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Life on the Edge:

A sociophonological analysis of diphthong variation and change

Jennifer Amos

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Abstract

This paper presents an innovative socio-phonological analysis of dialect variation and change. The analysis uses sociolinguistic data regarding the diphthongs /aʊ/, /aɪ/ and /ɔɪ/ in Mersea Island English, a variety of British English. The trajectory of change shown by the data, as well as certain aspects of contextual variation (namely Canadian Raising) will provide the basis for outlining a three-tiered model that represents both internal (linguistic) and external (sociolinguistic) factors on variation and, ultimately, change. The model draws on the mechanics of both Dispersion Theory and Optimality Theory. This allows for system optimisation in the underlying phonology to be represented alongside optimal candidate selections after phonetic contextual information becomes available. The outputs from these levels, together with other possible surface variants, are then shown to have sociolinguistic associations that influence which form is ultimately selected as the surface form.

The nature and scope of phonological variation and change has been widely studied by sociolinguists, dating back to one of the more prominent studies conducted by Labov (1963 and 1972, for example) in Martha's Vineyard. However, Anttila notes that 'work on phonological variation has continued largely independently of phonological theory, often consciously emphasising its empirical character' (2002:214). Some phonological models which use the mechanics of Optimality Theory (as proposed by Prince & Smolensky 1993, 2004) to account for phonological variation include Tied Violations (for example, Hammond 1994), in which surface variation results from two or more candidates being equally valued regarding constraint violations; Multiple Grammars (for example, Kiparsky 1993), where variation occurs due to there being two or more competing underlying grammars which each provide different outputs; Floating Constraints (for example Nagy and Reynolds 1997), whereby a mixture of discrete static constraints interact with those whose position is flexible and, thus, can 'float' to create variable ranking orders; and Stochastic OT (for example, Boersma & Hayes 1999), where each constraint has a degree of random movability along a continuous scale in the constraint hierarchy, resulting in inputs being evaluated by varying constraint rankings and thus producing differing outputs.

However, even though models such as these use empirical data to inform their structure and test their efficacy and predictability, they do not allow for sociolinguistic factors to influence variation (such as audience, style and context/ setting) - only linguistic constraints. Thus, while some social factors (such as age) are weighted statistically as a means of hypothesising language change, where any change is then reflected through different constraint rankings, direct interaction of social factors on the choice of surface forms is not represented. For example, the random positive or negative values, which are assigned to constraints at the point of speech represented by Stochastic OT, cannot necessarily predict which form will surface at any given time. Thus, it can't allow for changes in surface forms which sociolinguistic data may indicate as being triggered by, for example, a change in speech style or interlocutor.

Therefore, the aim of this paper is to introduce and present an integrated socio-phonological model which represents dialect variation and change. The model incorporates mechanical aspects of both Optimality Theory and Dispersion Theory (Flemming 2004, 2006) and allows

for the representation of phonological constraints (to derive an underlying inventory), phonetic constraints (to generate contextual variation) and sociolinguistic influences (to allow for the dynamic manipulation of surface variants in speech). However, before this model is introduced in Section 4, an overview of the sociolinguistic data from Mersea Island English will be provided, followed by a brief discussion of Optimality Theory and Dispersion Theory.

1. The Data

The data used for this analysis was extracted from a corpus of spoken data collected on Mersea Island, in north east Essex, England. The corpus representing Younger and Older speakers was collected between January 2006 and March 2007, and consists of casual conversations between the author and the participants in their homes. All participants used for this study were life-long Islanders from the Western side of the Island. In addition to these data sets, which give an apparent time perspective to the analysis, historical recordings were obtained from the local Mersea Island Museum. These museum recordings are part of an on-going project to provide the elderly and partially-sighted the chance to listen to a talking magazine which covers areas such local news and events, as well as interviews with Islanders. It is these interviews which allow a real time comparison to be made across the Mersea data, as the oldest recordings are from native Islanders born as early as the 1880s.

These data sets were analysed for three diphthongs, /aʊ/, /aɪ/ and /ɔɪ/, and only stressed syllables were considered for this analysis. For example, tokens such as *I*, *my* and *by* were discounted due to the tendency of these diphthongs in Mersea Island English to reduce to schwa (or other reduced vowel qualities) in these morphemes.

2. Results – a brief overview

The Mersea Island English data (MIE) did not show any variation in the offglide of these diphthongs. Therefore, the only variation that will be discussed here is that relating to the diphthongal nuclei of /aʊ/, /aɪ/ and /ɔɪ/. Using the data collected from Older and Younger speakers (giving an apparent time perspective) and comparing this to the Museum speakers

and other historical sources, such as Ellis (1889), (giving a real-time perspective), the following changes to the diphthongal nuclei have occurred:

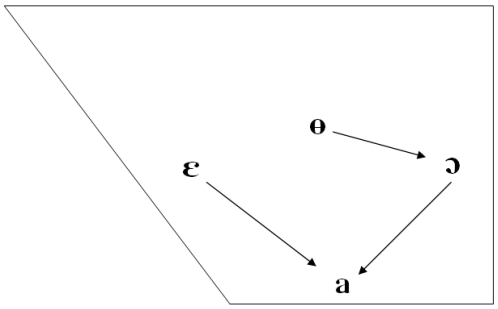
/aʊ/ = [ɛʊ] to [aʊ]

/aɪ/ = [ɔɪ] to [aɪ]

/ɔɪ/ = [ɵɪ] to [ɔɪ]

These changes can also be represented graphically as:

(1) The direction of change for the nuclei of Mersea Island /aʊ/, /aɪ/ and /ɔɪ/ diphthongs



In addition to these general findings, certain contextual variation patterns were also identified. Due to space limitations, this paper will only discuss the phenomenon of Canadian Raising (however, see Amos 2011 for details of other contextual and lexical variations). Canadian Raising (CR), as discussed by those such as Chambers (1989) and Britain (1991, 1997) in the sociolinguistic literature, is a vowel alternation which affects the diphthongs /aʊ/ and /aɪ/. Both these diphthongs vary between low and mid nuclei depending on following phonological context – mid nuclei are produced before voiceless consonants, while low nuclei are produced elsewhere. This creates allophonic variations in pairs, such as *lout* [lɛʊt] and *loud* [laʊd], and *price* [pɹɔɪs] and *prize* [pɹaɪz][1].

[1] Note that, in its original sense, Canadian Raising reflected the realisation of /aʊ/ and /aɪ/ as [əʊ] and [əɪ], respectively. However, in modern dialectology, this term is often used more generally to represent diphthong outputs which involve height alternations in pre-voiceless and pre-voiced contexts.

CR patterns, while attested for both diphthongs in, for example, Canada (Chambers1989) and for /aɪ/ in England (Britain 1991, 1997), have not been found for *both* /aʊ/ and /aɪ/ in England. Thus, the Mersea Island data are unusual with respect to previous dialectological findings. By way of explanation, Amos (2011) argues that the CR pattern has manifested in MIE for both /aʊ/ and /aɪ/ as a result of a transitional phase between the traditional diphthongs (with the mid nuclei) and innovative diphthongs (with the low nuclei) and, due to it being the product of on-going change, is not stabilising as a dialect feature of the Island. However, we still need to account for this variation in order to represent sociolinguistic change within a phonological framework.

3. An Introduction to Optimality Theory and Dispersion Theory

Optimality Theory (OT), as originally proposed by Prince & Smolensky (1993, 2004) is an output-based model of language. Therefore, the primary focus is not how an input sequentially derives towards an output, but, instead, how a number of possible outputs (including one that is identical to the input) compare in relation to each other. This comparison of possible outputs is done through a ranking of constraints which stipulate certain conditions that successful candidates must fulfil in order to win. This can be seen in the tableau below:

(2)

/input/	CONSTRAINT $_1$	CONSTRAINT $_2$	CONSTRAINT $_3$
☞ Candidate A			*
Candidate B		*!	

The further to the left a constraint is placed, the more important it is that candidates do not violate its condition. In this example, neither candidate violates the most significant constraint (labelled here as CONSTRAINT$_1$), but Candidate A becomes the winning output due to its only violation being the lowest ranked constraint.

While OT reflects underlying segments in the form of the input, it does not make any claims about how individual phonemes are organised in relation to each other in the underlying grammar. However, if a phonological model is going to represent linguistic change, it is logical that it must take into account how the underlying inventory of segments is constructed and modified during and after change.

In order to do this, we can turn to the foundations of Dispersion Theory (DT). DT, notably introduced by Flemming (2004, 2006), aims to explore, through an OT-type framework, the 'general character of the constraints imposed on the phonology by the need to minimise confusion' (Flemming 2004:232). As a result, the model takes a more perceptual (as opposed to productive) stance. It considers the conflicts between constraints which maintain contrasts and perceptual distance between sounds, and those which minimise the effort involved in speech production, thus leading to a reduction in phonemic distinctiveness.

Building on the idea that the phonological inventory is constructed by constraints which aim to maximise contrasts, while maintaining sufficient phonetic distance between each segment, Flemming (2006) constructs a three-tiered model, the first of which is how these inventory segments are selected. The second tier selects these segments and creates phonetically mapped strings of sounds, which are then evaluated against contextual constraints (which prompt processes such as assimilations). Finally, the third tier evaluates these modified strings of sounds to check that any segments in the potential surface form remain distinct enough from other inventory forms - otherwise, neutralisations and mergers will occur. The example that Flemming (2006) uses is the spreading of labiality from a labial consonant to the following high vowel in Cantonese. The result is the surface merger of two underlying vowels, /i y/, to one labialised vowel [i^{β}].

This system worked well for Flemming who was primarily concerned with describing surface neutralisations of phonemes. However, even though the fundamental aspects of the first two tiers can be applied to a model of variation and change, the mechanics of the third tier need to be adapted so that it can accommodate processes beyond that of contextual mergers (see Amos 2011 for an example of how this model fails at representing variation data). Indeed,

this is the stage where the model presented here deviates from Flemming's and introduces an innovative Sociolinguistic Level of speech production.

4. A Three-Tiered Sociophonological Model of Speech Production

The following sections will present and discuss each tier of this model in full, using the data from Mersea Island English as a base for any examples.

4.1. The Inventory

In order to select the phonemic inventory, Flemming (2004) introduces two primary constraints: MINIMUM DISTANCE (MIN DIST) and MAXIMISE CONTRASTS (MAX CONT). MIN DIST uses formant structure as descriptors and phonetic reference points. Thus, he uses the following 'coarsely quantised 3D vowel space' (2004:238) in order to describe vowels by their dimensional values.

(3)

F2							F3				
6	5	4	3	2	1		3	2	1		
i	i̱	y	ɨ	ɯ	u	1	i		y,ɯ,u	1	
	ɪ	ʏ			ʊ	2		ɪ	ʏ,ʊ	2	
	e̞	ø̞		ɤ̞	o̞	3		e̞	ø̞,ɤ̞,o̞	3	
	e	ø	ə	ɤ	o	4		e	ø,ɤ,o	4	F1
		ɛ	ɜ	ʌ	ɔ	5		ɛ	ʌ,ɔ	5	
		æ	ɐ		ɑ	6			ɑ	6	
			a	a̱		7			a	7	

F1

For example, using only the first two formants, /æ/ and /u/ can be described as F1 *6*, F2 *4* and F1 *1*, F2 *1*, respectively. Using this notation, MIN DIST constraints can stipulate how separated phonemes need to be in a language. By way of illustration, a constraint stipulating MIN DIST F2:*2* would be violated by an inventory containing the pair u ~ ɯ (as there is only a distance of 1 on the F2 dimension), while a pair such as u ~ i would be acceptable (as there is a gap of 5).

In contrast, MAX CONT aims to select an inventory that represents the largest number of contrasts. Thus, a five vowel system, such as /i u e o a/ is preferred over a three vowel inventory, such as /i u a/. As a result, this constraint works in opposition to MIN DIST, as MAX CONT is only able to select the largest inventory permitted by the relative rankings of MIN DIST. For example, consider the tableau below:

(4)

		MIN DIST F1:3	MAX CONT
a.	☞ i - e - a		✓✓✓
b.	i - e - ɛ - a	* * !	✓✓✓✓

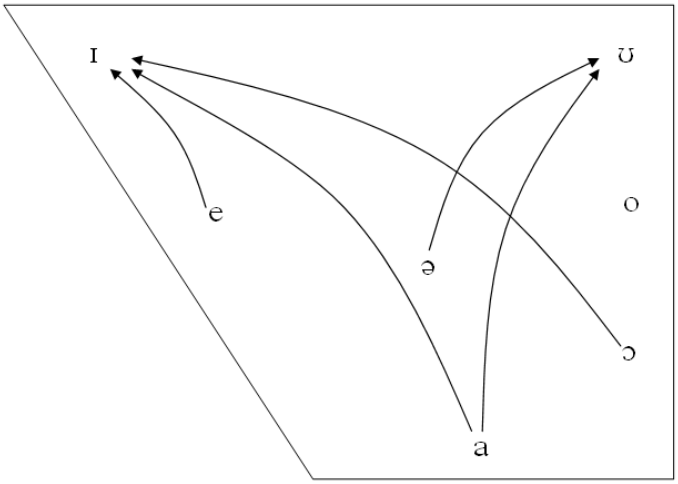
As MAX CONT is a positive scalar constraint, ✓ is used to indicate fulfilment as opposed to a violation. We can see that, although the front vowel system in (4b) has a four-way distinction, it is blocked by the violations of Min Dist F1:3 (as the distance between e ~ ɛ and ɛ ~ a is only one and two, respectively).

4.1.1. Dealing with Diphthongs

The analysis offered by Flemming (2004) only focussed on simple, single vowels. Therefore, certain modifications must be made in order to accommodate the articulation of two vowels within a single syllable nucleus.

The primary Standard English rising diphthong inventory consists of /aɪ aʊ eɪ ɔɪ əʊ/, which can be shown as follows:

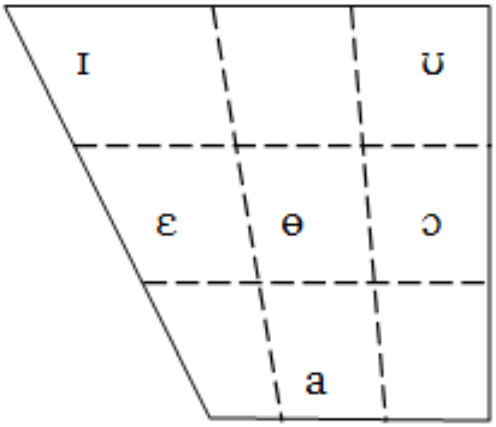
(5)



This inventory demonstrates how nucleic distinctiveness plays a greater role than offglide distinctiveness. Thus, there is greater flexibility in what may be a diphthong nucleus than what can be an offglide. As a result, we can claim that, in Standard English, it is more important in the inventory selection to have a contrast between diphthong nuclei than the offglides (with /aʊ/ and /aɪ/ the only primary pair to be distinguished by the offglide).

For the purpose of this analysis, I will employ a simplified segmental grid, even though it does not have the same level of phonetic detail as Flemming's, in order to reflect the more familiar IPA division of vowel space. In addition, in order to simplify the analysis, only the vowels relevant to the current analysis have been marked.

(6)



Using this segmental grid as a reference, the following Inventory constraints can be constructed:

> MIN DIST $_{nucleus}$ – In this case, minimal distance is referring to the diphthongal nucleus and it stipulates that diphthongal nuclei must not be in the same or adjacent zones.
>
> MIN DIST $_{offglide}$ – The constraint, similar to that outlined above, applies to the diphthongal offglides.
>
> MAX CONT – The aim of Maximise Contrast is to exploit the articulatory/ perceptual space as much as possible.

These will be used in conjunction with the following constraints which oversee the structure of the diphthongs themselves:

DIPHTHONG CONTRAST (Internal) – This would be implemented as a segmental markedness constraint. DIPH CONT acts to maintain a particular distance between the two diphthongal elements. Thus, focusing on height:

> DIPH CONT $_{HEIGHT\ 2}$ – diphthongal elements are separated by two zones with respect to height
>
> DIPH CONT $_{HEIGHT\ 1}$ – diphthongal elements are separated by one zone with respect to height

Since this paper is concerned with the behaviour and interaction of the three diphthongs /aʊ/, /aɪ/ and /ɔɪ/, this is where the following tableaux will focus, and not on the representation of the entire MIE diphthongal system. In addition, the tableaux are not directly concerned, as in Flemming's work, with the number of contrasts which can be established through the optimisation of the vowel space. Instead, the primary concern of the model outlined here is to examine how, by using DT, the integrity of the diphthongal system is established and maintained. Thus, by using a subset of this system (namely /aʊ/, /aɪ/, /ɔɪ/), we can explore how the direction of change in Mersea Island English is motivated and optimised, as opposed to seeing how the entire system is maintained over various linguistic contexts.

To start, let us consider how we might derive these three diphthongs in Standard English (which is also representative of the data from the Younger Mersea Island speakers):

(7) The Inventory Tableau: To achieve the Standard English Inventory

	PRICE ~ CHOICE ~ MOUTH	MAX CONTRAST	DIPH CONT $_{\text{HEIGHT-2}}$	DIPH CONT $_{\text{HEIGHT-1}}$	MIN DIST $_{\text{NUCLEUS}}$	MIN DIST $_{\text{OFFGLIDES}}$
A	ɔɪ ɵɪ ɛʊ	✓✓✓	*P *C *M !		*P~C *C~M	*P~C
B	☞ aɪ ɔɪ aʊ	✓✓✓	*C	*P *M	*P~M	*P~C
C	ɔɪ ɔɪ ɛʊ	✓✓ !	*P *C *M		*P~C	*P~C
D	aɪ ɔɪ aa	✓✓✓	*C *M !	*P *M	*P~M	*P~C
E	aɪ ɔɪ ɛʊ	✓✓✓	*C *M !	*P		*P~C

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How to read this tableau - Explanatory Points

- The top left cell is not representative of an input, since there are no inputs in the Inventory. However, the lexical set references (Wells 1982) are included in this cell to indicate which diphthong in the cells below correspond to which phoneme.

- This is also reflected in the use of *P(rice), *C(hoice) and *M(outh) as violation markers so that the reader can see which diphthong (or pair of diphthongs) is in violation of which constraint.

- The MAX CONTRASTS constraint does not allow the same diphthong to be associated with more than one lexical set. Therefore, candidate set C only has a two-way contrast between /ɔɪ/ and /ɛʊ/ meaning that this variety, should it surface, would have an underlying /aɪ/~/ɔɪ/ merger.

- Candidate set D still has a three-way distinction. However, /aʊ/ has monophthongised to /aa/ (the notation of aa representing a consistent vowel quality across both timing tier slots of a syllable nucleus)

- The violations allocated in DIPHTHONG CONTRAST relate to the differences between both elements of the diphthong. For example, each candidate in set A violates $\text{DIPHCONT}_{\text{HEIGHT-2}}$ as they only have a difference of 1 between the elements /ɔ/ and /ɪ/, /ɵ/ and /ɪ/ and /ɛ/ and /ʊ/. However, only /aa/ violates $\text{DIPHCONT}_{\text{HEIGHT-1}}$, since the diphthong has been monophthongised and thus there is no qualitative difference in the vocalic articulation across timing tier slots.

- The constraint $\text{MINDIST}_{\text{NUCLEUS}}$, which guards against contrasting nuclei occupying the same or adjacent zones, is violated by, for example, the relation between /ɔ/ and /ɵ/ (*price~choice) and /ɵ/ and /ɛ/ (*choice~mouth) in candidate set A.

  When this is applied to the offglide, we can see that all candidate sets are in violation of this constraint since they all replicate either /ɪ/ or /ʊ/ offglides within a set of proposed inventory segments.

The implication of this tableau is that, the wider the two elements, the more optimal the diphthong. This observation has already been noted by, for example, Yamada (1984) who formalises it as part of her investigation of diphthongisation following the Great Vowel Shift. Therefore, it can be suggested that the wider the diphthong, the less marked it is in terms of perceptual distinctiveness (even though more articulatory effort would be involved). Indeed, if we consider the quantum vowels /i a u/ as being unmarked, the same description could be attached to the diphthongs /ai/ and /au/, which combine these vowels. As a result, any changes in the phonological system towards these two forms would be less marked and more natural.

Working backwards in time then, the primary difference between the Younger speakers and the Museum speakers is the phonetic distance between their respective diphthongal nuclei and their corresponding offglides. Thus, Younger speakers represent /aɪ ɔɪ aʊ/, while the Older speakers represent /ɔɪ ɵɪ ɛʊ/. One solution is the re-ranking of the DIPHTHONG CONTRAST (i.e. $\text{DIPHCONT}_{\text{HEIGHT-1}}$ >> $\text{DIPHCONT}_{\text{HEIGHT-2}}$) constraints so that less importance is placed upon the height contrast between nucleus and offglide.

(8) The Inventory Tableau – To achieve the traditional Mersea Inventory

	PRICE ~ CHOICE ~ MOUTH			MAX CONTRAST	DIPH CONT $_{\text{HEIGHT-1}}$	DIPH CONT $_{\text{HEIGHT-2}}$	MIN DIST$_{\text{NUCLEUS}}$	MIN DIST$_{\text{OFFGLIDES}}$
A	☞ ɔɪ	ɵɪ	ɛʊ	✓✓✓		* P *C *M	*P~C *C~M	*P~C
B	aɪ	ɔɪ	aʊ	✓✓✓	* P *M !	*C	*P~M	*P~C
C	ɔɪ	ɔɪ	ɛʊ	✓✓ !		*P *C *M	*P~C	*P~C
D	aɪ	ɔɪ	aa	✓✓✓	*P *M !	*C *M	*P~M	*P~C
E	aɪ	ɔɪ	ɛʊ	✓✓✓	*P !	*C *M		*P~C

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With respect to the development of /aʊ/ and /aɪ/ in this dialect, historical data suggest that the nuclei have changed from [əʊ] and [əɪ] to [ɛʊ] and [ɔɪ] (following the Great Vowel Shift), which enhances the distance between the two diphthongal elements. Therefore, the further development towards an [a] nucleus for both is in accordance with the optimisation of the system outlined by DT (see Amos 2011 for a more detailed exploration of the historical paths of these diphthongs).

Now that we have seen how the Inventory tier is constructed, we shall now turn our attention to the next tier, Realisation of Contrasts.

4.2. Realisation of Contrasts

This is the phase where the Inventory constraints become deactivated and contextual markedness constraints are activated. Thus, individual segments are selected from the Inventory and mapped together to form phonetic strings. As a result, once isolated phonemes now have surrounding context, and certain phonetic information, such as gestural articulation becomes available. This leads to the implementation of markedness and faithfulness constraints, which evaluate the possible outputs in accordance with the new contextual conditions. These constraints could include, for example, those which neutralise aspiration of voiceless stops after /s/ in English, positional assimilation of nasals, or stress assignment and subsequent vowel weakening in unstressed syllables. In this working example, we shall look at the phenomenon of Canadian Raising (though see Amos 2011 for the modelling of further contextual processes).

Canadian Raising is a phonological rule in which the nuclei of /aɪ/ and /aʊ/ are realised as higher vowels (In MIE, this is in the regions of [ɔ] and [ɛ], respectively) before voiceless consonants. In order to do this, we can construct the following constraints:

> RAISE VOWEL – No diphthongal nuclei of [+low] before a voiceless consonant (However, [+low] required elsewhere)

IDENT 1st/ 2nd element – The specifications of the diphthongal elements in the input are preserved in the output

The RAISE VOWEL constraint penalises the nuclei of diphthongs if they are low before a voiceless consonant. It also prompts a violation if diphthong nuclei are not [+low] in other environments. This constraint also works in line with cross-linguistic observations made by Laver (1994:445-447), who demonstrates that vowels are shorter in the context of voiceless coda consonants. Building on this, Trudgill (1986:155) proposes that more open diphthongs would be favoured before a voiced consonant, due to the greater amount of time available for their articulation.

In Standard English, the only diphthongs with phonologically low nuclei are /aʊ/ and /aɪ/ and so these are the only diphthongs which would be affected by this constraint. Working in opposition to this are the two faithfulness constraints IDENT $_{\text{1st element}}$ and IDENT $_{\text{2nd element}}$. These act to preserve the quality of the inventory forms which provide the input for the Realisation stage. In order to achieve a CR correspondence, these constraints can be ranked as follows:

RAISE VOWEL >> IDENT 1st element >> IDENT 2nd element

The two IDENT faithfulness constraints have been ranked in this way to reflect the idea that it is a worse violation to alter the quality of the diphthong nucleus than it is to alter the quality of the offglide. In the tableaux below this ranking becomes apparent.

Concentrating on /aʊ/, the Museum speakers' Inventory generated the diphthong /ɛʊ/. The tableaux in (9a) and (9b) show how, with this input, the Canadian Raising pattern can emerge for the items *house* and *houses*.

(9a)

/hɛʊs/	RAISE VOWEL	IDENT$_{1st\ element}$	IDENT$_{2nd\ element}$
haʊs	*!	*	
☞ hɛʊs			
haas	*!	*	*

(9b)

/hɛʊ.zɪz/	RAISE VOWEL	IDENT$_{1st\ element}$	IDENT$_{2nd\ element}$
☞ haʊ.zɪz		*	
hɛʊ. zɪz	*!		
haa. zɪz		*	*!

The faithful candidate [hɛʊs] wins in (9a) due to the contextually appropriate raised vowel. However, it loses out in (9b) due to a raised vowel being found before a voiced consonant (when the constraint stipulates that the diphthong nucleus must be [+low] in contexts which are not pre-voiceless consonants).

A benefit of this approach is that no re-ranking of the contextual constraints is necessary to achieve the same Canadian Raising pattern in the Younger speakers, even though the input is different. This can be seen in the tableaux below:

(10a)

/haʊs/	RAISE VOWEL	IDENT$_{1st\ element}$	IDENT$_{2nd\ element}$
haʊs	*!		
☞ hɛʊs		*	
haas	*!		*

(10b)

/haʊ.zɪz/	Raise Vowel	IDENT$_{1st\ element}$	IDENT$_{2nd\ element}$
☞ haʊ.zɪz			
hɛʊ. zɪz	*!	*	
haa. zɪz			*

Thus, consistency of constraint application at this level allows for changes to take place in the underlying Inventory, but, until alterations are made in the constraint ranking, contextually motivated patterns and dialect specific patterns can remain constant.

Until now, these have been internal linguistic influences on the shape of phonological forms. However, as we shall see below, surface variation is readily influenced by external sociolinguistic factors.

4.3. The Sociolinguistic Level of Speech Production

So far in this model, we have seen how phonological considerations select the underlying phonemic inventory and how the phonetics-phonology interface can be represented through the application of contextual constraints, once phonetic information becomes available in the Realisation. However, neither of these allow for the manipulation of outputs which are prompted by external influences. For example, sociolinguistic studies (such as Labov 1994, for example) have demonstrated how, when more attention is paid to speech during style tests, contextual co-articulation effects and variant usage changes (compared to that of speech in more natural, relaxed contexts). These correlations in sociolinguistic data cannot be accounted for through a purely phonological approach. Thus, if we allow for linguistic contextual constraints to influence phonetic mappings within our phonology, we must also, by logic, integrate mechanisms that can override or manipulate these constraints if necessary.

The incorporation of a Sociolinguistic level of speech production, which implements sociolinguistic constraints, would recognise a speaker's communicative competence and give the speaker the ability to override certain linguistic constraints which have been imposed at previous levels. For example, Tatham and Morton explain that, even though co-articulation is not a phenomenon which can be turned on and off at the will of the speaker, it can be described as 'a involuntary process which, like many others, can be voluntarily influenced' (2006:29). Therefore, the Sociolinguistics level is able to modify the previous phonological outputs, as it is where knowledge about how to manipulate the phonology is collected and stored, together with the social meaning of competing phonological forms. However, as

Preston (1991) demonstrates, the range of sociolinguistic variation is limited by the scope of the underlying phonology, be it through universal linguistic constraints or those which are language specific. As a result, we can say that it is the linguistic factors which provide the possible variations, while it is the sociolinguistics which selects the most appropriate form in a particular social context.

The collection and storage of the sociolinguistic information may be achieved through exemplars. Exemplar Theory (see, for example, Pierrehumbert 2001) proposes that detailed phonetic memories of individual linguistic forms can be stored. The stored exemplars then form an exemplar cloud which is continuously added to every time a form is perceived. When we wish to produce a particular form, we select from the exemplar cloud, with those which are most frequently perceived as being the ones with the fastest selection times. Thus, the model allows for the behaviour of speaker accommodation since 'speech patterns, which are heard recently and frequently, dominate the set of exemplars for any given label, and therefore guide typical productions' (Pierrehumbert 2001:13). Thus, it is through linguistic experience, both production and perception, that we acquire associations between linguistic variants and, for example, specific interlocutors, social contexts and topics. A speaker can use this information when it comes to production so that appropriate, or conversely inappropriate linguistic forms are selected. By taking this into account, accommodation to a speaker is not only possible, but accommodation to a particular situation or topic is also possible. The integration of these considerations in a model of speech production allows for a speaker to switch between styles and registers dynamically as the speech event or conversational exchange unfolds in time.

Up to this point, we have seen how the language or dialect specific conditions on diphthong shape take the primary role in shaping the underlying segmental inventory. These inventory segments can then be altered by additional factors once phonetic mapping takes place. For example, as we have seen through the example of Canadian Raising, the Inventory may select /ɔɪ/ while the Realisation may select either [ɔɪ] or [aɪ], depending on the phonological context. However, we may get variation between these allophones in natural speech and so we need to construct a component which allows the speaker to retain trace memories of the

outputs from both previous levels, so that they can both be evaluated according to real-time sociolinguistic considerations.

For example, regarding the lexical item *prize*, a Museum speaker's inventory segment would be /ɔɪ/ while the Realisation would alter it to [aɪ]. This can be represented in the following way, along with possible evaluations which may be attracted to each form.

(11)

	Audience		Style		Context	
	Known	Unknown	Informal	Formal	Familiar	Unfamiliar
pɹɔɪz	✓		✓		✓	
pɹaɪz		✓		✓		✓

By using ✓, we can map each candidate in terms of social and stylistic value. Thus, this level does not work on a selection-through-violation process. Instead, the ✓ -mapping allows for variable selections based on which candidate fulfils particular criteria. By way of illustration, using the, albeit, simplistic distinctions above, [aɪ] may be selected in more formal speech styles (like public speaking) with people unfamiliar to the speaker, while [ɔɪ] may be selected in situations which are more casual. However, this need not be the case. For example, if the speaker wanted to diverge from a formal situation, they may pick [ɔɪ] instead.

This can be expanded to represent any ambient variants which are being perceived by introducing additional candidates at this level. A Younger Mersea speaker may have /aɪ/ and [aɪ] selected in both the Inventory and the Realisation (due to the loss of the Canadian Raising rule during dialect change). However, they may perceive the [ɔɪ] form when talking to an Older islander and accommodate to it in order to show solidarity, for example.

Taking this into consideration, the example and subsequent tableaux in (12) below illustrate the selection process of variants using an example from the Mersea Island English data:

(12)

A and B, who are Older Mersea speakers, are husband and wife. They are being interviewed by J, a Younger Mersea speaker, in the living room of their house. In the middle of talking to J, the phone rings outside the interview room and A goes to answer. The caller, it is later revealed, is A's son X.

(12a) A's Sociolinguistic Matrix for 'might' – Addressing the interviewer J in the presence of his wife B

	Audience		Style		Context	
	B	J	Informal	Formal	Familiar	Unfamiliar
mɔɪt Inventory	✓		✓		✓	
mɔɪt Realisation	✓		✓		✓	
maɪt Interviewer		✓		✓		✓

(12b) A's Sociolinguistic Matrix for 'might' – After answering the phone to X in a separate room

	Audience			Style		Context	
	X	B	J	Informal	Formal	Familiar	Unfamiliar
mɔɪt Inventory	✓	✓		✓		✓	
mɔɪt Realisation	✓	✓		✓		✓	
maɪt Interviewer			✓		✓		✓

The subscripts in the far left column indicate the source of the candidate. Note how the interviewer's variant of choice also becomes a candidate, since it is the form which is being perceived, decoded and stored in association with any relevant social factors. This allows accommodation to take place between speakers, as any new phonetic forms introduced from outside can be interpreted and evaluated by the phonological and sociolinguistic systems.

The darkened cells at this level show which of the social factors are applicable and relevant at the time of the utterance. Therefore, we can see that the context does not change (that is, both utterances were carried out in A's home) unlike the interlocutor and the style which do change (the latter since a telephone conversation is outside the confines of the sociolinguistic interview). As a result, the parameters for candidate evaluation also change. Thus, the

speaker's choice in (12a) is between [aɪ], which the interviewer is using and which is also associated with the current speech style, or [ɔɪ], whose only relevant associations are to do with the familiarity of the context. Conversely, when the audience and style of speech change, there are no associations of [aɪ] in the activated cells, making [ɔɪ] the likely surface form and accommodation to the interviewer less likely, even though J maintains the type of status associated with over hearers (Bell 1984, 2001).

One benefit of this approach is that it is able to demonstrate surface variation in a dynamic way by allowing consistency in the linguistic selection of sounds but variation in their selection. Even though the examples presented here have been simplified, they can be adapted to reflect any number of additional or personalised factors - that is, sociolinguistic factors which are not only salient to groups, but salient to the individual. Indeed, in group situations, or in the cases of dialect contact, there may be a number of new forms added from speakers which will work to bolster their respective exemplar clouds and create numerous sociolinguistic associations. If contact with these forms is limited, the associations will remain weak. Conversely, if the associations are continually activated, they will gain strength over time as they are used with more frequency. Eventually, these strengthened forms will cause a shift or change on the part of the speaker and the underlying system will need to be adjusted to compensate.

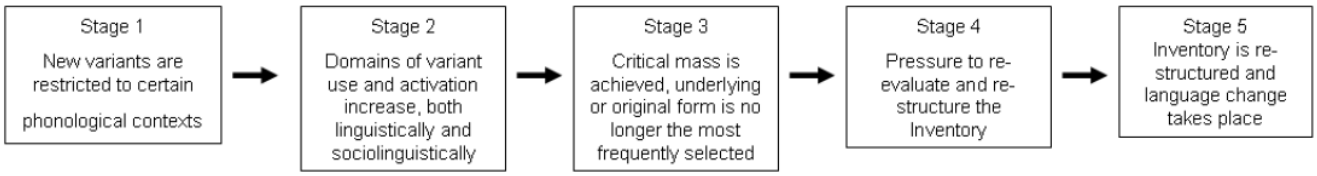
5. Implications for Language Change

The model presented above has demonstrated how underlying phonological forms may be generated and modified by constraints to provide allophonic and contextual variation, as well as how surface variation can be produced in accordance with sociolinguistic factors. However, any model of variation must also make provision for language and/ or dialect change. Indeed, this section explores how each level of the model can represent different types of change.

Through the investigation of a number of vowel and diphthong shifts, Minkova & Stockwell (2003) state that 'once phonetically motivated surface changes gather enough momentum,

they percolate into the underlying structure, creating new phonologies' (2003:184). Therefore, we could say that in the early or initial stages of a change, contrasts in the underlying inventory would remain unaltered. Applying the principles of the quote, however, 'phonetically motivated' changes may be regarded as those natural changes which arise in the second tier, the Realisation. Even though the initial domains of application would be phonetically restricted, once these patterns are established, frequently used and reinforced by the speaker and the speech community, other domains of application may emerge through constraints in the Realisation. The momentum of change will increase as the domains are extended, and, once it reaches a critical mass, the change may be filtered up to the Inventory. It is at this point that the underlying structure of the sound system will readjust to accommodate the new phoneme or phonemes and, possibly, set about adjusting the relative position of other phonemes in the system, resulting in a chain shift.

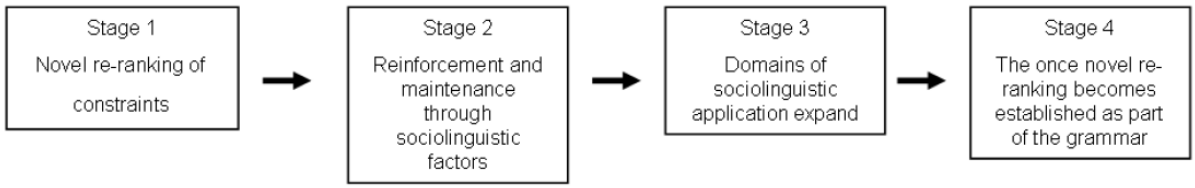
This type of change can be outlined as follows:



This approach is mainly focussed upon linguistic factors (namely naturalness) as the main driving force of change, with sociolinguistic factors there to reinforce and promote the newly developed variants. Therefore, we also need to allow for driving forces of change to originate from outside the domain of phonetic or phonological motivation.

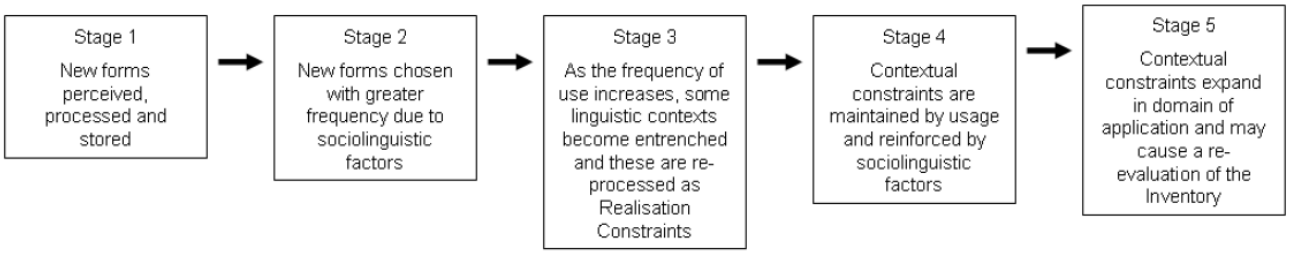
Whilst examining constraint re-ranking in phonological change, Gess (2003) presents a three-level model in which he makes the distinction between lexical and post-lexical components. The structure of the post-lexical level is of most relevance here as Gess proposes that it is split into two levels – 'register-dependent' and 'register-independent'. The important factor, with respect to language change, is that the register-dependent level is where a new form is

developed due to a novel re-ranking of applicable OT constraints. Gess (2003:76) suggests that this novel re-ranking will be a rarity at first and will be restricted to a minority of speech styles, a minority of speakers and, maybe, only feature in frequently occurring words. However, this once novel re-ranking will gradually become more frequent across a speech community and will extend its application regarding speech styles and lexical items. This proposal, therefore, does not deny the role of sociolinguistic factors, as Gess suggests 'the spread of change through speech contexts and speakers is due to sociolinguistic factors [while] the spread of change through the lexicon (lexical diffusion) is due to both social factors and frequency' (2003:77). Thus, once again, with respect to this model, we can say that new forms resulting from a novel re-ranking would be generated in the Realisation, while the notion of register variation would be incorporated at the Sociolinguistics level. This process is outlined below:



Even though this type of change is instigated by a novel re-ranking, as opposed to more natural linguistic tendencies, it still implies that new variants are generated internally by the linguistic system, albeit maintained, at least initially, by the sociolinguistic system. Therefore, one final aspect of change to account for is change which is prompted by external influences, such as that instigated by contact and long-term accommodation. Cases such as these can be associated directly with the Sociolinguistic level. When a speaker is introduced to a new form, this linguistic input is then analysed by the phonology and stored amongst other appropriate exemplars. The sociolinguistic information will be catalogued together with the linguistic information, so these details will be ready for retrieval by the system when required. The more a speaker is exposed to the new form, the more likely it is to be selected from the Sociolinguistic level's candidate set as an appropriate form (unless divergence from the new variants is particularly desired by the speaker instead of convergence). The increased frequency of use may prompt a re-analysis of the constraint ranking in the Realisation, perhaps prompting specific lexical constraints or more general contextual

constraints. Once these are established, increased pressure from the Realisation once again may cause a shift in the Inventory. However, if a more linguistically naturalistic pattern of variation is established through Realisation constraints, and the innovative forms are not extended to other, more marked contexts, the Inventory may be left unaltered. Instead, allophonic variations become established and entrenched as part of the language or dialect's grammar. The following illustrates this type of change:



However, if the contact that prompted the processing of these external variants is withdrawn, alterations in the Realisation (and subsequent re-adjustment of the Inventory) will not take place. Thus, short-term contact can be dealt with directly in the Sociolinguistic level.

In summary then, we can propose three types of change, each having a different influence on the phonological system:

I. Change which is introduced and maintained by the linguistic system. These changes will reflect natural processes and motivations.

II. Change which is introduced by the linguistic system, but maintained by the sociolinguistic system. These changes are the result of novel constraint re-rankings, which then become established.

III. Change which is introduced externally to the Sociolinguistic level and is maintained by the sociolinguistic system. These new forms may never become adopted by the linguistic system in the form of Realisation constraints if, for example, the contact situation which originally introduced the innovations diminishes.

6. Concluding Remarks

This paper has explored and presented a new socio-phonological model and has demonstrated how it can be applied to data relating to variation and change. This model uses a combination of Optimality theory and Dispersion theory to construct two linguistic levels in our

phonologies – the Inventory and the Realisation. These levels act to select the underlying phonemic inventory and, from the inventory of sounds, modify segmental strings once they are given phonological and phonetic context. The outputs of both these levels can then be evaluated, alongside any additional forms which are provided by the ambient linguistic environment. This allows the model not only to represent variation influenced by linguistic factors, but also variation triggered by phenomena such as accommodation. In addition, the Sociolinguistic level provides the means for the dynamic evaluation of output forms, allowing a speaker to manipulate or select surface forms according to ever-changing external influences. Further to this, we have briefly seen how it is possible to represent different types of phonological linguistic change within the model presented here, once again highlighting the close relationship between internal and external influences on language use.

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