thus, this aspect of the authors' analysis of Class 3 words is also flawed.

The final problem with Borowsky and Horvarth's analysis is that they fail to take into account the many possibilities for syllabification. Since the /l/ is in the nucleus already in a Class 1 word like /*botl*/, there is not really any other way to syllabify the word; the /l/ here cannot appear as a coda. However, for both Class 2 words and Class 3 words, there are other possible syllable structures that Borowsky and Horvarth do not consider.

For example, for the Class 2 word /*fi:l*/, the potential candidate [*fi:l*] violates not only *___ but also Co=Gl/V. Borowsky and Horvarth fail to examine the possibility that the interaction between this constraint and the faithfulness constraint, for which they propose the ranking is variable, may have some role to play in the variability of the pronunciation of /l/ in this class. This is particularly important in the case of Class 2 words without high front vowels, like /*ku:l*/. Borowsky and Horvarth argue that these words can be pronounced monosyllabically, as explained above. If this is indeed the case, and they are correct *___ constraint is ranked differently here than it is with /*fi:l*/ (though I disagree with this argument), then the coda constraint might play a very significant role here.

Similarly, Borowksy and Horvarth fail to examine the possibility that the /l/ in a Class 3 word like /*milk*/ might potentially be parsed as part of the nucleus. Since /l/ can in fact appear in the nucleus, as in the non-vocalized pronunciation /*b_.t_*/, the nuclear constraints must come into play, in order to rule out potential candidates like /*mi_)k*/ (where the ")" symbol divides the nucleus from the coda). They also ignore the question of how the vocalized /l/ is parsed; here, too, it is important to examine the interaction of the constraints on codas and the constraints on nuclei.

In rectifying Borowksy and Horvarth's analysis in the next section, my hope is to provide a superior examination of possible factors that might be causing the pressure on Australian English as spoken in Adelaide to vocalize /l/ in the coda and nucleus. While I would agree with most of Borowksy and Horvarth's assumptions, as described above, I feel that they failed to stick to established principles of OT constraint development. Furthermore, they also ignored certain important potential candidates and consequently did not take the chance to tie their analysis of the three separate classes together through the use of all of their candidates to examine each class.

5. A Superior OT Analysis of the Data

5.1 A More Useful Constraint Set

As described above, there are many flaws in Borowsky and Horvarth's choice of a constraint set. Therefore, the analysis of the data proposed in this paper will use a different set of constraints to explain the data.

First of all, it is important to note that a faithfulness constraint is certainly needed. Without any such constraint, there would be no reason for /l/ to ever be pronounced as a consonant. This paper will use the faithfulness constraint FAITH/l/. As Borowsky and Horvarth did, I am actually creating a useful oversimplification. The faithfulness of /l/ is probably based on a correlation between the features of this segment in the input and its features in the output candidates. Thus, FAITH/l/ should be interpreted as a convenient shorthand for constraints marking this kind of correlation (for example, they may include IDENT[±cons] and IDENT[±lat], /l/ being a lateral consonant). However, this shorthand is in appropriate OT terms, as opposed to the constraint that Borowsky and Horvarth use in its place.

Secondly, it is important to note that much of the data can in fact be explained solely by recourse to the interaction of this faithfulness constraint with constraints based on the sonority marking scale presented in (7). The segment /l/ seems to be vocalized in different percentages of its appearances depending on whether it can only be parsed in the nucleus or if it can also potentially be parsed in the coda. Consequently, it makes sense to propose that there are separate constraints dealing with nuclei and codas. Therefore, there would be a set of constraints on nuclei, universally ranked as follows, because the most sonorous nucleus is always the most desirable:

24) *N:stop > *N:fric > *N:nas > *N:l > *N:r > *N:Gl > *N:V

Similarly, as the most sonorous coda (ie, no coda at all) is also always the most desirable, the set of constraints on codas is universally ranked thus:

25) *C:stop > *C:fric > *C:nas > *C:l > *C:r > *C:Gl > *C:V

As mentioned above, a high-ranked DEP constraint is necessary in order to rule out the possibility of epenthesis.

Finally, the *___ constraint that Borowsky and Horvarth propose may in fact be useful for an analysis of the words in Class 2. However, it is important to note that these words do not seem to be fully amenable to a phonological analysis. Consequently, while I will make use of this constraint later on, it is not entirely clear that it is necessary.

5.2 An Analysis of Bottle

I will now proceed to attempt an analysis for each of the three major cases. In the following analysis, however, I will largely avoid the issue of variation. To the extent possible (and it is not fully possible in some of these cases), I will merely set out analyses that make clear how I propose to deal with both the pressure to vocalize and the pressure to keep the /l/.

First, let us examine *bottle*, a word that is an example of Class 1, where the /l/ is in nuclear position. In their analysis, Borowsky and Horvarth only examine the ranking of two constraints, /l/=[l] and N=V. They claim that these constraints are unranked with respect to each other. These results are easy to mimic using the constraints described in the section above. We can translate the two constraints that Borowsky and Horvarth use into the constraints FAITH/l/ and *N:l.

These two constraints are fairly obvious choices in this particular case. The pressure to vocalize the /l/ comes from the markedness of having an /l/ in a nucleus, which is stated in *N:l. The pressure to keep it as a consonant comes from the faithfulness constraint. Furthermore, one must also make use of the DEP constraint in order to rule out the candidate *b_.t__*, which Borowsky and Horvarth only deal with in a footnote. Since, according to our analysis, *b_.t__* never appears, this constraint is universally ranked above the other two. As for those two, depending on how they are ranked, there are two possible tableaux for the input /botl/:

26) Tableau 5a: output = *b_.t_*

/botl/	. . .	DEP	FAITH/l/	*N:l	. . .
☞b_.t_				*	
b_.t_			*!		
b_.t__		*!			

27) Tableau 5b: output = *b_.t_*

/botl/	. . .	DEP	*N:l	FAITH/l/	. . .
b_.t_			*!		
☞b_.t_				*	
b_.t__		*!			

These results should be unsurprising. The case that we have here does not differ significantly from Borowsky and Horvarth's examination of the same data in Tableaux 2a and 2b. The only differences are the appearance of DEP in order to rule out the extra, epenthetic candidate [*b_.t__*] and the replacement of Borowksy and Horvarth's statement of the constraints with my own. Note that a dialect of English in which /l/ categorically remains as /l/ in this position would rank FAITH/l/ above *N:l and make use of tableaux like 5a. Meanwhile, a dialect of English in which /l/ is categorically vocalized in nuclear position would rank *N:l above FAITH/l/ and make use of tableaux like 5b. This case, consequently, should appear straightforward enough.

5.3 An Analysis of *Milk*

In contrast, Class 3 words such as *milk*, with /l/ appearing in a post-nuclear cluster, are more complicated to deal with. The two potential candidates that Borowsky and Horvarth propose, which they choose to transcribe very broadly, are [*milk*] and [*miwk*] (118). Theoretically, based on some simple assumptions about English, one might expect that the /l/ in the former pronunciation appears as part of a complex coda, whereas the /w/ off-glide in the latter appears as part of a diphthong in the nucleus. Such a suggestion about Australian English is backed up by Kate Burridge and Jean Mulder in their 1998 work, *English in*

Australia and New Zealand: an introduction to its history, structure, and use. They specifically propose that in the syllable *salt,* the /l/ is part of a complex coda (64). Although they do not analyze a word with a glide that occurs because of vocalization, they do analyze the word *eye* as /a_/, with the entire syllable being the nucleus (65). This suggests that an off-glide like /j/ (another way of transcribing /a_/ is as /aj/) or /w/ would get parsed as part of the nucleus.

As the two different options for pronunciation of the segment actually lead to two different ways of parsing its place in the syllable, both nucleus and coda constraints should play a role in the determination of these pronunciations. This is clearly a more complex case than that of *bottle*.

Clearly, the constraints FAITH/l/ and *C:l must come into play in any analysis of this data, standing in for Borowksy and Horvarth's /l/=[l] and C=G/V. *C:l is the constraint that provides the motivation for vocalization in this case. Vocalization occurs because syllables with /l/ in the coda are marked. FAITH/l/ prevents vocalization from occurring when it is ranked higher than *C:l, because, as always, it eliminates candidates that remove the /l/ that appears in the input.

*N:l and *C:Gl should also be involved. In theory, the former of these constraints would rule out a pronunciation of *milk* with the /l/ being parsed in the nucleus, while the latter would rule out a pronunciation of *miwk* with the /w/ parsed in the coda. However, we must be explicit about some categorical rankings in order to ensure that the constraints do their job. First of all, *N:l must be categorically ranked above *C:l. With this ranking, whenever the /l/ is not vocalized, the pronunciation that parses the /l/ in the nucleus will violate a higher constraint than the one that parses the /l/ in the coda. Therefore, the former pronunciation can never be selected for. Similarly, *C:Gl must rank categorically higher than *N:Gl. Whenever the /l/ *is* vocalized, the pronunciation which parses the /w/ in the coda will violate a higher constraint than the one which parses the /w/ in the nucleus. Again, the former pronunciation can never be selected for. This ranking seems to fit well with the facts of the English language – if there is a vowel, a consonant will be parsed in the coda, not the nucleus, while glides are in fact probably parsed in the nucleus, not appearing in the coda.

If we are using both *N:l and *N:Gl, and both *C:l and *C:Gl, we theoretically might also include the constraints between these in the sonority scales, which is to say *N:r and *C:r. Including DEP, which we need to rule out the possibility of *mi._lk*, this gives us a total of eight constraints. Many of these constraints must be categorically ranked with respect to each other. First of all, DEP is ranked higher than all of the other constraints. Secondly, the three nucleus constraints are totally ranked with respect to each other, as are the three coda constraints. Finally, *N:l is ranked higher than *C:l and consequently higher than all of the coda constraints, while *N:Gl is ranked lower than *C:Gl and consequently lower than all of the coda constraints.

This class differs from Class 1 in that there is no obvious starting point for our analysis. This is because, before we can propose any grammar, we must decide what to do with *N:r and *C:r, and there are no blatantly correct rankings for these constraints. *N:r must be ranked somewhere between *N:l and *N:Gl, but, theoretically, it could be unranked with respect to the coda constraints. Similarly, *C:r must be ranked somewhere between *C:l and *C:Gl, but we do not know how it is ranked with respect to the nuclear constraints. We also do not have any idea how either of these constraints are ranked with respect to FAITH/l/.

On the whole, I will simply ignore these issues. After all, *N:r and *C:r are unimportant to the pronunciation of a word like *milk*, and we might as well leave these constraints out of our tableaux, leaving us with only six constraints. In this case, the only question mark in our rankings is the ranking of FAITH/l/. Ignoring FAITH/l/, we know that DEP is ranked above all the other constraints, that *N:l is next highest, followed by the two coda constraints, and that *N:Gl is the lowest.

The placement of FAITH/l/ in this set of rankings is clearly the key as to whether or not the /l/ will be vocalized. There are many possible placements, but what is really significant is the ranking of FAITH/l/ with respect to *C:l. When FAITH/l/ is ranked higher than *C:l, the pressure to keep the /l/ will outweigh the pressure to avoid an /l/ in the coda. When the opposite ranking occurs, the opposite will happen. To make this clear, I will include two tableaux, one in which FAITH/l/ is ranked directly above *C:l, and on in which it is ranked directly below. For the purposes of these tableaux, please interpret the ")“ symbol as a mark separating the nucleus from the coda. Aside from the *m*, which always appears in the onset, those segments prior to the "(“ are in the nucleus; those after it are in the coda:

28) Tableau 6a: output = *mi)_k*

/milk/	. . .	DEP	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
mi_)k			*!					
☞mi)_k					*			
miw)k				*!			*	
mi)wk				*!		*		
mi._)_k		*!			*			
mi.__)k		*!	*					

29) Tableau 6b: output = *miw)k*

/milk/	. . .	DEP	*N:l	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
mi_)k			*!					
mi)_k				*!				
☞miw)k					*		*	
mi)wk					*	*!		
mi._)_k		*!		*				
mi.__)k		*!	*					

These tableaux therefore demonstrate the relevant factor of this analysis of *milk*. It is largely similar to Borowksy and Horvarth's analysis, relying on the interaction of the same two constraints. However, it includes the nuclear constraints and the constraint on glides in the coda in order to rule out some significant possibilities that Borowksy and Horvarth failed to notice. A tableau like 6a, with FAITH/l/ ranked above *C:l, would be used in a dialect that categorically keeps /l/ in the complex coda position. A tableau like 6b, with FAITH/l/ ranked below *C:l, would be used in a dialect that categorically vocalizes the /l/ in this position.

5.4 Class 2 Words: an Analysis Ignoring Variability

As has been discussed above and will be discussed further below, there are serious problems with the development of an OT analysis for Class 2 words, like *feel* and *cool*. However, these problems largely stem from the fact that some of these words seem to have categorical /l/ pronunciation, whereas some of them are variable. In this section, we are ignoring variability and just attempting to develop an analysis of what phonological factors might potentially account for the pressure to either keep the /l/ or vocalize it. Ignoring the problems with the variation, such an analysis does seem to be possible.

Firstly, we should note that Borowsky and Horvarth include an extra constraint, *___, in their analysis of the word *feel*. Their goal here, as explained above, is to rule out the monosyllabic pronunciation, [*fi)*_], for words with a high front vowel followed by /l/. However, they fail to explain why this constraint would be ranked differently for words like *feel* and words like *cool*, although they claim that the latter can be pronounced monosyllabically. As explained above, I do not think that this distinction can in fact be phonologically justified. Instead, I prefer to assume that all of the words in Class 2 can have either monosyllabic or bisyllabic pronunciations. If this is true, then we do not actually need to use *___ with Class 2 words in order to make this distinction. While, later on, I will discuss the possibility that it might be useful to help explain some facts about variation, it is not obviously a necessary pressure causing /l/ to vocalize or remain the same. Therefore, I will ignore this constraint for the moment.

In fact, it seems possible to analyze Class 2 words in exactly the same way as we analyzed Class 3 words in the previous section. Once again, we are dealing with /l/ found in a coda. The fact that the coda is not complex does not really have any bearing on the analysis of Class 3 words as presented above. We can use the same six constraints that we used for the Class 3 words to deal with Class 2. The rankings of these constraints remain the same, and, again, it is the interaction between FAITH/l/ and *C:l that is the relevant factor.

In fact, we can present tableaux with identical rankings to those found in Tableaux 6a and 6b in order to demonstrate the essential similarity between these two cases. In this case, Borowsky and Horvarth are unclear as to precisely what vowel results when the /l/ vocalizes, so I have chosen to use /_^{w}/ as a neutral vowel which has high back rounded elements:

30) Tableau 7a: output = *fi)_*

/fil/	. . .	DEP	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
fi_)			*!					
fi._			*!					
Fi._^{w}				*!				
☞fi)_					*			
fi.__		*!			*			

29) Tableau 7b: output = *fi(_^{w}*

/fil/	. . .	DEP	*N:l	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
fi_)			*!					
fi._			*!					
☞fi._^{w}					*			
fi)_				*!				
fi.__		*!		*				

There are, obviously, some differences between this case and that of the Class 3 words. In this case, the /l/ does not become an off-glide when it vocalizes, but instead it becomes the nucleus of a new syllable. However, the most significant point is still the interaction between *C:l and FAITH/l/. According to this analysis, any dialect of English with categorical /l/ pronunciation in Class 3 words would also have categorical /l/ pronunciation in Class 2 words, and the same is true for categorical vocalization.

What the above sections have demonstrated is that Borowsky and Horvarth's basic insight, that the pressure to vocalize comes from constraints on the sonority of segments in the nucleus and coda, seems correct. However, Borowsky and Horvarth failed to realize and deal with all of the potential candidates by making use, in the case of Classes 2 and 3, of *both* nuclear and coda constraints. This analysis shows that this problem is easily fixed by paying more attention to the nature of the constraints.

These sections have therefore revealed the source of the pressure to vocalize, as well as the source of the pressure to resist vocalization. However, I have not yet actually dealt with the issue of variation. In the next section, I intend to go into detail on the possible benefits of an OT-based theory of phonological variation. Borowksy and Horvarth fail to make any quantitative predictions about how variation works, and their analysis is consequently also flawed on this level. My goal will be to take a careful look at the possible quantitative predictions that OT can make in this particular case and to see if such an analysis is in fact in any way useful.

6. Integrating Variation into the Analysis

6.1 Theories of Variation in OT

In their paper, Borowsky and Horvarth explain that they have chosen to use OT as a theoretical basis for analyzing this situation of variation because it "is designed to explain the interplay of different pressures in the system by interaction between violable constraints" (102). In other words, as variation is the result of conflicting pressures, OT, which specifically explains phonological changes as the effect of such pressures, is perfectly fit for explaining it.

However, Borowsky and Horvarth do not go into much detail on the theoretical background for their choice. Other writers, including Arto Anttila and William Thomas Reynolds, have discussed more thoroughly the implications of using OT to discuss variation. In this section of the paper, I will explore some of the arguments that these writers make in favor of this method in the hope of justifying the exploration of the variation in this data that I will undertake in the next section. I will also examine some of the differences between their theories, in order to justify my own use of OT in this case.

To start with, let us look at Anttila's concept of partial rankings, as discussed in his 1997 paper, "Deriving Variation from Grammar." As I already discussed in section 3.1, the basic justification for any theory of variation in OT stems from the possibility that some constraints might not have a set ranking with respect to certain other constraints. Anttila's proposal is that these partially-ranked grammars, consisting of several differing tableaux for each word, could provide an explanation for systematic variation within a language. Anttila argues that such an analysis makes quantitative predictions, because it is based on setting up possible rankings and comparing the percentage of rankings which predict the varying possible candidates (48).

Anttila gives a fairly detailed explanation of how this system would work. Although I explained how variable constraints might work on a simple level above in describing Borowsky and Horvarth's proposal, it might be instructive to examine Anttila's argument more carefully. For example, imagine that the constraints A, B, and C are not fully ranked. While A is ranked above B and C, B and C are unranked with respect to each other. Tableau 1a would therefore be one possible tableau for the input, in which B is placed above C. However, the tableau below, Anttila's Tableau 2.2, would also be a possibility, since B and C are not actually ranked with respect to each other, and C can therefore be placed above B:

30) Tableau 1b: output = $cand_1$

input	A	C	B
☞ $cand_1$	*		*
$cand_2$	*	*!	

Note that this tableau selects $cand_1$, not $cand_2$, as in Tableau 1a. In this case, there are two possible tableaux in the grammar for this input, and each candidate gets selected in one of them. Anttila proposes a quantitative prediction based on this fact: each candidate has a 50% chance of appearing in any given case of the input being pronounced (46-47).

Anttila uses his theory to explain a case of variation in Finnish. Apparently, there is a stable variation, having existed without change for centuries, in the use of the Finnish genitive plural form. Some Finnish stems take a strong form, with a heavy penult and a final syllable onset of /t/ or /d/ (for example, /*puu*/, "tree" becomes [*pui.den*]). Some take a weak form, with a light penult and a final syllable onset that is either /j/ or absent (for example, /*kala*/, "fish," becomes [*ka.lo.jen*]). Finally, some stems, in particular those that are at least trisyllabic and CV final, show free variation, although often one variant or the other sounds better for a specific stem (for example, /*naapuri*/, "neighbor," becomes either [*naa.pu.rei.den*] or [*naa.pu.ri.en*]) (37). Therefore, this variation is not entirely free; certain factors, such as the sonority of the final vowel in the stem and the weight of the antepenult, can affect the prominence of various outcomes (39-44).

Anttila's argument is that this variation is based on the existence of universal prominence scales for the alignment of stress, weight, and sonority. Optimal syllables are either stressed and heavy with a sonorous vowel or light and unstressed with an unsonorous vowel. Furthermore, optimal words preferentially alternate their syllables, so that the qualities of stress, weight, and sonority differ in two adjacent syllables. These prominence scales and proximity restrictions can then be expressed as constraints (50-51).

The actual constraints that Anttila constructs, the partial rankings he provides for them, and the tableaux he produces are fairly complex and irrelevant to the main thrust of this paper, and therefore I will not actually go into too much detail about them. However, by analyzing the interactions of these constraints, Antilla does in fact provide examples of cases where the percentages of weak and strong forms that his theory predicts (much as it predicted a 50% occurrence rate for $cand_1$ in the simple case above) correlate well with the actual percentages that he found in the *Suomen Kuvalehti 1987* Finnish corpus (52-62).

Anttila's results are impressive, but it is important to note a couple of caveats. First of all, Anttila stresses the fact that the data which he examines reveals a stable variation that does not seem to have a strong sociolinguistic component (53). His theory is purely phonological and, consequently, cannot explain the obvious sociolinguistic elements of much variation, in particular variation that is a marker of a linguistic change as opposed to a purely stable feature of the language. Also, Anttila's theory is largely based on statistics; a linguist would need very precise data in order to determine the significance of the percentages that the theory is based on. Therefore, the theory is difficult to use in a case where only less precise data is available.

In his 1994 dissertation, "Variation and Phonological Theory," Reynolds describes another method of adapting OT to account for variation. This theory differs from Anttila's in a couple of significant ways.

A first important note about Reynolds' theory is that, unlike Anttila, he focuses on the fact that "extralinguistic factors" play a significant role in linguistic variation, one that cannot be explained away by purely linguistic theories (103-4). Thus, whereas Anttila focuses on a case of static variation, Reynolds' devotes more attention to examining variation as part of a change in process. This point is particularly relevant to the data in this paper, as Borowsky and Horvarth specifically note that /l/-vocalization "is a sound change in progress" (101). Backing this up, they explain the relevance of various social factors to the variation, including age, gender, and social class. There were statistically significant differences between members of varying groups in terms of how frequently they vocalized /l/ (107). Therefore, obviously, some of the variation can not be accounted for by purely phonological factors; sociolinguistic elements must affect it. However, this fact does not mean that we can ignore phonological factors; it merely means that we must be careful to avoid trying to explain every element of variation using phonological analysis.

Reynolds achieves this balance by very specifically making the point that the probabilities developed from an analysis of the phonological tableaux produced by a certain grammar with variable constraints should not be expected to be "identical with the exact probabilities. . . in each environment which have been observed for individual speakers of these dialects in quantitative studies." He argues that these exact probabilities must be based in part on extralinguistic, social factors. However, "the model provides us with a means for representing the relative *strength* of the effects of the *linguistic* environments" (136-137). In other words, he argues that the percentage of tableaux produced by a grammar that spits out a candidate cannot be equivalent, as Anttila argues, to the percentage of times that an individual uses that candidate in actual speech. However, this type of analysis is qualitatively significant, in that it can represent the strength of linguistic factors.

Reynolds' argument here is fairly convincing – the fact is, it is impossible to avoid the conclusion that linguistic change has a social element, so that no purely phonological analysis of variation involved in change can possibly hope to fully explain the data. This point is even more relevant to a study like Borowksy and Horvarth's that is actually summarizing the results for many speakers rather than focusing on the variation within one individual speaker. While it is clear from the presence of certain words pronounced categorically with a non-vocalized /l/ that individual speakers do vary their pronunciation, the fact that their data does not deal with the variation within an individual speaker makes a quantitative analysis less suitable than it would be otherwise. After all, an OT analysis of variation must be based on the premise that the grammar within one speaker is producing the variable pronunciations. Variation between speakers also involves the potentially different grammars possessed by different speakers.

All this being so, in the next section I will adhere more to a Reynolds-like theory of quantitative analysis than an Anttila-based one. Instead of trying to form a grammar in which the percentage of times a specific candidate is picked by tableaux is directly linked to the percentage of times that it appears in speech, I will take a more general approach. I will assume that Borowksy and Horvarth's data makes a decent case for a significant distinction between the three classes that they describe. Class 1 words are vocalized the most frequently and Class 3 words the least. Class 2 words are vocalized with a frequency somewhere in between. Individual speakers presumably differ with respect to how exactly these differences are expressed. However, I will attempt to see if there is a phonological, OT explanation for these general observations.

That said, we must also note that Reynolds' specific method of explaining how variation works also differs from Anttila's. Instead of proposing constraints that are partially ranked as Anttila does, he argues in favor of what he calls "floating constraints." What this means is that, within a dialect, a given constraint is not ranked directly between two other constraints, but is instead ranked as lying between two constraints. Its ranking with respect to other constraints that lie within those two constraints is not specified. He graphically represents this framework within his paper as follows (116):

31) {…………….…CONX....……………..}

CONW >> {CONY$_1$ >> CONY$_2$ >> … >> CONY$_n$} >> CONZ

CONX, which floats above the other constraints, is unranked with respect to all of the constraints labeled as CONY$_n$. It is therefore a floating constraint, whereas the other constraints, which are fully ranked with respect to all of the constraints except CONX, are called "hard-ordered" constraints, or perhaps "anchored" constraints. Reynolds is careful to note that one describes the range of the floating constraints in terms of the furthest right and left constraints with which it is variably ranked, which is to say CONY$_1$ and CONY$_n$ in this case, rather than CONW and CONZ (116-117).

This theory may seem similar to Anttila's theory, but it actually is rather distinct. For example, let us take a situation with five constraints, A, B, C, D, and E. In Anttila's terms, imagine that the only categorical rankings in this case are that C is categorically ranked below B and above E, and D is categorically ranked below A. All of the other constraints are unranked with respect to each other. This leaves us with the following ten possible constraint rankings:

32) A >> B >> C >> D >> E

A >> B >> C >> E >> D

A >> B >> D >> C >> E

A >> D >> B >> C >> E

B >> A >> C >> D >> E

B >> A >> C >> E >> D

B >> A >> D >> C >> E

B >> C >> A >> D >> E

B >> C >> A >> E >> D

B >> C >> E >> A >> D

Such a set seems like it would be very difficult to achieve using floating constraints. All of the constraints are unranked with respect to at least one other constraint, so defining the floating set of each constraint with respect to certain "anchored constraints" would be impossible. Constraint B, for example, has an apparent range of A to D, for it can appear anywhere from above A to below D. However, it is categorically ranked above C. In consequence, it can only appear below D when D is ranked above C. This kind of complex interplay among the possible rankings of various candidates is not allowed for by Reynolds' theory.

It is not within the scope of my paper to discuss in depth whether Anttila's prediction that such a set of rankings would be possible or Reynolds' prediction that it would not is correct. I am only exploring a single data set, whereas a definite choice between the two would probably require a study of many different cases of variation. That said, I find the concept of partial rankings more intuitive than the concept of floating constraints. I find it hard to believe that constraints that have no inherent connection, such as *___, FAITH/l/, and *N:l, cannot all be unranked with respect to each other, especially since, as Anttila points out, adding further rankings to a grammar actually means complicating that grammar, not simplifying it (63). However, modeling such a system using floating constraints is difficult. Therefore, in order to allow myself more scope for analysis, I choose to use partial rankings rather than floating constraints in the upcoming analysis. I think that Anttila's system simply leaves more room for certain possibilities that Reynolds' system leaves out, and I am not really clear on the theoretical justification for leaving these possibilities out.

In summary, I am using a mixture between the two theories in my analysis of this variation. In particular because Borowksy and Horvarth are studying a change in progress and do not provide detailed data on individuals' variation, I prefer Reynolds' more general view of the quantitative utility of OT-based analysis. However, because Reynolds' actual method seems to rule out certain possibilities without providing a satisfactory justification for why this is valuable, I prefer to make use of Anttila's method in what follows.

6.2 An OT Analysis of the Variation in /l/-vocalization in Class 1 and Class 3

In order to analyze how partial rankings in this case might help provide an explanation for the variation, it is not sufficient to follow Borowksy and Horvarth and look at each class of words separately. Instead, in order to make any sort of qualitative argument about the relative strength of various linguistic factors, we must examine the classes in tandem, attempting to analyze the significant difference that Borowksy and Horvarth discovered between them.

Therefore, let us start with another quick look at the case of Class 1 words, with /l/ in the nucleus, such as our example *bottle*. The three constraints DEP, FAITH/l/, and *N:l are still sufficient to explain the variation in this case. The variation depends entirely on the ranking of FAITH/l/ and *N:l with respect to each other; both constraints are categorically ranked below DEP so as to completely rule out the possibility of epenthesis. This is a simple enough analysis.

Once we examine Class 3 words like *milk*, the issue becomes more complicated. Because of the interaction between the nuclear and coda constraints, there are six relevant constraints that actually are necessary for the correct result to be achieved (DEP, FAITH/l/, *N:l, *C:l, *N:Gl, and *C:Gl). Furthermore, rather than the relevant condition being the ranking of FAITH/l/ with respect to *N:l, as it was above, here, it is the ranking of FAITH/l/ with respect to *C:l. What this means is that, even in the very simplest case of describing the variation, FAITH/l/ actually must vary with respect to two constraints, not merely one.

In consequence, let us look at the possible tableaux that this analysis suggests the grammar would produce for both of these cases. I will now include all of the constraints relevant to Class 3 words even in the Class 1 tableaux, since these constraints are relevant to the general case. In each case, since FAITH/l/ is the only varying constraint, and it varies with respect to two other constraints, there are three possibilities (one with FAITH/l/ ranked above both other constraints, one with it ranked below, and one with it ranked in between).

Here are the three tableaux for *bottle*:

33) Tableau 8a: output = *b_.t_*

/botl/	. . .	DEP	FAITH/l/	*N:l	*C:l	*C:Gl	*N:Gl	. . .
☞b_.t_				*				
b_.t_			*!					
b_.t__		*!			*			

34) Tableau 8b: output = *b_.t_*

/botl/	. . .	DEP	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
b_.t_			*!					
☞b_.t_				*				
b_.t__		*!			*			

35) Tableau 8c: output = *b_.t_*

/botl/	. . .	DEP	*N:l	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
b_.t_			*!					
b_.t_					*			
b_.t__		*!		*				

Note how the vocalized candidate [b_.t_] is selected in two of the three tableaux, or 66.7% of the time.

Now, here are the three tableaux for *milk* (two of them are repeated from above):

36) Tableau 6c: output = *mi)_k*

/milk/	. . .	DEP	FAITH/l/	*N:l	*C:l	*C:Gl	*N:Gl	. . .
mi_)k				*!				
☞mi)_k					*			
miw)k			*!				*	
mi)wk			*!			*		
mi._)_k		*!			*			
mi.__)k		*!		*				

28) Tableau 6a: output = *mi)_k*

/milk/	. . .	DEP	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
mi_)k			*!					
☞mi)_k					*			
miw)k				*!			*	
mi)wk				*!		*		
mi._)_k		*!			*			
mi.__)k		*!	*					

29) Tableau 6b: output = *miw)k*

/milk/	. . .	DEP	*N:l	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
mi_)k			*!					
mi)_k				*!				
☞miw)k					*		*	
mi)wk					*	*!		
mi._)_k		*!		*				
mi.__)k		*!	*					

Unlike with the Class 1 word, *bottle*, for the Class e word, *milk*, only one of the three tableaux, or 33.3%, picks out the vocalized candidate.

This is a very positive result, because it suggests that this analysis does in fact correspond to Borowsky and Horvarth's data. As already mentioned above, these authors found a significant difference between the two classes. The specific percentages in this case are that Class 1 words showed vocalization 63% of the time and Class 3 words 41.7% of the time. However, these specific percentages are not important. What is relevant is that there is a significant distinction, and Class 1 words are vocalized more frequently than Class 3 words. The fact that an OT analysis of this variation based on fairly straightforward principles produces exactly this result provides strong support for such an analysis.

In fact, this analysis usefully demonstrates that the difference between the two cases is easily explained by a simple phonological principle. On account of the way that syllable structure works, a consonant like /l/ is more harmonic in the coda than it is in the nucleus. Therefore, *N:l is categorically ranked above *C:l. The variation in Class 1 is entirely due to the interaction between FAITH/l/ and a higher ranked constraint; the variation in Class 3 is due to the interaction between FAITH/l/ and a lower ranked constraint. This being the case, it is only reasonable that a larger percentage of tokens of the first class are vocalized than those of the second class; the pressure to vocalize /l/ in the nucleus is simply stronger than the pressure to vocalize it in the coda. This convenient explanation definitely backs up Borowksy and Horvarth's theory that the variation is occurring because of the pressures of sonority in the nucleus and coda.

6.3 Adding Class 2 into the Mix

There is, I think, a fairly good case to be made for stopping at this point and simply ignoring Class 2, as, for the reasons explained above, it is not really clear that an OT analysis of the words in this class can be as useful in describing the pressures involved as it was for the other two classes. Since there is no valid phonological explanation as to why some of the words with /l/ in a simple coda (or "breaking," as Borowsky and Horvarth put it) have categorical /l/ pronunciation whereas others have variable vocalization, there is no real phonological explanation for what is going on in this case.

However, it may be worth taking a look at Class 2 simply to see what kind of analysis we might produce if it were in fact possible to make a distinction based on collapsing the difference between morpheme boundaries and word boundaries, as Borowsky and Horvarth do. Given that step, at first glance we have the analysis for these words that I described above, in section 5.4. This analysis does not actually depend on the introduction of any further constraints. In fact, recall that it is in general entirely similar to the analysis of Class 3 words; the variation is entirely dependent on the interaction between FAITH/l/ and *C:l. To prove this point, here are the three tableaux for *feel* (again, two of these are repeated from above):

37) Tableau 7c: output = *fi)_*

/fil/	. . .	DEP	FAITH/l/	*N:l	*C:l	*C:Gl	*N:Gl	. . .
fi_)				*!				
fi._				*!				
fi._ʷ			*!					
☞fi)_					*			
fi.__		*!			*			

30) Tableau 7a: output = *fi)_*

/fil/	. . .	DEP	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
fi_)			*!					
fi._			*!					
fi._^{w}				*!				
☞fi)_					*			
fi.__		*!			*			

29) Tableau 7b: output = *fi(_*^{w}

/fil/	. . .	DEP	*N:l	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
fi_)			*!					
fi._			*!					
☞fi._^{w}					*			
fi)_				*!				
fi.__		*!		*				

Just as with the Class 2 word, the vocalized candidate appears in one of the three tableaux, 33.3% of the time.

There are, however, a couple of problems with this analysis. Note that while this type of analysis does get us a variation between vocalized and non-vocalized varieties of the word, the very high ranking of *N:l prevents a bisyllabic [ku._] from ever being selected. This is clearly a problem with the analysis; not only is this form actually possible, but it is the only non-vocalized form that Borowsky and Horvarth claim even exists for *feel*-type words. Also note that Borowsky and Horvarth do claim to find a statistically significant distinction between Class 2 and Class 3 words, so a result that collapses the distinction between them is undesirable (105).

Instead of dealing with constraints on possible codas, Borowksy and Horvarth use their bimoraicity constraint in (15), *___, to come up with variation in this case, as described above (116-117). This is indeed another possibility, although, given that the coda constraints do clearly exist and play a role, they too must have an effect. In their 1978 work, *Introduction to Phonology,* Clarence Sloat, Sharon Henderson Taylor, and James E. Hoard argue that English vowels are partially lengthened before voiced stops. They mark this partial lengthening with a single raised dot (_) (19). Perhaps English vowels are partially lengthened before all voiced consonants, including /l/. In this case, there would be some high-ranked constraint ruling out short vowels before voiced consonants. Sloat, Taylor, and Hoard do not specify whether these partially lengthened vowels take up two morae, but, for the sake of argument, let us say that they do. A coda can be considered to take up another mora. Therefore, if there is indeed a constraint ruling out trimoraic syllables, and FAITH/l/ is unranked with respect to it, this could explain the difference between Class 2 and Class 3 words, which only have trimoraic candidates and thus are not affected in the same way by this constraint.

If we do in fact propose a bimoraicity constraint, we need to figure out how it is ranked with relation to all of the six other constraints that we have been using. Obviously, in order for it to play a role in variation, it must be unranked with respect to FAITH/l/. A reasonable proposal would be that it is also unranked with respect to *N:l, because if *___ is ranked higher than *N:l and FAITH/l/ is ranked high enough to prevent vocalization, *___ would provide the motivation for a bisyllabic, non-vocalized pronunciation by ruling out the monosyllabic, non-vocalized pronunciations:

38) Tableau 9a: output = *fi._*

/fil/	. . .	DEP	FAITH/l/	*___	*N:l	*C:l	*C:Gl	*N:Gl	. . .
fi_)				*!	*				
☞fi._					*				
fi._^{w}			*!						
fi)_				*!		*			
fi.__		*!				*			

However, the interactions of *___ with FAITH/l/ and *N:l are the only significant ones that *___ is involved in. Therefore, for the sake of simplicity, we may as well assume that it is only unranked with respect to those two constraints and is categorically ranked above the other constraints, starting with *C:l. Since we are not dealing with specific percentages, whether or not this is true should not be a serious issue.

We now have tableaux involving seven constraints. FAITH/l/ is unranked with respect to *___, *N:l, and *C:l, and *___ is unranked with respect to FAITH/l/ (obviously) and *N:l. There are two different possible rankings for the two constraints *___ and *N:l, and four possible rankings of FAITH/l/ for each one of these two possibilities. In total, therefore, there are now eight possible tableaux for each class. Let us now examine each class and how these tableaux come out.

We start with Class 1 words like *bottle*:

39) Tableau 10a: output = *b_.t_*

/botl/	. . .	DEP	FAITH/l/	*___	*N:l	*C:l	*C:Gl	*N:Gl	. . .
☞b_.t_					*				

b_.t_			*!						
b_.t___		*!		*		*			

40) Tableau 10b: output = *b_.t_*

/botl/	. . .	DEP	*___	FAITH/l/	*N:l	*C:l	*C:Gl	*N:Gl	. . .
☞b_.t_					*				
b_.t_				*!					
b_.t___		*!	*			*			

41) Tableau 10c: output = *b_.t_*

/botl/	. . .	DEP	*___	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
b_.t_				*!					
☞b_.t_					*				
b_.t___		*!	*			*			

42) Tableau 10d: output = *b_.t_*

/botl/	. . .	DEP	*___	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
b_.t_				*!					
☞b_.t_					*				
b_.t___		*!	*			*			

43) Tableau 10e: output = *b_.t_*

/botl/	. . .	DEP	FAITH/l/	*N:l	*___	*C:l	*C:Gl	*N:Gl	. . .
☞b_.t_				*					
b_.t_			*!						
b_.t___		*!			*	*			

44) Tableau 10f: output = *b_.t_*

/botl/	. . .	DEP	*N:l	FAITH/l/	*___	*C:l	*C:Gl	*N:Gl	. . .
b_.t_			*!						
☞b_.t_				*					
b_.t___		*!			*	*			

45) Tableau 10g: output = *b_.t_*

/botl/	. . .	DEP	*N:l	*___	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
b_.t_			*!						
☞b_.t_					*				
b_.t___		*!		*		*			

46) Tableau 10h: output = *b_.t_*

/botl/	. . .	DEP	*N:l	*___	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
b_.t_			*!						
☞b_.t_						*			

b_.t___		*!		*	*				

The candidate in which vocalization occurs is selected for in five of the eight tableaux, or 62.5% of the time.

Now, let us move on to Class 2 words like *feel*. One of the tableaux is shown in (38) above, which selects for one of the non-vocalized pronunciations. The remaining seven tableaux are as follows:

47) Tableau 9b: output = *fi_._*

/fil/	. . .	DEP	*___	FAITH/l/	*N:l	*C:l	*C:Gl	*N:Gl	. . .
fi__)			*!		*				
☞fi_._					*				
fi_._^{w}				*!					
fi_)_			*!			*			
fi_.__		*!				*			

48) Tableau 9c: output = fi_._^{w}

/fil/	. . .	DEP	*___	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
fi__)			*!	*					
fi_._				*!					
☞fi_._^{w}					*				
fi_)_			*!			*			
fi_.__		*!				*			

49) Tableau 9d: output = fi_._^{w}

/fil/	. . .	DEP	*___	*N:l	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
fi__)			*!	*					
fi_._				*!					
☞fi_._^{w}						*			
fi_)_			*!		*				
fi_.__		*!			*				

50) Tableau 9e: output = *fi_)_*

/fil/	. . .	DEP	FAITH/l/	*N:l	*___	*C:l	*C:Gl	*N:Gl	. . .
fi__)				*!	*				
fi_._				*!					
fi_._^{w}			*!						
☞fi_)_					*	*			
fi_.__		*!				*			

51) Tableau 9f: output = *fi_)_*

/fil/	. . .	DEP	*N:l	FAITH/l/	*___	*C:l	*C:Gl	*N:Gl	. . .
fi__)			*!		*				
Fi_._			*!						
fi_._^{w}				*!					
☞fi_)_					*	*			
fi_.__		*!				*			

52) Tableau 9g: output = *fi_._*^{w}

/fil/	. . .	DEP	*N:l	*___	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
fi__)			*!	*					
fi_._			*!						
☞fi_._^{w}					*				
fi_)_				*!		*			
fi_.__		*!				*			

53) Tableau 9h: output = *fi_._*^{w}

/fil/	. . .	DEP	*N:l	*___	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
fi__)			*!	*					
fi_._			*!						
☞fi_._^{w}						*			
fi_)_				*!	*				
fi_.__		*!			*				

The candidate in which vocalization occurs is selected for by in four of the eight tableaux, or 50% of the time. Note that this is a positive sign, as this means that our grammar correctly predicts that Class 2 words are vocalized less frequently than Class 1 words.

Finally, let us examine the Class 3 words, like *milk*. The eight tableaux for this case are as follows:

54) Tableau 10a: output = *mi_)_k*

/milk/	. . .	DEP	FAITH/l/	*___	*N:l	*C:l	*C:Gl	*N:Gl	. . .
mi__)k				*	*!				
☞mi_)_k				*		*			
miw)k			*!	*				*	
mi)wk			*!	*			*		
mi.__)_k		*!		*		*			
mi.___)k		*!		*	*				

55) Tableau 10b: output = *mi_)_k*

/milk/	. . .	DEP	*___	FAITH/l/	*N:l	*C:l	*C:Gl	*N:Gl	. . .
mi__)k			*		*!				
☞mi_)_k			*			*			
miw)k			*	*!				*	
mi)wk			*	*!			*		
mi.__)_k		*!	*			*			
mi.___)k		*!	*		*				

56) Tableau 10c: output = *mi_)_k*

/milk/	. . .	DEP	*___	*N:l	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
mi__)k			*	*!					
☞mi_)_k			*			*			
miw)k			*		*!			*	
mi)wk			*		*!		*		
mi.__)_k		*!	*			*			
mi.___)k		*!	*	*					

57) Tableau 10d: output = *miw)k*

/milk/	. . .	DEP	*___	*N:l	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
mi__)k			*	*!					
mi_)_k			*		*!				
☞miw)k			*			*		*	
mi)wk			*			*	*!		
mi.__)_k		*!	*		*				
mi.___)k		*!	*	*					

58) Tableau 10e: output = *mi_)_k*

/milk/	. . .	DEP	FAITH/l/	*N:l	*___	*C:l	*C:Gl	*N:Gl	. . .
mi__)k				*!	*				
☞mi_)_k					*	*			
miw)k			*!		*			*	
mi)wk			*!		*		*		
mi.__)_k		*!			*	*			
mi.___)k		*!		*	*				

59) Tableau 10f: output = *mi_)_k*

/milk/	. . .	DEP	*N:l	FAITH/l/	*___	*C:l	*C:Gl	*N:Gl	. . .
mi__)k			*!		*				
☞mi_)_k					*	*			
miw)k				*!	*			*	
mi)wk				*!	*		*		
mi.__)_k		*!			*	*			
mi.___)k		*!	*		*				

60) Tableau 10g: output = *mi_)_k*

/milk/	. . .	DEP	*N:l	*___	FAITH/l/	*C:l	*C:Gl	*N:Gl	. . .
mi__)k			*!	*					
☞mi_)_k				*		*			
miw)k				*	*!			*	
mi)wk				*	*!		*		
mi.__)_k		*!		*		*			
mi.___)k		*!	*	*					

61) Tableau 10h: output = *miw)k*

/milk/	. . .	DEP	*N:l	*___	*C:l	FAITH/l/	*C:Gl	*N:Gl	. . .
mi__)k			*!	*					
☞mi_)_k				*	*!				
miw)k				*		*!		*	
mi)wk				*		*!	*		
mi.__)_k		*!		*	*				
mi.___)k		*!	*	*					

The candidate for which vocalization occurs is selected in only two of the eight tableaux, or 25% of the time. Again, the analysis seems to successfully predict Borowksy and Horvarth's results, for Class 3 is indeed the class in which vocalization occurs least frequently.

Again, an OT-based explanation for the variation can indeed be developed that matches the patterns found in the data. The theory behind the OT analysis can then be used to develop an explanation of *why* the data patterns in the way it does. Vocalization occurs most frequently in the Class 1 words because these are the only words that have /l/ in the nucleus. Consequently, they are the only words in which the pressure to vocalize is coming from a constraint on nuclear structure. As /l/ is less harmonic in a nucleus than it is in a coda, it makes sense that this pressure would be more extreme from the pressure found when /l/ is in a coda.

As for Class 2 and Class 3, words in both classes feel pressure to vocalize because of the presence of /l/ in the coda. However, the classes can be differentiated between on account of their different moraic structure. In Class 3, there is no way to avoid trimoraic syllables – every potential candidate has one. In Class 2, however, it is possible to avoid these syllables by moving the /l/ to the nucleus and then potentially vocalizing it. What this means is that there are actually three constraints interacting to produce vocalization rather than just two. Therefore, vocalization is more frequent in this case, because it is a combination of two separate pressures that causes it to occur. However, since neither of these pressures is as consistently strong as the pressure to vocalize /l/ in the nucleus, vocalization still occurs less frequently in Class 2 than it does in Class 1.

There are two important points that I ought to make before concluding this section. The first is a reminder that individual speakers will differ from each other in their percentages of vocalization on account of social factors. This variation cannot be explained by phonological means and helps to explain why the percentages derived from the number of tableaux in each case that produce a vocalized /l/ do not exactly match the percentages of vocalization that occur in tokens of each class. This is especially true for this data, considering that Borowksy and Horvarth did not provide any analysis of how each individual speaker behaved and pooled all of their data. Perhaps a method similar to that of variable rules, describing the chance that each constraint has of appearing in each potential slot, could be constructed in order to provide a quantitative presentation of this consideration. However, I do not think that Borowsky and Horvarth provide sufficient statistics for me to develop such a method for this data.

The other important point to make is that, as satisfying as this analysis is, there is still the problem of those words in Class 2 that have categorically non-vocalized pronunciation. It is simply unclear what the distinction between a word like *skillful* and a word like *Nelson* is. Even if one does collapse word and morpheme boundaries into one category, the analysis does not in any way rely upon these boundaries, so it does not rule out a variable pronunciation for *Falcon* or *Nelson*. This means that there is a significant problem with the analysis; I do not know what a valid phonological explanation for this distinction would be. I think that there is definitely some evidence that a *___ constraint might help to explain some of the differences between Class 2 and Class 3. However, because of the problems with the analysis of Class 2 words, I do not know that this evidence is sufficiently convincing.

7. /r/-deletion: A Possible Flaw with the Analysis

Before concluding, I would just like to examine one more potential issue with this analysis. The issue is related to the very common phenomenon of /r/-dropping. There seems to be a clear similarity between this phenomenon and that of /l/-dropping. In both cases, a liquid is dropped from nucleus and coda position and replaced with a vocalic sound. In both cases, the phoneme in question remains present in onsets. In fact, the main featural difference between /l/ and /r/ is simply that the former is [+lateral], whereas the latter is [-lateral].

This being the case, it seems desirable that an explanation of /l/-vocalization also potentially deal with /r/-deletion. However, the analysis presented here is actually not in sync with the most common explanation of /r/-deletion, which involves epenthesis of an [_]. In fact, the following quote from Cemil Orhan Orgun's 2001 paper, "English *r*-insertion in Optimality Theory," bears directly on our discussion of /l/: "schwa epenthesis applies between a tense vowel. . . and a liquid." Orgun gives the following two examples for an /r/-deleting but non-/l/-vocalizing dialect, his (15) and (16) (747):

(62) /fij_l/ "*feel*"

(63) /fij_/ "*fear*"

This interpretation of the bisyllabic pronunciation of *feel* is directly opposed to Borowsky and Horvarth's already-mentioned footnote arguing that epenthesis does *not* occur in English (112). Instead of suggesting that the /r/ in *fear* becomes vocalized, Orgun suggests that there is an added epenthetic [_], and the /r/ is simply deleted. Presumably, he would offer a similar explanation for /l/-vocalization.

However, there are some problems with this analysis from an OT perspective. As Orgun himself notes, if the motivation for this epenthesis is claimed to be the presence of the liquid, then in cases where the liquid is deleted, like in (63), there is no valid OT-explanation for why this deletion occurs. A candidate that simply deletes the /r/ without adding an epenthetic [_] is just as harmonic as one that adds the [_]. If epenthesis is happening, it is happening because of something that is present in the input form but not, in this particular case, the output form. This is directly contrary to the spirit of traditional OT, which does not make reference to intermediate steps between the input and the output (746).

Orgun proposes a solution to the problem based on a theory called “Sympathy Theory.” According to this theory, “one of the losing candidates is singled out by a specially designated selector (“flower”) constraint.” Whichever constraint this is, it picks out the candidate that, while not violating it, does the best with respect to the other constraints. There is then another candidate, the “flower-output constraint,” which is violated by candidates that do not share a specific feature of the flowered candidate. In the case of r-deletion and the inclusion of an epenthetic [_], the flower constraint would be the constraint MAX, which prevents deletion and thus would pick out a constraint that does not delete the /r/. The candidate with an /r/ that violates the fewest other constraints is one that includes an epenthetic [_]. There would then be a flower-output constraint that would require similarity in terms of vowels but not consonants, thus leading the grammar as a whole to select for the candidate with no /r/ but an epenthetic [_] (747-748).

This “Sympathy Theory” may in fact be necessary to explain some cases of “opacity effects” where some aspect of the input seems to have some clear effect on the output, although it is not present in the output itself. However, given a choice between an explanation based on this theory and a simple OT-based explanation, I think that the latter is preferable. After all, it is not clear what the theoretical justification for the existence of flower constraints and flower-output constraints is, and it certainly seems to add complications to the theory.

Therefore, it seems to me that, instead of resorting to Sympathy Theory to explain the existence of these proposed epenthetic /_/s, one can accept Borowksy and Horvarth’s position on epenthesis in English. Instead of assuming epenthesis, we can interpret the placement of an [_] in the output where there was an /r/ in the input as a case of /r/-vocalization. This can be explained in much the same way as /l/-vocalization is, as a result of a highly ranked DEP constraint and the pressure, based on sonority sequencing, to remove /r/ from nuclei and codas.

I already mentioned above, in section 5.3, the possibility of including the constraints *N:r and *C:r in our tableaux. It would be very neat if our FAITH/l/ constraint could actually be changed to some sort of IDENT constraint that specified the liquids. However, this is not the case; in Australian English, as in RP, /r/ is categorically not pronounced in nuclear or coda position (it is only pronounced at the end of words when it can be syllabified as an onset) (Burridge & Mulder 82). As we know, *N:r must be ranked lower than *N:l and *C:r lower than *C:l, for /r/ is higher on the sonority scale than /l/. We know that the IDENT constraint is variable with respect to *N:l and *C:l, though. When this constraint is ranked above *N:l or *C:l, depending on the placement of the /l/, the /l/ is not vocalized. The same should be true of its ranking with respect to *N:r and *C:r, but, logically, the constraint must be able to appear ranked higher than these constraints. This suggests that if one IDENT constraint were sufficient to deal with both cases, the vocalization of /r/ would be variable or perhaps even categorically nonexistent. Clearly, therefore, this explanation is not a good one.

However, this does not rule out the possibility of a FAITH/r/ constraint consisting of a bundle of IDENT constraints, just as I proposed the FAITH/l/ constraint does. After all, these two phonemes do differ: /l/ is [+lateral] while /r/ is [-lateral]. In consequence, it is not really a failure of the theory that /r/ in Australian English is categorically vocalized. Instead, we can propose that a FAITH/r/ constraint does exist, but it is categorically ranked below *N:r and *C:r. In consequence, there is no pressure for /r/ to remain the same in any nuclei or codas. This explanation for vocalization, meanwhile, seems logical enough and far simpler than the explanation based on Sympathy Theory. Therefore, I would say that, in OT, a vocalization analysis is superior to an analysis that relies on epenthesis, for both /r/ and, more importantly for this paper, /l/.

8. Conclusion

Borowsky and Horvarth proposed that the variation in Adelaide English as to the vocalization of /l/ could best be explained in terms of an OT analysis. They proceeded to offer the beginnings of such an analysis, based on the pressures of sonority sequencing and moraic structure on the one hand and faithfulness on the other. The proposal basically implies that the current change going on in this dialect of English is a result of a gradual reorganization of the ranking of the FAITH/l/ constraint. This constraint was once categorically ranked above *N:l, *C:l, and *___ (note that if both disyllabic pronunciations and monosyllabic pronunciations of Class 2 words like *feel* were always possible, than *___ has always been unranked with respect to *N:l. This may therefore be a case of stable variation). Now, it is variably ranked with respect to these constraints. Perhaps one day it will end up categorically ranked below them, and /l/, like /r/, will no longer be present in Australian codas and nuclei.

Borowksy and Horvarth's own explanation of the data was somewhat flawed because of a misunderstanding of the nature of constraints in OT and a failure to analyze the cases as a group and certain significant candidates. I improved upon this analysis, ending up with a constraint set of seven or eight constraints, depending on whether or not phonological analysis of Class 2 words is entirely futile. These constraints are DEP, FAITH/l/, *N:l, *C:l, *N:Gl, *C:Gl, and, optionally, *___. FAITH/l/ is unranked with respect to *N:l and *C:l, and *___ with respect to *N:l, but apart from those considerations, they are ranked in the order shown above.

I showed that not only can this analysis explain the sources of pressure for vocalization and non-vocalization in each case, but it also accurately predicts the relationships between the three classes. Based on this grammar, Class 1 words with the /l/ in the nucleus should vocalize the most, since the nuclear constraint is higher ranked than the coda constraint. Class 3 words should vocalize the least, since the coda constraint is ranked relatively lower. Class 2 words should vocalize at a rate somewhere in between. They depend on the coda constraint, but *___ also plays a role, allowing for more vocalization than in Class 3. These predictions accurately correspond to Borowksy and Horvarth's actual data.

Obviously, the phonological analysis I have presented here is not the only important fact about this phenomenon. There are clearly, as Borowksy and Horvarth argue, some very significant sociological factors that affect the pronunciation of /l/, and these factors deserve to be studied of their own right. However, I hope that this paper has successfully demonstrated that phonological factors, too, are playing a role in the variation. Indeed, the change that is occurring truly seems to be the result of a change in constraint rankings. Borowksy and Horvarth may have been rather unclear on many of the details of their analysis, but, in the end, I think that their contention that OT is a useful and revelatory method for analyzing this data is in fact correct.

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