DIALECTOLOGY, PHONOLOGY, DIACHRONY: LIVERPOOL ENGLISH REALISATIONS OF PRICE AND MOUTH

Amanda Beth Cardoso

A thesis submitted in fulfilment of requirements for the degree of

DOCTOR OF PHILOSOPHY

to Linguistics and English Language
School of Philosophy, Psychology and Language Sciences
UNIVERSITY *of* EDINBURGH

June 2015

DECLARATION

I hereby declare that this thesis is of my own composition, and that it contains no material previously submitted for the award of any other degree. The work reported in this thesis has been executed by myself, except where due acknowledgement is made in the text.

Amanda Beth Cardoso

CONTENTS

ABSTRACT

Dialect emergence or new-dialect formation in intensive contact situations has been the subject of research for decades. Approaches to dialect emergence have led to a more solid understanding of the origins of specific phonological features. This line of research often approaches issues of new-dialect formation and phonological feature development within the confines of one linguistic subfield. However, new-dialect formation is a multifaceted phenomenon which results from a combination of dialectological, phonological and historical linguistic factors. The current thesis presents a comprehensive account of phonological feature development in new-dialect formation from a combined theoretical perspective by exploring historical and contemporary processes in the emergence of phonologically-conditioned variation in the PRICE and MOUTH lexical sets in Liverpool English.

This feature has been widely researched in other varieties of English and has previously been attributed to new-dialect formation. However, little is known about the patterns of PRICE and MOUTH in Liverpool English. The current thesis relies on multiple methods of data collection (e.g. a combination of fieldwork and corpus data), various quantitative methods, and detailed acoustic analyses (e.g. formants and Euclidean distance in a two-dimensional formant space) to investigate the precise details and the processes involved in the emergence and development of PRICE and MOUTH patterns in Liverpool English.

Liverpool English is thought to have emerged during the 19th century as a result of extensive and prolonged immigration from the surrounding areas of Lancashire and Cheshire, and from Ireland, Wales, and Scotland. However, the specific timing, extent of immigration, and proportion of immigrant populations have not been investigated in detail. The current thesis provides the first in-depth analysis of historical census records in order to extend our knowledge of the populations in Liverpool at the time of new-dialect formation. The insights obtained from this analysis provide a more nuanced picture of the development of Liverpool English. They are essential for determining what dialects potentially contributed to dialect formation and the repertoire of PRICE and MOUTH variants present at the time that these processes were developing. The analysis of historical census records is further augmented by using a combination of quantitative methods and historical corpora in order to gain a fuller understanding of the processes involved in the formation of these dialect features.

The contemporary investigation of PRICE and MOUTH in Liverpool English shows that these patterns are separate, but related, and that their phonological conditioning environments resemble those reported for cases of PRICE and MOUTH variation in other varieties of English. I present a detailed overview of the phonetics and phonology of PRICE and MOUTH variation in Liverpool English, looking at a wide range of conditioning environments. This investigation also reviews a range of different quantitative measurements useful for research on variation involving diphthongs.

The origins of PRICE and MOUTH phonological patterns in Liverpool English indicate that an approach combining different theoretical perspectives is required to adequately explain the development of these patterns. The current thesis suggests that PRICE and MOUTH phonologically conditioned variation in Liverpool English initially resulted from variants of different dialects within the dialect contact situation. However, some features of the contemporary patterns developed following new-dialect formation as a by-product of phonetic and phonological properties of diphthong production in certain following environments. By approaching the development of these phonological features in Liverpool English from a combination of theoretical perspectives, the current thesis expands our understanding of emergent phonological features in new-dialect formation.

LAY SUMMARY

Massive immigration into an area may result in a situation commonly referred to as new-dialect formation: a new dialect emerges as a result of intensive contact among several different source dialects. The emergence of this new dialect is the result of small adjustments in individuals' speech, which take place over several generations. Approaches to new-dialect formation have led to a more solid understanding of the origins of specific dialect features. This line of research often approaches issues of new-dialect formation within the confines of one linguistic subfield. However, new-dialect formation is a multifaceted phenomenon, which results from a combination of different factors. The current thesis presents a comprehensive account for a dialect feature in Liverpool English ('Scouse') that has been widely reported in other situations of new-dialect formation: variation in the pronunciation of the vowels in the words PRICE and MOUTH.

In Liverpool English and many other dialects, the pronunciation of PRICE and MOUTH changes as a function of the following consonant. For example, the vowels in *tight* and *tide* in Liverpool English often sound quite different from each other. Interestingly, these sounds are still perceived as the same vowel by speakers of the dialect. This feature has been widely researched in other English dialects (such as Canadian English) and has previously been attributed to new-dialect formation. However, little is known about this feature in Liverpool English.

Liverpool English is thought to have emerged during the 19th century as a result of extensive and prolonged immigration from the surrounding areas of Lancashire and Cheshire, and from Ireland, Wales, and Scotland. However, the specific timing, extent of immigration, and proportion of immigrant populations have not been investigated in detail, or at least not in the context of dialect features. The current thesis provides an in-depth analysis of historical census records in order to extend our knowledge of the populations in Liverpool in the 19th century. The insights obtained from this analysis provide a more nuanced picture of the development of Liverpool English and are essential for determining what dialects potentially contributed to new-dialect formation.

The current investigation finds that the variation in the pronunciation of PRICE and MOUTH in present-day Liverpool English resembles the patterns that are reported in other English dialects. I present a detailed overview of the phonetics and phonology of PRICE and MOUTH in Liverpool English, looking at a wide range of following consonants. Furthermore, I argue that an approach combining different theoretical perspectives is required to adequately explain the origins of these pronunciations in Liverpool English. The current thesis also expands our understanding of emergent dialect features in new-dialect formation.

ACKNOWLEDGEMENTS

I owe a debt of gratitude to my supervisors, Patrick Honeybone and Warren Maguire, for their knowledge and support from the beginning of the PhD process until the end. They have been invaluable throughout this process and I cannot thank them enough for the numerous meetings, suggestions for analyses, readings of drafts and edits during the writing process. To Patrick, thank you for encouraging me to start the PhD and for giving me a more or less realistic understanding of what it would entail. To Warren, thank you for your guidance throughout the PhD and for your honest feedback. You have both been an integral part of my post-graduate study at the University of Edinburgh and have had a substantial influence on the development of my academic career.

This work has benefitted greatly from the help of a number of linguists, who I would like to thank. Lauren Hall-Lew has not only been an inspiration for my current and future research, but has also been an incredible teacher, colleague and friend. Thank you for the support that you have given in both professional and personal contexts. I am also indebted to the following people for their suggestions and ideas: Ricardo Bermúdez-Otero, Gerry Docherty, Josef Fruehwald, Carmen Llamas, Graeme Trousdale, Alice Turk, Marilyn Vihman and Dominic Watt.

I would also like to thank the University of Edinburgh for the generous grant that made this work possible. Special thanks are due to Ghada Khattab and the School of Education, Communication and Language Sciences at Newcastle University, and Paul Foulkes and Marilyn Vihman and the Department of Language and Linguistic Science at the University of York for their support in the final year of my PhD.

Last but definitely not least, I would like to thank my family and friends who have given their support over the years of the PhD. To those who have taken my mind off the PhD (Danielle, Jyoti, Louise and Ruth), those who have shared the experience with me (Julie and Manuela), those who work in similar fields and kept my mind on the end game (Keelin, Koen, Pat, and Petya) and those who have listened and been there through it all (Mom, Dad, Crystal, Matthew, and Marissa), I am forever grateful for how enjoyable you've made my life. Finally, I would like to thank Esme for love in the form of licks and Márton Sóskuthy for well … everything, there are no words.

LIST OF ABBREVIATIONS

EModE	Early Modern English
GVS	Great Vowel Shift
LE	Liverpool English or 'Scouse'
ME	Middle English
OLIVE	Origins of Liverpool English Corpus
ONS	Office of National Statistics
PDE	Present-Day English
RP	Received Pronunciation
SED	Survey of English Dialects
SVLR	Scottish Vowel Length Rule
VD	voice-driven
Abbreviations used in Analysis & Results	
ed	Euclidean distance
poa	place of articulation
moa	manner of articulation
cat	factor combining number of syllables and morphological structure
mono	monosyllabic monomorphemic or polymorphemic (pilot study)
di	disyllabic monomorphemic (pilot study)
morph	disyllabic polymorphemic (pilot study)
momorph	monosyllabic monomorphemic (main study)
bimorph	monosyllabic bimorphemic (main study)
voiclass	factor combining voicing and manner of articulation
vl_st	before voiceless stops
vl_fr	before voiceless fricatives
vl_nast	before nasal + voiceless stop consonant cluster
vd_st	before voiced stops
vd_fr	before voiced fricatives
vd_nast	before nasal + voiced stop consonant cluster

na	before nasals
la	before laterals
op	in word final open syllables
ure	before etymological ‘r’, not produced with rhotic consonant
re	before etymological ‘r’, produced with rhotic consonant
vow	before vowel
m_bound	before morpheme boundary (main study)
s-ss	disyllabic word with primary stressed syllable + secondary stressed syllable
s-us	disyllabic word with primary stressed syllable + unstressed syllable
conv	speech style
n	not conversation speech (word list data)
y	conversations speech (interview & map task data)
not_ME ix	before voiceless stop, not in ME ix subclass
ME ix	before voiceless stop, in ME ix subclass
not_ME ei	in word final open syllable, not in ME ei subclass
ME ei	in word final open syllable, in ME ei subclass

CHAPTER 1

INTRODUCTION

This thesis investigates the development of phonological features in dialect emergence. I further consider the interaction between features that are the result of new-dialect formation and those that are endogenous developments. Understanding what mechanisms underlie the formation of a new dialect has been approached from numerous theoretical perspectives and is the subject of lively debate within the linguistic community. In nearly every case of new-dialect formation in varieties of English, phonologically-conditioned variation of the PRICE and MOUTH vowels – these lexical sets (Wells 1982) are discussed below – has developed (Trudgill 1986), and is, therefore, the main focus of this thesis. PRICE and MOUTH phonologically-conditioned variation are defined as patterns of variation of the PRICE and MOUTH vowels that are conditioned by the following phonological environment. As a result of these patterns frequently emerging in new-dialect formation situations, some of these patterns have been extensively studied, such as Canadian Raising (Joos 1942, Gregg 1973, Chambers 1973, Picard 1977). Within the research on PRICE and MOUTH patterns is a focus on the origins of these patterns in varieties of English. However, it is difficult to determine the processes involved in the formation of these patterns, as many of them emerged prior to systematically recorded materials. The difficulty in obtaining evidence for the processes that are responsible for PRICE and MOUTH phonologically-conditioned variation has resulted in various approaches to the formation of PRICE and MOUTH patterns. In order to obtain the necessary evidence to evaluate previous approaches, the current thesis discusses a relatively recent case of new-dialect formation in Liverpool (Knowles 1973, Honeybone 2007, Watson and Clark forthcoming). A variety of historical events in the nineteenth century resulted in massive immigration in Liverpool leading to dialect mixture and subsequently new-dialect formation. Previous work on Liverpool English (LE) suggests that PRICE and MOUTH phonologically-conditioned variation emerged following dialect formation (Knowles 1973). While some phonological features that resulted from the formation of LE have been investigated (Honeybone 2007, Watson and Clark forthcoming), PRICE and MOUTH variation in LE has received little attention. Therefore, the current thesis provides a detailed investigation of the PRICE and MOUTH vowels in current LE to examine the specific characteristics of these patterns. The results of this investigation are used to evaluate the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation. Each of the previous approaches explains some aspects of the resultant patterns in LE, but, as it turns out, none of them can account for PRICE and MOUTH phonologically-conditioned variation in LE on their own. The current thesis augments the previous approaches to origins of PRICE and MOUTH phonologically-conditioned variation in varieties of English by proposing a combined approach to the origins of PRICE and MOUTH phonologically-conditioned variation in LE.

Liverpool is situated in the northwest of England on the coast of the River Mersey at the division between Lancashire and Cheshire, as shown in Figure 1.1. Liverpool had humble beginnings as a small fishing village. However, its establishment as an important port in Britain, its proximity to Ireland and historical events, such as the Great Irish Famine, led to massive immigration into Liverpool. This immigration came from the surrounding areas, as well as other parts of England, Ireland, Scotland and Wales.

The population of Liverpool before these waves of immigration would likely have spoken a variety of English along the Lancashire-Cheshire dialect continuum. However, a new dialect began to form as the original native population mixed with the immigrant populations. The current thesis evaluates this traditional account of the emergence of LE by presenting a detailed analysis of historical census records in the nineteenth and early twentieth century. This analysis provides a clearer picture of the timeline of events that led to dialect formation and the populations that likely contributed to the original dialect mixture.

Wells' (1982) lexical sets are used in the current thesis, as they describe

(a) Location of Liverpool (*red dot*) within the United Kingdom produced in UK Statistics Authority (2014)

(b) Map of Liverpool and the Merseyside produced in UK Statistics Authority (2014)

Figure 1.1: Liverpool and the Merseyside within the United Kingdom

the set of lexical items where the target vowels occur in reference varieties. For the purposes of this thesis, PRICE represents the set of words that are produced with the diphthong /aɪ/ in Received Pronunciation (RP) and General American English (Wells 1982), such as *site, side,* and *sign.* This diphthong is mostly derived from Middle English /i:/ as a result of the Great Vowel Shift and subsequent changes. MOUTH refers to the set of words that are produced with the diphthong /aʊ/ in RP and General American (Wells 1982), such as *lout, loud,* and *clown.* It is derived mostly from Middle English /uː/ as a result of the Great Vowel Shift and subsequent developments.

In order to discuss the processes that affect the production of the PRICE and MOUTH vowels, it is necessary to distinguish between the different parts of a diphthong. While there are a number of terms used to describe the parts of a diphthong, the current thesis uses ‘nucleus’ and ‘offglide’. The nucleus refers to the diphthong’s initial position or the onset, which is generally stressed and has a stable state. The offglide refers to the diphthong's final position or the offset, which is generally unstressed and may not have a stable state.

The main set of processes that affect the realisations of PRICE and MOUTH are termed phonologically-conditioned variation in the current thesis, which refers to a pattern whereby the target vowels are realised differently depending on the following context. These patterns may involve different processes, such as nucleus centralisation found in Canadian Raising (Joos 1942) and monophthongisation found in some Southern American Englishes (Thomas 2001). PRICE and MOUTH phonologically-conditioned variation has been reported in almost all cases of new-dialect formation that have been investigated, including LE.

Knowles' (1973) results suggest that there is phonologically-conditioned variation in PRICE and MOUTH in LE. However, little is known about the details of these patterns in Liverpool. In order to understand the origins and development of PRICE and MOUTH phonologically-conditioned variation in LE, the current thesis provides a detailed investigation of contemporary and historical datasets. The main investigation is a detailed acoustic and quantitative analysis of newly collected data. The acoustic analysis uses multiple measurement types, such as formant measurement and amount of diphthongisation (operationalised as Euclidean distance between the nucleus and offglide), as well as statistical analysis using mixed effects models. This multi-pronged approach to the realisations of the target vowels provides empirical evidence for the processes that occur in the contemporary PRICE and MOUTH vowels in LE. The investigation of the historical dataset is in part a detailed analysis of the *Survey of English Dialects* (Orton and Dieth 1962–1971) in the localities in southwest Lancashire and north Cheshire for PRICE and MOUTH lexical items. This data represents a time period around the time of dialect formation and provides some insights into the realisations and processes that occurred in the areas surrounding Liverpool at this time. The second part of the investigation is a detailed acoustic and quantitative analysis of the PRICE vowel in the earliest recordings at the time of writing in the *Origins of Liverpool English* corpus (Watson and Clark forthcoming). This second corpus represents speakers born at a time period shortly following the formation of LE and is the oldest audio materials of LE. A comparison of the results of the investigation of the main and historical datasets provides evidence for the processes that occurred as a result of dialect formation and those that are later developments. It is important to understand this distinction in order to evaluate the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation in varieties of English.

There are four main approaches to the origins of PRICE and MOUTH phonologically-conditioned variation discussed in the current thesis: 'failure-to-lower' (Gregg 1973), 'asymmetric assimilation' (Moreton and Thomas 2007), 'enhancement of pre-fortis clipping' (Bermúdez-Otero 2014c), and 'new-dialect formation' (Trudgill 1986). The 'failure-to-lower' approach suggests that PRICE and MOUTH phonologically-conditioned variation is the result of historical reflexes of the target vowels. Gregg (1973) suggests that Canadian Raising, where a process of nucleus centralisation occurs, resulted from the following voiceless obstruents inhibiting PRICE and MOUTH nuclei from lowering. In other words, PRICE and MOUTH before voiceless obstruents are stuck in a previous historical reflex of the target vowels, while PRICE and MOUTH in other contexts continue to later stages of the target vowels.

The second approach, 'asymmetric assimilation' (Moreton and Thomas 2007), proposes that different processes that occur in PRICE and MOUTH phonologically-conditioned variation result from a difference in vowel trajectories based on the phonetic effects of the following environment. Before voiceless obstruents the nucleus has a shorter duration than in other environments as a result of phonetic coarticulatory effects. This shorter nucleus is misperceived and subsequently reanalysed by speakers as raising, which results in subsequent generations of speakers producing raised nucleus realisations of PRICE and MOUTH before voiceless obstruents. On the other hand, some environments promote longer duration nuclei. The long nucleus in those environments may also be misperceived as offglide weakening and subsequently reanalysed as a monophthong, which results in later generations of speakers having monophthongal realisations in these contexts.

Another approach, which expands on the 'asymmetric assimilation' approach and uses phonetic and phonological effects as an explanation for PRICE and MOUTH patterns is 'enhancement of pre-fortis clipping' (Bermúdez-Otero 2014c). This account suggests that environments with short durations (pre-fortis clipping) often overlap with the environments where there is a shorter nucleus ('asymmetric assimilation'), i.e. before voiceless obstruents. Speakers begin to reanalyse the short nucleus as an enhancement of pre-fortis clipping. As a result, the short nucleus diphthongs are re-associated to clipping environments. The short nucleus is misperceived as a centralised nucleus and produced as centralised in subsequent generation.

Finally, new-dialect formation (Trudgill 1986) proposes that PRICE and MOUTH patterns are the result of the retention of different variants from the original dialect mixture situation. In the dialect formation, there are numerous PRICE and MOUTH variants. When there are no clearly dominant variants in the original dialect mixture more than one is retained, and so a PRICE and/or MOUTH pattern occurs. The variants that are retained are then reallocated to specific environments that are phonetically plausible for those variants. In other words, centralised nucleus variant may be reallocated to before voiceless obstruents as the duration of the vowel is shorter and the movement from nucleus to offglide is shorter in a centralised nucleus variant.

The current thesis finds that a combined approach to the origins of PRICE and MOUTH phonologically-conditioned variation in LE is necessary to account for the results obtained from the current investigation. While some features of these patterns appear to be the result of new-dialect formation, there are other features that develop afterwards and are not found in the historical datasets. These subsequent developments appear to be the result of phonetic effects on the production of the target vowels. Specifically, the results suggest that for the PRICE and MOUTH vowels monophthongisation before nasals and /l/ emerged from dialect formation and may be explained with reference to the new-dialect formation approach. There is evidence of this pattern occurring throughout the main and historical datasets. On the other hand, PRICE nucleus raising and fronting before voiceless obstruents does not occur in the *Origins of Liverpool English* corpus, suggesting that this process is a later development. However, prior to the occurrence of nucleus raising and fronting, nucleus shortening does occur. Therefore, it appears that PRICE nucleus raising and fronting is the result of 'asymmetric assimilation'. Therefore, an approach that combines aspects of the approaches to the origins of PRICE and MOUTH patterns of variation are necessary to explain the result of the current investigation.

Chapter 2 establishes the historical context of dialect emergence in Liverpool. The chapter presents support for the formation of a new dialect in Liverpool as a result of massive immigration. It is important to establish that new-dialect formation was a possibility in Liverpool, so the first section describes the historical events that led to mass immigration into Liverpool and consequently new-dialect formation. A detailed analysis of historical census data provides evidence for large immigration into Liverpool. This analysis is essential for evaluating the two hypotheses regarding when LE was formed. Crowley (2012) proposes that LE developed prior to the nineteenth century, whereas Knowles (1973) among others propose that LE developed in the mid-nineteenth century. The timeline of new-dialect formation in Liverpool greatly affects which immigrant populations were influential in the development of the dialect and the materials that can be used as evidence for the emergence of dialect features in LE. While the historical census data demonstrates that large immigration from different populations did occur in Liverpool, it is not necessarily the case that this immigration would lead to new-dialect formation. Therefore, the second section of this chapter looks at phonological features in LE that provide evidence for new-dialect formation. If other features in LE provide evidence for new-dialect formation, it is reasonable to examine PRICE and MOUTH phonologically-conditioned variation in LE as another case of these vowel patterns occurring as a result of dialect emergence. The final section discusses the areas of Liverpool, which are discussed in relation to the main dataset.

Chapter 3 discusses the variation in PRICE and MOUTH vowels in varieties of English. Two types of variation are discussed in this chapter: unconditioned variation and phonologically-conditioned variation. The section on unconditioned variation of PRICE and MOUTH presents the various realisations of PRICE and MOUTH in the varieties of English that likely contributed to the dialect mixture in Liverpool. The varieties of English used in the section are those that belong to large immigrant population in Liverpool at the time of dialect formation, both of which are established in the previous chapter. It is important to establish the variants that were likely in the initial dialect mixture in order to understand the origins of different realisations of the target vowels in the resultant patterns and evaluate the new-dialect formation approach. The second section discusses the second type of variation, phonologically-conditioned variation, and demonstrates the prevalence of PRICE and MOUTH patterns in varieties of English, particularly in dialect emergence situations. Included in this discussion is previous work on PRICE and MOUTH patterns in LE. There are two main types of PRICE and/or MOUTH phonologically-conditioned variation that are found in varieties of English: voice-driven type patterns and Scottish Vowel Length Rule type patterns. These patterns provide evidence for conditioning environments that are likely to affect the productions of PRICE and MOUTH. This evidence is used to motivate the design of the main data collection. As a result of this discussion four hypotheses are proposed to be tested in the main investigation. These are: PRICE and MOUTH in LE are phonologically conditioned by the following environment; PRICE and MOUTH phonologically-conditioned variation in LE are separate, but related, patterns; PRICE and MOUTH monosyllabic and disyllabic lexical items in LE have different phonologically-conditioned patterns; word list speech has different phonological conditioning of PRICE and MOUTH compared to casual speech in LE.

Chapter 4 describes the historical development of PRICE and MOUTH from Middle English and the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation in varieties of English. The development of PRICE and MOUTH as a result of the Great Vowel Shift and subsequent changes is an important aspect of one of the approaches to the origins of PRICE and MOUTH patterns. Furthermore, previous work on the *Survey of English Dialects* and the current analysis provides evidence for different realisations of the target vowels based on differences in the development of certain Middle English vowel subclasses and lexical items that become present-day English PRICE and MOUTH in most varieties of English. These subclasses are described in Chapter 4 in order to expedite the discussion of the results of the investigation of the historical datasets. The second section outlines the fundamental assumptions of the approaches to the emergence of PRICE and MOUTH phonologically-conditioned variation in varieties of English discussed in this thesis. These fundamental assumptions are evaluated in relation to the results of the investigation of the main and historical datasets.

Chapter 5, Chapter 6 and Chapter 7 provide details of the investigation of the main dataset with specific reference to the main motivations for collecting new data, methodological decisions and results. The main approaches investigated based on previous description of PRICE and MOUTH patterns in LE and other varieties of English, as discussed in Chapter 3, are tested in these chapters. These approaches are used to determine the main characteristics of the patterns in LE and how it relates to previously attested patterns in varieties of English.

The specific layout of the investigation of the main dataset is divided in the following way: Chapter 5 is an introduction to the investigation, a discussion of the main motivation for collecting a new data set and a description of the methodological decisions and environments included in the investigation. In order to motivate methodological decisions and provide a principled exclusion of certain following environments, a small pilot study was conducted. The results of this pilot investigation and the implications of these results for the data collection of the main dataset are described in Chapter 5. As a result of the pilot study, methodological changes were made to the main data collection. Chapter 6 presents the revised methodology, a description of the data analysis and the graphical representations used to illustrate the results of this investigation. Chapter 7 presents the results of the investigation of PRICE and MOUTH in LE in the newly collected dataset. The results pertaining to each of the hypotheses are discussed in turn, as well as, any inter-speaker variation that is found. The results of this investigation suggest that PRICE and MOUTH are phonologically conditioned by the following environment. There are two main processes that occur: nucleus raising and fronting, and monophthongisation. While the same processes are found to occur for the target vowels, the environments where these processes occur differ slightly between PRICE and MOUTH. Therefore, the results support the second hypothesis as PRICE and MOUTH patterns are likely separate, but related. Finally, PRICE realisations are not found to be affected by speech style, but MOUTH realisations are. As a result, the third hypothesis is supported by the results for MOUTH, but not for PRICE.

Chapter 8 and Chapter 9 discuss the investigation of the historical dataset. In the previous chapters, the main investigation provides insights into the present-day patterns found in LE. However, in order to evaluate the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation, data closer to the time of dialect formation is necessary. Therefore, the investigation of the historical datasets provide insights into the original characteristics of the PRICE and MOUTH patterns in LE. Chapter 8 outlines the methodology of the second investigation, which consists of two datasets: the *Survey of English Dialects* (Orton and Dieth 1962–1971) and the *Origins of Liverpool English* corpus (Watson and Clark forthcoming). The *Survey of English Dialects* records archaic PRICE and MOUTH variants in southwest Lancashire and north Cheshire, which are likely to be much closer to the variants found in the speech community more generally at the time of new-dialect formation. The analysis of the *Origins of Liverpool English* data demonstrates features of PRICE phonologically-conditioned variation in LE for speakers born shortly following new-dialect formation. The results of this second investigation are provided in Chapter 9. These results in conjunction with the main investigation provide a clearer picture of the emergence and development of PRICE and MOUTH phonologically-conditioned variation in LE.

Chapter 10 compares the results of the investigations of the main and historical datasets to determine the processes that are likely a result of new-dialect formation and those that are later developments. These results lead to the necessity for a combined approach to the formation of the current patterns found in LE. An evaluation of the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation is discussed in relation to the findings of the current investigations. Finally, I propose an explanation for the emergence of these features in LE using a combined approach.

Chapter 11 provides a conclusion of the findings of the thesis.

CHAPTER 2

LIVERPOOL, MERSEYSIDE AND ‘SCOUSE’

The development of Liverpool English (LE) is intertwined with the historical development of Liverpool. In order to better understand the development of PRICE and MOUTH phonologically-conditioned variation in LE, it is important to establish the historical context that led to the formation of LE. This chapter traces the historical development of Liverpool with particular focus on the populations that have given the city its character and ultimately its variety, ‘Scouse’, the areas of the city, and the linguistic characteristics that provide evidence of dialect formation resulting from dialect mixture.

I begin with a discussion of the history and growth of Liverpool concentrating on the time periods hypothesised for dialect formation of LE. This section includes the first detailed account of the populations immigrating to Liverpool around this time through the use of historical census records (see §2.1). In §2.1.1, the competing hypotheses regarding the actual timeline for the formation of LE are evaluated using evidence from the investigation of the historical census records and from previous work. Section 2.2 summarises linguistic characteristics of LE which provide evidence for new-dialect formation and dialect mixture and discusses some of the previous work on LE. This thesis investigates the hypothesis that LE is a product of the dialect mixture that resulted from mass immigration in the eighteenth century. While §2.1 establishes that mass immigration and dialect mixture occurred, §2.2 provides evidence that new-dialect formation occurred as a result of this. The chapter concludes with information about the wards in Liverpool with a map for reference (§2.3). In order to categorise the speakers’ location in the current study, broad reference terms are used, such as north and south (see Chapter 6). An explanation of how these categories are determined is discussed in this section.

The new-dialect formation approach is discussed in relation to the formation of LE throughout the current thesis. While there is an in-depth discussion of the main principles of new-dialect formation in §4.2.4, it is referred to prior to §4.2.4. Therefore, in the interest of clarity for the following chapters, a brief description of the theoretical underpinnings is presented here. The new-dialect formation approach discussed in the current thesis was conceptualised by Trudgill (1985, 2004) to explain the development of colonial varieties of English and used by Honeybone (2007) and Watson and Clark (forthcoming) in investigations of the development of features of LE. A similar description of the formation of LE is given by Knowles (1973), who contributes the emergence of LE to the dialect mixture situation. Trudgill (1986, 2004) suggests that rapid urbanisation can lead to new-dialect formation from dialect mixture. He further proposes that if the proportion of populations is known then it is possible to predict the linguistic outcomes in a dialect mixture situation.

The fundamental assumptions of new-dialect formation suggest that there are three stages that correspond to subsequent generations, so that the first stage occurs with the 'rapid urbanisation', the second stage is the first generation of children born in the area and the third stage is the second generation of children born in the area. In the first stage, adults faced with a dialect mixture situation accommodate to each other and traditional dialect characteristics are lost. These features are generally ones that are in the minority, marked linguistically, stigmatised or hinder mutual intelligibility. First generation speakers in stage two are faced with extreme variation, due to variability both in the parent and peer groups. This results in idiolects, original combinations of features and inter-speaker variability. However, this system is more consistent than that of the first stage. Trudgill (2004) posits that features which are underrepresented will also be lost at the second stage. Finally, in stage three there is a stable uniform dialect in the second generation of speakers. The intricate details of the new-dialect formation approach are presented in §4.2.4. However, the general principles presented here provide an overview of the assumptions of new-dialect formation, which is sufficient for the following discussions.

2.1 THE HISTORICAL AND DIALECTAL DEVELOPMENT OF LIVERPOOL

It is difficult to picture present-day Liverpool as the small fishing village and later the small port city that it was for centuries. There are a number of historical events which contributed to the expansion of the small village and the development of the variety. As a result of these events the Liverpudlian or 'Scouser' has developed a strong sense of identity connected in part to the variety spoken in Liverpool. In order to understand the development of Liverpool and LE and population changes that occurred at the time of dialect formation, this section traces the milestones that led to the development of Liverpool. I describe the development of Liverpool starting from its creation as a borough and continuing to the mass immigration and commercial expansion of the eighteenth and nineteenth centuries into the beginning of the twentieth century.

Liverpool officially became a borough in 1207 by royal decree and was used as a port for the Irish campaign by King John to retain control over Ireland (Farrer and Brownbill 1911: 2). Before this time, there was a small population which lived away from the flooded area near the coast. A large portion of this population was transplanted from the hundred[1] of West Derby. Figure 2.1 shows historical maps of the boundaries of West Derby from Farrer and Brownbill (1907: 1, 3).[2]

In 1295 representatives from Liverpool attended parliaments, attesting further to the beginning of its importance in Britain (Farrer and Brownbill 1911: 5). The small port city continued to show growth in its population, and economic and political standing until the fifteenth century when a violent feud between the main ruling families and the coming of the plague left the city

[1]The term hundred refers to an ancient division of English counties that dates back to the Domesday Book. Hundreds were a well-recognised type of division at the time of the initial censuses and, consequently, were used in the historical censuses (Great Britain Historical GIS Project 2004).

[2]West Derby was a historical division in Lancashire in the initial census materials. In contemporary terms it would encompass the Merseyside, Wigan, Warrington, Halton and parts of west Lancashire.

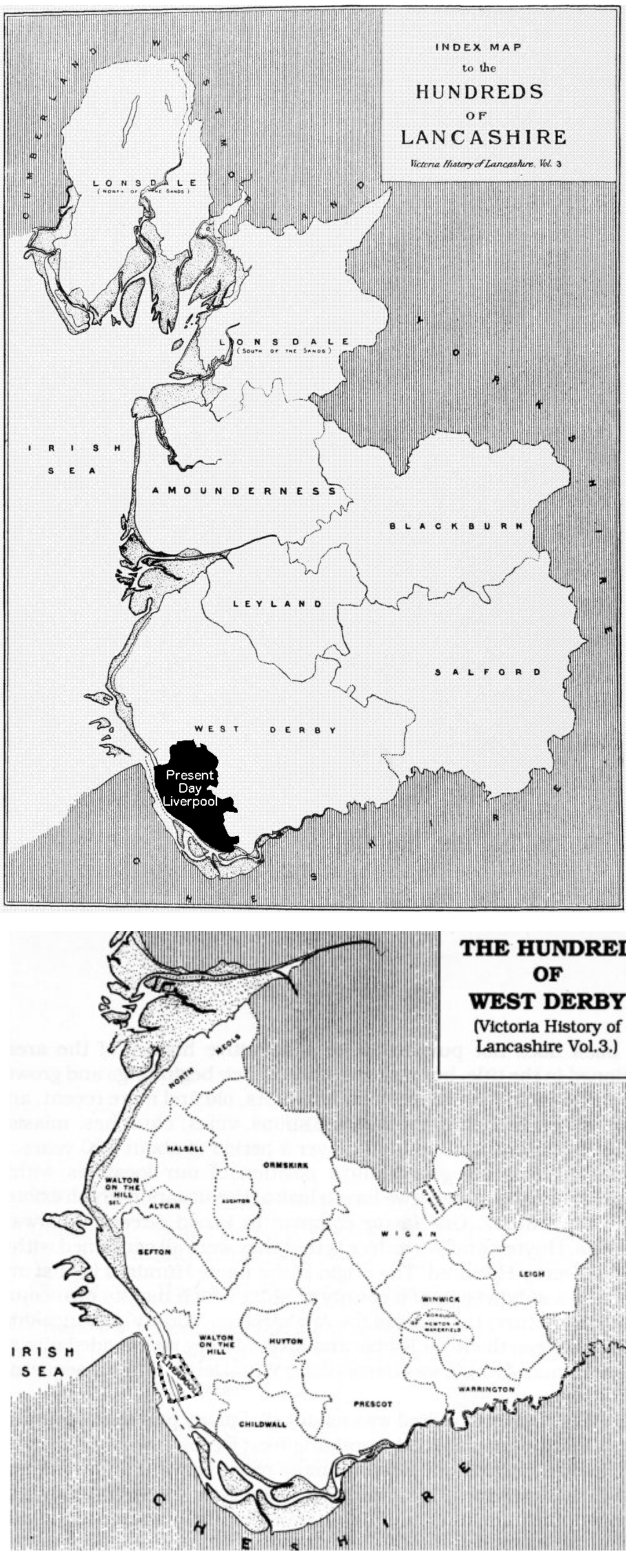


Figure 2.1: Historical county of Lancashire with reference to the Hundred of West Derby (Farrer and Brownbill 1907: 1, 3). The present-day boundary of Liverpool is overlaid on the Hundred of West Derby.

a 'decayed town' until the seventeenth century (Farrer and Brownbill 1911). There were 196 households and a population of approximately 1000 in 1346, but as a result of the troubles that Liverpool faced in the following centuries, such as the feud and plague, there were only 138 households in 1534 with a population of approximately 700 - 800 (Farrer and Brownbill 1911: 8). It was not until the end of the sixteenth century that Liverpool recovered its former population. This revival was due in part to the renewed use of the port for transport to Ireland. For much of the previous period Chester and Liverpool ports were on equal footing. However, Liverpool's almost exclusive transportation of troops in the late 1500s established Liverpool over Chester as the most important port in the northwest (Farrer and Brownbill 1911).

During much of the seventeenth century the port was used for transport to Ireland, but there are also records of trade with America at this time. The eighteenth century saw the creation of new streets for the first time since the fourteenth century and the building of the first dock in 1715 (Farrer and Brownbill 1911: 1). It is throughout the eighteenth and nineteenth centuries that waves of immigration increased Liverpool's population significantly, creating a situation of dialect mixture which eventually resulted in the formation of a new dialect.

In the eighteenth century, Liverpool's population increased from 7000 inhabitants in 1708 to 34,000 in 1773 (Power 1992: 22). Belchem (2000a: 37) suggests that the first indications of Liverpool's population boom can be seen in the Moss Guide 1796: "the first town in the kingdom in point of size and importance, the metropolis excepted." This quotation compares Liverpool to London, 'the metropolis', and alludes to the rapid population growth in Liverpool (see Figure 2.2) and importance as a trade, transport, and military port.

In the thirty-five year period between 1673 and 1708 the population grew by more than fourfold. It should be noted that the accuracy of early population estimates cannot be verified through census or other materials. These estimates are taken from previous works on the development of Liverpool, such as Farrer and Brownbill (1907), and are generally based on contemporary descriptions, parish records or government records, such as tax information. Nonetheless, at no other point in Liverpool's history did it experience a comparable fourfold increase in population. Furthermore, in the period between 1708 and 1773 the rate of natural increase was approximately -1% (Census of Great Britain 1801a: 149). The rate of natural increase is described in detail below. It accounts for population increases based solely on births and death of the current population. Therefore, the population growth during this period was likely due to immigration (Figure 2.3).

While there was no other period in the history of Liverpool that experienced the fourfold increase of the seventeenth century, there were other periods throughout the eighteenth and nineteenth centuries which also had rapid population growth. Given the vast difference between the size of the population in the seventeenth and eighteenth centuries the later growth is much more striking and likely more relevant to growth of Liverpool into a large commercial centre (see Table 2.1 for details of the population counts and Figure 2.2 for the absolute population increase and proportional population increase). In other words, a population growth from 1000 to 3000 is less related to the massive expansion of Liverpool than from 100,000 to 200,000 over the same length of time. In order to capture these different types of population increase, two measures of population increase are discussed: absolute population increase and proportional population increase. Proportional population increase is calculated from the difference in population size at two consecutive time points divided by the population of the later time point. This ratio is multiplied by 100 to yield a percentage increase in population. On the other hand, absolute population increase is calculated from the difference in population size at two consecutive time points.

Figure 2.2 shows the proportional population growth (*grey line*) and absolute population growth (*black line*) in Liverpool from mid 1500 to 1931. In Liverpool, the period with the largest proportional population increase was between 1673 and 1708. Therefore, by the Moss Guide in 1796 Liverpool had already gone through its most rapid period of proportional population growth. However, the largest absolute population increase was between 1831 and 1841. For the purposes of the current thesis, the absolute population increases explains the population increase in Liverpool to a large centre more so than proportional population increases. Absolute population increase demonstrates the periods with the largest number of immigrating populations,

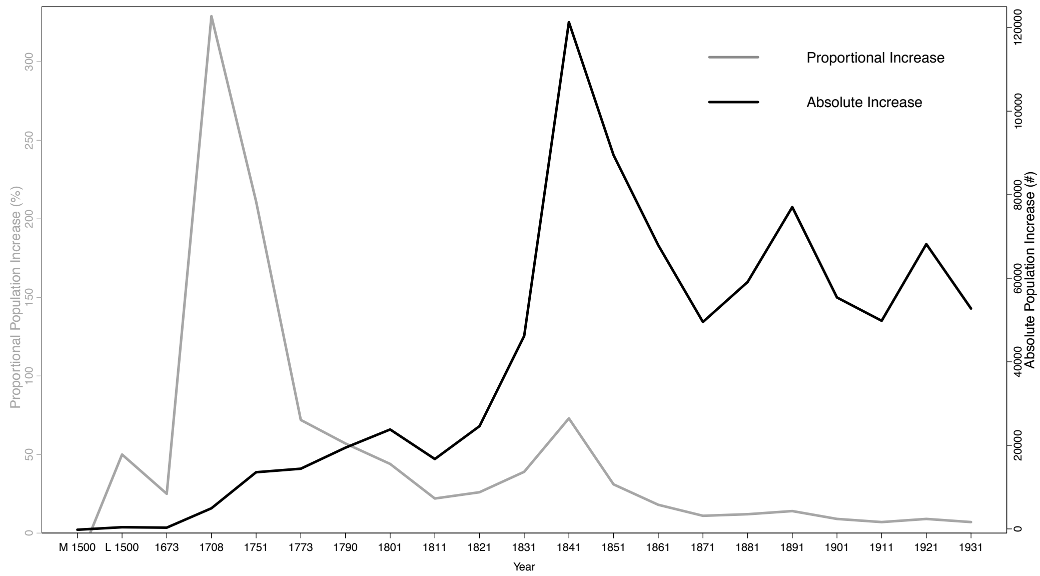


Figure 2.2: Comparison of absolute population growth (*black line*) and proportional population growth (*grey line*) in Liverpool

which is confirmed by comparing the rate of natural growth with the absolute population increase as described below (see Figure 2.3). In other words, the 13,500 immigrants between 1708 and 1751 likely did not have as much of an effect on the Liverpool population as the 89,500 immigrants between 1831 and 1841. Therefore, as discussed in §2.1.1, it is likely that the origins of LE coincided with the largest absolute population increases.

The expansion of the seaport, increased trade and development of the commercial centre precipitated the population growth in the eighteenth and nineteenth centuries and in 1880 Liverpool received the official title of 'city' (Farrer and Brownbill 1911: 41), despite it already being a large urban centre well before this date. These economic advancements in trade and commerce provided employment opportunities which could not be covered by the population of Liverpool at the time. In a large part the population growth resulted from immigration of workers seeking employment from the new and expanding commercial enterprises, such as the slave trade and trade with America, which had doubled by the 1850s (Honeybone 2007). In fact, immigration accounted for approximately 80% of the population growth from 1773 to 1801 (Power 1992: 22).

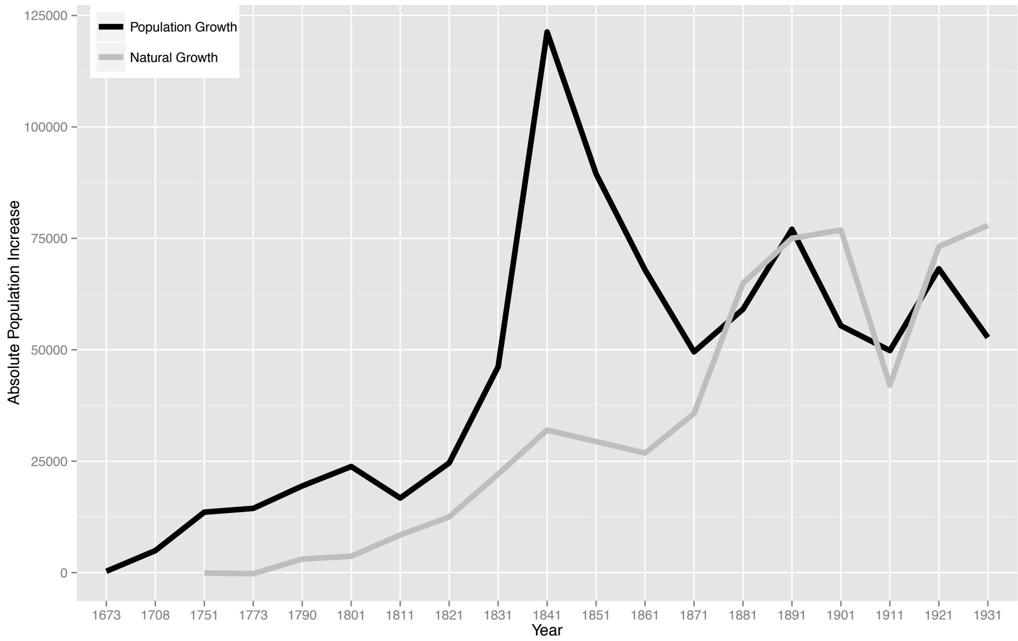


Figure 2.3: Comparison of absolute population growth (*black line*) and rate of natural increase (*grey line*) from 1673 to 1931

Figure 2.3 confirms that much of the population growth during the eighteenth and nineteenth centuries resulted from immigration by comparing the absolute population increase with the rate of natural increase. The rate of natural increase calculates the population growth based on the birth rate minus the death rate and is commonly used to estimate population growth (Shryock et al. 1980). Population increases that are above the rate of natural growth are necessarily the result of immigration. It was not possible to calculate the rate of natural increase for the population of Liverpool prior to the eighteenth century, as information regarding the number of births and deaths in Liverpool is not available prior to 1708. The rate of natural increase shown in Figure 2.3 is based on estimates from the historical census data (Her Majesty's Home State Department 2007). From 1708 to 1841 birth rates are calculated from the number of baptisms and death rates are calculated from the number of burials. After 1841 the census records birth rates and death rates, so the rate of natural increase from 1841 to 1931 is calculated from those estimates with the exception of 1851. There are no records of either births, baptisms, death or burials in 1851, so the rate of natural increase could not be calculated.

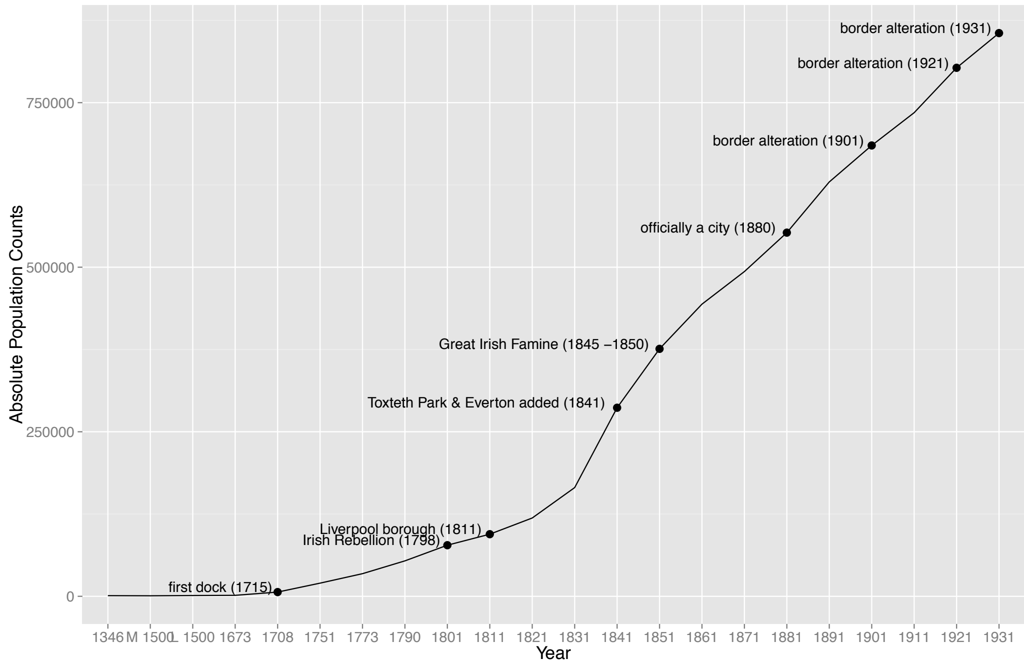


Figure 2.4: Liverpool population counts from 1346 to 1931 with influential events listed and border alteration in historical censuses listed

The rate of natural increase (*grey line* in Figure 2.3) in comparison to the absolute population increase (*black line* in Figure 2.3) demonstrates that much of the population increase in Liverpool in the late eighteenth and nineteenth centuries was the result of immigration. In the mid-nineteenth century there was a large immigration, which can also be seen in the population counts. Table 2.1 and Figure 2.4 are derived from a combination of works – Farrer and Brownbill (1911), Power (1992), Honeybone (2007) – and census data from 1801 to 1931 (Her Majesty's Home State Department 2007). The population counts demonstrate the exponential population growth from the fourteenth century until the 1860s, after which time population growth was linear and accounted for by the rate of natural increase. In fact, the census records in 1851 report Liverpool as the city or borough with the highest population, well above the population of the city of London at this time.[3] The 1851 census states: "Liverpool continues to be the largest and most populous area [...] ranking after London and Birmingham, third [...] largest in the country"

[3]The city of London does not refer to the entire metropolis, but rather, the historical roman city of London, a county within Greater London.

(Census of Great Britain 1851: lxviii).

Figure 2.4 maps historical events that were influential with regards to population increases in Liverpool onto the population counts from 1346 to 1931. As described above, the opening of the first dock in 1715 shaped the development of Liverpool by allowing increased use as a port and requiring more workers. Furthermore, Figure 2.4 shows when the historical census borders were altered and increased the area of land that was calculated in the population counts of Liverpool. These border alterations may have had a small effect on the population counts for Liverpool.

In the time period between 1801 to 1931 population counts come from historical census data and are, therefore, more reliable than the earlier population estimates. Prior to 1801, population records were periodically taken in Great Britain for taxing and religious purposes, although some form of census is reported as early as the seventh century in Scotland (Office for National Statistics 2001). However, regulated census began in March 1801 (Office for National Statistics 2001: 1) after King George III and parliament passed the Population Act of 41st Geo III (Census of Great Britain 1801b), which stated that it was "[a]n Act for taking an Account of the Population" (Census of Great Britain 1801b: B). This act stipulated that the census would occur every ten years, which has happened with the exception of 1941 because of World War II. Censuses from 1801 to 1831 were taken by the parish leaders and 'overseers of the poor', but from 1841 onwards censuses have been using self-completion forms collected by fieldwork enumerators (Office for National Statistics 2001). As stated by the Office for National Statistics (2001), "[i]t is a testament to the organisation of the early censuses that the most significant changes in census taking in Britain since 1841 have occurred in the processing of the information and the addition of new questions."

The investigation of the historical population of Liverpool ends at 1931 for a number of reasons. The historical census records after this period were difficult to obtain until the more recent censuses, as they have not been digitised. Detailed records of the birthplaces of the population are not recorded after 1911. However, from the records that were available the population at this point was mostly from Lancashire and likely from Liverpool (Figure 2.6). The birthplace records and the data in Figure 2.3 demonstrate

Year	Population	Absolute Population Increase from Previous Date	Proportional Population Increase from Previous Date	Rate of Natural Increase from Previous Date
1346	c. 1,000	unknown	unknown	unknown
mid 1500	c. 800	c. -200	c. -20%	unknown
late 1500	c. 1,200	c. 400	c. 50%	unknown
1673	c. 1,500	c. 300	25%	unknown
1708	6,435	4,935	329%	unknown
1751	20,000	13,565	211%	-1%
1773	34,407	14,407	72%	-1%
1790	53,853	19,446	57%	9%
1801	77,653	23,800	44%	7%
1811	94,376	16,723	22%	11%
1821	118,972	24,596	26%	13%
1831	165,175	46,203	39%	19%
1841	286,487	121,312	73%	19%
1851	375,955	89,468	31%	unknown
1861	443,874	67,919	18%	7%
1871	493,405	49,531	11%	8%
1881	552,508	59,103	12%	13%
1891	629,548	77,040	14%	14%
1901	684,947	55,399	9%	12%
1911	734,764	49,817	7%	6%
1921	802,940	68,176	9%	10%
1931	855,688	52,748	7%	10%

Table 2.1: Liverpool Population Growth from 1346 to 1931

that immigration had substantially decreased and was not responsible for most of the population growth at this time. Finally, 1931 is already well past the point where LE is thought to have emerged (discussed in §2.1.1). Therefore, it is unlikely that the population information after 1931 would be useful in determining the development of Liverpool or the populations which contributed to the formation of LE.

The present investigation uses historical census data taken from the Online Historical Population Reports (Her Majesty's Home State Department 2007) created by the University of Essex, which provides scanned copies of historical censuses. My account is the first detailed account of the population of Liverpool using historical census data. In order to establish that a dialect mixture situation occurred in Liverpool resulting in new-dialect formation of LE, it is important to understand the make-up of the population. Historical census data provides information about the population counts, birth-places of the population, and birth and death rates, all of which demonstrate the composition of the population of Liverpool.

Population counts were taken from each census using the counts that corresponded to the borough of Liverpool and not just the town of Liverpool (except for 1801). In later years, there are considerable differences in the populations of the borough and the town. I have chosen to use population values corresponding to the borough of Liverpool rather than the town for a number of reasons. Firstly, the population counts for the borough of Liverpool are always available, while other area divisions are not. This is possibly the reason that using the borough of Liverpool is the received method in a number of previous works (Knowles 1973, Neal 1988, Honeybone 2007). Secondly, the present thesis deals with the way in which Liverpool developed and how that affected the dialect spoken in the area. The town of Liverpool would roughly correspond to the present-day city centre, which is a very small portion of the area where LE is spoken and what would be considered contemporary Liverpool. Therefore, constraining the population counts to the town of Liverpool misrepresents the population that I am interested in. Finally, the birthplace records from the historical census data (discussed below) are based on the population of the borough of Liverpool. It would not be feasible to determine the birthplaces of the Liverpool population within the original town

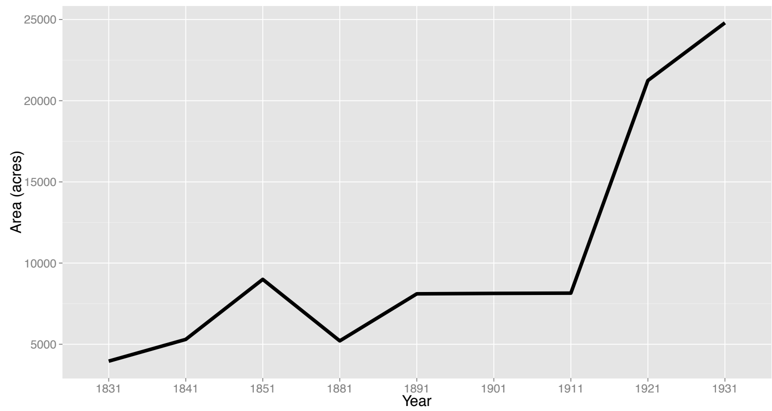


Figure 2.5: Liverpool area in acres from 1831 to 1931 from historical censuses

boundaries. Aside from this, the use of the Liverpool borough to determine the birthplaces of Liverpool's residents suggests that the borough was thought of as the 'real' Liverpool, not just the city centre.

While the population counts presented here provide insights into the growth of the population in Liverpool during this time, caution must be exercised when discussing these results. The fact that Liverpool had been developing at an exponential rate during this time is partially due to the geographic expansion of the city, i.e. the area of the borough changes. More specifically, earlier census data does not present the population counts for the same area as the later census data (see Figure 2.5). In 1801 Liverpool was listed as a town and did not include any of the surrounding areas, but by 1811 it is a borough and by 1841 it includes at least Toxteth Park and Everton.[4] During this period, Liverpool went through a number of minor and extensive border alterations, which is mentioned in the 1841, 1901, 1921 and 1931 censuses (Her Majesty's Home State Department 2007). As a result of this, Liverpool's border had been substantially enlarged by 1931. Figure 2.5 shows Liverpool's area in acres from 1831 onwards. Historical censuses use of different parliamentary, area and district divisions to report population counts for Liverpool has led to misrepresentations of the Liverpool population counts in previous work.

Knowles (1973: 17) suggests that the population was 269,742 in 1861,

[4]There were small populations in, at least, some of the areas later included in the borough of Liverpool even before they are subsumed under the Liverpool borough. In 1801 Toxteth Park and Everton had populations of 2069 and 499 respectively.

which is the population of the town of Liverpool in 1861, while the census reports a population count of 443,874 for the Liverpool borough. Many of the other population counts described by Knowles (1973) correspond to the population counts for the Liverpool borough. Likewise, Neal (1988: 2) reports that the population was 517,980 in 1891, which is a decrease from the previous census in 1881 (552,508). While 517,980 was reported in 1891 (as is 584,489), this is not consistent with other population statistics reported by Neal (1988) as it represents the Urban Sanitary District. Neal (1988) also generally reports the population counts for the Liverpool borough. However, the Liverpool borough population was recorded as being 629,548 in 1891 (Census of England and Wales 1901: 29).

A further issue that involves the census data is that the population that were dependant on Liverpool and its services far surpassed the population numbers recorded in the official census (Farrer and Brownbill 1911). Farrer and Brownbill (1911) suggest that by the mid 1800s the population dependant on Liverpool would have exceeded one million. The 1891 census reports that the diocese of Liverpool has a population of 1,207,557 (Census of England and Wales 1891: 188).

In the interest of transparency I have included these caveats with regards to the census data. However, it is reasonable to assume that the relatively minor changes in population data would not result in a complete overhaul of the general results obtained from the investigation of the historical census data presented here. The purpose of the census information presented here is to illustrate the population growth of Liverpool and the birthplaces of the population contributing to the dialect mixture in a fuller way than has been previously provided. As previously mentioned, the procedures of census collection in the UK have been largely unchanged since 1841 (Office for National Statistics 2001) suggesting that these earlier methods are generally reliable for the collection of population statistics.

Liverpool was not the only urban centre with a growing population and prosperity in the area. Population growth in other urban centres occurred at this time as well, with much of the immigration resulting from people moving into the city from the surrounding areas (Belchem 2000a). Liverpool was different in this respect, according to previous literature (see Knowles

1973, Belchem 2000a and Honeybone 2007). It is generally suggested that considerable immigration from Ireland, Wales, and Scotland rather than the surrounding areas provided much of the immigrant workforce, unlike places like Manchester where the immigration was generally from surrounding areas. According to the census data from 1841 to 1911, Manchester's population also had immigration from Ireland (highest was 12.5% in 1841), but did not experience the same influx of immigrants from Wales (around 1%) or Scotland (less than 2%) (Her Majesty's Home State Department 2007). This suggests that the situation in Liverpool was somewhat different, which might partially explain differences in dialect development between Liverpool and Manchester. In fact, Belchem (2000b) discusses the 'crowding-out' effect that occurred from the influx of other immigrants from Ireland, Wales and Scotland in particular. While much of the previous literature has focused on the immigrant populations from outside the surrounding areas, there is little mention of how much of the population came from within the area. Honeybone (2007) proposes that to gain a complete picture of the Liverpool population, immigration from the surrounding areas must also be considered.

In order to understand the varieties of the immigrant populations that contributed to the development of LE, I have analysed the census records from 1801 to 1931 to determine what the birthplaces of the population living in Liverpool during this time were. The results of this analysis are presented in Table 2.2 and Figure 2.6. In the initial censuses, respondents were not asked to provide their birthplaces and, therefore, only data from 1841 onwards exists for birthplace of respondent. For the most part, censuses recorded the same types of data. However, note the following differences in the data collected for respondents' birthplace:

- In 1841, 1921 and 1931 county of origin is not recorded except for home county, in this case Lancashire (includes Liverpool).
- In 1841, England and Wales are grouped together under one count.
- From 1851 onwards birthplace is recorded on a region and county basis in England and Wales.
- Counties are not specified for residents born in Ireland and Scotland in any of the censuses.

Year	Birthplace							
	Liverpool	Lancashire	Cheshire	England	Ireland	Wales	Scotland	Misc
1841	n/a	55.06%	n/a	22.41%	17.33%	n/a	3.87%	1.33%
1851	42.42%	7.89%	3.41%	12.38%	22.29%	5.40%	3.74%	2.47%
1861	n/a	55.64%	3.02%	11.46%	18.91%	4.76%	4.03%	2.19%
1871	n/a	58.71%	3.01%	11.48%	15.56%	4.33%	4.13%	2.77%
1881	n/a	62.62%	2.94%	10.86%	12.85%	3.90%	3.70%	3.13%
1891	n/a	68.85%	2.77%	9.99%	9.12%	3.37%	2.95%	2.95%
1901	n/a	72.27%	2.90%	9.53%	6.67%	3.02%	2.48%	3.12%
1911	71.06%	4.32%	3.33%	8.62%	4.61%	2.57%	1.90%	3.65%
1921	n/a	89.45%	n/a	3.90%	2.36%	1.53%	2.76%	
1931	n/a	82.30%	n/a	9.64%	3.14%	1.86%	1.21%	1.90%

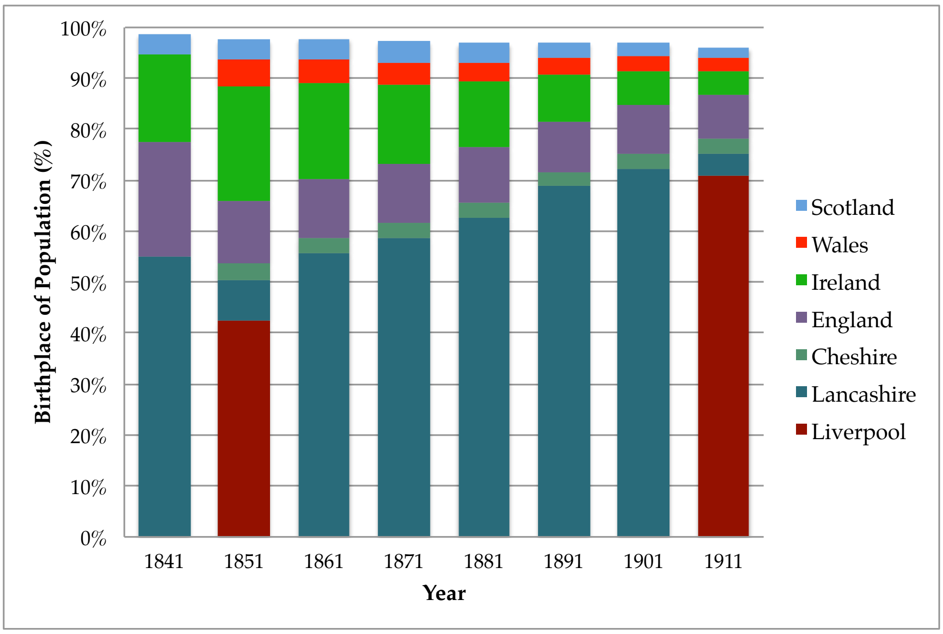
Table 2.2: Liverpool population birthplaces from 1841 to 1931

The current analysis records birthplace of respondents based on regions and does not record counties separately. Note that the region divisions used in the historical censuses do not map directly onto the contemporary regions of England (UK Statistics Authority 2014). For example, the contemporary South West region corresponds to the historic South West region with the addition of Gloucestershire. Nonetheless, I have opted to use the contemporary regions in England in Figure 2.6b. The contemporary regions as present in Figure 2.6b are: North East, North West,[5] Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East and South West.

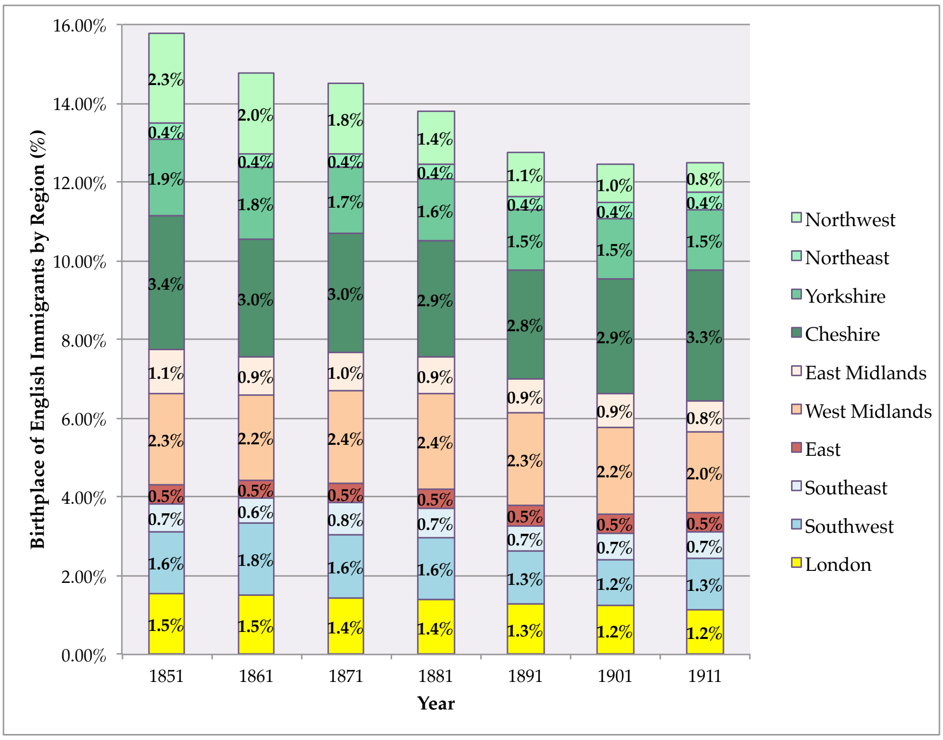
Table 2.2 demonstrates that the population mainly came from Lancashire, Cheshire, Wales, Scotland, and Ireland. For most years, it appears that the majority of the population came from Lancashire, which may be a deceptive result given that Liverpool is included in the county. Lancashire for the purpose of this thesis is defined as the historic county of Lancashire, as seen in Figure 2.7.

Liverpool is counted separately from Lancashire for two years, which shows that in 1851 42% and 1911 71% of the population was born in Liverpool itself. In other words, the large population recorded as being born in Lancashire is likely reflecting a large percentage of the population being Liverpool-born. Furthermore, the Liverpool-born population counts from 1851 and 1911 demonstrate that immigration from other parts of Lancashire was much smaller than

[5] Results for Lancashire and Cheshire are not included in this and are presented separately.



(a) Birthplaces of the Liverpool population from 1841 – 1911 census data (Her Majesty's Home State Department 2007)



(b) Birthplace of English immigrants by regions in England from 1851 – 1911 census data (Her Majesty's Home State Department 2007)

Figure 2.6: Birthplace of Liverpool population as recorded in the historical censuses (Her Majesty's Home State Department 2007)

Figure 2.7: Historic county of Lancashire (Census of Great Britain 1851)

immigration from Ireland. Ireland was the second most reported birthplace behind Lancashire. Aside from Lancashire and Cheshire, very little of the population came exclusively from any one of the other regions or counties in England with none of the other regions or counties reaching above 3% of the population at any one time, as shown in Figure 2.6b.

The data in Figure 2.6a shows that immigration from Ireland, Wales, and Scotland occurred to a large extent, but there was also a sizeable portion of the population born in Lancashire and Cheshire. While none of the other regions of England contributed a great deal to the population of Liverpool (Figure 2.6b), there is still immigration from other parts of England overall. 'Misc' is a category that includes those that were foreign born and born at sea, which does not contribute as much to the population of Liverpool (Table 2.2). In order to show the composition of the Liverpool population by birthplace in a more manageable way, Figure 2.6 provides the same data as Table 2.2 in percentages and removes the 'Misc' category.

As mentioned above, there were two years where Liverpool was recorded separately from Lancashire, which is included in 2.6a and demonstrates that a large portion of the population in Liverpool recorded for Lancashire was born in Liverpool. In Figure 2.6b the population of Liverpool that was born in England is separated into contemporary regions of England, in order to demonstrate that no one region contributed very much by itself. Lancashire is not included in this figure because it would be too difficult to see the other divisions in England, but Cheshire is. Figure 2.6b has also been colour-coded in a way that represents larger regions of England: North (*green*), Midlands (*orange*), East (*red*), South (*blue*) and London (*yellow*). Furthermore, Figure 2.6b demonstrates that Liverpool did not have a large North-born population, with the exception of those born within Lancashire and Cheshire. Overall, these population counts demonstrate that the main influences were from Lancashire, Ireland, Wales and some influence from Scotland and Cheshire. This is reflected in some of the census notes, such as in the 1911 census "[t]he towns on the rivers Tyne and Mersey appear to offer considerable attraction to Scotsmen, but they are not remarkably numerous in the inland manufacturing towns." and "a large proportion of the natives of Ireland in this country were enumerated in Lancashire and Cheshire" (Census of England and Wales 1911: xiii). Therefore, in the following sections when discussing PRICE and MOUTH, particular reference is made to those features from Lancashire, Cheshire, Ireland, Scotland and Wales (see §3).

Having firmly established the main patterns of population growth and birthplaces of immigrant populations in Liverpool, I now provide a more in-depth discussion of these immigrant populations and how they were likely to have affected the development of LE. Trudgill (2004) discusses the 'founder effect', which refers to the idea that linguistic features that belong to a founder or original population may have an advantage over competing linguistic features from later immigrants (Mufwene 1996). The example of English being spoken in the US, as opposed to German, is used to exemplify the concept of the 'founder effect' (Trudgill 2004). According to Trudgill (2004), there are more people descended from native German speakers than from native

English speakers. However, the English speaking population arrived first and the arrival of German speaking immigrants were not numerous enough to replace English at any one time.

The 'founder effect' may be relevant to some of the linguistic features of LE and was linked to the Lancashire immigrants and original Liverpool population. Figure 2.6a demonstrates that a relatively large portion of the population during this time period was born in Lancashire, which suggests that other immigrant populations would not have supplanted the Lancashire population and dialect completely. Much of the population listed under Lancashire is likely to have been born within Liverpool itself, as was seen in 1851 and 1911. Nonetheless, there was still substantial immigration from Lancashire with 8% of the population in 1851 born in Lancashire. This is second only to Ireland in the portion of immigrant-born populations in Liverpool. Furthermore, it is thought that the dialect in Liverpool prior to the large immigration in the nineteenth century would have been a variety of southern Lancashire, as discussed in §2.1.1.

While Honeybone (2007) suggests that the Lancashire dialect would not have had prestige over the other varieties in the Liverpool dialect mixture, the Lancashire dialect was also involved in the dialect mixture situation in Liverpool at the time of dialect formation. Furthermore, it is not necessarily the case that prestige of linguistic features equates to an advantage over competing forms (Trudgill 1986). Some of the Lancashire linguistic features may have had an advantage over competing variants, due to the large population which spoke the variety and the 'founder effect'.

Despite the importance of understanding the original population in Liverpool and the Lancashire immigrant population, there is little information available specifically about the Lancashire immigrants and the Liverpool-born population during this time period. Many of the previous accounts of the development of Liverpool and LE focus mostly on the other immigrant populations. Within this research, many of the other immigrant groups have been specifically linked to particular classes, occupations, and geographic locations within Liverpool. The lack of evidence that Lancashire immigrants were linked to specific demographics might suggest that they were linked to all sections of the society, more so than other immigrant classes. Alternatively, it could indicate previous works' focus on the other immigrant populations and that there is just too little information available. Nonetheless, linguistic investigations on features of LE demonstrate the influence that the Lancashire dialect had on LE. The characteristics of LE that have likely been influenced by the Lancashire dialect are discussed later in this chapter in §2.2.

In 1798 the Irish Rebellion against the British rule of Ireland brought the first large waves of Irish immigrants into Liverpool (Farrer and Brownbill 1911: 33). This substantial immigration and subsequent waves of immigration can be seen in the 1841 population counts where 17% of the Liverpool population were born in Ireland. The Irish immigrants in Liverpool accounted for 12% of all immigrants from Ireland in England at this time (Census of Great Britain 1841). The source of the second major immigration from Ireland to Liverpool is the Great Irish Famine in 1845–50 (MacRaild 1999). Failing crops and industrialisation prior to the Great Famine contributed to waves of Irish immigration before 1845 (MacRaild 1999). This may suggest that some of the immigration from Ireland captured in the 1841 population counts is related to the events leading up to the Great Irish Famine. However, this number would likely not have included the most substantial immigration that resulted from the Great Famine, which would have occurred in the early years of this historical crisis. Approximately 90,000 Irish came through Liverpool in the first three months of 1846 and around 300,000 in the twelve months following July 1847, most of whom emigrated to America (Farrer and Brownbill 1911: 38). By the next census, in 1851, Liverpool housed 16% of all immigrants from Ireland in England (Census of Great Britain 1851).

Liverpool was the main port in Britain from Dublin and the casual labour market attracted many of the impoverished Irish (Belchem 2000b). Irish workers were willing to do many of the jobs that native workers did not want and would do it for cheaper, so that the labour prices could be lowered, making it difficult for the existing labourers to keep up with lowering prices (Belchem 2000b). As a result the working-class Liverpool-Irish lived in the slums near the docks (Power 1992) or in the northern suburbs, which were relatively deprived and poor areas in the north of Liverpool (Belchem 2000b).

The Liverpool-Irish would have come from various parts of Ireland. This is in part due to the waves of immigration throughout the eighteenth and nineteenth centuries and the Great famine hitting the entirety of Ireland. Belchem (2000a) mentions literary evidence that the original immigrants from Ireland were distinct groups. While the census data provides some information about where the Irish immigrants had come from in Ireland, there is some debate over whether the Irish immigrants recorded the port they left from in Ireland or their current location rather than the county that they originated from (see Beal and Corrigan 2009). According to the census in 1911, immigrants from Ireland came from all four provinces of Leinster, Munster, Ulster, and Connaught in different proportions (Census of England and Wales 1911). It suggests that the Irish immigrants mainly came from the counties of Dublin, Kildare, Louth, Wexford, Cork, Waterford, and Mayo, which aside from county Mayo are all located on or near the east coast of Ireland (Census of England and Wales 1911). MacRaild (1999) also suggests that Irish immigrants into Britain mostly came from the southeast and eastern counties in Ireland. The census records the smallest number of immigrants from Clare, Kerry, Antrim, Donegal, Londonderry, and Leitrim (Census of England and Wales 1911). However, Kennedy and Clarkson (1999) and Fotheringham et al. (2013) discuss the population movements around the time of the famine, which demonstrates that much of the population in interior counties moved to the port cities. Similarly, Beal and Corrigan (2009) suggest that immigrants came from the western areas and not the southeastern and eastern areas recorded in the census. MacRaild (1999) finds that in the 1851 census in Ireland, emigration rates were high in all regions of Ireland, with the smallest loss of population in the region of Ulster and Dublin county. Therefore, some of the immigrants from Ireland may have recorded the location they moved to prior to immigration to England or the port they left from. These observations suggest that the Irish immigrant population would likely have come from all parts of Ireland.

If the Irish immigrant population came from different regions in Ireland, it is likely that they would have spoken different varieties of Irish English and Irish Gaelic. According to Honeybone (2007), Irish immigrants would have spoken Irish English dialects and Irish Gaelic, but Belchem (2000a) suggests that little Irish Gaelic was spoken in Liverpool. The waves of immigration over decades as well as, differences in place of origin, language and dialect may have led to the Irish community not being a cohesive one, as suggested by Belchem (2000a). Furthermore, due to forced immigration as a result of the Great Famine, poverty and lowering of workplace wages, the Liverpool-Irish suffered from prejudice and a negative reputation (Belchem 2000a) and were not able to integrate into the other populations of Liverpool at this time (Belchem 2000b). Not all immigrant populations experienced the same prejudice or community diversity.

The Liverpool-Welsh had a strong community with Welsh churches and traditional crafts and trades, but were much more dispersed throughout Liverpool than the Irish immigrants (Belchem 2000b). Welsh immigration mainly came from the historic counties of Wales in the north: Anglesey, Flintshire, Denbighshire and Carnarvonshire (Her Majesty's Home State Department 2007). Given that these counties are all those closest to Liverpool and would likely have been where immigrants travelled from, this could reflect that the Welsh immigrants simply recorded the port or area that they travelled from and not where they were born, similar to what may have happened with the Irish immigrants. However, this has not be previously suggested for the Welsh immigrants and there is little evidence to support this idea. Alternatively, large immigration of Welsh from the northern Welsh counties to Liverpool may also reflect the close proximity of these counties to Liverpool and Welsh emigrating from southern areas may have moved into other English cities.

The Liverpool-Welsh community had chapels and newspapers of their own where the Welsh language was used. Welsh services in church were reported as far back as 1793 (Farrer and Brownbill 1911: 48). In Liverpool today Welsh is still spoken in some of the Welsh chapels (Honeybone 2007). While the Liverpool-Welsh were generally dispersed, the areas where there were higher concentration of Welsh were not as ghettoised as the Irish enclaves. Welsh immigrants were less impoverished than the Irish, seeking employment as artisans and tradesman rather than casual labourers (Belchem 2000b). Their success in the new market even threatened some of the resident artisans and tradesmen. Welsh immigrants likely spoke both English and Welsh, similar to the Irish speaking both English and Irish (Honeybone 2007). Given the principles of new-dialect formation, it is unlikely that either Gaelic or Welsh would have contributed to the dialect mixture in Liverpool because Gaelic and Welsh would not have been mutually intelligible to the majority of the Liverpool population. Note that previous research has shown that the emergence of a dialect may be influenced by varieties that are not mutually intelligible in new-dialect formation situations. Knooihuizen (2009) hypothesises that Norn and Scots influenced the development of Shetland Scots. At the time of the Scots immigration into the Shetlands, there was no variety that was mutually intelligible between the original and immigrant populations: the original population spoke Norn and the immigrants spoke Scots. Therefore, the Norn population learned Scots and this L2 Scots variety contained some Norn features. Knooihuizen (2009) argues that the origins of consonant features in Shetland Scots is better explained with the inclusion of an L2 variety of Scots spoken by the Norn original population and the Scots spoken by the immigrant Scots populations. This suggests that it may be possible for dialect mixtures to include features of non-mutually intelligible varieties. However, the situation in the Shetlands is different from the situation in Liverpool. All of the immigrant populations in Liverpool already had a variety of English readily available to them. There is no reason why the immigrant populations would not have spoken with the original Liverpool population using these English varieties. Therefore, it is unlikely that Welsh or Gaelic were included in the dialect mixture, but Welsh English and Irish English likely would have been.

The immigrants from Scotland again had a different situation from the Liverpool-Irish and Liverpool-Welsh. Liverpool had the second largest immigrant population from Scotland in England, just behind Newcastle (Honeybone 2007, Sim 2011). Unlike the Irish and the Welsh, they were not straightforwardly distinguished by religion and integrated well into the Liverpool population (Munro and Sim 2001, Honeybone 2007, Sim 2011). The Liverpool-Scots were also not as ghettoised as the Irish and did not suffer the same prejudices (Munro and Sim 2001, Honeybone 2007).

The following summary on the Liverpool-Scots is based on Sim (2011). There were large concentrations of the Liverpool-Scots in the northern area of Kirkdale, which ranged from poor quality houses to average quality housing. However, a separate group of higher-class Scots lived in the Mount Pleasant and Princes Park areas of the city centre. Some of the immigrants from

Scotland may have spoken Scottish Gaelic, but not much was spoken in Liverpool and the Liverpool-Scots opted for the use of English. In terms of industry and work, using English would have been advantageous for the Scots as it would have been the common language. Similar to Welsh and Irish Gaelic, it is unlikely that Scottish Gaelic was a significant feature of the varieties spoken during dialect formation of LE, while Scots varieties of English might have been a contributing factor.

The analysis of the historical census data provides evidence that the main varieties that were likely to have had an effect on the formation of LE were Lancashire English, Cheshire English, Irish English, Welsh English, Scots English. The new-dialect formation approach discusses the proportion of certain linguistic features and, therefore, dialects that may have contributed to the retention of certain dialect features (see §4.2 for a detailed description).

2.1.1 Formation of the Liverpool dialect and identity

The current section discusses the formation of the Liverpool dialect and identity, which are shown to be intertwined. I describe the status of different populations in Liverpool and their relationship to the formation of a Liverpool identity. Given the contemporary evidence that 'Scouse' or LE and Liverpool identity are strongly connected, the following section provides a historical context for development of the dialect and identity.

The status of the immigrant populations and the commercial development of Liverpool had an impact on the social structure of Liverpool. In the 1800s the middle-class and working-class split, which would already have been present, became more noticeable (Power 1992). With a growing poor working-class in the slums and northern suburbs and a somewhat more wealthy population in other areas of the city, the social divide between the wealthy and poor became wider, which can be seen to some extent in the prejudice against the Liverpool-Irish, the slums by the docks and the deprived northern areas (Belchem 2000a). However, it was precisely this situation which may have been the catalyst for the formation of LE and changed the character of Liverpool and the Merseyside.

Liverpool identity is a strong feature of contemporary Liverpool, which stems from the historical development of the city and is entrenched in the belief that Liverpool is not like its neighbours. This belief can be seen in descriptions of Liverpool identity, such as the ‘wacker’:

> “[w]ackers are the inhabitants of the city of Liverpool famed for their humour, football, dockers, and judies. Wackers eat Scouse and wet nellies. Wackers and Woollybacks[6] are tough yet warm breeds. Although both are Northerners, they are different in many ways; culture and tradition and even language divides them” (Belchem 2000a: 47).

Liverpool identity and the different manifestation of it are discussed in more detail in §2.1.1.1.

Historical descriptions of Liverpool culture indicated that the strong Liverpool identity stems from the historical development of Liverpool and the mixture of the aforementioned populations. Belchem (2006: 387-8) suggests that “‘Scouse culture’ or ‘Liverpool stew’ has been described as a cosmopolitan blend of ‘Lancashire amiability, Irish blarney, Welsh acerbity, as well as bits of Chinese, German, Scandinavian, to name only the obvious ones’.” Liverpool built its identity from commercial success rather than an industrial one (Belchem 2000a), with the creation of the docks and the population’s reliance on the commercial enterprises resulting from it.

The accent also became a badge to demonstrate Liverpool’s apartness from other northerners and other English. It represented the city’s cosmopolitan roots and multicultural background. “Networks of economic and social life, even the formulation of the city’s distinctive accent, were subtly shaped by a rolling continuity of transients, sojourners, and settlers” (Belchem 2006: 387). McNeill (2009) surveyed 402 further education students from six establishments in Merseyside and found that 64% believed that accents give a sense of belonging, while 76% of those surveyed believed Liverpudlians are proud of the Liverpool dialect even outside of Liverpool. In this way, Liverpool identity, culture and dialect developed alongside each other. As previously mentioned, the formation of the dialect is linked with the historical development of Liverpool to a large extent.

[6]Woollybacks are historically the dock workers in Liverpool, but the contemporary use is someone from the surrounding area of Liverpool, such as St. Helens

Previous work suggests that before the eighteenth century the dialect spoken in the area would have been on the Lancashire-Cheshire dialect continuum (Knowles 1973, Honeybone 2004). The dialect was most likely similar to other south Lancashire dialects. Knowles (1973) suggests that 'serious phonetic studies' before 1880s made no distinction between Liverpool and the surrounding countryside. Aside from the fact that no serious phonetic study occurred prior to the late 1880s,[7] this quotation also alludes to the lack of information about the Liverpool dialect prior to this period. As discussed in detail below, there are competing hypotheses about the development of LE. One is that LE developed around the early to mid-nineteenth century. Prior to this, the linguistic features would have been similar to northwestern English varieties, some of which are maintained in LE today (see §2.2). The second is that the Liverpool dialect developed prior to the nineteenth century.

The development of the Liverpool dialect was heavily influenced by the development of the city itself. However, there are two substantial periods of population increase for Liverpool, one corresponding to the largest proportional population increase and another to the absolute population increase (see §2.1). This has resulted in disagreements as to the exact timescale of when the Liverpool dialect was formed. Knowles (1973) suggests that LE formed between 1830 and 1889. He uses negative evidence from the historical account of the *History of Everton* (Syers 1830), which does not describe the speech in Liverpool as different from Lancashire despite highlighting many other differences. The upper limit is taken from *On Early English Pronunciation* (Ellis 1889). Ellis (1889) indicates the spread of LE to the Wirral in northern Cheshire, which Knowles (1973) takes as evidence that by 1889 LE has emerged and is distinct from the neighbouring varieties. Wells (1982: 371) is more vague, suggesting that its development occurred in the nineteenth century. Honeybone (2004, 2007) presents a detailed account of LE based on the dates suggested by Knowles (1973) and suggests that the dialect was formed roughly between the mid-nineteenth century and the early twentieth century, using the new-dialect formation approach (Trudgill 1986). While slight differences between the different timelines occur, there is agreement that

[7] The phonetic study that is being referred to is *On Early English Pronunciation* by Ellis (1889).

the Irish, Welsh, and Scottish immigrants mixing with the resident population is a key component of the dialect's development.

Looking back at the birthplace of the population around this time, Figure 2.6 shows that the population in 1841 was mainly made up of people from Lancashire (55%), other parts of England and Wales[8] (23%), Ireland (17%), and Scotland (4%). By this time, the first large wave of Irish immigrants, as well as other immigrant populations would have already arrived in Liverpool and commercial enterprise was booming. Furthermore, evidence from investigations on linguistic features of LE supports the hypothesis that new-dialect formation occurred in Liverpool and that more than just the Lancashire dialect is required to account for these linguistic features. Therefore, previous work on LE supports the hypothesis that dialect formation occurred as a result of the dialect mixture caused by mass immigration into Liverpool. The results of the historical census data suggests that new-dialect formation most likely occurred in the mid-nineteenth century. The current detailed analysis of the population of Liverpool using census data is crucial evidence for this hypothesis.

Crowley (2012) suggests an alternative view of the development of LE. Specifically, he suggests that there was a Liverpool dialect prior to the nineteenth century and that there is literary evidence to suggest this. The first piece of evidence presented to support Crowley's (2012) hypothesis is Boulton's (1768) comedic play set in Liverpool with characters that represented people from a variety of different social classes. I read through the entire play in order to be able to understand the context that surrounds the evidence suggested by Crowley (2012). There are two plots in the play: one about enlisting sailors on treacherous voyages and another about a daughter (Kitty) betrothed to a country gentleman (Squire Catesby), but who is in love with a ship doctor (Dr. Free). In order to prevent her marriage to Squire Catesby, Kitty sends a message to Dr. Free telling him to impersonate the Squire's cousin and "[m]ind and forget not the Lancashire dialect" (Boulton 1768: 24). Crowley (2012) proposes that Kitty is asking Dr. Free not to speak in a Liverpool dialect. However, there are a number of issues with this claim.

Firstly, the only characters who are explicitly presented as citizens of

[8]The census does not provide separate counts for England and Wales in 1841, as described above.

Liverpool are Kitty and her father. In other words, Dr. Free may be from somewhere else. This is not an unlikely possibility given that he is a ship doctor and many of the ships' crews came from outside of Liverpool. Enfield (1773: 26) suggests that "seamen from other places are often employed in Leverpool ships" and he estimates that there are 6000 Liverpool seamen and 4000 foreign seamen. Therefore, it is possible that she was ensuring that he did not speak in his accent, whatever that may be. Furthermore, it is mentioned that he was an educated man and as there were no higher education institutions at the time in Liverpool, he would have had to, at least, be educated outside Liverpool if not in another area entirely, assuming that he is from Liverpool. The family name Free in the 1881 census records is predominantly found in the south and east areas of England (Longley et al. 2014) and, therefore, may suggest the doctor to be from another origin than Liverpool, but a more in-depth analysis would be required to confirm this possibility.

Secondly, the only characters which are written in dialect are the Irish doctor, the clown (Bob Bluff), and Squire Catesby. I focus on the speech characteristics of Bob Bluff and Squire Catesby who are both from Lancashire, but are of different social classes. Similar features are used to represent the Lancashire dialect regardless of social class. For example, the use of *th', blud, freeten* for *the, blood, frighten.* As this is a comedy, these features may be used for comic effect and are similar to those used in Tim Bobbin's Lancashire dialect literature (Collier 1748).[9] None of the other characters seem to have defining linguistic characteristics, even though there are sailors, servants, a carpenter, a squire, and captains. This suggests that, while Kitty does not have the comedic Lancashire dialect, there is no evidence of what dialect she does have. In other words, it is possible that there was some concept of a Liverpool dialect at this time, but this play does not give conclusive evidence.

The second piece of evidence that Crowley (2012) presents is a debate over whether Prime Minister Gladstone had a 'provincial' accent. In a response to the suggestion that Gladstone had a Lancashire accent, Picton (1888: 210)

[9]Collier (1748) wrote literature in the Lancashire dialect similar to the works of Robert Burns in Scotland. However, the crucial difference between him and Robert Burns is that Tim Bobbin's work was comedic satires. In fact, there were some contemporaries that criticised Collier (1748) for his representation of the Lancashire people. Brierley (1881) suggests that Tim Bobbin is the reason why other parts of England think of Lancashire as 'coarse, ill-bred' men.

suggests that Gladstone's "tones and mode of utterance are of decidedly a Liverpool origin." It is debatable whether this claim is valid, given that both Gladstone's parents were Scottish, he was educated from the age of 12 in Eton and then Oxford, and spent a large portion of his life in London in the parliament (Magnus 1960). Gladstone was born in 1809 and first elected to parliament in 1832, which meant that in 1888 he had spent more than 50 years in parliament. Gladstone recorded a message for Edison on a phonograph in 1888 (Gladstone 1888), which gives further evidence that Gladstone did not consistently exhibit Liverpool dialect features. I do not present an in-depth analysis of this recording as the quality is so poor, but mention some of the features that Gladstone seemed to have. Gladstone's dialect seems to be a mixture of northern and southern features. In this recording, he is variably rhotic, has the FOOT/STRUT split and does not have the BATH/TRAP split.

Despite the fact that it is unlikely that Gladstone had a Liverpool dialect due to having spent little time in Liverpool over his lifetime, Picton's (1888) claim suggests that there was a concept of the Liverpool dialect by 1888 and Picton (1888) believed the dialect may have been formed when Gladstone was young and living in Liverpool in the early nineteenth century. Picton (1888) further suggests that the Liverpool dialect was not like Cockney or like Tim Bobbin's Lancashire. As previously mentioned, Tim Bobbin's type dialect literature was comedic and may have been an extreme representation of the Lancashire speech of the time, especially in comparison to middle-class speakers, which Gladstone would have been. Other than these vague suggestions, there is no substantial evidence of what the Liverpool dialect at this time might have been linguistically speaking.

Finally, even if there was a Liverpool dialect prior to the mid-nineteenth century, that does not mean that new-dialect formation did not occur in the time period that is set out by many previous accounts. Recent research by Watson and Clark (forthcoming) supports the hypothesis that LE is the result of new-dialect formation as suggested by Knowles (1973), Wells (1982) and Honeybone (2007). Watson and Clark (forthcoming) discuss the presence of four features of LE in the *Origins of Liverpool English* (OLIVE) Corpus, which contains speakers born from 1890–1994 (see Chapter 8.2 for a more detailed discussion of this corpus). The findings suggest that some of the features of LE have changed in line with the prediction of the new-dialect formation approach. Some of the specific results of this study are discussed in §2.2.

Given the arguments against Crowley's (2012) hypothesis and the lack of evidence of linguistic characteristics of a Liverpool dialect prior to the late nineteenth century, the present thesis operates under the hypothesis that emergence of the Liverpool dialect related to the contemporary LE occurred in the mid-nineteenth century. Assuming this is the case, the historical census data regarding population and immigration from the nineteenth and twentieth century provides a fairly reliable picture of Liverpool's demographics around the time of dialect formation.

The following discussion examines the development of LE within the context of the contributing populations. Belchem (2000a: 41) suggests that "when Liverpool eventually acquired its own voice - [... it was] 'a mixture of Welsh, Irish, and catarrh' (Kerrigan 1996: 2)." In a similar vein, Knowles (1973) describes the Liverpool dialect as being Lancashire with Irish characteristics. These anecdotal descriptions reflect the role that different groups in Liverpool played in the formation of LE. Despite the apparent differences between the immigrant populations in Liverpool at the time of dialect formation, such as community ties and religion, there are many ways in which these groups would have had contact with each other and as intermingling occurred so did the development of the dialect.

The resident population prior to dialect formation would likely have been speaking the south Lancashire dialect, similar to the surrounding areas. Therefore, it is inevitable that this dialect would have been part of the dialect mixture in Liverpool at the time of dialect formation. The influence of the Lancashire dialect on LE can be seen in some of the linguistic features present in the present-day LE. Liverpool English shares many of the traditional characteristics of northern Englishes, such as the lack of a FOOT/STRUT split (see §2.2). However, LE is also linguistically different from other northern varieties, which may demonstrate influences from the varieties of other immigrant populations.

In the earlier periods of immigration from Ireland, the Liverpool-Irish were mostly separated from other Liverpool residents and lived tightly together with other poor in the slum areas. As mentioned above, the Irish immigrants were not from just one area of Ireland, but from a number of different counties, which resulted in dialect mixture within the Irish community itself. There is some evidence that demonstrates that the dialect in the slum areas was developing its own character, likely as a result of dialect mixture within these tightly packed areas (Belchem 2000a). A contemporary source comments on the dialect of the slums: "they speak a bastard brogue: a shambling, degenerate speech of slipshod vowels and muddied consonants" (Scott 1907: 144). However, as the city developed, more social intermingling occurred. Specifically the Liverpool-Irish were often involved in the management of public houses, as well as providing entertainment, such as blackface minstrelsy (Belchem 2007). These activities allowed the Irish to climb the social ladder and remove some of the prejudice they had endured. Blackface minstrelsy allowed the Irish to exert superiority over the black population and "enabled the Irish to confirm their whiteness while at the same time asserting their 'ethnic' difference" (Belchem 2007: 18). This eventual integration into Liverpool society meant that LE is likely also influenced by the Irish immigrant population (see §2.2).

Some previous work suggests that the Liverpool-Welsh may not have had as much of an influence on LE as other immigrant populations (Knowles 1973, Belchem 2000a). As mentioned above, the Welsh community was rather self-contained with Welsh-speaking churches and a close-knit community. Belchem (2007) suggests that the Welsh community would work in Liverpool for the summer months gaining income for their families and then return to their homes in the winter. The fact that the Welsh made up a much smaller portion of the population than the population born in Lancashire and Ireland would also have likely affected the extent to which the Liverpool-Welsh played a part in the development of the dialect. On the other hand, the Liverpool-Welsh did not experience the same prejudice that the Irish did, were not primarily in the working-class and did not live in uni-cultural pockets around the city. This suggests that the resident population would likely have had day-to-day contact with the Liverpool-Welsh. Therefore, it is likely that the Welsh immigrants would have had some effect on the development of LE. Features which may demonstrate the influence that Welsh English had on LE is described in 2.2.

2.1.1.1 Scouse identity

The current section discusses Liverpool identity and how this has affected language change in LE. Importantly, this shows that LE can still be thought of in terms of the dialect mixture presented above. There have been linguistic changes in LE, but there is also some resistance to dialect levelling.

Belchem (2000a: 32) discusses "the unmistakeable accent upon which the various cultural representations of the 'Scouser' have been constructed", which suggests that along with the Liverpool identity came the idea of the 'Scouser' and of their dialect 'Scouse'. However, prior to the 'Scouser', there were other identity constructions in Liverpool, such as 'Dicky Sam' and 'wacker'.[10]

Crowley (2012) finds evidence from a newspaper of 'Dicky Sam' being used to refer to 'the Liverpool man' in the 1820s. It is not clear what the 'Liverpool man' would have been referring to at this time, but given that this was before the largest periods of immigration it likely did not include most of the immigrant populations that contributed to the development of Liverpool. The origins of 'Dicky Sam' are disputed, with descriptions ranging from it having links to America (Belchem 2007) to derived from Celts words for 'ditch' or 'pit' (*dig*) and 'people' (*samhadh*) (Boult 1871) to a Lancashire historic patronym of 'Dick O'Sam's' or son of Sam (Oxford English Dictionary 2008). See Crowley (2012) for a detailed account of the different proposed origins of 'Dicky Sam'.

The term 'wacker' also emerged in the late eighteenth century, but was likely brought into common usage after 'Dicky Sam' (Crowley 2012). There are a number of different proposed origins of 'wacker' from a Lancashire dialect word 'wack' denoting 'to share' to the Anglo-Irish word 'whack' meaning 'food sustenance' to a shortening of the derogatory word 'paddywack' for a 'strong Irishman' (Crowley 2012).

The first documented use of 'Scouse' to describe LE was in 1945, according to the Oxford English Dictionary (Oxford English Dictionary 2008). The term 'Scouse' is derived from a soup called 'lobscouse', which was a popular dish in the poorer northern end of the city where many Liverpool-Irish lived (Belchem 2007). As a result of this, 'Scouse' is mostly agreed to have Irish affiliations

[10] Note that 'wacker', 'whacker' and 'wack' are all used.

and shows the Liverpudlian connection to working-class culture. Belchem (2007: 322) proposes that 'Scouse' developed from a dish to an identity label and finally into a label for a dialect: "Scouse gave voice to twentieth-century Liverpool, previously subsumed within standard south Lancashire speech." It became the predominate symbol of the Liverpudlian.

The earlier term of 'Dicky Sam' began to be used for those born only in the original area of Liverpool parish, 'wacker' began to be thought of as a greeting between Liverpudlians and 'Scouser' referred to Liverpool seamen (Crowley 2012). Picton (1875: 1) suggests that 'Dicky Sam' was "the local appellation for one born within the sound of the parish bells." The parish bells refer to the church of Our Lady and St. Nicholas (Crowley 2012). However, "the designation 'Scouser', as the Daily Post explained [...] during the city's 750th anniversary celebrations in 1947, 'crept into general use in the Scotland Road area of Liverpool after the First World War'" (Belchem 2007: 322).

The initial division of the identity labels to refer to different portions of the population alludes to the divisions among the population in the nineteenth century. However, the supplanting of 'Dicky Sam' and 'wacker' by 'Scouser' may suggest that the Liverpool population was creating a united identity under one label and that this label was focused on the working-class.

Crowley (2012) discusses the way in which Liverpool identity, its language and 'Scouse' became so 'firmly associated' with one another. He suggests that it was in part due to the efforts of Frank Shaw in the 1950s through a series of talks, editorials, and dialect literature (Crowley 2012). Shaw was concerned that there were fewer and fewer 'true Scousers' in Liverpool, and used language as the medium to preserve this identity. He created dialect literature for the Liverpool dialect, such as *You Know Me Aunty Nelly? Liverpool Children's Rhymes* and *The Scab: a one act play set in Liverpool during the General Strike, 1926* and a Liverpool slang dictionary (Crowley 2012). Fritz Speigl and John Farrell are also credited in helping to promote 'Scouse'. However, Crowley (2012) says that the concept of the 'Scouser' was further popularised by the rise of certain musicians and TV shows featuring 'Scousers', such as the Beatles and *Liver Birds*.

One result of the media exposure of the British population to 'Scouse' and 'Scousers' is that it is a well-recognised dialect among British speakers (Giles

1970, Coupland and Bishop 2007, Montgomery 2007). However, it is also highly stigmatised, much like some of the other northern and urban varieties (Hamer 2007). A number of studies have shown that LE is easily recognised, but also has a low perceived aesthetic value (Giles 1970, Honeybone 2007, Coupland and Bishop 2007, Montgomery 2007). The negative reputation of LE may be a reflection of the perceptions of Liverpool itself. Belchem (2007) discusses the provisions that were made in the mid-nineteenth century for people travelling through the Liverpool docks because of the reputation of the area. Specifically, the Liverpool-Irish were thought to be dishonest, cunning, and often involved in thievery (Belchem 2007). The connection between the Liverpool-Irish and Liverpool working-class and then Liverpool identity meant that this negative perception was extended to Liverpudlians in general. In the twentieth century this prejudice was further spurred on by 1980s TV shows like *Bread* and *The Boys from the Black Stuff* which depicted 'Scousers' as unemployed killers and thieves (BBC 2014). However, more recent research indicates that the attitude to 'Scouse' may be changing, as Watson and Clark (2011) find that 'Scouse' is thought of as friendly and welcoming. The fact that LE is so well-recognised and that it is such a huge part of the deep-seated Liverpool identity may also be affecting the way in which LE is changing.

LE does not appear to be experiencing dialect levelling to the same extent as some of the other British English varieties. Dialect levelling is reported to be influencing many British English varieties, see Trudgill (1983), Williams and Kerswill (1999), Watt and Milroy (1999), Britain (2002), Kerswill (2003). Briefly, this phenomenon occurs when stigmatised or local linguistic features are replaced by more wide spread linguistic features, resulting in less local regional variants. More specifically, the traditional local dialects are adopting non-local features from larger urban centres nearby.[11] This can result in supra-local dialect areas, which replace the traditional regional dialect areas. For example, Britain (2010) provides the example of the Newcastle non-standard realisation of /t/ as a glottal stop ([ʔ]) taking over the regional variants, such as the glottal reinforced variant ([ʔt]), and the 'default' variant ([t]). Previous work shows that dialect levelling is occurring in Newcastle (Watt and Milroy

[11]Geographic diffusion is also associated with dialect levelling, whereby linguistic features are spread from a "populous and economically and culturally dominant centre", with near-by towns and cities adopting the features before rural areas (Kerswill 2003: 1).

1999, Watt 2002), Middlesborough (Llamas 2000), Northamptonshire (Dyer 2002), and Norwich (Trudgill 1999) among other British cities. On the other hand, Watson (2006b, 2007a) suggests that LE is not levelling to the same extent as some other varieties and in some cases it may even be diverging further from the phonological norms.

Watson (2006b) looks at t-glottaling whereby /t/ is realised as a glottal stop, the same as the Newcastle process mentioned above. He suggests that "[t]he presence of the glottal stop as a realisation of /t/ is arguably one of the most common phonological process in that it occurs in many varieties of British English" (Watson 2006b: 56). Watson (2006b, 2007a) finds that t-glottaling is being resisted in LE in some environments which overlap with a feature that is distinctly Liverpudlian and which appears to be spreading within the lexicon. This feature is referred to as 't → h' by Watson (2006b). The /t/ is realised without an oral gesture, but with some audible release of breath. Knowles (1973) presents evidence that this process is found in monosyllabic tokens ending in /t/ like *got* and *not*. T-glottaling competes with t → h in LE as they occur in some of the same environments. If dialect levelling was taking place in Liverpool as with many other northern varieties, you may expect to see more t-glottaling and less t → h occurring. However, Watson (2006b) finds that there is still little t-glottaling and the environments for t → h are growing. Furthermore, in Watson (2007a), five stereotypical Liverpool features are surveyed and only one shows substantial evidence of potential dialect levelling.

The five features discussed by Watson (2007a) to examine the effects of dialect levelling in LE are: TH-stopping, START fronting, /u:/ in BOOK type words, /r/ tapping, and lenition. Of the five features he finds that TH-stopping and lenition may be resisting dialect levelling, START fronting and /r/ tapping have inconclusive results, and the /u:/ production in BOOK appears to be levelling towards the /ʊ/ production found in most other southern English varieties. That being said, in a later paper, Watson and Clark (forthcoming) present evidence that TH-fronting is occurring to some extent in LE. This may suggest that dialect levelling is occurring to some extent in TH words. Alternatively, it may be the case that retention of the internal variant (TH-stopping) and the levelled variant (TH-fronting) are being used in LE, as these variants do not completely overlap in environments.

Both dialect levelling and the 'Scouse' identity are relevant to the current research as they relate to two main points. The first is that the Liverpool identity is strong and rooted in the dialect. Therefore, speakers may produce more non-standard linguistic characteristics even in formal tasks rather than more standardised features, which is essential to the current work.[12] The second concerns the origins of the PRICE and MOUTH patterns in LE, as well as other linguistic characteristics common to LE. The current research uses historical population records as a guide for the linguistic features that contributed to the Liverpool dialect. However, if dialect levelling were found to be occurring for many features in LE, then it would be difficult to see the effects of the historical immigrant populations on the development of linguistic features in LE. On the other hand, since LE is not experiencing extensive dialect levelling, linguistic features may show the effects of the original dialect mixture, keeping in mind that dialects are constantly changing, and it should assumed that the present-day features may not be the same as those resulting from new-dialect formation. Furthermore, the proposed origins of Liverpool PRICE and MOUTH patterns suggest that Lancashire, Cheshire, Irish, Scottish, and Welsh productions of the target vowels are likely contributors to the original phonological patterns (see Chapter 10).

The current investigation has examined the dominant immigrant populations in Liverpool around the time of new-dialect formation. My findings suggest that Lancashire, Cheshire, Irish, Welsh, and Scottish Englishes are the most likely varieties to have contributed to the development of LE. Therefore, these varieties are considered in relation to the emergence and development of PRICE and MOUTH phonologically-conditioned variation (see §3.2). Furthermore, this section established that the historical development of Liverpool led to a strong Liverpudlian identity which has close ties to the Liverpool dialect. This identity may have helped LE to resist some of the effects of dialect levelling, which is occurring in a number of other areas of Britain.

[12] Previous work using ethnographic studies have suggested an interaction between identity and linguistic productions, for example Bucholtz (1999), Eckert (2000), Kallmeyer and Keim (2003).

2.2 THE GENERAL CHARACTERISTICS OF LIVERPOOL ENGLISH AND PREVIOUS WORKS

The previous section demonstrated that there were various dialects being spoken in Liverpool around the time of dialect formation. However, having different dialects spoken in Liverpool does not invariably mean that a new dialect will be formed. While the historical evidence suggests that the formation of a new dialect in Liverpool would be a likely outcome, providing examples of features which are likely to have developed as a result of dialect mixture presents an even stronger case. Therefore, the current section focuses on linguistic characteristics of LE which provide further evidence of dialect contact and mixture in Liverpool. It is essential to establish which varieties have likely had an influence on the linguistic characteristics of LE, so that the discussion of the origins of PRICE and MOUTH phonologically-conditioned variation in Chapter 10 focusses on relevant varieties.

The list of features provided in this section is not an exhaustive list of LE linguistic characteristics. It focuses on phonological characteristics, as Liverpool differs from other British varieties mostly in its phonology. Belchem (2000a: 32) suggests: "the peculiarities of 'Scouse' are almost entirely phonological."[13] Five phonological features of LE which indicate the influence of dialect mixture in the formation of LE are described in this section: TH stopping, lenition, non-rhoticity, the NURSE/SQUARE merger, and lack of the FOOT/STRUT split. These features are chosen as they are well-recognised features of LE, have been studied previously, and discussed in relation to new-dialect formation and the origins of LE.

TH-stopping occurs when dental fricatives are produced as dental or alveolar stops, which occurs in many English varieties (Hickey 2008). In US varieties, TH-stopping is linked to working-class and immigrant populations (for example, Labov 1966, Wolfram 1969 and Mendoza-Denton 2008). Hickey (2008) reports that the change from dental fricatives to dental stops is a supra-regional feature of southern Irish English, but the use of alveolar stops is a stigmatised feature.

[13]For a description of LE characteristics beyond the ones presented here, see Knowles (1973), which is the most comprehensive work on LE to date.

In LE, /θ/ can be realised as a dental or, less frequently, an alveolar stop, so that the articulatory contrast between *thin* and *tin* can be neutralised (Honeybone 2007). TH-stopping has been shown to be a robust and common feature of LE and occurs even in low-frequency words (Honeybone and Watson 2004), although it has also been shown to be lexically conditioned (Honeybone 2004). Furthermore, recent research suggests that TH-stopping may be in decline and TH-fronting is becoming more frequent (Watson and Clark forthcoming). Watson and Clark (forthcoming) also indicate that TH-stopping was never very frequent even in the speakers born in the late nineteenth and early twentieth centuries. However, it does still occur in younger Liverpudlians' speech (Watson and Clark forthcoming).

As mentioned above, present day southern Irish English varieties exhibit TH-stopping (Wells 1982, Hickey 1999b, 2004b). Specifically, the use of alveolar stops is found in eastern Irish English varieties (Hickey 2004b), but it is a stigmatised feature (Hickey 2008). In the west, Irish Englishes tended to have dental stops as the realisation of dental fricatives (Hickey 2004b). As the dental stop production was not as stigmatised, it has become the general realisation in Irish Englishes (Hickey 2008). It is also an important feature that distinguished the northern and southern varieties of Irish English (Hickey 2004b). Some historical evidence suggests that TH-stopping was a feature of Irish English in the early twentieth century. Joyce and Dolan (1910: 3) discusses the realisation of TH in Irish Englishes: "it may be said that the general run of the Irish people never sound it at all [...] excepting a small proportion of those born and reared on the east coast of Ireland." He further describes the production of TH as the 'Irish t and d'. Honeybone (2004) suggests that the presence of TH-stopping in LE may be due to influence from Irish immigrants. Given the influence of Liverpool-Irish on the development of LE and the Irish immigration from different areas in Ireland, it is not surprising that both alveolar and dental articulations may be found in LE.

The second feature I discuss and perhaps one of the most recognisable features of the Liverpool dialect is lenition: "[o]ne of the clearest phonological characteristics of Modern LE is the way in which underlying plosives are realised" (Honeybone 2007: 18). Watson (2007b) defines lenition as "a set of phonological processes which, amongst other things, turn plosives into affricates and fricatives." Lenition processes are reported in many languages, including other varieties of English (Watson 2006a, 2007b). The precise details of lenition in LE have been discussed in great detail (for example Knowles 1973, Sangster 2001, Honeybone 2001, Watson 2006a, Honeybone 2007 and Cardoso and Honeybone in preparation). However, a summary of this pattern is that stops are lenited to fricatives or affricates with the same place of articulation as the original stop (Knowles 1973, Wells 1982) in word-final and foot-medial position (Honeybone 2001). In LE, lenition can occur with stops at all places of articulation – bilabial, alveolar, and velar – and with both voiced and voiceless stops (Honeybone 2001, Watson 2007b), although the extent to which lenition occurs depends greatly on the place of articulation and voicing of the stop consonant.

Lenition may have originated from two sources in the dialect formation mixture: immigrants from Ireland, and possibly Wales. Lenition of voiceless alveolar stops is attested in many of the southern Irish varieties (Hickey 1996). However, other stops are generally not lenited in Irish varieties. Recent research on contemporary Welsh English suggests that lenition of the voiceless stops /p, t, k/ occurs in Welsh English (Paton 2013).

The third feature, non-rhoticity, is interesting in that it is an unlikely feature to be in LE given the input varieties. Most of the population of Liverpool would have been rhotic at the time of dialect formation: the English varieties in south Lancashire, Ireland and Scotland would have been mostly rhotic. However, current descriptions suggest that rhoticity was not a common feature of LE (Honeybone 2007). Watson and Clark (forthcoming) find that one of the oldest male speakers is variably rhotic, suggesting that LE may have been variably rhotic for a period of time.

Potentially, non-rhoticity came in through the immigrants from Wales, Dublin, Cheshire and other areas of England. Darlington (1887: 19) suggests that Cheshire is verging on non-rhotic in the nineteenth century: "after a vowel, provided that no other vowel immediately follows, it is very indistinct, and approaches the London quality of *r*, though it does not quite disappear." He further suggests that /r/ is deleted when it is before *s* and *z* and gives further lexical examples, such as *rhubarb* [r'oob'ub]. Ellis (1889: 293) mentions that the /r/ in Cheshire "when not before a vowel, had very little power, and was more felt by speaker than listener" and "is hardly perceptibly consonantal." However, Ellis (1889) also mentions that there is a report of /r/ being produced as the 'standard *r*' in Cheshire in all environments, but explains that he disagrees with this account. These descriptions provide evidence that Cheshire was not fully rhotic in the late nineteenth century. Furthermore, Hickey (2004b) suggests that earlier forms of Dublin English were non-rhotic. Finally, other varieties of English may have contributed to non-rhoticity in LE. Non-rhoticity in Southern British English seems to have arisen some time in the late seventeenth century to mid-eighteenth century, although there is some debate over the exact date (Wells 1982, McMahon 2000, Lass 2000). It is possible that non-rhoticity in LE is related to prestige of Southern British English.

Trudgill (2004) does not go into great detail about how prestige affects new-dialect formation, but suggests that prestige is only influential in the first stages of dialect formation. He examines some cases where prestige has been suggested to influence features in new-dialect formation. For example, Trudgill (2004) proposes that non-rhoticity in New Zealand English cannot be a case of prestige affecting linguistic features in new-dialect formation. He explains that during the development of New Zealand English it was away from the influence of British English and the perception of social prestige in Britain. This is not the same situation as LE, where it would have been influenced by prestige in Britain. Therefore, non-rhoticity in LE may be a case where prestige influences the retention of linguistic features. The spread of non-rhoticity has occurred in most of the varieties in the United Kingdom, but non-rhoticity was initially a feature of upper-class varieties of English, such as RP. It is possible that non-rhoticity would have been brought into LE by immigrants from Wales, Cheshire and southern parts of England, but that it progressively won out over rhoticity because of its social status or because is was generally spreading throughout British varieties. This seems possible given the evidence of variable rhoticity in the late nineteenth century (Watson and Clark forthcoming).

Other linguistic features provide evidence that LE remains similar to other northern variety and shares features with the ancestral south Lancashire dialect of the area. One of the characteristics that is likely to have been influenced by the south Lancashire dialect and Irish English varieties is the

NURSE/SQUARE merger. In a similar way to Liverpool lenition, this is a salient feature of the dialect and is fairly well-researched. Knowles (1973), Wells (1982), Honeybone (2004), Watson (2006b, 2007a) and Honeybone (2007) have all discussed the NURSE/SQUARE merger. In most varieties of English, the vowel in the NURSE lexical set contrasts with the vowel in the SQUARE lexical set, but this is not the case for LE. While the precise realisation of this vowel is under some debate, this feature is prevalent in LE. Watson and Clark (forthcoming) find that there is a great deal of variation in the phonetic quality of the NURSE/SQUARE vowels in early LE.

The NURSE/SQUARE merger is common in the northwest of England and has been attested in many of the varieties which were linked historically to the south Lancashire dialect, including Liverpool, Bolton, St. Helens and Wigan (Owen and Watson 2009). It is also reported in contemporary urban Dublin and some Ulster Englishes (Wells 1982, Hickey 2004a).[14] Watson and Clark (forthcoming) suggest that the NURSE/SQUARE merger may be explained by new-dialect formation. In the initial dialect mixture there are numerous variants of NURSE/SQUARE, some of which are merger for certain speakers. These variants create extreme variability in the early stages of the formation of LE, which eventually levels in the younger speakers to one variant. Alternatively, the consolidation to one variant for the NURSE/SQUARE mergers may be a change that occurred following LE formation (Honeybone 2007, Watson and Clark forthcoming).

The final characteristic presented in this section is the FOOT/STRUT non-distinction. The STRUT vowel is highly sociolinguistically salient according to Wales (2006) and Foulkes and Docherty (2007). One of the most well-known features of the linguistic divide between northern and southern English dialects is the realisation of the STRUT vowel. Liverpool patterns with the northern English varieties and some Irish English varieties in this respect and has no distinction between the FOOT and STRUT vowels (Knowles 1973), unlike the distinction that is found in southern British Englishes. Hickey (2004b) mentions that Dublin English similarly has no FOOT/STRUT split.[15] Therefore,

[14]Some rural varieties of Irish English have mergers between subsets of the words included in the NURSE/SQUARE lexical sets (see for example Lass 1990 and Hickey 2004c).

[15]For a more detailed account of the FOOT/STRUT lexical sets in Irish Englishes (see Kallen 2013).

this feature may have come in from the south Lancashire traditional dialect and some of the immigrants from Ireland and northern parts of England.

The current section provided evidence of linguistic features in LE that were influenced by the different populations in Liverpool at the time of dialect formation. Importantly, the discussed established that new-dialect formation occurred and that the varieties of the immigrant and resident populations in Liverpool influenced the development of some of the linguistic features of LE. Therefore, these varieties may also have contributed to development of PRICE and MOUTH phonologically-conditioned variation in LE that forms the main focus of this thesis.

2.3 THE AREAS OF LIVERPOOL

The final section introduces the areas of Liverpool referred to throughout the investigation of PRICE and MOUTH in LE. Specifically, wards and the division between the north and south of Liverpool are discussed. I have used electoral wards when discussing the different areas of Liverpool. As discussed in §6.1, speakers were asked to include what part of Liverpool they were from and where they had lived. Therefore, this section provides a geographic reference for any wards mentioned later in this thesis.

The Office for National Statistics has a number of ways of dividing up Liverpool. Wards give an advantage over some of the other divisions in that they are used for electoral purposes, in government public reports and anecdotally by the general population. Furthermore, the most recent censuses continue to make use of wards, as does Liverpool City Council. On a report discussing the city profile in 2012 (Office of the Chief Executive 2012) and the Liverpool Economic Briefing in 2013 (Liverpool City Council 2013), the Liverpool City Council used wards instead of Lower layer Super Output Areas (LSOAs).[16] Finally, most of the participants in my study recorded their current location and previous locations in Liverpool under the ward name, with only a few participants choosing other categorisations. Therefore, reference to Liverpool wards is made in following chapters. Figure 2.8 shows the location of Liverpool

[16] I do not refer to the LSOAs for the remainder of the thesis, for a detailed description and indication of the LSOAs in Liverpool and Britain refer to the ONS website (UK Statistics Authority 2014).

wards, which are: Allerton, Anfield, Belle Vale, Childwall, Church, Central, Clubmoor, County, Cressignton, Croxteth, Everton, Fazakerley, Garston, Greenbank, Hunts Cross, Kensington and Fairfield, Kirkdale, Knotty Ash, Liverpool Airport, Mossely Hill, Netherley, Norris Green, Old Swan, Picton, Princes Park, Riverside, Speke, St. Michael's, Tuebrook and Stoneycroft, Warbeck, Wavertree, West Derby, Woolton, and Yew Tree.

While speakers in my study were asked to indicate what area of Liverpool they were from, the final analysis divides speakers into the broader categories of Knowsley, Wirral, North Liverpool and South Liverpool. Liverpool was divided into north and south for a number of reasons based on historical divisions, anecdotal evidence, and official divisions. As mentioned in §2.1, the northern suburbs of Liverpool were historically inhabited by working-class and poorer populations. In discussions of the Liverpool dialect, many people, including some speakers in my own study, mention the divide between the north and south. Furthermore, amenities for Liverpool are often divided on the basis of a north-south division. For example, estate agents provide guides to north and south Liverpool, the Citizens Advice Bureau is divided on the same basis, as is the food bank (according to their websites).

The dividing line between the north and south of Liverpool may differ for individuals and agencies, so it is important to provide a principled division. I have chosen to use the official division used by the police force in Liverpool to determine the boundaries between the north and south of Liverpool. It should be noted that this north-south division is the same for estate agents and Liverpool Scouts, but many other organisations do not specify what is meant by 'north Liverpool'. According to the Merseyside police, north Liverpool consists of the following wards: Anfield, city centre, Clubmoor, County, Croxteth, Everton, Fazakerley, Kensington and Fairfield, Kirkdale, Knotty Ash, Norris Green, Old Swan, Tuebrook and Stoneycroft, Warbeck, West Derby, and Yew Tree. Therefore, south Liverpool includes the following wards: Allerton, Belle Vale, Childwall, Church, Cressignton, Garston, Greenbank, Hunts Cross, Liverpool Airport, Mossely Hill, Netherley, Picton, Princes Park, Riverside, Speke, St. Michael's, Wavertree, and Woolton. This division is marked on Figure 2.8 and when north or south Liverpool is mentioned elsewhere in the text it should be taken as the definition provided here.

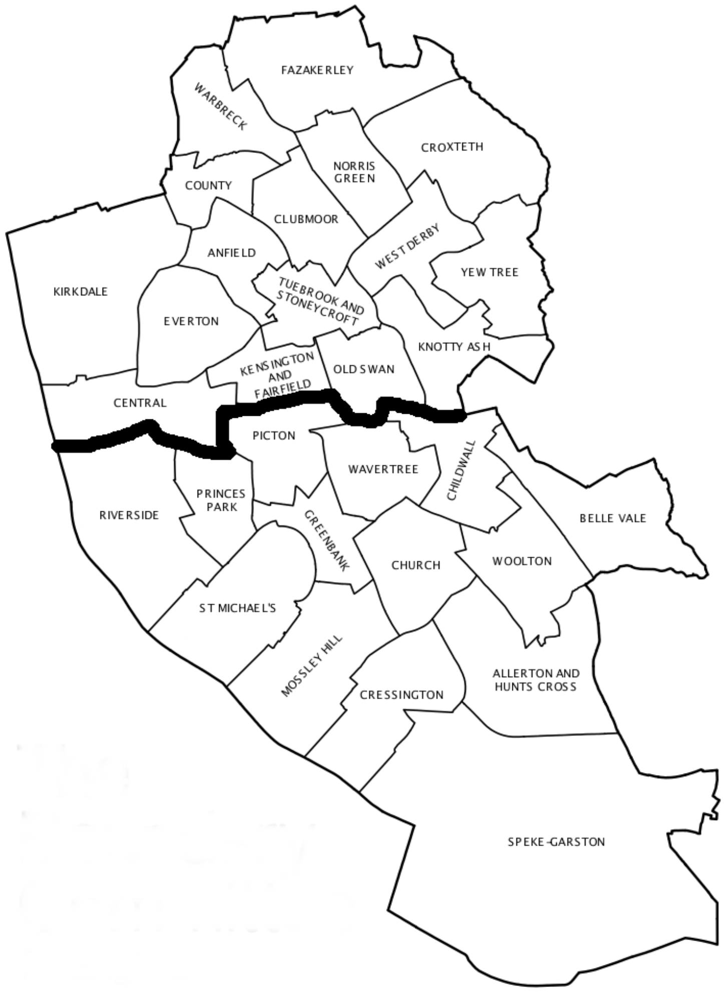


Figure 2.8: Liverpool wards (Liverpool City Council 2014) and north-south division (*black line*) of Liverpool

The Merseyside police boundary coincides with a number of north-south divisions in census data. In order to motivate the use of this boundary, I plotted the north-south division in Liverpool based on five different categories: employment, education, health, deprivation and religion (Figure 2.9). Employment is further divided into 'unemployed' vs 'employed' and type of employment. The two lowest socio-economic groups, according to Office for National Statistics (2014), 'elementary occupations' and 'plant operatives', have been included in Figure 2.9. Similarly, the highest socio-economic group, 'professionals', has been included. Unemployment, 'elementary occupations' and 'plant operatives' have higher percentages in the north than the south, whereas 'professionals' has higher percentages in the south than the north. The line that is marked for education demonstrates the difference between the population that has 'no qualification' and those that have some type of qualification. 'No qualification' is defined as someone aged 16 or older who has no academic or professional qualifications (Office for National Statistics 2011a). For example, someone who does not have O-levels, A-levels, GCSEs, Vocational training, or apprenticeships (Office for National Statistics 2011a). There is a higher percentage of population with 'no qualifications' in the north, but note that this is not very common regardless. The line for health is a division of the population based on those who have 'very good health', according to Office for National Statistics (2011b). The south has higher percentages of 'very good health' than the north. Levels of deprivation are calculated by the census and take into account many different variables, see McLennan et al. (2011) for a detailed description of how deprivation is calculated. Religion is based on the division of 'no religion' versus some form of religion. The north shows lower percentages of the population with 'no religion' than the south. Many of the lines that correspond to social categories line up with the Merseyside police north-south division, with the exception of 'Central' (city centre) ward. None of the participants in the current investigations were from the 'Central' ward, so it should not be an issue in the current investigation. Therefore, the boundary shown in Figure 2.8 demonstrates the north-south division in Liverpool used in the current thesis.

This chapter has established the historical context of Liverpool in relation to the development of LE. Historical census data and population statistics provide evidence that LE developed in the mid-nineteenth century when there was a large influx of immigrants from Lancashire, Ireland, Cheshire, Wales, and Scotland. The analysis of historical census data also established that a large portion of the population at the time of dialect formation would have come from Liverpool itself, who likely spoke a variety of southern Lancashire English. Furthermore, the chapter provides evidence from five linguistic features that the varieties of the resident and immigrant populations contributed to the formation of LE. These features have been used in previous investigations to demonstrate the influence of different varieties on the formation of LE. It is important for the discussion in Chapter 10 of the origins of PRICE and MOUTH

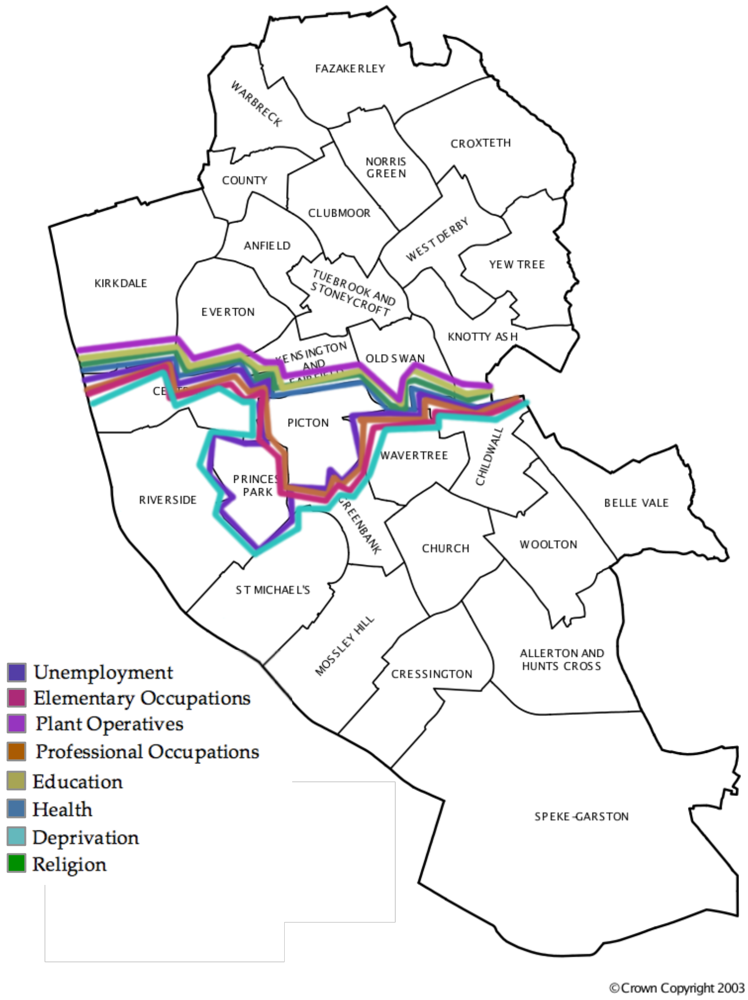


Figure 2.9: North-south divided based on results from the 2011 census (Office for National Statistics 2011b) for employment, education, health, deprivation and religion

phonologically-conditioned variation in LE to determine those varieties which have had a significant impact on the development of LE.

The chapter also provides a geographic orientation of Liverpool wards and a description of the divisions used to categorise speakers in the data collection of contemporary LE that forms a large part of this thesis (Chapter 6 and Chapter 7). As described in Chapter 6, speakers are divided based on the ward that they have lived the most time in and into the larger divisions: Knowsley, Wirral, north Liverpool, and south Liverpool. Section 2.3 provides principled reasons for the placement of the division between north and south Liverpool, which uses a number of recent census measures to indicate this division.

CHAPTER 3

VARIATION IN PRICE AND MOUTH

3.1 INTRODUCTION

This chapter provides an in-depth description of PRICE and MOUTH variation in varieties of English. As mentioned in the introduction (Chapter 1), Wells' (1982) lexical sets are used throughout this thesis as opposed to an abstract underlying representation. In other words, PRICE represents the set of words produced with /aɪ/ in Received Pronunciation (RP) and General American English that originated mostly from Middle-English (ME) /iː/ through the Great Vowel Shift (GVS) and subsequent changes (see §4.1.1 for a discussion of the historical development of PRICE). Likewise, MOUTH represents the set of words produced with /aʊ/ in RP and General American (Wells 1982) that originated mostly from ME /uː/ through the GVS and subsequent changes (see §4.1.2 for a discussion of the historical development of MOUTH).

There are two main types of variation discussed in this section: unconditioned variation and phonologically-conditioned variation. Unconditioned variation refers to phonetic realisations of PRICE and MOUTH in varieties of English without phonological conditioning. For example, PRICE is generally realised as [aɪ] in RP, but as [ɒɪ] in NewZealand English.[1] Section 3.2 focuses on the variants of PRICE and MOUTH in varieties of English that were likely part of the original dialect mixture in Liverpool, as described in §2.1, in order to better understand the emergence and development of these patterns in LE, which is discussed in Chapter 10. The *Survey of English Dialects*

[1] The phonetic realisations of PRICE as [aɪ] in RP and [ɒɪ] in NewZealand English are generalisations. There may be minor variation in PRICE realisations in these varieties, but that variation is not phonologically conditioned.

(SED) (Orton and Dieth 1962–1971) is used to determine variants in south Lancashire and north Cheshire and dialect descriptions are used to provide variants of PRICE and MOUTH for each of the varieties in the original dialect mixture. Investigating historical data alongside dialect descriptions provides insights into the possible input variants in Liverpool at the time of dialect formation and contributes to our understanding of the way in which PRICE and MOUTH phonological patterns may have emerged and developed in LE as described in Chapter 10.

Phonologically-conditioned variation refers to situations where different realisations of the target vowels are allophonic and have different distributions or conditioning environments. In other words, these realisations are phonologically-conditioned variants. A relatively common example of phonologically-conditioned variation of PRICE and/or MOUTH is where a raised nucleus diphthong occurs before voiceless consonants and a non-raised nucleus diphthong occurs elsewhere, which is widely reported in Canadian English and other varieties of English in North America. Section 3.3 summarises ways in which PRICE and MOUTH are phonologically conditioned in different varieties of English with reference to the two relevant types of phonologically-conditioned variation: voice-driven (VD) type patterns and Scottish Vowel Length Rule (SVLR) type patterns. Voice-driven phonologically-conditioned variation encompass those patterns where the main conditioning environments are before voiceless consonants and elsewhere and there is a qualitative difference in either the nucleus or offglide of the target vowels.

Voice-driven type patterns tend to be fairly homogenous in the realisations of PRICE and MOUTH and conditioning environments, despite many of the patterns developing independently from each other. Figures 3.2 and 3.3 in §3.3 demonstrate the geographical locations of VD and SVLR type patterns that have been reported in previous literature. While many of the varieties with VD type patterns presented in §3.3.1 are not directly related to the development of LE, the PRICE and MOUTH phonologically-conditioned variation in LE resembles VD type patterns more so than SVLR type patterns (Cardoso 2011b, 2015). Therefore, in order to design appropriate data collection materials and hypotheses for the acoustic analysis that incorporate commonly found characteristics of VD patterns (see Chapters 5 and 6 for descriptions of the methodology), a rigorous examination of the features and conditioning environments that have been described for other VD type patterns is presented in §3.3.1. Furthermore, a survey of the recurrent realisations of PRICE and MOUTH found in VD type patterns in English provides a basis for comparison of the results of the acoustic analysis of PRICE and MOUTH in LE.

While phonologically-conditioned variation of PRICE and MOUTH occurs extensively in varieties of English, it is by no means a universal process. However, one potentially universal pattern that is related to VD type variation is the voicing effect, as described by House and Fairbanks (1953), Chen (1970) and Hillenbrand et al. (1984). The voicing effect is generally described as a process whereby vowels are longer before voiced consonants and shorter before voiceless ones. This process in terms of quantitative differences based on the voicing of the following consonant is thought to be universal and occur cross-linguistically (see Chen 1970, Hussein 1994 and Sóskuthy 2013). More recent work on the voicing effect suggests that in all varieties of English a small qualitative difference occurs as a result of the voicing effect (Moreton and Thomas 2007, Gussenhoven 2007, Bermúdez-Otero 2014a,c). However, this small co-articulatory difference does not necessarily equate to VD patterns found in some varieties of English. In a recent study of the realisations of PRICE in the SED, Maguire et al. (in preparation) finds numerous examples of qualitative differences based on voicing of the following environment in British English varieties. It is, therefore, clear that the voicing effect and phonologically-conditioned variation are related. However, in the current thesis phonologically-conditioned variation of PRICE and MOUTH must involve a robust qualitative difference not just the universal quantitative voicing effect and be described in terms of an allophonic relationship with different conditioning environments. The approaches to the origins of PRICE and MOUTH phonologically-conditioned variation debate whether these patterns are the result of processes like the voicing effect which occurs universally as a result of universal phonetic pressures (Sóskuthy 2013) or dialect mixture situations (Trudgill 1986), similar to what occurred in Liverpool.

Scottish Vowel Length Rule type patterns involve a set of vowels that are long in some contexts and short in others, with quality and quantity differences for PRICE, as described in detail in §3.3.2. While PRICE has been shown to participate in SVLR patterns, there is some disagreement as to whether MOUTH also participates in these patterns. Many aspects of SVLR type patterns resemble VD type patterns, but there are some major differences. The vowels that participate in SVLR type variation and VD type variation differ and SVLR patterns have both phonological and morphological conditioning. In SVLR type patterns raised realisations of PRICE occur before some voiced consonants, unlike VD type patterns. Furthermore, as shown in Figures 3.2 and 3.3 and discussed in §3.3.2, the geographic distribution of SVLR type patterns is much more constrained than VD type patterns. In general it appears that all SVLR patterns are related to one another, while many VD patterns developed independently of each other. This begs the question "why discuss SVLR type patterns with regards to LE?". Given that SVLR patterns seem to be related, that Scots and Scottish English contain SVLR type variation, and that Liverpool-Scots made up one of the major immigrant groups in Liverpool (§2.1), it is possible that SVLR influenced the development of phonologically-conditioned variation of PRICE and MOUTH in LE. By considering conditioning environments that differ between SVLR type patterns and VD type patterns (Chapters 5 and 6), the current investigation can determine, to some extent, if SVLR influenced the development of PRICE and MOUTH phonologically-conditioned variation in LE.

Aside from phonological and morphological conditioning, there are some reports of sociolinguistic conditioning on VD and SVLR type patterns in varieties of English (see Labov 1972b, Roberts 2007 and West 2009 for sociolinguistic conditioning in VD type variation and Watt and Ingham 2000 and Scobbie et al. 2006 for sociolinguistic conditioning in SVLR type variation). The current investigation of PRICE and MOUTH phonologically-conditioned variation in LE does not find sociolinguistic effects in the main dataset (see Chapter 7) despite Knowles (1973) hinting at potential sociolinguistic conditioning in these vowels in LE. There are some gender correlations in the results of the historical dataset (see Chapter 9), but as this is not reflected in the contemporary pattern I will not discuss the potential explanations for gender differences. Therefore, previous literature on social factors that affect VD and SVLR type patterns are not discussed in the present thesis.

The final section (§3.3.3) summarises previous literature on PRICE and

MOUTH in LE. While there is little information on these vowels in LE, previous and current research suggests that PRICE and MOUTH variation in LE is phonologically conditioned (Knowles 1973, Berry 2009, Cardoso 2011b, 2015).

3.2 UNCONDITIONED VARIATION

This thesis often presents PRICE and MOUTH separately despite them being discussed in conjunction in some past literature. PRICE unconditioned variation is discussed in §3.2.1 and MOUTH unconditioned variation is discussed in §3.2.2. My decision to consider PRICE and MOUTH separately stems from historical descriptions of the vowels, typological evidence and analytical procedures that demonstrate substantial differences between the PRICE and MOUTH vowels. The historical development of PRICE and MOUTH is demonstrably independent for some varieties of English, as mentioned in §4.1. Furthermore, the current chapter discusses differences in phonologically-conditioned variation of PRICE and MOUTH. In some varieties with phonologically-conditioned variation of the target vowels, only one of the vowels participates in the pattern, as shown in §3.3.1.2. Additionally, providing an analysis which does not assume that the vowels are intrinsically connected helps to ensure that differences between the target vowels are not inadvertently concealed. Finally, the results of the current investigation (see Chapter 7) and Cardoso (2015) suggest that PRICE and MOUTH phonologically-conditioned variation in LE are separate, but related, patterns.

While unconditioned variation of PRICE and MOUTH occurs in many varieties of English, I focus on those varieties that may have contributed to the formation of LE. Therefore, variants of PRICE and MOUTH in English varieties spoken in south Lancashire, Cheshire, Wales, Ireland, and Scotland are discussed.

It is difficult or impossible to acquire information about many of the varieties at the time of LE dialect formation, as a result contemporary accounts of these varieties may be used. However, note that there are issues with looking at contemporary variants for the origins of a phonological pattern that was formed prior to the twentieth century (see §2.1.1 for a discussion of the timeframe of LE development). In Honeybone's (2007) discussion on the origins of four features of LE, he mentions that projecting contemporary dialect variants on historical dialects is undesirable, but may be a necessity in certain cases. Unfortunately, there is no explicit information about historical PRICE and MOUTH variants in the varieties involved in the original dialect mixture of LE, so the contemporary dialect variants act as a proxy. For example, the SED provides some insights into the historical variants of southwest Lancashire and north Cheshire, which are in close proximity to Liverpool.

Liverpool was not surveyed in the SED, as it is an urban variety and the SED was interested in recording traditional dialects. However, there are some areas in southwest Lancashire and north Cheshire that are near to or currently part of Liverpool which were surveyed as part of the project. The current discussion summarises dialectal variants from five southwest Lancashire areas and three north Cheshire areas in the SED (Orton and Dieth 1962–1971) to determine the most common dialectal variants in historical traditional dialects. For an in-depth discussion of the methodology and realisations of PRICE and MOUTH in the five southwest Lancashire localities and three north Cheshire localities see Chapters 8 and 9.

3.2.1 Unconditioned variation in the PRICE vowel

The realisation of PRICE in reference varieties is a diphthong that is generally described as a central low vowel nucleus [a] followed by a high front lax vowel offglide [ɪ] within a single syllable (Roca and Johnson 1999). Thomas (2001) suggests that PRICE is one of the most researched vowels because much of its variation is stereotyped, such as Canadian Raising in Canadian English and monophthongisation in the southern United States. As it is so well-documented there is a plethora of contemporary information regarding the realisations of PRICE in dialects of English, including those varieties that likely contributed to the formation of LE.

While the reference realisation of PRICE ([aɪ]) is attested in some of the varieties of English that were likely part of the original dialect mixture in Liverpool, other variants are also reported. Differences in both the nucleus and offglide occur in these varieties, such as a backed nucleus realisation ([ɑɪ]) reported in northern varieties of English. Van der Gaaf (1917) suggests that

Figure 3.1: SED localities in southwest Lancashire (*purple dots*) and north Cheshire (*blue dots*) closest to Liverpool (*red dot*) (Orton and Dieth 1962–1971), which are analysed in the current investigation

PRICE has been pronounced as [aɪ] or [ɑɪ] for a hundred years and that this realisation survives in the north of England. This is corroborated by the SED data, as six of the eight localities investigated have [ɑɪ] as the most common variant recorded (La10, La13, La14, Ch1, Ch3, Ch4) and La11 has it as the second most common variant. Furthermore, Ch1 has [aɪ] as the second most common variant. Only one locality, La12, does not have either [ɑɪ] or [aɪ] recorded as a common realisation. Figure 3.1 shows the locations of the SED localities discussed in the current sections, but see Chapter 8 for further details about the analysis of the SED dataset. Shorrocks (1998) finds the [aɪ] realisation in a study of the dialect of Bolton in south Lancashire using data from the 1970s and there are reports of the [aɪ] variant in Stockport (Lodge 1966), which is historically part of both Lancashire and Cheshire.

In contemporary descriptions of northern varieties of Welsh English, the [aɪ] realisation is found (Penhallurick 2004). This variant is also described for the west Wirral (Newbrook 1999), which is an area where LE is either spoken or has heavily influenced the dialect in the area. Wells (1982) suggests that PRICE in LE is generally produced as [aɪ] similar to other northern English varieties. Finally, both [aɪ] and [ɑɪ] occur in Ireland. The rural traditional varieties of the southwest and west of Ireland produced PRICE as [aɪ] (Hickey 2004c). The backed nucleus realisation ([ɑɪ]) occurs as a supra-regional southern Irish English and Dublin variant (Wells 1982, Hickey 2004c). Therefore, given that [aɪ] and [ɑɪ] are found as historical and present-day variants in southwest Lancashire, northern Cheshire, Wales and parts of Ireland, it is likely that these realisations were input variants in the initial dialect mixture in Liverpool.

Backed and rounded nucleus realisations ([ɔ̈ɪ]) are attested in southern and eastern Irish Englishes (Wells 1982). This variant is also discussed in a historical description of Irish English in Tipperary in southern Ireland (Joyce and Dolan 1910: 102): "[i]n Tipperary the vowel _i_ is generally sounded _oi_." Joyce and Dolan (1910: 102) uses the example of one boy making fun of another from Tipperary by saying *'foine day'* as evidence of this production. This variant may have been present in the original dialect mixture, as a result of the large Irish population in Liverpool at the time of dialect formation.

Raised and/or fronted or centralised nucleus diphthongs are also reported in the varieties in the original dialect mixture. The dialect variant [ɛɪ] occurs frequently in La12, Ch1 and Ch3 in the SED data (Orton and Halliday 1962, Orton and Barry 1969), in Bolton (Shorrocks 1998), and in rural western Ireland (Wells 1982). Fronted nucleus realisations ([æɪ]) are attested in the rural southwest and west of Ireland (Hickey 2004c) and Hickey (1999a) suggests that a centralised nucleus diphthong also occurs in the 'lower classes' of urban speech in Dublin.[2] The rural mid and western areas of Ireland have a number of PRICE variants with a raised, fronted or centralised nucleus, including [ɛɪ], [əɪ], [ʌɪ] and [eɪ] (Wells 1982). Therefore, it is likely that variants with a raised, fronted or centralised nucleus were present in Liverpool at the time of dialect formation.

Variation in the offglide is another possible difference in the realisation of the PRICE vowel. Some of the south Lancashire varieties produce the PRICE vowel with a centralised offglide, such as [aə] (Van der Gaaf 1917). Similarly,

[2]Dublin English has a phonologically conditioned pattern otherwise as described in §3.3.2.

Shorrocks' (1998) description of the Bolton dialect finds that [ɑˑə] occurs generally and [aˑə] occurs before /l/. None of the localities in the SED data report frequent use of a variant with a centralised offglide. However, it is possible that the small number of informants used in the SED do not have the centralised offglide diphthong, but that other south Lancashire speakers may have. Van der Gaaf (1917) suggests that this variant may lead to offglide assimilation to the nucleus resulting in monophthongal realisations of the PRICE vowel. Monophthongal realisations of PRICE are found in central and southern Lancashire, as well as other areas of the midland and north. Furthermore, a recent study of the vowels in Lancashire finds both monophthongal and diphthongal productions of PRICE (Ferragne and Pellegrino 2010).

Monophthongal variants are the most common realisations of PRICE in two of the localities in the SED (La11 and La12). While [ɑː] is the most common realisation of PRICE in La11, [aː] is found to be the most common realisation in La12. Furthermore, [ɑː] and [aː] are attested in Bolton (Shorrocks 1998) and Stockport (Lodge 1966). This evidence suggests that one of the possible input variants in Liverpool at the time of dialect formation was a monophthongal variant.

A summary of the potential realisations of the PRICE vowel that were likely part of the original dialect mixture in Liverpool and the source(s) of the variants is given in Table 3.1. Note that varieties which have phonologically-conditioned variation of PRICE, such as Scottish English, have not been included in this section, but are dealt with in §3.3.2.

3.2.2 Unconditioned variation in the MOUTH vowel

The realisation of MOUTH in reference varieties is generally described as [aʊ] with a central low vowel nucleus [a] followed by a high back rounded lax vowel offglide [ʊ] within a single syllable (Wells 1982, Roca and Johnson 1999). However, Thomas (2001) suggests that MOUTH has a 'bewildering' number of realisations across dialects and that the offglide rarely reaches the high back position given in the reference variant. Furthermore, he suggests that few dialects have the reference or 'common' realisation as their typical pronunciation. These observations appear to be reflected in the realisations

PRICE Variant	Origins
reference diphthong [aɪ]	Bolton, Stockport, north Wales, Cheshire, north England, & southwest & west Ireland
backed nucleus diphthong [ɑɪ]	southwest Lancashire (SED), north Cheshire (SED), south Ireland & Dublin
fronted nucleus diphthong [æɪ]	rural southwest & west Ireland
raised & fronted nucleus diphthong, e.g. [ɛɪ] or [eɪ]	Bolton, southwest Lancashire (SED), northern Cheshire (SED), west Ireland
centralised nucleus diphthong, e.g. [əɪ] or [ʌɪ]	south and east Ireland
raised, backed & rounded nucleus diphthong [ɔ̈ɪ]	southern Ireland
centralised offglide diphthong, e.g. [aə]	Bolton, south Lancashire
monophthongal realisations, e.g. [aː] or [ɑː]	Bolton, Stockport, southwest Lancashire (SED) & south Lancashire

Table 3.1: Possible input variants of PRICE in the original dialect mixture in Liverpool

of MOUTH in the varieties of English that contributed to the dialect mixture in Liverpool.

The reference realisation ([aʊ]) is attested in varieties in the west Wirral (Newbrook 1999), north Wales (Penhallurick 2004), south and west Ireland and Dublin (Hickey 2004c), and high status Scotland (Wells 1982). Liverpool itself is reported to have the [aʊ] realisation (Wells 1982). However, Knowles (1973) finds a number of different realisations of MOUTH in LE, with [aʊ] merely being one of them. In the localities analysed in the SED dataset only Ch4 has [aʊ] recorded as the most common realisation of MOUTH and four of the eight localities (La10, La14, Ch1 and Ch3) have it as the second most common realisation. However, there were likely other variants of MOUTH in the dialect mixture in Liverpool.

Raised and/or fronted nucleus variants are attested in south Lancashire, Ireland and Scotland. The second most common realisation of MOUTH in

La13, in the SED, is [ɛʊ]. Likewise, [ɛʊ] and [æʊ] variants of MOUTH are reported in Stockport (Lodge 1966). Traditional varieties spoken in east Ireland and Dublin have a fronted nucleus realisation ([æʊ]) or raised and fronted nucleus realisation ([ɛʊ]) (Wells 1982, Hickey 1999b). However, Wells (1982) suggests that MOUTH is generally produced as [ʌʊ] in Irish Englishes. While the PRICE vowel clearly participates in the SVLR pattern in Scots and Scottish English, there is some debate whether MOUTH is also included in this pattern. The realisation of MOUTH in varieties of English in Scotland is generally described as a raised nucleus variant ([ʌʊ]) (Wells 1982) or a raised nucleus variant with a centralised offglide ([ʌʉ]) (McMahon 1991, Scobbie et al. 1999b). However, in some varieties of Scots and Scottish English and northern Englishes, ME /u:/ did not diphthongise in the Great Vowel Shift (§4.1.2) and the historical production [ʉ] (Macaulay and Trevelyan 1973) remained, which is still found in some varieties (McMahon 1991). This vowel realisation did not become part of the MOUTH lexical set in these varieties and, therefore, it is not a variant of MOUTH. On the other hand, the raised and/or fronted nucleus variants would likely have been input variants in the formation of the MOUTH pattern in LE.

Differences in the realisation of the offglide of MOUTH are also reported in some of these varieties. Wells (1982) mentions that the offglide of MOUTH is fronted ([aʏ]) in some parts of south Lancashire and Greater Manchester. Similar realisations with raised and/or fronted nucleus and centralised offglides ([ɛːə], [ɛˑə] or [æˑə]) are reported in Bolton (Shorrocks 1998). However, the five localities is southwest Lancashire analysed from the SED all have a monophthongal variant as the most common realisation; either [aː] (La10, La11, La13, La14) or [ɛː] in La12. A fieldworker for the SED noted that speakers would produce the more RP-like [aʊ] in formal elicitation, but a monophthongal variant otherwise. The “[aʊ] form was used when words such as *round* were elicited as citation forms in response to the questionnaire, but the normal conversation form was [aː]” (Stoddart et al. 1999: 77). Furthermore, monophthongal productions of MOUTH that are either raised ([æː] or [æ̈ː]) or raised and fronted [ɛː] occur in all environments in Bolton (Shorrocks 1998).

The final variant discussed in the current section is the most common realisation of MOUTH in the SED localities Ch1 and Ch3, which is [aɪ]. It

MOUTH Variant	Origins
reference realisation [aʊ]	north Wales, Cheshire, south and west Ireland, Dublin, high status Scotland, southwest Lancashire (SED) & north Cheshire (SED)
fronted nucleus diphthong, e.g. [æʊ]	Stockport, traditional east Ireland & Dublin
raised & fronted nucleus diphthong, e.g. [ɛʊ]	Stockport, south Lancashire,(SED), east Ireland & Dublin
centralised nucleus diphthong [ʌʊ]	Ireland & Scotland
centralised offglide diphthong, e.g. [aʏ]	south Lancashire
raised &/or fronted nucleus centralised diphthong, e.g. [ɛˑə]	Bolton
monophthongal realisation [aː]	southwest Lancashire (SED)
raised &/or fronted monophthongal realisation, e.g. [ɛː] or [æː]	Bolton & southwest Lancashire (SED)

Table 3.2: Possible input variants of MOUTH in the original dialect mixture in Liverpool

is possible that neutralisation of PRICE and MOUTH could occur in these areas. However, the most common realisation of PRICE in these localities is [ɑɪ]. Therefore, in most cases PRICE and MOUTH are distinguished on the basis of the backness of the nucleus in these two localities, rather than the position of the offglide. Many of the other contributing varieties would have had overlap between this MOUTH realisation and their PRICE realisation, which may have caused neutralisation between the two vowels or extreme confusability. Furthermore, this variant has not been attested in any of the other varieties, so it is a minority feature. Therefore, it is unlikely that the [aɪ] variant of MOUTH would have survived into the resultant Liverpool dialect.

Table 3.2 summarises the variants of MOUTH and their source(s) likely present in the original dialect mixture for LE. While MOUTH variants for varieties of English in Scotland are mentioned, a discussion of the status of MOUTH in SVLR patterns is provided in §3.3.2.

Establishing input variants of PRICE and MOUTH that were likely present in dialects at the time of dialect formation of LE helps us to understand the potential origins and development of variants found in the present-day PRICE and MOUTH phonologically-conditioned variation in LE. Furthermore, a comparison of these variants to the results of the current investigation of main and historical datasets, help to determine whether the origins of PRICE and MOUTH phonologically-conditioned variation occurs as a result of new-dialect formation, phonetic processes, or a combination of factors (see Chapter 10).

3.3 PHONOLOGICALLY-CONDITIONED VARIATION

The current section discusses PRICE and MOUTH phonologically-conditioned variation, which has been found in many English varieties spoken around the world. These patterns have been reported in Canada, various parts of the US, the Falkland Islands, St. Helena, Tristan du Cuhna, various parts of Ireland, various parts of England, and Scotland. As previously mentioned, phonologically-conditioned variation falls into two broad categories: VD type variation and SVLR type variation. Voice-driven type patterns are described as those that have qualitative differences in the nucleus or offglide of PRICE and MOUTH realisations before voiceless consonants compared to other following environments (see §3.3.1). While the conditioning environments and vowel realisations for SVLR type variation largely overlap with the general pattern for VD type variation, one of the main differences is that SVLR patterns involve both phonological and morphological contexts (see §3.3.2).

The locations of reported VD (*blue markers*) and SVLR (*green markers*) type phonologically-conditioned variation in the world and, specifically, in the United Kingdom and Republic of Ireland are shown in Figures 3.2 and 3.3, respectively. One of the most well-known instances of VD phonologically-conditioned variation is Canadian Raising (Joos 1942). This phonological process can affect both PRICE and MOUTH or just PRICE and is characterised by a raised nucleus diphthong in pre-voiceless environments and a non-raised nucleus diphthong elsewhere, as discussed in §3.3.1.1 and §3.3.1.2. The blue markers for Canadian Raising in Canada (Figure 3.2) indicate specific locations of previous studies on these patterns, which are discussed below. However, previous work suggests that Canadian Raising occurs in all varieties of Canadian English with the exception of varieties in Quebec and some

Figure 3.2: Locations of investigations of VD *(blue)* and SVLR *(green)* phonologically-condition variation discussed in this chapter. Liverpool is indicated in *red*

maritime provinces (see Chambers 1973).

The green markers for SVLR type patterns in Scotland (Figure 3.3) indicate locations where SVLR type variation has been investigated and are included in the discussion below. However, all of lowland Scotland is reported to have SVLR type patterns (see Mather and Speitel 1977). Similarly, the green marker in Northern Ireland (Figure 3.3) represents much of Northern Ireland, where SVLR type patterns have been reported, such as in varieties of Ulster Scots and Mid-Ulster English (see Harris 1985).

As illustrated in Figures 3.2 and 3.3, VD phonologically-conditioned variation in varieties of English generally emerges independently from other varieties and often in instances of dialect formation resulting from a dialect mixture situation, whereas instances of SVLR phonologically-conditioned variation is generally related. Therefore, a discussion of the origins and development of PRICE and MOUTH phonologically-conditioned variation in

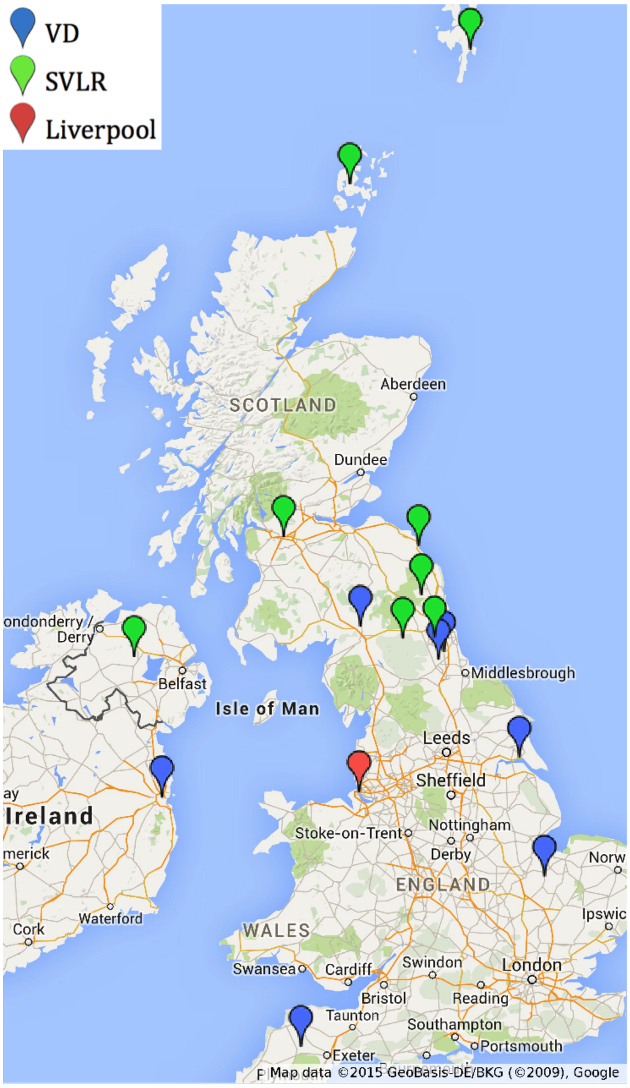


Figure 3.3: Locations of investigations of VD *(blue)* and SVLR *(green)* phonologically-conditioned variation in the United Kingdom and the Republic of Ireland discussed in this chapter. Liverpool is indicated in *red*

LE is greatly informed by a thorough understanding of VD type variation that has occurred in other varieties of English and SVLR type variation that may have come into LE through the Liverpool-Scots. Investigating instances of phonologically-conditioned variation in other varieties of English greatly influences our understanding of the pertinent environments for these patterns and, consequently, the environments to include in data collection materials for the investigation of the PRICE and MOUTH patterns in LE (Chapters 5 and 6). In essence, an understanding of the previously attested conditioning environments provides a basis of potential conditioning factors to investigate in LE PRICE and MOUTH and may also contribute to understanding the development of these patterns.

3.3.1 Voice-driven phonologically-conditioned variation

In the following sections, VD type phonologically-conditioned variation is divided into patterns that affect both PRICE and MOUTH (§3.3.1.1) and patterns which affect only the PRICE vowel (§3.3.1.2). I have not included a section on VD type variation that affects only MOUTH because to my knowledge there is no such pattern. Upon close inspection of VD type patterns of variation, it is found that either both vowels participate in these patterns or PRICE alone is affected.

3.3.1.1 Voice-driven patterns in PRICE and MOUTH

Voice-Driven type patterns of both PRICE and MOUTH have been extensively studied. In particular, Canadian Raising found in Canadian English has been the focus of much research in this area. In fact, discussions of patterns in other varieties of English tend to centre around the degree to which they are similar/different to Canadian Raising. While PRICE and MOUTH are reported to participate in these patterns, investigations tend to focus on PRICE, which is reflected in the examples used to illustrate the general characteristics of these types of patterns. The majority of examples provided in the following section are taken from the authors who conducted the studies under discussion. As a result, it becomes apparent that authors discussing PRICE and MOUTH

VD type patterns overwhelmingly use PRICE lexical items to exemplify the features of the patterns rather than MOUTH lexical items.

Joos (1942) provides the first linguistic account of phonological conditioning of PRICE and MOUTH in Canadian English, although it was mentioned in Ahrend (1934). The description proposed by Joos (1942) is that PRICE and MOUTH have fronted and raised nuclei when followed by voiceless consonants and backed lowered nuclei elsewhere.[3] Further to this, there are two dialect groups based on the pronunciation of words like *typewriter* and *writer*. Canadian Raising interacts with the flapping process in North American varieties, which exhibits a well-known case of phonological opacity. In North American English varieties, a /t/ in intervocalic position may be produced as a flap ([ɾ]). When this occurs PRICE is followed by a phonetically voiced consonant and should, therefore, not be realised with the raised nucleus variant. However, in many patterns described under the label of Canadian Raising, the target vowel realisation corresponds to the underlying voicing of the intervocalic segment not the surface phonetic variant of the consonant.[4] According to Joos (1942), dialect group A would produce [təɪpɹəɪɾəɹ] with a raised nucleus variant preceding both [p] and [ɾ]. This dialect group shows the opaque form, as the raised nucleus variant is followed by a voiced consonant. On the other hand, dialect group B would only have a raised nucleus variant before [p], resulting in a realisation like [təɪpɹaɪɾəɹ]. Note that none of the studies following Joos (1942) have found evidence to support the existence of speakers in dialect group B, likely suggesting that dialect group B never existed (see Kaye 1990,

[3]For an account of possible neighbourhood effects from the preceding consonants rather than following ones, see Hall (2005). Given that the purpose of this section is to understand the conditioning environments that are commonly reported for VD phonologically-conditioned variation and the overwhelming evidence that Canadian Raising and other VD type patterns are conditioned by following environments, limited neighbourhood effects from preceding consonants are not discussed.

[4]According to (Kiparsky 1973: 79) opacity is defined as follows: A phonological rule P of the form A → B / C __ D is opaque if there are surface structures with either of the following characteristics:

a instances of A in the environment C __ D.

b instances of B derived by P that occur in environments other than C __ D.

In other words, opacity refers to a process where there is a mismatch between the derived phonetic realisation and the conditioning environment for that process, which results in a non-surface true alternation.

which gives arguments for dialect B never existing).

A further conditioning environment that has been reported for Canadian Raising in Canadian English is before nasal-obstruent consonant clusters. Gregg (1957) finds that some speakers produce raised nucleus variants when followed by [nt] consonant clusters. At first glance, this appears to complicate the phonological conditioning of Canadian Raising. However, nasal-voiceless obstruent clusters have been show to pattern with voiceless environments rather than voiced ones, mainly in North American English varieties, but also, in Northern Irish, Holy Island and LE (Malecot 1960, Selkirk 1972, Gregg 1973, Zue and Laferriere 1979, Kahn 1976, Maguire 2013, Cardoso 2015). In some of the varieties where this occurs, the [nt] cluster may be realised as a nasalised vowel with deletion of the nasal segment, resulting in, for example, [pãɪt] for *pint*. In Canadian Raising, it may be the case that the speakers who produce raised nucleus variants before [nt] clusters are the same speakers who realise [nt] clusters as a nasalised vowel + stop. Therefore, in some cases, an explanation for the raised realisation occurring before [nt] consonant clusters, is that the [nt] clusters pattern with voiceless stops because of the deletion of the nasal. While there are currently no studies that demonstrate that the raised realisations of PRICE and MOUTH before [nt] consonant clusters is due to nasal deletion in Canadian Raising, there is empirical evidence that this is what occurs in LE (see Cardoso 2015 and §A.3). However, this may not be an explanation for all varieties where the voiceless obstruents and nasal-voiceless obstruent clusters environments pattern together, as some of these varieties do not have reported nasal deletion in nasal-obstruent clusters, such as Northern Irish and Holy Island English.

Chambers (1973) proposes that Canadian Raising in Canadian English is a within word process and, therefore, the following voiceless consonant must be within the same word as the target vowel in order for raising to occur and raising is blocked across word boundaries. There are a few compound word exceptions, where nucleus raising can occur across word boundaries, as in *high school* (Chambers 1973). However, Idsardi (2006) controversially claims that Canadian Raising in Canadian English generally occurs across word boundaries. Idsardi's (2006) argument is based on intuitions of his own speech for the productions of the following sentences: *He lied to me* ([aɪ]), *Don't lie* *to me* ([ʌɪ]) and *Don't lie about me* ([aɪ]). Most previous studies on Canadian Raising explicitly argue that raising does not occur across word boundaries (Chambers 1973, 1989, Bermúdez-Otero 2004). However, if Idsardi's (2006) intuitions are correct, encliticisation patterns of *to* and *for* may explain the distribution of raised and non-raised variants in the examples he provides, without proposing that Canadian Raising occurs across word boundaries.

There is evidence that Idsardi's (2006) observations could be due to the encliticisation of the function word *to*, but not *for*. Selkirk (1995, 1996), Lahiri and Plank (2010) discuss *to* being encliticised in English. Selkirk (1995) suggests that encliticisation of *to* may be blocked if there are phonological constraints that are violated by the encliticisation, as with the example *She can go to Toronto tomorrow.* In this example if *to* were to encliticise[5] to *Toronto* then either **tʰo Toronto* or **tʰo Tʰoronto* would occur, neither of which is phonologically licensed for aspiration. Therefore, Lahiri and Plank (2010) propose that *to* is encliticised on *go*, which does not violate any phonological principles. This particular phenomenon may be what has occurred for Idsardi (2006), whereby the *to* in *Don't lie to me* has been encliticised onto the preceding *lie* creating the appropriate environment for Canadian Raising, while maintaining the largely undisputed hypothesis that Canadian Raising does not occur across word boundaries. However, encliticisation does not occur in *He lied to me* as the preceding voiced stop in *lied* would block encliticisation. Bermúdez-Otero (2007) shows possible support for the encliticisation hypothesis, as he finds that *lie for me* ([aɪ]) does not have a raised variant. If raising occurred regularly across word boundaries, it is expected that *lie for me* and *lie to me* would both have raised variants. However, the fact that Idsardi (2006) reports a raised realisation in *lie to me* and Bermúdez-Otero (2007) finds a non-raised realisation in *lie for me*, suggests that Canadian Raising does not regularly occur across word boundaries. Furthermore, Selkirk (1972) and Selkirk (1995) proposes that in *lie for me* the *for* is more likely to not encliticise or encliticise to *me* than it is to *lie*. Selkirk (1995) suggests that stress patterns in the production of a preposition + personal pronoun block enclicitisation on the element that is before the

[5]This may also be referred to as *proclisis* as the main stress is on the following word and not the preceding word.

preposition. Therefore, *lie for me* retains a word boundary between *lie* and *for*, having blocked encliticisation, while *lie to me* goes through encliticisation creating the phonological conditioning necessary for raising to occur. While this discussion may seem orthogonal to the current study, it is important to establish whether VD type variation is a within word or across word process, to ensure the materials for data collection and data analysis are chosen on a principled basis.

Discussions of Canadian Raising in varieties of English have mainly focussed on monosyllabic tokens. However, as a results of the extensive body of work on Canadian Raising in Canadian English, there is some information about the conditioning of Canadian Raising in polysyllabic tokens. Both stress and foot structure have been used to explain the raising effect found in disyllabic tokens in Canadian English (see Chambers 1973, 1989 and Bermúdez-Otero 2003). However, the basic pattern that is found is that raised realisations occur in words like *titan* and *microscopic*, but not in *titanic* or *microscope*. The generalisations reported for polysyllabic tokens in Canadian English is shown in the following examples:

Realisation	**Stress Account (Chambers 1989)**	
raised nucleus	tautosyllabic voiceless consonant	
	ˈti.tan	ambisyllabic /t/ (*ti**t**an*)
	ˈi.con *ˌi.coˈno.gra.phy* *ˌmi.croˈsco.pic*	ambisyllabic /k/ (*i**c**on, i**c**onography, mi**c**roscopic*)
non-raised nucleus	non-tautosyllabic voiceless consonant	
	ˌci.ˈta.tion *ˌti.ˈta.nic*	not ambisyllabic /t/
	ˌi.ˌco.no.ˈcla.stic	not ambisyllabic /k/

Realisation	**Foot account (Bermúdez-Otero 2003)**	
raised nucleus	the following voiceless consonant is in a weaker foot than the diphthong	
	nitrate	[^{s}(ˈnəɪ)^{w}(treɪt)]
	microscopic	[^{s}(ˌməɪ.kroʊ)^{w}(ˈskɑ.pɪk)]
non-raised nucleus	the following voiceless consonant is in a stronger foot than the diphthong	
	syphonic	[^{w}(ˌsaɪ)^{s}(ˈfɑː.nɪk)]

As shown above, Chambers (1989) relies on the assumption that some of the following voiceless consonants are ambisyllabic, which is problematic. The idea of ambisyllabic consonants has come under intense criticism; see Trammell (1993), Jensen (2000), Harris (2012). It is one of the issues that influenced Bermúdez-Otero (2003) analysis of both stress and foot structure in order to explain the polysyllabic words conditioning of Canadian Raising.

Bermúdez-Otero (2003) finds that word-level suffixes also block raising, as seen in *eyeful* ([aɪ]) compared to *Eiffel* ([ʌɪ]). He claims that Canadian Raising occurs in the same environments that are shown for pre-fortis clipping (Wells 1990)[6] in words such as *lawful*.

The conditioning environments reported for Canadian Raising in Canadian English are:

1. In monosyllabic words:
   (a) raised nucleus variants of PRICE and MOUTH occur preceding voiceless consonants, and non-raised nucleus variants occur elsewhere
2. In polysyllabic words:
   (a) nucleus raising may occur if the following voiceless consonant is in a weaker foot than the foot of the diphthong
   (b) nucleus raising is blocked if the following voiceless consonant is in a stronger foot than the foot of the diphthong
   (c) nucleus raising is blocked if followed by a word level suffix

Similar phonological conditioning and vowel realisations to those described for Canadian Raising in Canadian English are reported for VD phonologically-conditioned variation of PRICE and MOUTH in other varieties of English. The pattern of variation found in monosyllabic tokens in Canadian Raising, is also found in the Midwestern and Western US, Virginia, New Hampshire and Massachusetts. Therefore, there is a raised nucleus variant before voiceless consonants and non-raised nucleus variant elsewhere in these varieties. Gordon (2004) describes this pattern occurring for both PRICE and MOUTH in the

[6] Pre-fortis clipping and the voicing effect are generally described as the same phenomenon (Wells 1990, Fletcher 2006). However, Bermúdez-Otero (2014a) suggests that pre-fortis clipping is more phonologised than the voicing effect.

Midwestern and Western US and Thomas (1961) describes a similar pattern in New Hampshire and Massachusetts.[7]

Primer (1890) makes specific reference to a "peculiar" pronunciation of MOUTH in the word *out* in Fredricksberg, Virginia: "[t]here is an affected pronunciation of the diphthong *ou* sometimes heard which sounds something like (*ooə*) or (ooə)" (Primer 1890: 198). However, he also makes the observation that within the "cultured" and/or "more intelligent" speakers words such as *house*, *doubt*, and *bout* are pronounced with a shorter nucleus and a longer offglide than *sound* and *round*. Further studies suggest that both PRICE and MOUTH participate in a VD type pattern with a raised nucleus diphthong before voiceless consonants and non-raised diphthong elsewhere in eastern Virginia (Shewmake 1925).

A number of other VD phonologically conditioned patterns resemble Canadian Raising, but have some further conditioning environments. These patterns are found in the US in Ann Arbor, Michigan, and Martha's Vineyard and in South Africa in Cape Flats.

Dailey-O'Cain (1997) provides a detailed phonetic analysis of the VD pattern in the municipality of Ann Arbor, Michigan. Through the use of spectral measurements and auditory judgments, Dailey-O'Cain (1997) finds that there are three PRICE vowel variants, and four MOUTH vowel variants in the following environments:

1. PRICE

   (a) [ʌɪ] (raised nucleus) occurs before voiceless consonants in unstressed syllables, before underlying /t/ when flapped, and variably preceding [nt] and [r].

   (b) [aɪ] (non-raised nucleus) occurs before voiced consonants, morpheme boundaries, voiceless consonants in a stressed syllable, and variably preceding [nt] and [r].

   (c) [a] (monophthong) minimally occurs before nasals (6.4%) and [l] (9.2%).

[7] Thomas (1961) includes Vermont as well. However, further investigations mentioned in the present section suggest that the Vermont pattern differs from the pattern reported for New Hampshire and Massachusetts.

2. MOUTH
    (a) [ʌʊ] (raised nucleus) occurs minimally before voiceless consonants (9.5%), and underlying /t/ when flapped (6.8%).
    (b) [aʊ] (non-raised nucleus) occurs before voiceless and voiced consonants, vowels, and morpheme boundaries, but variably before [r].
    (c) [æʊ] (tense non-raised nucleus) occurs minimally variably before vowels (12.5%).
    (d) [a] (monophthong) occurs variably before [r].

Interestingly, Dailey-O'Cain (1997) finds that PRICE is produced as a monophthong preceding nasals 6.4 % of the time and before /l/ 9.2% of the time. Monophthongal productions in these two environments are also reported in LE (Knowles 1973, Berry 2009, Cardoso 2011b, 2015) (see §3.3.3).

Labov (1972b) describes a semi-phonologically conditioned pattern for the PRICE and MOUTH vowels in Martha's Vineyard, Massachusetts. He suggests that there is a hierarchy of following consonants that are most likely to affect the realisation of PRICE and MOUTH. The diphthongs are most likely to raise to [ɐɪ]/[ɐʊ] or [əɪ]/[əʊ] before: [t],[s] > [p], [f] > [d], [v], [z] > [k], [θ], [ð] > word boundary > [l], [r], [n], [m]. Labov (1972b) finds that certain segments preceding the diphthong seem to occur more with a raised nucleus variant. These are: [h], [l], [w], [r], and [n]. Finally he found that stress can promote centralisation, but is not necessarily a strict conditioning environment.

Blake and Josey (2003) returned to Martha's Vineyard to determine whether changes to the PRICE and MOUTH phonological pattern had occurred in the time between Labov's (1972b) investigation and 2003. The findings suggest that the pattern had become more in line with other VD type patterns than it was in the 1970s. Blake and Josey (2003) report that the nucleus of PRICE and MOUTH raise most often before voiceless consonants, but raising can occur in any environment.

The VD phonologically-conditioned variation in Cape Flats English in South Africa is described as a process whereby the PRICE vowel variants [ɛi], [əi] and [æi] are produced in pre-voiceless environments and non-raised nucleus diphthongs and monophthongal variants ([ai] and [aː]) are produced elsewhere (Finn 2004). Finn (2004) provides the examples *bite* [bɐit], *bide* [baid] and *buy* [bai] to demonstrate this pattern. He also finds that some informants realise the PRICE vowel with a raised offglide before [l], such as [aᵊ] or rarely [aˑu]. In this same variety, MOUTH is produced as [ɛu], [əu] and [æu] before voiceless consonants and [au] elsewhere, such as *bout* [bɐut] or [bæut], *bowed* [baud] and *bow* [bau]. Some speakers also realise the MOUTH vowel as [aᵊ] or [auw] before [l]. Therefore, for some speakers, the distinction between PRICE and MOUTH may be neutralised before /l/. If a speaker uses [aᵊ] for both PRICE and MOUTH before [l] then the words *file* and *foul* would both be realised as [faᵊl].

Finn (2004), influenced by the analysis of a similar process described for the Fenlands in England (Britain 1997) discussed in §3.3.1.2, suggests that the PRICE and MOUTH pattern found in Cape Flat English emerged as a result of dialect mixture and inter-language processes. He proposes that during dialect formation speakers were faced with different variants from Afrikaans and English. As the dialect developed, the different phonetic realisations were allocated to phonologically plausible environments. Similar explanations of this sort are used for other varieties with VD phonologically-conditioned variation as support for the new-dialect formation approach (Trudgill 1985) (see §4.2.4 for a detailed description of new-dialect formation and its relationship to the emergence of phonologically-conditioned variation of PRICE and MOUTH).

The final set of patterns demonstrate PRICE and MOUTH phonologically-conditioned variation, whereby the variation of PRICE and MOUTH seem to be related, but have differences in their conditioning environments and realisations. These patterns are reported in the US in Vermont and Smith Island, Maryland and the Falkland Islands off the coast of Argentina. Phonologically-conditioned variation of PRICE and MOUTH where differences between the patterns of variation of the target vowels occur are relevant to the current study, as LE likely exhibits separate, but related, PRICE and MOUTH patterns (Chapter 7).

As previously mentioned, Thomas (2001) finds that the PRICE and MOUTH pattern in the traditional Vermont dialect is the same as the general Canadian Raising pattern. He further reports that PRICE is diphthongal before voiceless consonants and monophthongal elsewhere, and the nucleus of MOUTH is raised before voiceless consonants and non-raised elsewhere in eastern Vermont. However, a subsequent study on Vermont English provides evidence that PRICE and MOUTH are behaving independently of each other (Roberts 2007) and suggests that MOUTH may not be phonologically conditioned. According to Roberts (2007), the nucleus of MOUTH is raised and sometimes fronted in all environments, whereas the nucleus of PRICE is raised only before voiceless consonants. Furthermore, he finds a subset of informants that raise the nucleus of both MOUTH and PRICE in every environment. Without further study in Vermont it is difficult to determine what overall pattern or patterns occur in this dialect. However, much of the evidence does suggest that PRICE, at least, is phonologically conditioned for many speakers of Vermont English.

In Smith Island, Maryland PRICE has a raised nucleus before voiceless consonants and non-raised nucleus elsewhere (Schilling-Estes and Wolfram 1997). On the other hand, MOUTH is produced as [aø] before obstruents and monophthongal word finally. Therefore, PRICE exhibits a pattern like Canadian Raising, whereas MOUTH demonstrates a pattern that is unlike other patterns in varieties of English that have been found for MOUTH.

Initial research on PRICE and MOUTH in the Falkland Islands off the coast of Argentina suggests that both vowels are phonologically-conditioned similar to Canadian Raising (Sudbury 2001). The PRICE vowel is commonly realised as [əɪ] before voiceless consonants. In the non-raised environment, PRICE is often realised as [ɐɪ], but may also be realised as [aɪ] and [ɑɪ], and rarely as a monophthong ([aː] or [ɑː]). Similarly, MOUTH is most often realised as a raised variant ([ɛʊ]) before voiceless consonants, and non-raised variant ([ɐʊ] and [aː] or less commonly [aʊ]) in other environments. However, a subsequent investigation indicates that PRICE and MOUTH behave differently from each other and that MOUTH may not be phonologically conditioned.

Britain and Sudbury (2008) provide a further investigation into the patterns in Falkland Island English and find that PRICE is raised before a voiceless consonant ([əɪ] or [əːɪ])[8] and as [ɐɪ] or [ɐːɪ] when followed by a voiced consonant or boundary. This is similar to the pattern found by Sudbury (2001). However, Britain and Sudbury (2008) find that MOUTH is produced predominantly as

[8]It is unusual for the nucleus of a raised variant to be lengthened as it is generally assumed that a raised variant occurs in the voiceless environment, at least, partially as a result of the voicing effect and offglide peripheralisation (Moreton 2004).

[ɛʊ], [ɛːʊ], and [ɛː] in all environments with a few other infrequent variants that occur before voiced consonants and boundaries. Therefore, PRICE continues to show phonologically-conditioned variation, but the second investigation finds that MOUTH does not show phonological conditioning.

The VD type phonologically-conditioned variation affecting both PRICE and MOUTH described in this section can be grouped into three main categories:

1. Raised nucleus variant before voiceless consonants and non-raised nucleus variant elsewhere. In some of these varieties raising may be blocked in polysyllabic words as a result of the following voiceless consonant being part of a suffix or if it is in a stronger foot than the diphthong
   – found in Canada and parts of the US
2. General pattern is the same as the first group, but with further conditioning environments, such as monophthongisation before nasals
   – found in parts of the US and South Africa
3. PRICE and MOUTH behave differently from each other
   – found in parts of the US and Falkland Islands

3.3.1.2 Voice-driven patterns in the PRICE vowel

PRICE has dominated much of the literature on dialects in the United States in the past, in part as a result of numerous PRICE phonologically-conditioned patterns of variation, which occur independently of MOUTH. There are two main types of PRICE only VD phonologically-conditioned variation. The first type is where a raised nucleus variant occurs in the pre-voiceless environment and a non-raised nucleus variant occurs elsewhere (§3.3.1.2), similar to Canadian Raising. This type of pattern in the current thesis is termed a 'Raising Pattern'. The second type is where a diphthongal realisation occurs in the pre-voiceless environment and a weakened offglide diphthongal or monophthongal realisation occurs elsewhere (§3.3.1.2), which is termed an 'Offglide Weakening or Monophthongisation Pattern'.

Raising of PRICE PRICE raising patterns are found in the US in Pennsylvania, New York and the northern states, and in England in Longtown, Cumbria and the central Fenlands. The patterns in the varieties in some parts of England and Pennsylvania are fairly straightforward and are the same as the general characteristics described for this type of pattern. However, other varieties resemble the general characteristics of raising patterns with additional features.

An investigation of SVLR in Northumberland, Cumberland, and Durham finds evidence of a raising pattern in Longtown, Cumbria (Glauser 1988).[9] Glauser (1988) examines the claim from the *Atlas of English Sounds* (Kolb et al. 1979) that two PRICE vowel realisations are found in Northumberland, north Cumberland, and north Durham. Based on a subset of SED data, Kolb et al. (1979) suggests that [aɪ] occurs in open syllables and raised or centralised nucleus variants ([ɛɪ], [ɛ̈ɪ], [ɛ̞̈ɪ] and [ɛ̝ɪ]) occur elsewhere. However, the results of the *Atlas of English Sounds* indicate that in more south areas of Northumberland, north Cumberland, and north Durham the [aɪ] realisation occurs more at the expense of the centralised ones. In other words, VD type patterns are developing in southern areas.

Glauser (1988) uses a more detailed analysis of SED data and draws his findings from all nine Northumberland localities, two localities in Cumberland and three in Durham. His findings suggest that the [aɪ] variant in southern areas has expanded from SVLR contexts only to all voiced consonants. This is observed in Tyneside, Longtown and Durham. However, the only locality that demonstrates a consistent VD phonologically conditioned pattern of variation is Longtown, Cumbria. Glauser (1988) finds that in Longtown [aɪ] occurs preceding voiced segments and a raised nucleus variant ([eɪ]) occurs before voiceless ones almost categorically. Farther south in England, a similar pattern is found in the central Fenland dialect

The central Fenlands dialect in eastern England has been reported to have a PRICE raising pattern (Britain 1997). Britain (1997) investigates the central Fenlands in the SED and finds that PRICE is realised with a raised nucleus before voiceless consonants and non-raised nucleus before voiced consonants, morpheme boundaries and [ə]. He does not find a similar pattern for MOUTH, which is monophthongal ([ɛː]) in the central and western Fenlands and diphthongal ([ɛʊ]) in the eastern Fenlands in all environments. In a

[9] Glauser's (1988) results pertaining to SVLR are discussed in §3.3.2

subsequent investigation, Britain and Trudgill (2005) use auditory judgments with a six variant scale to analyse the pattern in the central Fenlands. The scale is as follows: 5 [ʊi], 4 [ɤi], 3 [əi], 2 [ʌi], 1 [ai] – [ɑi], 0 [aː] – [ɑː]. This study confirms that [əɪ] occurs before voiceless consonants, while [ai] and [aː] occur elsewhere with no specific conditioning of the monophthongal or diphthongal realisations in the elsewhere environment.[10]

Britain (1997) also examines the possible origins of the PRICE pattern in the central Fenlands and suggests that it likely emerged as a result of massive immigration from the surrounding areas causing new-dialect formation. While the situation in the central Fenlands is similar to what occurred in Liverpool, there are differences in terms of population size, who the immigrant populations were and that the central Fenlands were empty prior to immigration from the surrounding areas. Britain (1997: 15) describes the Fenland region as being "noted in the dialectological literature as the site of a number of important phonological transitions, which separate northern and southern varieties of British English". Liverpool is on a similar border between Lancashire and Cheshire dialects. Given that the central Fenlands demonstrates PRICE VD phonologically-conditioned variation in England that likely resulted from new-dialect formation, this pattern is particularly relevant to the current study and, specifically, to the exploration of the relationship between the emergence of PRICE and MOUTH phonologically-conditioned variation in LE and the new-dialect formation approach to origins of these types of patterns.

PRICE raising patterns are also reported outside of England, in parts of the US. Fruehwald (2008) uses the Philadelphia Neighbourhood Corpus (Labov and Rosenfelder 2011) to investigate a PRICE raising pattern that occurs in the Pennsylvania dialect. He finds that the nucleus of PRICE is raised before voiceless consonants and not raised elsewhere. The study further suggests that, in the Pennsylvania dialect, the lexical items *spider*, *cider*, *cyber*, and *snyder* may exhibit lexical effects, as all of these lexical items had raised variants instead of the expected non-raised variant. A subsequent in-depth investigation of the Philadelphia Neighbourhood Corpus examines the interaction of flapping of /t/ and /d/ and the PRICE vowel pattern to better understand the opaque

[10]While it is not specifically mentioned in the article that the monophthongal or diphthongal realisations were not otherwise conditioned, this was confirmed through conversation with Dr. David Britain.

relationship between these two process across an extended period of time (Fruehwald 2013). See §3.3.1.1 for a detailed discussion of opacity in relation to Canadian Raising and flapping in Canadian English.

Fruehwald (2013) finds that PRICE nucleus raising before voiceless consonants is not present at the beginning of the corpus in the late nineteenth century. It develops as a gradient process throughout the twentieth century, so that there is a large difference in the nucleus f1 measurements of PRICE before voiceless consonants compared to elsewhere in the most recent speakers' data in the early twenty-first century, but no difference for the oldest speakers' data (Fruehwald 2013). On the other hand, flapping of /t/ and /d/ is found to occur in the late nineteenth century in Philadelphia. These findings add a further complication to the issue of opacity in Philadelphia English. The alveolar stops are neutralised intervocalically before there is a difference in the nucleus of PRICE based on voicing. However, when the PRICE nucleus begins to raise before voiceless stops, it also raises in the flapped /t/ instance but not flapped /d/ despite this contrast already being neutralised (Fruehwald 2013). Therefore, Fruehwald (2013) suggests that prior to the nucleus raising of PRICE there are two allophones, one before voiceless stops and one elsewhere. Finally, Fruehwald (2013) reports that the PRICE vowel pattern is an endogenous change and not brought into the Philadelphia dialect from other PRICE vowel patterns found in parts of the northern US.

Vance (1987) finds a PRICE raising pattern in the northern US and New York, whereby PRICE is realised as a raised nucleus variant before voiceless consonants and /r/, unless there is a morpheme boundary. He uses the following examples to demonstrate this: *fire*, *tire* and *pirate* [ʌɪ] versus *flier* and *higher* [aɪ]. However, there are some lexical exceptions to this: *diary* and *gyrate* [aɪ] (Vance 1987). As previously mentioned, morphological conditioning is also a feature of SVLR, which is discussed in §3.3.2. He further discovers that the pattern in the northern US exhibits phonological opacity, as PRICE nucleus raising interacts with flapping in the same way as in Canadian English (see §3.3.1.1). Therefore, *writer* is realised with a raised nucleus variant ([ʌɪ]) and *rider* with a non-raised nucleus variant ([aɪ]). Furthermore, Vance (1987) reports that this VD type pattern is a within word process, in order to account for the observation that raising is generally blocked across compounds (*dry* *clean* and *eye piece* [aɪ]), albeit with some exceptions (*high school* and *high chair* [ʌɪ] versus *high tops* and *high point* [aɪ]). Finally, stress affects the realisation of PRICE in the pattern in the northern US varieties (Vance 1987). Vance (1987) proposes that there are three types of prefixes: stress-neutral, loose stress-determining, and tight stress-determining. The stress-neutral prefix (*bicuspid* [aɪ]) and loose stress-determining prefix (*bifocals* [aɪ]) block raising, while the tight stress-determining prefix (*bicycle* [ʌɪ]) does not. This seems to follow the same stress/foot conditioning as proposed for Canadian Raising in Canadian English in §3.3.1.1.

1. *bicuspid* [(ˌbaɪ)(ˈkʌ.spɪd)]
2. *bicycle* [(ˈbʌɪ)(ˌsɪ.kəl)]

A further instance of a PRICE raising pattern is found in New York (Lass 1981). Similar to the other patterns discussed in the current section, PRICE has a raised nucleus variant when followed by a voiceless consonant and a more open, longer nucleus when followed by a voiced consonant or in an open syllable. Phonological opacity is also reported to occur in New York, as the raising pattern interacts with flapping. However, the conditioning environments and phonetic realisations of PRICE vary more in this pattern than reported for other PRICE phonologically-conditioned variation described in this section. Lass (1981) illustrates this with numerous lexical exceptions to the general pattern which have unexpected PRICE realisations, such as the following:

1. Open Syllable: *I*, *by*, *Thai* [ʌɪ] vs. *eye*, *buy*, *tie* [aɪ]
2. Before [r]: *tyre*, *Irish* [ʌɪ] vs. *tire*, *Ireland* [aɪ]
3. Before nasals: *(your) Highness*, *Hyman*, *dinosaur* [ʌɪ] vs. *highness*, *diamond*, *rhinitis* [aɪ]
4. Before [l]: *pilot* [ʌɪ] vs. *pile*, *pylon* [aɪ]
5. Before obstruents: *isinglass*, *Hayden*, *eider* [ʌɪ]
6. Across word boundaries: *high school* [ʌɪ] vs. *high jump* [aɪ]

As a result of all the exceptional PRICE vowel productions, Lass (1981) suggests that the pattern observed in New York English is partially lexically specified. If indeed this pattern has been phonemicised, then it likely does not exhibit a case of phonological opacity. While there is little, if any, evidence of the other VD type patterns being phonemicised, it is entirely possible that the New York pattern has been. If this is the case, this pattern demonstrates a possible instance of VD type phonologically-conditioned variation that has been phonemicised as evidenced by numerous lexical exception. Therefore, the current data analysis takes into account the possibility that phonologically-conditioned variation in LE could have been phonemicised, as evidenced by lexical exceptions. Chapter 7 demonstrates evidence the PRICE and MOUTH patterns in LE are phonologically conditioned and not phonemicised.

Offglide Weakening or Monophthongisation of PRICE PRICE offglide weakening or monophthongisation patterns are those that have a diphthong before voiceless consonants and a weakened offglide diphthong or monophthong elsewhere. This type of pattern is reported in the US in Texas, Louisiana, Gulf Plain & Piedmont and Tuscaloosa in Alabama. It is also found in the United Kingdom in Durham; Middlesborough and Teesside; and Hackness and Hull, Yorkshire. Finally, it occurs in Tristan du Cunha in the Southern Hemisphere.

Thomas (2001) provides an acoustic analysis of vowel systems in 'new world Englishes', which focusses mainly on varieties in the US and varieties which are based on ethnicity rather than geographical location. The investigation includes results for PRICE and MOUTH in pre-voiceless and pre-voiced contexts. Thomas' (2001) findings suggest that PRICE is realised as a non-raised diphthong in the pre-voiceless environment and monophthong in the pre-voiced environment in old fashioned southern American English in Texas and Louisiana. He further reports that the varieties of English in Gulf Plain and Piedmont produce PRICE as non-raised diphthongs in the pre-voiceless environment and weakened offglide diphthongs or monophthong in the pre-voiced environment (Thomas 2001).[11]

A similar PRICE monophthongisation pattern is found in south Durham in the United Kingdom by West (2009). In an earlier study on Byers Green in south Durham, Orton (1933) reports a PRICE VD phonologically-conditioned variation unlike the raising patterns discussed in §3.3.1.2 or the offglide weakening and monophthongisation patterns discussed in the current section.

[11]Formant plots are used in Thomas (2001) to demonstrate differences in vowel realisations. Therefore, I have not supplied phonetic transcription for these varieties, but rather I use the descriptions that Thomas (2001) provides.

Orton (1933) finds that PRICE was realised as [ai] before voiceless consonants and [ɑi] before voiced consonants and word finally. The [ai] realisation also occurs before orthographic *r*, such as *iron* [aiərən], *fire* [faiə] and *umpire* [ʊmpaiə]. However, West (2009) suggests that the conditioning environments in the south Durham pattern have remained the same in the contemporary pattern, but the phonetic correlates have changed. West (2009) observes that the [aɪ] variant generally occurs before voiceless consonants and [aːɪ], [aːᶦ] or [aː] occur before voiced consonants and word finally. She further reports that [aːᶦ] and [aː] variants occur most often when followed by voiced plosives and nasals. The pattern in south Durham is interesting as the contemporary pattern shows similarities with the phonologically-conditioned variation in PRICE that has been reported in previous research on the LE (Cardoso 2011b) (see §3.3.3). Furthermore, it demonstrates a PRICE VD type pattern that has changed in a relatively short period of time, which is relevant to the discussion of the origins and development of PRICE and MOUTH phonologically-conditioned variation in LE (see Chapter 10).

Beal et al. (2012) discuss the PRICE realisations in Middlesborough and Teesside. Their findings suggest that PRICE is generally realised as [ai] or [aːi] (Beal et al. 2012: 34). However, there were instances of an open monophthong variant ([aː]) also reported. These monophthongal variants were found "particularly before nasals" (Beal et al. 2012: 35). It is not clear whether the PRICE realisations in these varieties have phonologised into PRICE phonologically-conditioned variation, but it is possible. However, further research is required to explore this possibility.

In Yorkshire, Williams and Kerswill (1999) describe a PRICE monophthongisation pattern in the Hull dialect and the areas surrounding Holderness. A similar pattern is found in the Hackness dialect, further to the north, where [ɛi] is produced in pre-voiceless environment and [ɑ̃] in the pre-voiced environment (Cowling 1915, Orton 1933). According to Trudgill (1990b: 69), the traditional dialect of the area has a distribution of [ai̞] before voiceless consonants and [aː] before voiced consonants. Evidence of this pattern is clearly demonstrated in the SED (Maguire et al. in preparation) and in a publication from the *English Dialect Society* (Ross et al. 1877: 9), where they suggest that before voiced consonants "[aa. . . y]" or "[aa. . .]" is produced and "[ey]" is used before voiceless consonants. This report suggests that in the north and west of England there is a tendency to produce the monophthongal variant "[aa. . .]" in voiced contexts. In Hull, Williams and Kerswill (1999) observe that the monophthongal variant has become almost categorically realised in the voiced environment and the raised nucleus variant has been lowered to [ai̞] in the voiceless environment. Much like the pattern found in south Durham, this pattern demonstrates to some extent regularisation of PRICE phonological variation and changes which have occurred over a relatively short period of time, such as the lowering of the PRICE nucleus before voiceless consonants.

Turning to varieties of English in the southern hemisphere, Schreier and Trudgill (2006) find evidence of a PRICE offglide weakening pattern in Tristan Du Cunha. The variant [ɐɪ] occurs before voiceless consonants, while the weakened offglide variant ([ɒˑɛ]) occurs elsewhere.

The final PRICE phonologically-conditioned variation discussed in the current section, does not fit with either the raising patterns or the offglide weakening and monophthongisation patterns. In the 'fashionable' dialect in Dublin, Ireland, Hickey (1998, 1999a) reports that the nucleus of PRICE is fronted ([aɪ]) when followed by voiceless consonants in stressed syllables, and backed ([ɑɪ]) before voiced consonants and in open syllables. This is the same as the pattern found in the earlier study of Byers Green (Orton 1933), but not the further investigation in south Durham (West 2009). For the pattern in Dublin, Hickey (1998, 1999a) further suggests that there may be some lexical exceptions: *crisis* [krɑɪsɪs] and *nice* [nɑɪs].

PRICE VD phonologically-conditioned variation can be summarised as follows (also see Table 3.5 for a summary of all VD type patterns with PRICE).

1. Raising Pattern:
   (a) raised nucleus diphthong before voiceless consonants
   (b) non-raised nucleus diphthong elsewhere
2. Offglide weakening or Monophthongisation Pattern
   (a) non-raised nucleus diphthong before voiceless consonants
   (b) weakened offglide diphthong or monophthong before voiced consonants and word finally
3. Other Characteristics of PRICE patterns:
   (a) nucleus fronting before voiceless consonants
   (b) nucleus raising before /r/
   (c) nucleus backing word finally
   (d) monophthongisation before voiced stops and nasals

The tables on the following pages provide a summary of the VD phonologically-conditioned variation discussed in the current section. The first table (Table 3.3) provides an overview of PRICE and MOUTH VD type patterns, Table 3.4 provides an overview of the VD type patterns where PRICE and MOUTH have separate, but related, patterns, and the final table (Table 3.5) provides an overview of PRICE only VD phonologically-conditioned variation.

3.3.2 Scottish Vowel Length Rule-type phonologically-conditioned variation

Scottish English and some varieties in Northern Ireland, northeast England and north Cumberland have been shown to exhibit SVLR type patterns, whereby a subset of vowels are long before voiced fricatives, /r/, and morpheme boundaries and short elsewhere. The general characteristics of SVLR type patterns are described in §3.3.2.1. However, the patterns in northern English varieties are often different from this general description, as they tend to only affect the PRICE vowel (§3.3.2.2). In SVLR type patterns, PRICE is different

Variety	__vl C	elsewhere	Further Envir.	Notes
Canadian English	raised	non-raised	opacity	interacts with stress/foot structure
Midwest/West US, Virginia, New Hampshire, Massachusetts	raised	non-raised	-	-
Ann Arbor	raised	non-raised	some monophthongs before nasals, [l]	interacts with stress
Martha's Vineyard (Labov 1972b)	raised	non-raised	-	hierarchy for the following segment
Martha's Vineyard (Blake and Josey 2003)	raised	non-raised	-	can have raising in all environments
Cape Flats	raised	non-raised & monophthong	can be neutralisation before [l]	-

Table 3.3: Summary of PRICE and MOUTH VD type phonologically-conditioned variation

Variety	Vowel	__vl C	elsewhere	Notes
Vermont (Thomas 1961, 2001)	PRICE	non-raised	monophthong	-
	MOUTH	raised	non-raised	
Vermont (Roberts 2007)	PRICE	raised	non-raised	-
	MOUTH	-	-	raised in all environments
Falkland Island (Sudbury 2001)	PRICE	raised	non-raised/ monophthong	-
	MOUTH	raised	non-raised/ monophthong	
Falkland Island (Britain and Sudbury 2008)	PRICE	raised	non-raised	-
	MOUTH	-	-	same in all environments
Smith Island	PRICE	raised	non-raised	-
	MOUTH	-	-	centralised offglide before obstruents, monophthong word finally

Table 3.4: Summary of PRICE and MOUTH VD type phonologically-conditioned variation, where the target vowels behave differently

Variety(s)	__vl C	elsewhere	Further Envir.	Notes
Pennsylvania, Cumbria - Longtown	raised	non-raised	-	-
Central Fenland	raised	non-raised/ monophthong	-	-
Northern US	raised	non-raised	raising before /r/, opacity	interacts with stress
New York	raised	non-raised	-	possibly phonemicised
Durham - Hackness (Cowling 1915)	raised	monophthong	-	-
Durham - Byers Green (Orton 1933)	non-raised	backed	variable before/r/	-
Dublin	non-raised	backed	-	-
Tristan du Cuhna	non-raised	weakened offglide	-	-
Gulf Plains, Piedmont	non-raised	weakened offglide/ monophthong	-	-
south Durham (West 2009)	non-raised	weakened offglide/ monophthong	monophthongs before voiced stops and nasals	-
Middlesborough & Teesside	non-raised	monophthong	monophthong before nasals	-
Texas, Louisiana, Yorkshire - Hull	non-raised	monophthong	-	-

Table 3.5: Summary of PRICE VD type phonologically-conditioned variation

from the other vowels affected as it has a quality and quantity difference, so that a raised nucleus realisation occurs in short environments and a non-raised nucleus realisation (possibly with a weakened offglide) occurs in long environments.

McMahon (1991) suggests that the SVLR pattern developed in the late sixteenth century, but was initially reported in descriptions of Scottish English in the mid-nineteenth century. As described in §2.1, immigrants from Scotland likely contributed to the dialect mixture that formed LE. Therefore, a thorough understanding of the features of SVLR patterns and the inclusion of conditioning environments that differentiate VD type patterns from SVLR type patterns in the data collection materials contributes to understanding the origins of PRICE and MOUTH phonologically-conditioned variation in LE and the extent of the influence that SVLR had on the resultant LE patterns.

3.3.2.1 General pattern

The first descriptions of SVLR discuss the sub-phonemic length differences of the vowels /i, e, ɛ, u, o, ɔ, aɪ, aʊ, ɔɪ, ɪʊ/ when followed by a voiced fricative, /r/, morpheme boundary or in an open stressed syllable[12] in Scots and Scottish English (Aitken 1962, 1981, McClure 1977). Specifically, vowels are long in the contexts described above and short elsewhere. Note that the vowels /ɪ/ and /ʌ/ are always short and do not participate in SVLR patterns. Initial accounts of SVLR in Scots and Scottish English suggest that diphthongal MOUTH[13] may be included in this pattern (Aitken 1962, 1981, McClure 1977), but further research provides evidence that this is not the case (McMahon 1991, Scobbie and Stuart-Smith 2008). Therefore, MOUTH is not discussed in relation to SVLR. While the preliminary accounts include many of the vowels in Scots and Scottish English as part of the overall pattern, Scobbie and Stuart-Smith (2008) find strong evidence that SVLR only affects /i, ʉ, aɪ/. PRICE behaves differently from the other vowels associated with SVLR, as it is "the only

[12]Aitken (1981) suggests that in some Scottish dialects long vowels are also produced before [g] and [ʤ].

[13]In some varieties in northern England and Scotland, ME /u:/ did not diphthongise as a result of the Great Vowel Shift (§4.1.2), so that lexical items generally ascribed to MOUTH are realised as a monophthong (/u/). Aitken (1962, 1981) suggests that both the ME monophthong and diphthongal productions of MOUTH participate in SVLR.

vowel to be effected both qualitatively and quantitatively" (McMahon 1991: 33) and may, therefore, be treated separately from the other vowels. It is for this reason and in the interest of a focused discussion on the vowels relevant to the current study that the remaining discussion pertains directly to results found for the PRICE vowel and not other vowels participating in SVLR.

McClure (1977) finds that [ae] occurs in long contexts and [ʌɪ] occurs in short contexts in Scots and Scottish English. However, he also suggests that there is at least one minimal pair (*file* [fʌɪl] and *phial* [fael]),[14] as well as a number of lexical exceptions: *knives* [ʌɪ] and *Forsyth, Kilsyth* [ae].[15] Aitken (1981) finds a number of other lexical exceptions with an optional long or short PRICE vowel in the following: *oblige, tithe, lithe, precise* and *concise*. Previous work often focusses on the quality difference in the PRICE vowel in SVLR, but McClure (1977) reports on both the qualitative and quantitative differences of PRICE productions in the conditioning environments. In word list utterances, [ae] has a duration of 400 - 445 ms, while [ʌɪ] has a duration of 230 - 320 ms. Sentence token samples indicate durations of 320 - 400 ms for [ae] and 190 - 260 ms for [ʌɪ] (McClure 1977: 13). These results suggest a clear difference in the duration of PRICE in long and short contexts in addition to the quality difference.

There is some evidence of differences between monosyllabic, disyllabic, and bimorphemic tokens in SVLR type patterns, similar to the findings for some VD type patterns. Aitken (1981) investigates Abercrombie's (1979) claim that disyllabic words have a 'short' first syllable and a 'long' second syllable. He finds that this pattern only occurs when the first syllable contains a SVLR short context. However, when there is a long context in the first syllable then disyllabic productions of PRICE are more variable. In disyllabic bimorphemic words with stressed penultimate syllables the general SVLR conditioning is the same, so *mighty* has [əi] like *might* and *diving* has [a˔e] like *dive*. On the other hand, disyllabic monomorphemic words have much more

[14] Note that *phial* is potentially disyllabic for some speakers.

[15] *Forsyth* and *Kilsyth* are dubious exceptions as they are both names: one is a Scottish clan name and the other a place name in Scotland. Proper nouns and place names have been shown to have different phonotactics and phonological processes than other lexical items (Skandera and Burleigh 2005, Ivanovic 2009, Goldsmith et al. 2011). In other words, these particular exceptions may be a result of differences in phonological processes involving names and not lexical exception to the process involved in SVLR.

variation. Aitken (1981) suggests that some lexical items with long contexts in the first syllable are produced with partial shortening, in words like *idea*, but other lexical items behave like monosyllabic words, such as *rival* and *vizor*. Furthermore, some lexical items with long contexts in the first syllable optionally produce both long and short realisations, such as *tiger*. Many disyllabic monomorphemic words with a short context in the first syllable produce the short realisations, such as *sidle* and *viper*. However, some lexical items produce the long realisation ([aˑe]) invariably or optionally, as in *fibre, lido, pilot* and *pylon*. Aitken (1981) explains that he cannot provide a "clear picture of principles of selection 'longs' or 'shorts'" (Aitken 1981: 148) in words with stressed antepenultimate syllables. The discussion of SVLR in disyllabic words is further pursued by Carr (1992) and Anderson (1993).

Anderson (1993) seeks to resolve the disyllabic lexical exceptions *spider*, *pylon*, and *bias* found by Carr (1992), proposing that [aːɪ] occurs not on morpheme boundaries but syllable finally. While this does explain these particular exceptions, it also produces a major issue with well-attested examples like *tide* [ʌɪ] and *tied* [aːɪ], where morpheme boundaries are undeniably the conditioning environment. As a result of morpheme boundaries being well-attested as a conditioning environment, Scobbie et al. (1999a) return to looking at morpheme boundaries and propose that SVLR demonstrates a quasi-phonemic contrast. In other words, there is more than just phonological conditioning that influences vowel duration (and quality for PRICE), but also morpheme boundaries which may produce apparent minimal pairs, such as *brood* and *brewed*. However, the impressionistic results for the disyllabic monomorphemic tokens of PRICE in this study, 'tentatively support' Aitken's (1981) suggestion that there is a phonemic split of PRICE in disyllabic monomorphemic tokens (Scobbie et al. 1999b).

Scobbie et al. (1999b) provide evidence that the apparent quality difference of the long and short PRICE variants mostly result from timings of the trajectory and not the phonetic start and end points of the vowel. The difference in the production of PRICE in the long versus short contexts relies on where the stable state of the diphthong occurs. In other words, in the short contexts there is almost no stable state in the nucleus of the diphthong, but there is a short stable state in the offglide, whereas the opposite occurs for the long contexts. The nucleus has a longer stable state and the offglide has less of a stable state in long contexts. Scobbie et al. (1999a) suggest that this mismatch of stable states produces the perception of a substantial qualitative difference between the long and short contexts, even though this difference is not as prevalent in the acoustic analysis. As discussed in §4.2, this type of account relates to the 'asymmetric assimilation' and 'enhancement of pre-fortis clipping' approaches to the origin and development of PRICE and MOUTH phonologically-conditioned variation in varieties of English.

3.3.2.2 SVLR in England and Northern Ireland

The varieties in England that show SVLR type patterns are in the far north of England, which may be on a dialect continuum with Scottish dialects (see Llamas et al. 2009, Watt et al. 2010 and Maguire forthcoming for descriptions of border effects in this area and Milroy 1996 and Maguire forthcoming for discussions of the origins of lowland Scots and Northeast Englishes). In Northern Ireland, Ulster Scots and Mid-Ulster English dialects exhibit SVLR type variation.

As mentioned in §3.3.1.2, Glauser (1988) investigates the PRICE vowel in the SED for localities in Northumberland, Cumberland and Durham. While he observes some areas with VD type patterns, the majority of the locations exhibit patterns that are more similar to SVLR. Specifically, processes that resemble SVLR are found in one of the localities in Cumberland and all of Northumberland and northern Durham localities. Furthermore, when Glauser (1988) combines the results for all of the localities it appears that these areas have SVLR type patterns, whereby a non-raised nucleus variant occurs before voiced fricatives, /r/, and in word final position and a centralised nucleus variant occurs elsewhere. However, upon closer inspection, Glauser (1988) reports that only Thropton and Allendale in Northumberland categorically produce SVLR type variation and the other areas have varying degrees of the pattern. As a result, he suggests that SVLR type patterns extends as far as Tyneside and north Durham, but are not found further south. This is partially confirmed by Milroy (1996) who finds that PRICE is participating in SVLR in Tyneside.

Watt and Ingham (2000) investigate nine vowels for the dialect in Berwick upon Tweed and suggest that [i, u] and [ai] are more prone to SVLR. In order to differentiate between the voicing effect (§3.1) and SVLR in Berwick upon Tweed, a comparison of the duration of voiced to voiceless stops (voicing effect) and voiced to voiceless fricatives (SVLR) was used. If the voiced to voiceless stop duration ratio is longer than the voicing effect is present, but if the voiced to voiceless fricative duration ratio is longer then SVLR is likely more prevalent in the speakers surveyed. Watt and Ingham (2000) find that SVLR type variation is more prevalent in older speakers and younger males and that younger female speakers show a greater effect of the voicing effect than SVLR.

Harris (1985) finds that SVLR only affects the vowels /i, ʉ, aɪ/ in mid-Ulster English and Ulster Scots, similar to the findings of Scobbie et al. (1999a). Furthermore, he suggests that the PRICE vowel is lexically determined and, therefore, there are two separate phonemes (short phoneme: /ə̆i/ and long phoneme: /aĕ/). The distribution of these phonemes generally coincide with SVLR contexts. However, he also finds that the short and long phonemes of PRICE occur word finally in different lexical items, such as *I* vs. *eye*, and that there are some lexical exceptions whereby both long and short variants of PRICE are optionally used, such as *hive, lives* and *rise* (Harris 1985).

One of the main differences between VD and SVLR type variation is the effect of morpheme boundaries on the phonologically-conditioned variation. VD type patterns do not have morpheme boundaries as a conditioning environment, whereas SVLR type patterns do. Therefore, in Scots and Scottish English *tide* is pronounced with the short raised nucleus variant of PRICE and *tied* is pronounced with the long non-raised nucleus variant, whereas in VD type patterns these are pronounced with the same variant. As a result, I have included morpheme boundaries and non-morpheme boundary minimal pairs, like *tide* and *tied* in the data collection materials for the investigation of the contemporary pattern (see Chapter 6).

3.3.3 Preliminary studies of Liverpool PRICE and MOUTH

Knowles (1973) is the first source to mention that PRICE and MOUTH in

LE may have phonologically-conditioned variation. His study includes 100 participants from the areas of Vauxhall and Aigburth in Liverpool.[16] These areas of Liverpool were chosen specifically because Vauxhall had the lowest percentage of "professional and managerial residents", while Aigburth had the highest percentage (Knowles 1973: 2). This suggests that Vauxhall is more of a working-class neighbourhood and Aigburth, according to Knowles (1973), is a middle-class suburb. The purpose of Knowles' (1973) study was to "give a general description of English as it is spoken in Liverpool, to relate Liverpool speech [...] to other varieties of contemporary English, and to discuss variation in the dialect" (Knowles 1973: 1). As a result, Knowles (1973) surveys a vast number of features of LE in the study and, consequently, he presents a small section on the realisations of PRICE and MOUTH in LE using impressionistic judgements.

Firstly, note that Knowles (1973) generally did not use an established system of phonetic description in his discussion on the patterns found for PRICE and MOUTH, instead using a system of 'focus'. In this system, the diphthongs were either described as having end or initial 'focus'. If a diphthong was end-focused, it suggests that the offglide is protected from weakening, but the nucleus may be centralised or raised. On the other hand, an initial-focused diphthong protects the nucleus, so that raising or centralisation of the nucleus does not occur, but weakening or deletion of the offglide is possible. For example, an end-focused diphthong could represent anything from a raised/fronted nucleus diphthong to a centralised nucleus diphthong to a non-raised nucleus diphthong ([aɪ], [aʊ]).[17] Likewise, initial-focus could indicate a lengthened nucleus diphthong or a monophthong. It is, therefore, difficult to interpret with certainty what the realisations of the target vowels in LE were, aside from before a voiceless stop and etymological *r* where he provided more detailed phonetic descriptions. Knowles (1973: 311) asserts that the "discussion on focus must remain inconclusive" and "a lot more work needs to be done to clarify the notion of focus" in relation to this work. However, some general trends can be gleaned from the descriptions provided by

[16]See Figure 5.1 for the location of these participants in Liverpool.

[17]The phonetic representations presented here approximate the descriptions laid out by Knowles (1973), but are not judgments on the precise phonetic nature of the nucleus or offglide.

Knowles (1973). It is likely that PRICE and MOUTH phonologically-conditioned variation in LE in Knowles' (1973) investigation resembles something like the following:

1. before voiceless consonants: centralised nucleus diphthong ([əɪ], [əʊ])[18] or non-centralised nucleus diphthong ([aɪ], [ɑʊ])

2. in open syllables: non-centralised nucleus diphthong ([aɪ], [ɑʊ])

3. before voiced obstruents and nasals: non-centralised nucleus diphthong ([aɪ], [ɑʊ]), lengthened nucleus diphthong ([aˑɪ], [ɑˑʊ]) or lengthened monophthong ([aː], [ɑː])

4. before an etymological *r*,[19] as in *fire, flower*:

   (a) commonly [ajə], [ɑwə], where the offglide is simply a transition between the first and third elements of the diphthong

   (b) less commonly non-centralised diphthong ([aɪə], [ɑʊə])

   (c) rarely monophthong ([aə], [ɑə]) or centralised nucleus ([əjə], [əwə])

Following this study, Berry (2009) investigates PRICE and MOUTH realisations in seven participants from the area of Halewood (see Figure 5.1 in Chapter 5 for the specific location of Halewood). She classifies the diphthongs based on auditory judgments for the amount of diphthongisation only and not the quality of the nucleus. As a result, she categorises PRICE realisations as either [aɪ] or [aː], and MOUTH realisations as either [aʊ], [aᵊ] or [aː]. The results of her study suggest that PRICE and MOUTH are realised as [aɪ] and [aʊ] in pre-voiceless environments. In open syllables and before voiced consonants, excluding /l/, PRICE is realised as a lengthened monophthong ([aː]) and as a diphthong ([aɪ]) before [l]. The results for MOUTH, on the other hand, are more complicated. In open syllables, [aʊ] is produced 100% of the time and before /l/ the lengthened monophthong is produced 100% of the time. With

[18]Knowles (1973) specifically mentions that *white* and *mouth* have centralised nucleus diphthongs.

[19]Due to the fact that LE is a non-rhotic variety (Honeybone 2004), it is unclear without further study whether it is the etymological *r* which is the conditioning environment or it is merely before schwa.

regards to the results for MOUTH before fricatives, [aʊ] is realised the majority of the time when followed by dental fricatives, while [aᵊ] is used the majority of the time before alveolar fricatives. The variants [aᵊ] and [aː] were both used frequently before nasals and voiced alveolar stops.

Cardoso (2011b) provides an analysis of the realisations of PRICE in LE, analysing corpus samples both auditorily and acoustically. The study was limited to PRICE followed by voiceless consonants, voiced obstruents and nasals, as those environments were the only ones with enough tokens to provide reliable results. There is a degree of both intra-speaker and inter-speaker variation and so the findings presented here represent that majority patterns found. I suggest that [əɪ] or [aɪ] occur before voiceless obstruents, [aˑɪ], [aː] or rarely [aːɪ] occur before voiced obstruents, and lengthened monophthongs ([aː]) occur before nasals. Furthermore, speech style is found to affect the realisations of PRICE, so that monophthongisation occurs less in word list speech (Cardoso 2011b).

Similar to results presented by Berry (2009), Cardoso (2015) finds that PRICE and MOUTH have separate, but potentially related, phonological patterns (see §A.3). The purpose of my study was to provide evidence that variation in the realisation of the following environment interacts with the production of the target vowels. This is demonstrated by examining the variation in the production of nasal-voiceless obstruent and nasal-voiced obstruent clusters and PRICE and MOUTH realisations found in those environments compared to the target vowel productions found before voiceless stops, voiced stop, and nasals. The results of that investigation suggest that there are differences between the characteristics of the PRICE and MOUTH phonological patterns in LE. Mainly, the dominant realisation of PRICE before voiceless obstruents is a raised nucleus diphthong, but the most common realisation of MOUTH is a non-raised nucleus diphthong. Otherwise the two patterns are similar in the pre-voiced and pre-nasal contexts. However, when looking at the realisations of PRICE and MOUTH before nasal-obstruent clusters, it is found that PRICE followed by the nasal-voiceless obstruent cluster ([nt]) is realised as a raised nucleus diphthong, whereas PRICE is often monophthongal before the nasal-voiced obstruent cluster ([nd]). I suggest that this is due to a higher proportion of nasal deletion in nasal-voiceless obstruent clusters in the sample under investigation of LE and a higher proportion of obstruent shortening or nasal lengthening in nasal-voiced obstruent clusters in the sample under investigation. On the other hand, the results for MOUTH demonstrate influences from both the nasal and the obstruent in the nasal-voiceless obstruent cluster, as the nasal is often not deleted when preceded by MOUTH. This investigation demonstrates differences in the realisations and conditioning environments of PRICE and MOUTH, thereby suggesting that PRICE and MOUTH have separate, but potentially related, phonologically-conditioned variation in LE.

At the current juncture, the pattern in LE seems to be a VD type pattern rather than SVLR one. Specifically, there are a number of VD type patterns that have a raised nucleus variant before voiceless consonants, as found by Knowles (1973), Cardoso (2011b). Furthermore, the patterns described for LE suggest that monophthongisation may occur before voiced consonants and before nasals, as was shown in Ann Arbor (Dailey-O'Cain 1997), Falkland Islands (Sudbury 2001), Cape Flats (Finn 2004), Hackness (Cowling 1915), South Durham (West 2009), and Hull (Williams and Kerswill 1999).

The current section provided a summary of the research on the PRICE and MOUTH vowels in LE and other varieties of English and established potentially relevant environments which may condition the variation of these vowels. The limited information on these patterns in LE leads to the necessity for a systematic acoustic investigation of PRICE and MOUTH in LE, which includes both monosyllabic and disyllabic tokens, as well as, morphological boundaries. In order to provide a clear discussion of the processes that form the PRICE and MOUTH phonologically-conditioned variation in LE, the following hypotheses, which are informed by the findings discussed in this section, are used to examine these patterns in the main investigation:

1. PRICE and MOUTH in LE are phonologically conditioned by the following environment.
2. PRICE and MOUTH phonologically-conditioned variation in LE are separate, but related, patterns.
3. PRICE and MOUTH monosyllabic and disyllabic items in LE have different phonologically-conditioned patterns.
4. Word list speech has different phonological conditioning of PRICE and MOUTH compared to casual speech in LE.

CHAPTER 4

THE HISTORY OF PRICE AND MOUTH

The current chapter provides an overview of the history of the PRICE and MOUTH vowels in English (§4.1), and current approaches to the origins of PRICE and MOUTH phonologically-conditioned variation in varieties of English (§4.2).

The historical development of PRICE and MOUTH involved the Great Vowel Shift (GVS), which is an set of interconnected sound changes that mark the move from Middle English (ME) to Early Modern English (EModE). All ME long vowels were affected by the GVS, including ME /iː/ and /uː/, which developed into the Present-Day English (PDE) PRICE and MOUTH diphthongs through a multi-stage process. The stages between the ME long monophthongal vowels and the EModE diphthongs can arguably be seen in different realisations of PRICE and MOUTH that occur in varieties of English. A keen understanding of the different realisations of the target vowels throughout the different stages of development from ME to EModE provides insights into the origins of the variants described in §3.2, which are likely the input variants in the original dialect mixture for LE. Furthermore, the 'failure-to-lower' approach (Gregg 1973) to the origins of PRICE and MOUTH patterns in English (see §4.2.1) suggests that these patterns arise from the different stages of development of the target vowels. Therefore, a discussion of the development of PRICE and MOUTH is integral to understanding the fundamental assumptions of this approach.

The final section describes the fundamental assumptions of the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation that are considered in the current thesis (see §4.2). 'Failure-to-lower' (Gregg 1973) is a structural/endogenous historical account, 'asymmetric assimilation' (Moreton and Thomas 2007) and the 'enhancement of pre-fortis clipping' (Bermúdez-Otero 2014c) are approaches based on phonetic and phonological assumptions, and new-dialect formation (Trudgill 1986, 2004) is a contact/exogenous historical dialectological approach. These approaches compete to provide an explanation for the origins of PRICE and MOUTH phonologically-conditioned variation in varieties of English. However, as shown in Chapter 10 using an combined approach to explain the origins and development of PRICE and MOUTH phonologically-conditioned variation in LE provides a fuller understanding of the processes involved in the formation of these types of patterns in varieties of English.

4.1 THE HISTORICAL DEVELOPMENT OF PRICE AND MOUTH

The change from ME to EModE is marked by a number of different processes, including the GVS in the fifteenth century, which is a chain shift of the ME long vowels (Lass 1987, Stockwell and Minkova 1988, Baugh and Cable 1993, Barber 1997, Barber et al. 2009). This is relevant to the current thesis, as the change from the ME long /iː/ and /uː/ to the PDE PRICE and MOUTH vowels was initiated by a process of diphthongisation that occurred as part of the GVS (MacMahon 1998, Barber 2000).

The series of vowel changes from the ME long vowel system to the EModE vowel system that are described as the GVS are shown in Figure 4.1, which is taken from Barber et al. (2009). These changes are described as a chain shift, which occurs when several sound changes are interconnected and dependent on each other (Campbell 1998) and there is a causal relationship between those sound changes (Labov 1994). There are different types of chain shifts and, so, there are debates about which type the GVS is categorised as. As these debates are orthogonal to the current thesis, they are not discussed here, but see Martinet (1952) for an in-depth discussion of the different types of chain shifts and for debates with regards to the different types of chains shifts and the GVS see Luick (1896), Jespersen (1909), Carter (1975), Lass (1987), Stockwell and Minkova (1988), Labov (1994) and Stockwell (2002).

While Figure 4.1 demonstrates the processes that are generally described

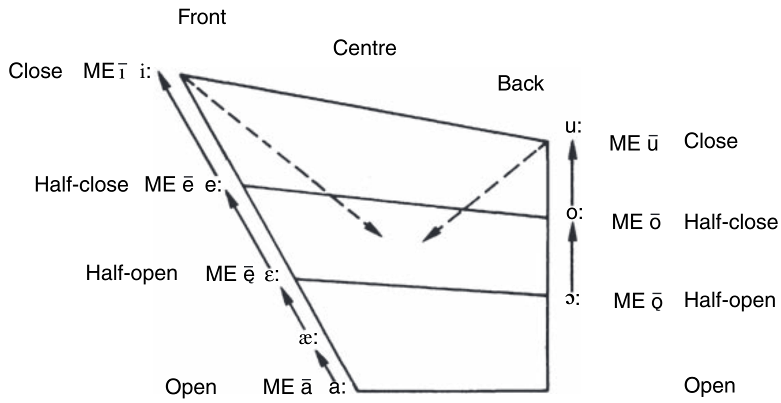


Figure 4.1: The Great Vowel Shift (taken from Barber et al. 2009: 202)

for the GVS, there are geographical differences. The GVS processes that occurred in the far north of England and Lowland Scotland differ from those that occurred in the rest of England. In the south, the GVS follows the pattern shown in Figure 4.1. However, the Northern Great Vowel Shift (NGVS) occurs in the far north of England and lowland Scotland, whereby only the front vowels and potentially some of the back vowels follow the pattern presented in Figure 4.1 (Luick 1896, Lass 1976). Given that Liverpool is south of where the NGVS would have occurred, the specific details of the differences between the northern and southern developments of the GVS are generally not relevant to the current thesis. The only difference that is relevant is that ME /u:/ did not diphthongise in the NGVS (Luick 1896, Lass 1976), and, therefore in these varieties it did not develop into PDE MOUTH. However, see Luick (1896), Jespersen (1909), Dobson (1962), Lass (1976) and Stockwell and Minkova (1988) for an in-depth discussion of the NGVS and see Smith (2007) for a discussion of the vowel changes that occurred after the GVS was complete that resulted in the PDE northern vowel system being similar in many ways to other varieties of English.

The historical development of PRICE (§4.1.1) and MOUTH (§4.1.2) are presented separately in the following sections. This structure allows for an in-depth discussion of each of the vowels and helps to highlight the differences in the development of PRICE and MOUTH in some varieties of English.

4.1.1 The development of the PRICE vowel

The development of the ME /i:/ and /u:/ has dominated much of the discussion regarding the GVS. One of the reasons for interest in the development of ME /iː/ and /uː/ is the presence of many different realisations in varieties of English, some of which are thought to represent different stages of the progression of diphthongisation. While PRICE largely developed from ME /i:/, there are two further subclasses in ME that generally result in the PDE PRICE vowel. These are ME /ix/ and /ei/, which are described in detail below. The current section focuses on the trajectory from the subclasses of ME /i:/, /ix/ and /ei/ to PDE realisations of PRICE.

There is much debate over how the initial diphthongisation of the ME high vowels occurred (see Luick 1900, Dobson 1968, Stockwell 1961, Stockwell and Minkova 1988 and Lass 2000 for competing proposal for the initial stages of diphthongisation). However, the focus of the current discussion deals with evidence from varieties of English for different stages of development of the PRICE vowel in the form of realisations of PDE PRICE. The reference realisation of PRICE (/aɪ/) is a relatively recent development, as there is evidence of numerous stages or realisations of the PRICE vowel before reaching this variant. Lass (1992) suggests that 'Standard English' did not reach the modern value /aɪ/ until the nineteenth century. Given this, it is likely that some of the varieties in the original dialect mixture would have had PRICE realisations that had not yet progressed to /aɪ/. This claim is supported by the diversity of realisations of the PRICE vowel that are proposed as input variants in §3.2.1. Likewise, the variety of English spoken in Liverpool at the time of dialect mixture may not have had an /aɪ/ realisation.

Ogura et al. (1998) provide a comprehensive account of the different reflexes of ME /i:/ in varieties of English. The study examines 311 localities from the *Survey of English Dialects* (SED) (Orton and Dieth 1962–1971) and finds 17 reflexes of ME /i:/ for 39 PRICE lexical items (Ogura et al. 1998: 238–239). As mentioned in §3.2 and described in detail in §8.1, the data from the SED (Orton and Dieth 1962–1971) represents archaic realisations from historical traditional dialects. Ogura et al. (1998) use this data to investigate the reflexes of ME /i:/ in varieties of English in England in order to determine

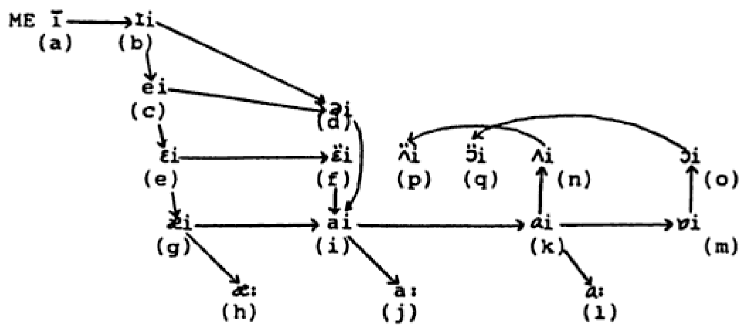


Figure 4.2: Reflexes of ME /iː/ in the SED taken from Ogura et al. (1998: 239)

the diachronic development of ME /iː/ (Figure 4.2) and to find support for the hypothesis that sound change proceeds by lexical diffusion. In other words, "the change of ME ī does not simultaneously occur but gradually extends its scope across the lexicon" (Ogura 1987: 45). However, see Labov (1994) for arguments that the results of this investigation do not support the lexical diffusion hypothesis for sound change.

Figure 4.2 demonstrates the diachronic development of ME /iː/, according to the results of the investigation by Ogura et al. (1998). Each of the alphabetic labels corresponds to attested realisations of ME /iː/ in the SED data and the arrows demonstrate the diachronic relationship, whereby the arrowhead points to the later development. For example, reflex *b* (ɪi) developed from reflex *a* (ME ī) and so *a* evolved before *b*. Likewise, reflex *d* (əi) developed from both reflex *b* and reflex *c* (ei). Therefore, *b* and *c* evolved earlier than *d* and *b* also evolved before *c*. As demonstrated by Figure 4.2, the developments of ME /iː/ are quite complex, and result in various realisations and pathways of development.

Section 3.2.1 discusses potential input variants in the dialect mixture in Liverpool using the SED and dialect descriptions of the varieties that likely contributed to the development of LE. However, examining the different stages of development of ME /iː/ and other historical developments also provides evidence for potential realisations of PRICE in Liverpool at the time of dialect formation. In particular, some evidence suggests that Liverpool and some of the surrounding areas had centralised nucleus realisations in the nineteenth century. Barber (1997) discusses a potential merger of ME /ui/ and ME /iː/ realisations around the seventeenth century. The independent developments of ME /ui/ and ME /iː/ resulted in both vowels having a centralised variant at a similar time. Earlier work, such as Ellis (1874) and Wyld (1936), suggest that, as a result of this, neutralisation occurred in words such as *line* and *loin*. However, Nunberg (1980) and Labov (1994) demonstrate that it is more likely that there was never a 'true merger' of the realisations. There may have been a merger in the perception of these two vowels, but not in production (Nunberg 1980, Labov 1994). Labov (1994: 376) describes that at the time when the ME /ui/ productions were centralised "they were still distinct in production from the /ay/ tokens, but so close that they were judged as 'the same' by most observers." This is relevant to the current investigation as there is some evidence that in the late eighteenth and early nineteenth centuries this merger or close approximation between the productions of ME /ui/ and ME /iː/ occurred in Liverpool and the surrounding areas. Importantly, this would suggest that a centralised nucleus variant of PRICE was likely present in the dialect mixture in Liverpool. Figure 4.3 reconstructs the diachronic development of ME /ui/ and ME /iː/ in the vowel phonetic space and indicates the near-merger of the centralised realisations of ME /ui/ and ME /iː/, which is taken from Labov (1994: 376).

Wyld (1936), Wolfe (1972), Barber (1997) and Smith (2007) discuss the uses of rhyming within historical linguistics, particularly with reference to its advantages in looking at the mergers of different vowels. I use this technique to provide evidence that the ME /ui/ and ME /iː/ supposed merger occurs in Liverpool and the surrounding dialects around the time of dialect formation. William Roscoe, a famous poet born in Liverpool, rhymes words that belong to the ME /ui/ and ME /iː/ vowels in his poetry. In *Mount Pleasant*, his first poem written at the age of sixteen (1769), he rhymes *supply/joy*, *deny/enjoy* and *toil/pile* (Roscoe 1777). He also rhymes *supply/die* and *foil/toil* (Roscoe 1777) providing evidence that the ME /ui/ and ME /iː/ supposed merger occurred at this time in some speakers in Liverpool. Given the results of Nunberg (1980) and Labov (1994), this realisation was likely a centralised nucleus diphthong for both vowels. Heywood (1862) also mentions that the Lancashire and Cheshire dialects pronounced the words *dry, groin* and *lout* as

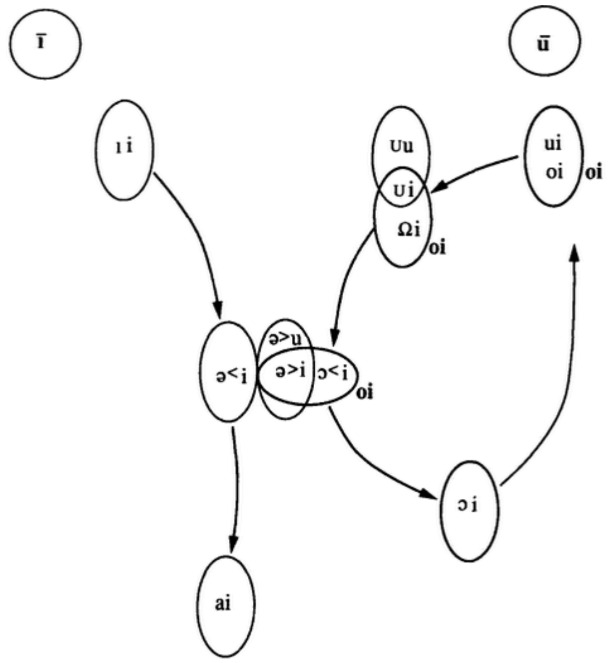


Figure 4.3: Development of ME /ui/ and ME /i:/, which results in the *line/loin* near-merger taken from Labov (1994: 376)

/oi/, which provides evidence for the close approximation of the production of ME /ui/, ME /i:/ and ME /u:/ in the dialects surrounding Liverpool. Note that this account suggests that, in the Lancashire and Cheshire varieties, the nucleus is retracted from a centralised nucleus realisation. However, it is unlikely to have been retracted to the extent of /oi/ given that similar realisations are the latest developments for ME /i:/ (Labov 1994, Ogura et al. 1998). Evidence for the ME /ui/ and ME /i:/ supposed merger in nineteenth century Cheshire can be found in Darlington (1887), who suggests that *height, mice, boil* and *moisten* can all be pronounced with the same vowel.

While the descriptions above seem to indicate instance of mergers between ME /ui/ and ME /i:/, there is also evidence that supports Nunberg's (1980) and Labov's (1994) proposal that these vowels were not wholly merger, but that the productions were only in close proximity and for most speakers they were perceptually merged. Darlington (1887) explicitly mentions that the vowel sound in *coil* is often produced with the vowel sound in *fine* and vice versa. This observation demonstrates that Darlington (1887) is aware that these words are not always produced with the same vowel in all cases.

Furthermore, pointing out that the vowel in *coil* is produced with the vowel in *fine* suggests that Darlington (1887) is aware that *coil* is of a different origin than *fine*. The awareness of these two things potentially suggests that a full merger has not occurred. Alternatively, it could indicate that Darlington (1887) knows that the local dialect with a merger differs from a non-local one without a merger. Nonetheless, literary evidence suggests that around the time of dialect mixture in Liverpool, there were likely centralised nucleus diphthongs that were produced in both ME /ui/ and ME /iː/ words and perceived as the same production. The 'failure-to-lower' approach (§4.2.1) relies on there being a centralised nucleus variant in Liverpool at the time of dialect mixture. Therefore, if there were no indications of this type of realisation in Liverpool, the 'failure-to-lower' approach could not explain the origins of the PRICE pattern in LE.

The following discussion concentrates on the two other subclasses of ME lexical items that developed into PDE PRICE. The second class consists of ME /ix/ lexical items, where the short ME /i/ was followed by a voiceless velar fricative and often /t/. These are lexical items orthographically represented as *-igh* or *-ight*, such as *sigh, light* and *right*. The final class of lexical items that became PDE PRICE are ME /ei/ lexical items, which refers to a set of words that had Old English /eː/ or /ɛː/ followed by ɡ, such as *lie, fly* and *eye*. In some dialects of English ME /ix/ and ME /ei/ words do not follow the same developments as the ME /iː/ words, as discussed below. This is relevant to the current thesis, as results of the present investigation on the SED data suggest that ME /ix/ and ME /ei/ words developed differently from ME /iː/ words in some localities in southwest Lancashire and north Cheshire (see Chapter 9).

The development of ME /ix/ to the PDE PRICE vowel began with the voiceless velar fricatives becoming voiceless palatal fricatives and subsequently deleting, which resulted in the vowel lengthening (Luick et al. 1929 – 1940, Labov 1994, Lass 1997, Campbell 1998). In the fifteenth and sixteenth centuries both monophthongal /iː/ and diphthongised realisations are attested in London English (Labov 1994). However, Orton and Dieth (1962–1971) and Anderson (1987) demonstrates that not all dialects of English went through diphthongisation and Barber (2000) describes how you can still hear [niːt] *night* in Northern Englishes today. Presumably the difference between the development of ME /ix/ in the north and south is the result of differences in the chronological order: in the south, fricative deletion and lengthening happened before the GVS, but it occurred after the GVS in the north (Lass 1992). There is evidence from the SED that demonstrates that in some areas of the north the fricative was not lost and/or the vowel remained a monophthong (Orton and Dieth 1962–1971, Orton et al. 1978, Anderson 1987). Orton et al. (1978: Ph.33) mentions a participant in Yorkshire who knew a woman that produced *night* as [nɪçt]. In the maps for *night, light* and *right* from the SED data, [iː] realisations predominately occur in the north and north-east of England (Orton et al. 1978: Ph.33–35), but are attested as far south as the Liverpool area (see §9.1.1). Furthermore, Darlington (1887) suggests that monophthongal /i:/ type variants occur in south Cheshire in the nineteenth century. The use of *ey* ([eɪ]) or *ee* ([iː]) is possible for the pronunciation of the vowels in *night, light* and *right* (Darlington 1887: 26). He further suggests that the [iː] pronunciation in Cheshire is found mainly in more northern areas: "the further a district is from the Shropshire or Welsh border, the more prevalent does the [ee] sound become" (Darlington 1887: 26).

ME /ei/ also retains monophthongal productions in the north, as demonstrated in Orton and Dieth (1962–1971), Orton et al. (1978) and Anderson (1987). Orton et al. (1978: xviii) discuss the differences in the production of ME /ei/ words and suggests that the productions of *die, eyes, flies* and *thigh* show "the existence of two different bases in ME", one of which is northern and one that is non-northern (Orton et al. 1978). As demonstrated by the SED maps for ME /ei/ words in Orton et al. (1978), the northern variant developed into /i:/ as a result of a merger between ME /ei/ and ME /e:/ vowels (Labov 1994). This /i:/ realisation is found as far south as the Liverpool area from some of the ME /ei/ words, such as *flies* (Orton et al. 1978: Ph.115). However, other ME /ei/ words demonstrate levelling and are recorded as being diphthongal in the Liverpool area, such as *eye* (Orton et al. 1978: Ph.114). Again there is evidence that some of the localities closest to Liverpool in the SED have traditional forms which have not been diphthongised (see §9.1.1). That being said, Roscoe (1777) does not seem to have this feature in his variety, as he rhymes *lies/prize*, *supply/die*, *rise/eyes* and *flies/joys*. These rhymes would suggest that Roscoe (1777) has merged the ME /i:/ and ME /ei/ words into one vowel realisation. Furthermore, in the present investigation of the historical datasets (see Chapters 8 and 9), ME /ix/ and ME /ei/ are analysed separately from the ME /i:/ lexical items to ensure that there is not a confound in the investigation of the differences of PRICE realisations before voiceless stops and word-finally in open syllables. It is found that ME /ix/ and ME /ei/ words do not differ from the ME /i:/ words in the *Origins of Liverpool English* corpus (Watson and Clark forthcoming), suggesting that monophthongal realisations of ME /ix/ and ME /ei/ have been replaced by diphthongal ones in LE (see Chapter 9).

The current section demonstrated that the development of ME /i:/, /ix/, and /ei/ to PDE PRICE is not a straightforward process. Previous work proposes that the different stages in the development of the PRICE vowel are observable in different dialects. Therefore, understanding these stages sheds light on the origins of the input variants that likely occurred in the original dialect mixture in Liverpool. Furthermore, establishing that the monophthongal realisations of the ME /ix/ and ME /ei/ words in the SED can occur as far south as Liverpool, demonstrates the necessity to keep these subclasses separate in the analysis of historical dataset and the need for both a synchronic and diachronic discussion of the possible origins of PRICE phonologically-conditioned variation.

4.1.2 The development of the MOUTH vowel

Present-day English MOUTH developed from ME /u:/ through a series of stages, which can be observed in the many different realisation of ME /u:/ in varieties of English. For example, the reference variant (/aʊ/) illustrates one of the later stages, as it is thought to have emerged relatively recently, potentially even as late as the twentieth century (MacMahon 1998). As mentioned in the previous section, discussions of origins and development of PRICE and MOUTH tends to centre on the initial stages of diphthongisation that occurred as a result of the GVS and subsequent changes. However, much of this work focusses on the diachronic development of PDE PRICE from ME /i:/ and assumes that the diachronic development from ME /u:/ to

PDE MOUTH mirrors the development of ME /i:/, notable exceptions being Stockwell and Minkova (1988) and Lass (2000). This general view that ME /i:/ and ME /u:/ developed along the same trajectories is reflected in the statement: "often the development of ME *ī* only will be discussed, but this is to be taken as reflecting parallel views for ME *ū*" (Wolfe 1972: 9). However, the current section demonstrates that treating ME /i:/ and ME /u:/ as parallel developments does not adequately represent the stages of development for these vowels. This section summarises research on the different realisations of ME /u:/ in varieties of English in order to understand the complex nature of its development from ME /u:/ to PDE MOUTH.

Ogura (1987) provides a comprehensive study of the reflexes of ME /u:/ in 30 words over 311 localities in the SED (Labov 1994: 479). The results of this study are shown in Figure 4.4, which is an adapted representation by Labov (1994: 479) of Ogura (1987: fig. 3.2). The figure demonstrates the various different realisations of ME /u:/ found in dialects of English. Realisations that are circled are the most frequent stages found in the investigation, which Ogura (1987) terms 'main routes'. The numbers represent the successive stages of advancement of ME /u:/, so that lower numbers are older reflexes and higher numbers are more recent reflexes, which is similar to the alphabetic labels in Figure 4.2. The arrows indicate the direction of the development from one reflex to another, as the arrowhead points to the later development. For example, *2* (ʊu) develops into *3* (əu, ou, oː) and *3* (ou) develops into *4* (ɔu). The 'main routes' of these realisations are /ʊu/, /əu/, /ou/ and /ɔu/, but /oː/ is not a frequent stage.

In order to examine potential MOUTH vowel realisations in the variety spoken in Liverpool in the nineteenth century, rhyming in literary works are investigated. Wolfe (1972) uses rhyming in literary works as evidence that ME /u:/ lowered first without centralisation, as she found rhymes, such as *avow/flow* and *town/atone*. Similar rhymes can be found in eighteenth century literary works written by Liverpudlians. Boulton (1768) uses the rhyme *flower/o'er* and Roscoe (1777) rhymes *bough/blow* and *brow/woe*, which might suggest that ME /uː/ in Liverpool in the late eighteenth century was diphthongal with a lowered or centralised nucleus. In southern Lancashire varieties in the nineteenth century, MOUTH seems to be a fronted monophthong

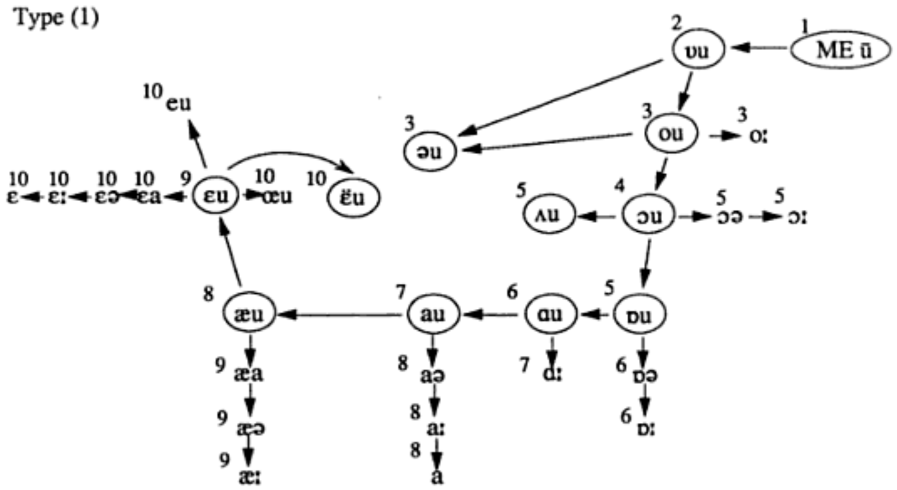


Figure 4.4: Reflexes of ME /u:/ in the SED (Ogura 1987: fig. 3.2 adapted by Labov 1994: 479)

([ɛː]) in some positions. Heywood (1862) describes the realisations of *cleawd* (cloud) and *feawl* (fowl) in south Lancashire. This realisation has been retained in Bolton in the twentieth century (Shorrocks 1998), as mentioned in §3.2.2. Furthermore, Orton et al. (1978) mention that in the north-west midlands ME /u:/ is realised as a monophthong, but after first becoming diphthongal.

There is some evidence from the SED analysis that a subset of MOUTH lexical items did not diphthongise in some localities in southwest Lancashire and north Cheshire (see §9.2). However, ME /u:/ in the varieties around Liverpool would be expected to diphthongise, as these varieties are south of the Ribble-Humber line (Wakelin 1972). The Ribble-Humber line represents a bundle of isoglosses for traditional dialects that extend from the Humber River in the east to the Ribble River in the west. These isoglosses delineate the far northern and north-eastern varieties from other varieties. Middle English /u:/ categorically did not diphthongise north of the Ribble-Humber line (Luick 1896, Wakelin 1972), which is one of the isoglosses that differentiates the varieties in the far north and north-east of England (Wakelin 1972). Barber (2000) suggests that [huːs] can still be heard in the North and Scotland. However, /u:/ realisations do not predominately occur in MOUTH lexical items in Liverpool, as it is south of the Ribble-Humber line. That being said, some dialect descriptions in Lancashire and Cheshire suggest that /u:/ realisations occurred in a limited set of lexical items. Darlington (1887) lists *uw* as the pronunciation of *shout* and *bout* in south Cheshire and Heywood (1862) suggests that *dower* is produced with /uː/ in south Lancashire. Therefore, it is likely that the majority of MOUTH lexical items were realised as diphthongs or later stage monophthongs, such as [ɛː], in the variety spoken in Liverpool at the time of dialect formation. At the same time, a small subset of MOUTH words did not diphthongise in the varieties in and around Liverpool.

The current section provided evidence for both monophthongal and diphthongal realisation of MOUTH in varieties in and around Liverpool. Literary works may suggest that a lowered or centralised nucleus diphthong occurs in Liverpool in the eighteenth century. However, subsequent dialect descriptions indication that this realisation was a centralised or fronted monophthong in the varieties in south Lancashire by the nineteenth century. Furthermore, dialect descriptions and results from the analysis of the SED data suggest that a subset of MOUTH lexical items did not diphthongise in this area and remained /u:/ type realisations.

While the development from ME /i:/ and /u:/ to the PDE PRICE and MOUTH vowels helps us to understand the origins of the different realisations of these vowels in the varieties of English that contributed to the dialect mixture in Liverpool, PRICE and MOUTH phonologically-conditioned variation cannot be wholly explained through tracking the historical development of these vowels. In order to account for the fact that some varieties retain more than one realisation of PRICE and MOUTH and that these realisations are phonologically conditioned, there must be other factors in play.

4.2 APPROACHES TO THE ORIGINS OF PRICE AND MOUTH PHONOLOGICALLY-CONDITIONED VARIATION

The origins of PRICE and MOUTH phonologically-conditioned variation has been analysed using different approaches. These approaches generally focus on the origins of voice-driven (VD) patterns rather than Scottish Vowel Length Rule (SVLR) patterns, and more specifically on the origins of Canadian Raising. There are numerous instances of VD patterns emerging independently in varieties of English around the world, which suggests that varieties that are not related may develop a VD type pattern as a result of other factors. Researchers strive to uncover the factors that influence the development of such patterns in order to account for the consistent features that occur across PRICE and MOUTH phonologically-conditioned variation and understand the reasons behind the development of such features. The discussions of the origins of these patterns often focus on Canadian Raising, as it is the most well-known VD type pattern with a plethora of investigations into the precise details of the pattern. It is possible to discover more about the ways in which these patterns emerge and develop with more detailed information on the patterns themselves. Notwithstanding, some of the approaches presented in this section discuss the origins of both VD and SVLR phonologically-conditioned variation.

The present thesis focusses on competing approaches which are the most relevant to the current thesis, have the most clearly defined fundamental assumptions, and have generally dominated much of the discussion on the origins of PRICE and MOUTH patterns. The 'failure-to-lower' approach is from a structural/endogenous historical linguistic perspective (Gregg 1973) (§4.2.1); Thomas (1991) and Moreton and Thomas (2007) propose the 'asymmetric assimilation' approach centred around phonetics and phonology (§4.2.2); a similar approach from a more phonological perspective, is 'enhancement of pre-fortis clipping' suggested by Bermúdez-Otero (2014c); and new-dialect formation is a contact/exogenous historical dialectological approach proposed by Trudgill (1985) (§4.2.4).

The following discussion of the approaches on origins of PRICE and MOUTH patterns presents each of the approaches separately. In each of the sections the fundamental assumptions of the approach and their relationship to the possible origins of PRICE and MOUTH phonologically-conditioned variation in varieties of English are reviewed. Finally, an evaluation of each of the approaches in light of the current research on these pattern is presented, which discusses some of the arguments that have previously been put against each of the approaches. It is important to understand the strengths and weaknesses of these approaches in order to propose a comprehensive approach that builds on these existing strengths and limits the potential weaknesses.

4.2.1 The 'failure-to-lower' approach

The 'failure-to-lower' approach has been used by King (1972), Gregg (1973) and Picard (1977) to explain the origins of Canadian Raising in Canadian English, but has also been discussed in relation to other VD and SVLR type patterns (Gregg 1973, Moreton and Thomas 2007). This approach suggests that VD phonologically-conditioned variation is the result of different reflexes of ME /i:/ and ME /u:/ that represent stages of the development from the ME vowels to the PDE vowels. It suggests that Canadian Raising is not a raising process, whereby the nucleus of the /aɪ/ pronunciation is raised to something like [əɪ] preceding voiceless consonants. Instead, it is a non-lowering process that results from different reflexes of the target vowels being inhibited from lowering in certain following environments. Gregg (1973) criticises phonologists for not recognising the part that the GVS and subsequent changes may have played in the origins of Canadian Raising: "[i]t is perhaps not surprising that many American and other phonologists, encountering the phenomenon of the general Canadian [...] diphthongal alternants *ɑɪ* and *əɪ* [...] wish to explain *əɪ* as an idiosyncratic, regional 'raising' of an underlying *ɑɪ*" (Gregg 1973: 137). He suggests that by looking at the features of Anglo-Irish, Scotch-Irish[1] and Scottish English there is a much more straightforward explanation for the development of Canadian Raising.

Firstly, Gregg (1973) discusses the difference between the development of ME /iː/ and ME /uː/, asserting these phenomena are 'clearly' separate processes, "though parallel and related" (Gregg 1973: 137). As a result of this, he limits his discussion of the development of Canadian Raising to the PRICE vowel alone, noting that "[i]t would undoubtedly be best to leave for another article" a discussion of the origins of the phonologically-conditioned variation of MOUTH, among other topics. Therefore, the remaining description of this approach is focussed on the PRICE vowel alone.

The approach combines the hypothesis that a series of asynchronous sound changes from ME /iː/ to /aɪ/ spread throughout phonological environments with the observation that earlier reflexes of ME /iː/ are observable in some

[1]This label refers to Scottish influenced speech in Ulster or Ulster Scots and Mid-Ulster English.

dialects of English (Gregg 1973), as demonstrated in §4.1.1. Other cases of sounds changes progressing from one phonological environment to another are well-attested (Labov 1994, Flemming 2003, Hall-Lew 2011). Ogura (1990) even proposes that the development from ME /i:/ and /u:/ to PDE PRICE and MOUTH progressed by lexical diffusion (§4.1.1 and §4.1.2). Therefore, there is support for both of these hypotheses.

Gregg (1973) discusses the phonetic variants that occur in Anglo-Irish, Scotch-Irish and Scottish Englishes. He suggests that by surveying these dialects we can see the development of PRICE phonologically-conditioned variation. According to Gregg (1973), Anglo-Irish produces PRICE as a centralised nucleus variant ([əɪ]) in all phonetic contexts, whereas Scotch-Irish and Scottish English exhibit SVLR (see §3.3.2). The discussion in §3.2.1 demonstrates that the situation in Irish varieties of English is more complicated than the one described in this approach. While some varieties of Irish English in the south, east and west of Ireland have a centralised nucleus realisation, other varieties in the south and west have lowered nucleus realisation or backed and rounded nucleus realisation. All of the varieties except modern Dublin English have unconditioned variation of PRICE, which supports Gregg's (1973) suggestion that the same variant occurs in all phonetic contexts. According to Gregg (1973), the environment where the earlier form [əɪ] can occur has been reduced in Scottish varieties and the later reflex [aɪ] is produced in some environments. Canadian English further expands the environments where [aɪ] can be produced and reduces the environments of the [əɪ] realisation. Finally, he suggests that you arrive at dialects like many in the United States and Britain where [aɪ] occurs in all environments. This progression can be seen in Table 4.1.

Gregg (1973) is careful to suggest that Canadian Raising in Canadian English is a Canadian innovation and is not due solely to immigration from Scotland and Ireland. However, he proposes that Scottish and northern Irish immigrants reinforced the Canadian Raising pattern and its preservation, as they would easily be able to extend SVLR to encompass the further environments for [aɪ] in Canadian Raising (Gregg 1973).

Finally, the approach seems to suggest that [əɪ] is retained in the pre-voiceless consonant environment because of the shorter duration of the vowel

Stage	Dialect	Sound Change	Phonological Environment
Stage 1	Anglo-Irish	/iː/ → [əɪ]	in all environments
Stage 2	Scottish English, Scotch-Irish	[əɪ] → [aɪ]	before: voiced fricatives, /r/, morpheme boundaries, word-final/open syllables
Stage 3	Canadian English	[əɪ] → [aɪ]	before voiced consonants
Stage 4	Standard Southern British	[əɪ] → [aɪ]	in all environments

Table 4.1: Progression of PRICE phonologically-conditioned variation in dialects of English, according to Gregg (1973)

(Moreton 2004). In other words, [əɪ] has a smaller distance between the nucleus and offglide and is, therefore, more likely to occur in an environment that has a shorter duration. As a result of the voicing effect (see §3.3), pre-voiced environments are longer than pre-voiceless ones (Moreton 2004). This is similar to SVLR, whereby the environments that have a shorter vowel duration have a centralised nucleus diphthong realisation (see §3.3.2).

Therefore, fundamental assumptions of the 'failure-to-lower' approach are:

1. Centralised nuclei are inhibited from lowering in certain environments.

2. Lowering is inhibited in environments where the vowel productions have shorter durations.

3. This lowering results in two allophones

4. Diphthong nuclei cannot have already reached a lowered stage in all environments.

The remainder of this section discusses potential weaknesses of the 'failure-to-lower' approach. It is generally desirable to account for phonologically-conditioned variation of both PRICE and MOUTH using the same approach, as many varieties of English with PRICE phonologically-conditioned variation also have a similar MOUTH pattern. However, Gregg (1973) proposes that the origins of MOUTH patterns may be different from PRICE patterns, as PRICE and MOUTH patterns are separate, but related, phenomena. The fact that PRICE and MOUTH patterns are likely related suggests that there is some overlap in the factors that affect the development of these patterns. Therefore, an approach on the origins of one of the vowels' patterns should extend to the other. While Gregg (1973) does not discuss MOUTH phonologically-conditioned variation, it is possible to examine whether this approach accounts for MOUTH patterns.

MOUTH patterns that resemble stage 1, stage 3 and stage 4 of Gregg's (1973) account are attested, but stage 2 patterns are not uncontroversially reported (see §3.3.2). In the varieties of English where the PRICE vowel participates in SVLR or stage 2 patterns, the duration of the MOUTH vowel follows the voicing effect and not SVLR, so that it is short before voiceless consonants and long before voiced consonants (Scobbie et al. 1999a). As a result, MOUTH phonologically-conditioned variation would be predicted to be a less gradual process than similar PRICE patterns, as the lowered nucleus realisation should extends to all voiced consonants after stage 1. As described in §3.2.1, ME /u:/ is generally realised as [ʌu] or [ʌʉ] in all phonetic contexts in Scottish Standard English and [u:] or [ʉ] in all phonetic contexts in Scots and Scottish English, which indicates that these varieties are in stage 1 and pre-stage 1. Theoretically, these observations about MOUTH realisations in Scottish varieties of English would not be predicted by the 'failure-to-lower' approach. However, there are other factors that affect the development of ME /u:/ in these varieties (see §4.1.2), so that the diphthongal realisations in Scottish Standard English are likely not straightforwardly a result of the GVS and subsequent changes. Consequently, it is difficult to assess how the fundamental assumptions relate to these varieties specifically. But at this juncture, Gregg's (1973) approach seems to account for, at least, some of the MOUTH patterns found in varieties of English.

Gregg (1973) proposes that large amounts of immigration from Scotland and northern Ireland to Canada would have helped to retain the Canadian English PRICE pattern. It is possible to evaluate the validity of this proposal by looking at the timeline for development of Canadian Raising to see if this proceeds or coincides with immigration from Scotland and northern Ireland into Canada. Thomas (1991) suggests that Canadian Raising was an established pattern in Canada by 1880 and did not appear to be a change in progress. If we take the view that it takes at least three generation for phonologically-conditioned variation to be established, as is claimed in new-dialect formation (see §4.2.4), then Canadian Raising would have been starting to form in the late eighteenth or early nineteenth century. McInnis (2000) finds that much of the immigration at this time came from other areas of North America. Larger amounts of immigration from Britain did occur in the early to mid-nineteenth century with its peak in the 1830s (McInnis 2000). However, this immigration would have been from different parts of the United Kingdom, not just Scotland and northern Ireland, which implies that there would have been a large portion of the population who did not have VD or SVLR type phonologically-conditioned variation. Therefore, it is unlikely that immigrants from Scotland and northern Ireland helped to retain Canadian Raising.

Finally, as a result of the debate over different stages of development of ME /iː/ and how it progressed (§4.1.1), Gregg (1973) suggests that there may be an issue with his approach. If the first mora of ME /iː/ initially lowered rather than centralised (for example Lass 2000), it begs the question why are there no PRICE patterns that involved [ɛɪ] and a centralised nucleus diphthong ([əɪ]) or a lowered nucleus diphthong ([aɪ]) distributed in different phonetic contexts? These reflexes should have spread gradually through phonological environments, as Gregg (1973) suggests. However, there is no clear reason as to why centralised nucleus realisations are inhibited by short environments, while [ɛɪ] is not. If the amount of diphthongisation of PRICE realisations is a factor in determining what realisations are inhibited from lowering in short environments, then [ɛɪ] and [əɪ] are both much less diphthongal than [aɪ]. Therefore, [ɛɪ] should have been inhibited from lowering in, at least, some cases of PRICE phonologically-conditioned variation.

The current section summarised the main assumptions of the 'failure-to-lower' approach, which suggests that PRICE phonologically-conditioned variation is the result reflexes of ME /i:/ being inhibited in certain phonetic contexts.

4.2.2 The 'asymmetric assimilation' approach

The 'asymmetric assimilation' approach to the origins of VD phonologically-conditioned variation uses experimental methods and acoustic analysis to determine differences primarily in PRICE realisations. Thomas (1991), Moreton (2004) and Moreton and Thomas (2007) discuss the difference in phonetic realisations of the nucleus and offglide of the target diphthongs in voiceless and voiced environments. They suggest that the first steps towards VD phonologically-conditioned variation lies in the realisation of the offglide before voiceless consonants, which was borne out of a study by Thomas (1991) on the origins of Canadian Raising in Ontario.

Thomas (1991) suggests that it would not be possible to acoustically analyse the initial stages of Canadian Raising in Canadian English, as the pattern had developed by 1880. Therefore, he proposes that by using speakers in the United States who are beginning to develop a VD pattern, it is possible to determine the phonetic correlates that result in VD type patterns. In this study, PRICE and MOUTH are analysed in a number of different environments, but the final analysis conflates the categories to before voiceless consonants and before voiced consonants (Thomas 1991).

Previous work on VD phonologically-conditioned variation tends to focus on the phonetic realisation of the nucleus and not the offglide. However, Thomas (1991) asserts that examining the offglide provides a possible explanation for VD type patterns. He finds that higher and more fronted offglides occur before voiceless consonants more than before voiced consonants. This difference in the realisation of the offglide before voiceless consonants is perceived as a raised nucleus (Thomas 1991). Once it is perceived as a raised nucleus younger speakers begin to accommodate and produce raised nucleus diphthongs before voiceless consonants (Thomas 1991).

Thomas (1991) presents arguments against the 'failure-to-lower' approach, suggesting that the pattern in United States that he investigates could not have resulted from the different reflexes of ME /iː/, as raised nucleus realisations of PRICE and MOUTH were not previously attested in this dialect. The general realisations in these dialects prior to the emergence of this pattern were realisations that represent later stages than the centralised nucleus realisation. Furthermore, PRICE and MOUTH are more diphthongal before voiceless consonants than voiced consonants, as the offglide is higher and more fronted before voiceless consonants. If the nucleus is the same regardless of the following environment, but the offglide extends further away from the nucleus before voiceless consonants than before voiced consonants in the initial stages of the pattern, then the diphthong realisations before voiceless consonants are more diphthongal than those before voiced consonants. The 'failure-to-lower' approach suggests that lowering of the nucleus of the diphthong is inhibited as a result of the voicing effect. However, if the pre-voiceless variant is more diphthongal than pre-voiced one, it is unlikely that raising (or lowering) results from the phonetic pressure of a shorter duration.

Moreton and Thomas (2007) build on Thomas' (1991) proposal by taking into account various dialects of English which exhibit VD phonologically-conditioned variation. That study only considers phonologically-conditioned variation of PRICE and not MOUTH. However, Moreton (2004) suggests that the results may be extended to MOUTH patterns.

According to Moreton and Thomas (2007), the many different realisations of PRICE in dialects of English are the result of 'conflicting demands on the tongue body' in the movement from the nucleus to the offglide, which creates an articulatory strain unlike any other vowel. They suggest that either the nucleus or offglide may be subject to undershoot because of phonetic assimilation (see Lindblom 1963). There is evidence that offglides of diphthongs in English are more susceptible to undershoot than nuclei (Gottfried et al. 1993). Gottfried et al. (1993) test the accuracy of American English participants in classifying diphthongs using different characteristics of the diphthong. They explore what the main cues are for identifying diphthongs. The results suggest that the nucleus is integral to the classification of diphthongs and the addition of other properties, such as the movement to the offglide, only enhances the classification but is not a necessity. Related to this is that offglide undershoot commonly occurs in faster speech rates (Lehiste and Peterson 1961, Gay 1968). Moreton and Thomas (2007) suggest that these observations are able to account for the development of offglide weakening before voiced consonants, which occurs in some varieties of English. However, this does not account for the second process that often affects PRICE and MOUTH phonologically-conditioned variation, which is raising or centralisation of the nucleus before voiceless consonants.

Based on the findings of Thomas (2000) and Moreton (2004) that pre-voiceless and pre-voiced environments produce different coarticulatory pressures on diphthongs, Moreton and Thomas (2007) propose that pre-voiceless environments assimilate the nucleus to the offglide, while pre-voiced environments assimilate the offglide to the nucleus. Having surveyed a number of different dialects, they find that the pre-voiceless allophones are never phonetically lower in either the nucleus or offglide than pre-voiced allophones (Moreton and Thomas 2007). The in-depth discussion of PRICE and MOUTH phonologically-conditioned variation in varieties of English presented in §3.3 supports this observation with two possible exceptions. In the northern US, Vance (1987) reports raised nucleus realisations before /r/ and raised nucleus realisations before nasal-voiceless obstruent clusters are reported in Canada (Gregg 1957) and Liverpool (Cardoso 2015). Regardless, the vast majority of evidence from different PRICE and MOUTH phonologically-conditioned variation in varieties of English supports Moreton and Thomas' (2007) observations. Given that the offglide is higher or peripheralised, Moreton and Thomas (2007) propose that pre-voiceless environments must assimilate the nucleus to the offglide.

As previously mentioned, offglides in English are generally subject to undershoot, which is directly opposed to the observations above that the nucleus assimilates to the offglide before voiceless consonants. Therefore, Moreton and Thomas (2007) propose that offglides before voiceless consonants are protected from undershoot as a result of two phonetic processes. The first claim is that the offglide is peripheralised in the pre-voiceless environment (Moreton and Thomas 2007). For PRICE this occurs as a results of lower f1 values (raised) and higher f2 values (fronted) at transitions before /t/ compared to before /d/ (Thomas 2000, Moreton 2004). Moreton (2004) also finds that pre-voiceless environments affect MOUTH in a similar way with lower f1 values (raised) and lower f2 values (backed) before /t/ compared to /d/. This process is said to occur in varieties of English, even those that do not have phonologically-conditioned variation (Kwong and Stevens 1999, Thomas 1991, Moreton 2004).

The second process that protects the offglide of PRICE involves the voicing effect. As previously mentioned in §3.3, vowel durations are shorter before voiceless consonants than before voiced ones. Moreton and Thomas (2007) propose that this duration difference occurs mainly in the nucleus. In other words, the duration of the nucleus before voiceless consonants is shorter than the duration of the nucleus before voiced consonants. If the duration of the offglide remains relatively constant, then pre-voiceless diphthongs are composed of a shorter nucleus and longer offglide, while pre-voiced diphthongs are composed of a longer nucleus and a shorter offglide (Thomas 2000). As a result of this phenomenon, pre-voiceless nuclei are more vulnerable to coarticulatory processes than pre-voiced ones.

Given the above explanation, Moreton and Thomas (2007) suggest that on average pre-voiceless offglides will be slightly higher than pre-voiced ones. This is essentially the initial stage of VD phonologically-conditioned variation. After this initial difference, subtle changes in subsequent generations lead to a misinterpretation of the pre-voiceless and pre-voiced phonetic differences in the offglide as a phonological one (Moreton and Thomas 2007). Moreover, Thomas (1991) proposes that this raised offglide is often perceived as a raised nucleus, as mentioned above. In other words, the learner reinterprets the difference in the offglides as a nuclear difference. Consequently, with successive generations the nucleus of PRICE is raised. Moreton and Thomas (2007) test their approach on a selection of speakers from Ohio who have developed a VD pattern much later than the one in Canadian English. According to their results, the approach is borne out by this data. Further support may be found in a recent study on Philadelphia English (Fruehwald 2013), which finds that PRICE nucleus raising is a gradient process in the variety that has occurred over the twentieth century in the *Philadelphia Neighbourhood Corpus* (Labov and Rosenfelder 2011), as discussed in §3.3.1.2.

Finally, Peeters and Barry (1989) may provide perceptual evidence that short nuclei steady-states may be reinterpreted as raised nucleus realisations. In their study of the production and perception of diphthongs in southern British English, participants were given paired stimuli of PRICE productions and of MOUTH productions that had been manipulated in three possible ways: the duration of the steady steady of the nucleus, the duration of the steady state of the offglide, or the duration of the transition from nucleus to offglide. It is important to note that the f1 and f2 frequency values at the onset and offglide were never manipulated. The participants were then asked to choose between the paired stimuli that they heard. Overall, Peeters and

Barry (1989) found that participants preferred PRICE and MOUTH stimuli with a long nucleus steady state and long transition, but a very short or no offglide steady state. This observation supports the first assumption of 'asymmetric assimilation' that offglides are more susceptible to undershoot. However, Peeters and Barry (1989: 1056) also find that certain configurations of the PRICE vowel were perceived as /ei/ by up to 70% of the participants, despite frequency values remaining constant throughout the stimuli. They suggest that the perceived /ei/ stimuli were "those stimuli with no, or very short onset steady-states" (Peeters and Barry 1989: 1056). This observation may support the second assumption of 'asymmetric assimilation', that short nuclei are misperceived and then reinterpreted as raised nuclei.

While Moreton and Thomas (2007) do not discuss the possible relationship between SVLR and the 'asymmetric assimilation' approach, Scobbie et al. (1999a) and Hall (2003) allude to features of SVLR that would be predicted by this approach. Scobbie et al. (1999a) mention that differences in the realisation of PRICE in SVLR long and short contexts is reflected in the steady state of the nucleus. Furthermore, Hall (2003) finds that offglide peripheralisation resulting in nucleus centralisation occurs in all SVLR short environments. These results suggest that offglide peripheralisation for SVLR patterns are influenced by the duration of the vowel rather than f1/f2 transitions, given that following voiceless and voiced obstruents both have centralised nucleus realisations. However, Hall (2003) suggests that 'asymmetric assimilation' may play a part in the origins of SVLR patterns.

The fundamental assumptions of the 'asymmetric assimilation' approach are:

1. Offglides are more susceptible to undershoot than nuclei, except before voiceless consonants.

2. Offglide undershoot results in glide weakening.

3. Offglide peripheralisation occurs before voiceless consonants as a result of phonetic effects, which protects offglides from undershoot.

4. Offglide peripheralisation before voiceless consonants results in short nuclei steady states.

5. Short nuclei steady states are misperceived as raised, fronted or centralised nuclei.
6. Subsequent generations then begin to adjust their nuclei productions to the (mis)perceived raising, fronting or centralisation.
7. These processes result in different allophones: one in the pre-voiceless environments and one or more in other environments.

Previous evaluations of the 'asymmetric assimilation' approach have suggested that there are potential weaknesses with the approach. If the processes that led to offglide weakening and nuclei raising are present in all varieties of English, there should be some consideration as to why the pattern has not developed in all varieties of English. In other words, why is offglide peripheralisation misinterpreted as a phonological process in some cases and not in others? Moreton and Thomas (2007) note that this is a potential issue and that other approaches may have an explanation for this, such as new-dialect formation (see §4.2.4), as these patterns are generally reported in areas where dialect mixture has occurred.

PRICE and MOUTH phonologically-conditioned variation in varieties of English tend not to develop beyond a certain point. If these patterns result from a phonetic misinterpretation, then there is no explanation as to why the phonetic realisation of the nucleus only raises to a certain extent. Moreton and Thomas (2007) suggest that the pressure to keep FLEECE and/or KIT and PRICE as separate phonemes may provide an explanation. However, there is still a large phonetic distance between the raised or centralised nucleus and the offglide in all of the patterns described in Chapter 3.

Finally, as suggested by Hall (2003) and Bermúdez-Otero (2014c), the 'asymmetric assimilation' approach only accounts for some of the properties of SVLR. The fact that nucleus raising occurs in both pre-voiceless and pre-voiced environments possess a problem for the argument that /t/ transitions affect the offglide differently from /d/ transitions. However, Hall (2003) suggests that the difference in the PRICE realisations as part of SVLR patterns may have started with offglide peripheralisation in pre-voiceless contexts only and then shifted to encompass all PRICE vowels in short duration contexts. Therefore, in order to account for the PRICE qualitative difference in SVLR some additions to the ‘asymmetric assimilation’ approach are necessary.

The current section provided an overview of the fundamental assumptions of the ‘asymmetric assimilation’ approach, which proposes that the misinterpretation of offglide peripheralisation before voiceless consonants and the susceptibility of offglides to undershoot in other environments accounts for PRICE and MOUTH phonologically-conditioned variation.

4.2.3 The ‘enhancement of pre-fortis clipping’ approach

The ‘enhancement of pre-fortis clipping’ approach is closely related to the ‘asymmetric assimilation’ approach. While the underpinnings of the ‘enhancement of pre-fortis clipping’ approach come from Gussenhoven (2007), Bermúdez-Otero (2014c,b) provides an in-depth description of its relationship to PRICE phonologically-conditioned variation in varieties of English. Bermúdez-Otero (2014c,b) suggests that raised nucleus realisations of PRICE originate as an enhancement of the phonetic cues to pre-fortis clipping (or the voicing effect).

Bermúdez-Otero (2014c) suggests that aspects of pre-fortis clipping help to explain the origins of PRICE phonologically-conditioned variation. Previous research has demonstrated that there is a large difference between the vowel duration before voiceless consonants and the vowel duration before voiced consonants (Chen 1970), as described in §3.1. Furthermore, these vowel duration differences are a robust phonetic cue to the laryngeal specification of the following consonant (Port and Dalby 1982). In other words, the vowel duration alone allows English speakers to determine whether the following consonant is voiceless or voiced.

At the same time, offglide peripheralisation before voiceless consonants occurs as a result of the processes described in the ‘asymmetric assimilation’ approach (§4.2.2), which occurs to some extent in all varieties of English (Thomas 1991, Kwong and Stevens 1999, Moreton 2004, Bermúdez-Otero 2014c). Learners observe that the nucleus duration is perceived as shorter where offglide peripheralisation has occurred (Bermúdez-Otero 2014c). As a result, the learners reanalyse offglide peripheralisation as a phonetic cue for what Bermúdez-Otero (2014c) calls ‘clipped’ environments. Clipped environments are those environments that induce shorter vowel durations relative to other environments. Note that in Bermúdez-Otero's (2014b, 2014c) definition of clipped environments, some varieties of English may include more than just following voiceless consonants, as demonstrated in SVLR (§3.3.2). The association of offglide peripheralisation with clipped environments leads to nucleus raising, as a result of offglide peripheralisation, becoming an acoustic cue to clipped environments (Bermúdez-Otero 2014b,c).

Therefore, clipped environments begin to have raised nucleus diphthongs initially as an enhancement of the contrast between clipped and unclipped environments. Bermúdez-Otero (2014b,c) suggests that this approach is able to account for both VD and SVLR phonologically-conditioned variation, as the raised nucleus diphthong 'tracks the status' of categorical clipped environments and not gradient duration or voicing of the following consonant.

The fundamental assumptions of the 'enhancement of pre-fortis clipping' approach are:

1. Offglide peripheralisation occurs before voiceless stops.
2. Clipped environments are those that induce shorter vowel durations.
3. Learners perceive offglide peripheralisation as a reduced nucleus duration.
4. As a result, offglide peripheralisation is reanalysed as a cue for clipped environments.
5. Nucleus raising occurs as a result of offglide peripheralisation.
6. Therefore, nucleus raising become a cue for clipped environments.
7. This enhances the difference between clipped and unclipped environments.
8. Resulting in two allophones: one with offglide peripheralisation/nucleus raising in clipped environments and one without offglide peripheralisation/nucleus raising in unclipped environments.

Bermúdez-Otero (2014b,c) circumvents one of the arguments against the 'asymmetric assimilation' approach. He provides an account of both VD and SVLR patterns. However, there still remains the problem as to why this only occurs in some varieties and why the nucleus of the target vowels never raise beyond a certain point. Finally, while Bermúdez-Otero (2014b) suggests that the 'enhancement of pre-fortis clipping' approach may account for patterns with offglide weakening, it is not considered in detail. Therefore, it is not clearly defined why offglide weakening would be associated with unclipped environments.

The current section discussed the main assumptions of the 'enhancement of pre-fortis clipping' approach, which suggests that initial offglide peripheralisation is reanalysed as a cue for clipped environments.

4.2.4 The new-dialect formation approach

The final approach discussed in this chapter is new-dialect formation in the form presented by Trudgill (1985, 2004). A brief summary of the main points of new-dialect formation was provided in §2. However, this section discusses in detail the processes involved in new-dialect formation. Trudgill (2004) suggests that dialect mixing can lead to new-dialect formation, but that this is not a forgone conclusion. Whether a new dialect is formed hinges on a number of different factors, such as the relative social status of different dialects (Trudgill 1985).

Trudgill (2004) discusses six processes that occur in new-dialect formation, which are active at three different stages of the development of a dialect: mixing, levelling, unmarking, interdialect development, reallocation, and focussing. These processes are described in more detail here and the three stages of new-dialect formation are presented following the discussion of the six processes.

Rapid immigration or urbanisation can result in mixing where face-to-face interactions with speakers from different dialects occur. In order for mixing to take place the dialects involved must be mutually intelligible. In other words, it is unlikely for mixing to occur with different languages.

Trudgill (2004: 84) provides an example of two features discussed by Penny (2000) that show mixing of southern and northern European Spanish in the formation of South American Spanish. Both the merger of /j/ and /ʎ/, a southern Spanish characteristic, and affrication of /tr/, a northern Spanish characteristic, occur in South American Spanish (Penny 2000: 157).

Levelling is a process that results in the reduction of demographically minority variants from the original dialects (Trudgill 2004: 84). In this process variants with a large proportion of speakers will be retained and those with a smaller proportion of speakers are levelled out. It is important to note that different dialects might share some of the same features. Therefore, levelling is not contingent on the proportion of speakers of a particular dialect, but rather the proportion of speakers who have a particular dialect feature. In other words, it is not a case of one dialect dominating over another but of one variant dominating over other variants. Trudgill (2004: 85) mentions that pronunciations that were lost in Quebec French are those that were demographically restricted (study done by Juneau 1972).

The third key process is unmarking, which is similar to levelling in that it reduces the number of variants. Unmarking often occurs when there is no clearly dominant variant. Trudgill (2004: 85) proposes that variants that are less linguistically marked or more simplistic may be retained over the most frequent variant. Linguistic markedness is referring to the 'naturalness' of a variant or how likely a variant is to occur in a wide range of languages (Roca and Johnson 1999). Variants that occur very frequently in the world's languages are said to be less marked than those that occur less frequently. Furthermore, marked variants are thought to occur in a language only if an unmarked variant is also present (Roca and Johnson 1999). The development of Fijian Hindi involved three different varieties (Moag and Narayan 1977) and the features that have generally survived the dialect mixture are those with a two-to-one majority (Trudgill 2004: 86). However, the first person plural ending had a three-way contrast or three input variants (-ẽː, -ĩː and -iː) in the initial dialect mixture (Trudgill 2004: 86). In this case the least marked variant (-iː) became the first person plural ending in the newly formed Fiji Hindi variety. Nasalised vowels are more marked than non-nasalised vowels, as most of the world's languages do not have nasalised vowels (Maddieson 1984).

Interdialectal development is a process where innovative forms that are not present in any of the original dialects occur as the result of interactions between different dialectal forms (Trudgill 2004: 86). Trudgill (2004: 86–87) suggests that there are three different types of interdialectal forms: forms that are more regular or simpler than original variants, forms that are phonetically intermediate between original forms, and forms that are the result of hyperadaption. The first two types of interdialectal forms are fairly straightforward, but hyperadaption requires a more in-depth explanation.

An example of a more regular interdialectal form is the present tense inflectional endings in Afrikaans (Trudgill 2004: 94). There were twenty-three different present tense inflectional systems in the Dutch dialects in the original dialect mixture (Combrink 1978 cited in Trudgill 2004: 95). However, the resultant Afrikaans system is regularised and all of the present tense inflectional endings are the same. For example, first and second person singular of *werk-* 'to work' is *werk* in Afrikaans, but *werk* and *werkt* in Dutch (Trudgill 2004: 94).

Interdialectal forms that are phonetically intermediate are demonstrated in the GOAT vowel in East Anglia (Trudgill 1986) and in *gens* 'people' in Quebecois French (Trudgill 2004). The input variant of *boat* was [buːt] to the north of East Anglia, and the input variant was [bæut] to the south of East Anglia around London (Trudgill 1986). Therefore, the intermediate form [bout] developed in the intervening area in East Anglia (Trudgill 1986). The word *gens* 'people' had three input variants in the original dialect mixture for Quebecois French: Standard French [ʒã], Picard French [ʒẽ], and Saintongeai French [hã] (Rivard 1914: 59 cited in Trudgill 2004: 94). An intermediate form [hẽ] is found in Quebecois French (Trudgill 2004: 94).

Trudgill (2004: 87) suggests that the most well-known example of interdialectal hyperadaption is hypercorrection, where speakers attempting to use high status forms overgeneralise the forms and extend them into contexts that are 'inappropriate'. Trudgill (2004: 87) suggests that Jamaican English shows examples of hypercorrection which have had a lasting effect on the dialect (see Cassidy and LePage 1980). An example in Jamaican English is the overextension of /h/ in initial position, so that /h/ can occur in all words that have an initial stressed vowel (Cassidy and LePage 1980 cited in Trudgill 2004: 87).

The fifth key process is particularly relevant for the present study, as it has been used to explain the origins of VD patterns in Canadian English and the Fenland. Reallocation is a process that occurs after levelling whereby more than one variant survives the levelling process and the variants are (re)allocated to different conditioning environments. Trudgill (2004: 87–88) suggests that the remaining variants can be reallocated in different types of conditioning, such as phonological context, sociolinguistic class or speech style.

Voice-driven patterns in Canadian English (Trudgill 1986, 2004) and the central Fenlands are given as examples of reallocation (Britain 1997, 2002, Britain and Trudgill 2005). In Canadian English, the original dialect mixture would have been the result of contact between speakers from Scotland, Ireland, America and England (Trudgill 1986). According to Trudgill (1986: 159), there would have been two dominant realisations: [aɪ] from American and southern English varieties and [əɪ] from Scottish and some northern English varieties.

Given the dynamics of the population in Canada and the salience of both variants, Trudgill (1986) suggests that neither of the variants would have been dominant. As a result, speakers reallocate variants of the PRICE vowel to phonetically plausible contexts. With regards to Canadian Raising specifically, Trudgill (2004) suggests that as there is less tongue movement in the centralised variant, it was (re)allocated to the pre-voiceless context which has shorter vowel durations. This suggestion occurs in other works as well (for example Chambers 1973). However, Thomas (1991, 2000), Moreton (2004) and Moreton and Thomas (2007) demonstrate that pre-voiceless diphthongs can be more diphthongal than pre-voiced ones, especially in the initial stages of VD patterns.

A similar account is given for the formation of the VD pattern in the central Fenland (Britain 1997, 2002, Britain and Trudgill 2005). Immigration from the surrounding areas in the mid-seventeenth century due to highly fertile farmland created a dialect contact situation (Britain 1997: 19). Immigrants that came from east of the Fenland had a centralised diphthong [əɪ], while ones from the west had an [aɪ] variant (Britain 1997: 36), as a result of differences in the historical development of the ME /iː/. As explained for Canadian Raising in Canadian English, there was no dominant variant so both were retained with the centralised variant being allocated to before voiceless consonants.

Trudgill (2004: 89) proposes that the first five processes collectively are called koinéisation. The combination of koinéisation and focussing, the sixth process, makes up new-dialect formation (Trudgill 2004: 89). Focussing is the acquisition of norms and stability in dialects. However, these six processes take place over three stages of new-dialect formation which represent three successive generations.

Stage one occurs with the initial contact between speakers of different dialects and the process of mixing takes place. Trudgill (2004: 89) terms this stage 'rudimentary levelling'. This would involve face-to-face contact between adults with different dialects where only the most local or traditional features are levelled (Trudgill 2004). Local features would be those that are the least frequent, very localised or traditional and/or impede intelligibility (Trudgill 2004). Interdialectal development is also possible in stage one due to adult accommodation. In this initial stage, salience of particular features and attitudes towards traditional dialects may have an impact on the retained variants (Trudgill 2004). Those features that are 'noticed' or salient[2] are more likely to be involved in accommodation (Trudgill 2004: 93). Furthermore, stigmatised variants or 'negative sentiments' towards certain varieties may result in the loss of those features (Trudgill 2004: 93).

Trudgill (2004: 90) suggests that due to the effects of dialect levelling, stage one may have had more of an impact on the loss of variants historically than nowadays. In other words, this stage was more pertinent in the past when dialects were more different from each other. However, Trudgill (2004: 90) also suggests that dialects that are too different from each other might result in bidialectalism rather than new-dialect formation, which occurred in the Lowland Scotland area according to Trudgill (2004). Bidialectalism is when speakers retain two different dialects which they fluently use. Generally, it is the case that a traditional variety is retained alongside a more standardised variety. See, for example, Smith and Durham (2012), who discuss bidialectalism in the Shetland Islands in northern Scotland.

The second stage corresponds to the first generation of speakers born to the speakers of stage one. Trudgill (2004: 101–112) propose five results of stage two of new-dialect formation: extreme variability, original combinations, intra-individual variability, inter-individual variability and apparent levelling. At stage two, there is still an extreme amount of variability (Trudgill 2004). Children are exposed to many different linguistic systems, which results in extreme variability in the children's linguistic systems. While it is generally

[2]See Rácz (2013) for a detailed discussion of salience in linguistic research.

accepted that children acquire language from a number of sources and that peers are integral to this process (see Kerswill 1996), Trudgill (2004) proposes that the instability of the linguistic system at stage one means that adults will play a larger role in dialect development at stage two. Original combinations occur when different features are combined in innovative ways to make various linguistic systems as a result of the lack of a stable model for the children to learn from (Trudgill 2004: 103).

The third consequence of an unstable linguistic model is a large amount of intra-speaker variability or variability within a speaker's linguistic system. Trudgill (2004: 106) discusses a New Zealand speaker in stage two that has a vast amount of variability in his linguistic system. The speaker is variably rhotic, has variable H-dropping, produces both [ɛ] and [a] for the TRAP vowel, and produces [i] and [əi] for the FLEECE vowel to name a few (Trudgill 2004: 106).

Related to intra-speaker variability is inter-speaker variability. Inter-speaker variability refers to the vast number of linguistic forms that would still be used in the different linguistic systems or many different idiolects being present in stage two (Trudgill 2004: 105). Each individual's idiolect agrees to a large extent with the members of the speech community that they belong to in linguistic systems that are not undergoing new-dialect formation. However, Trudgill (2004) suggests that the idiolects in stage two would agree in linguistic forms to a lesser degree than normal with linguistic forms of other members of the speech community. He gives the example of PRICE and MOUTH in Arrowtown, New Zealand (Trudgill 2004: 108) from the *Origins of New Zealand English* corpus (Gordon et al. 2007), which has recordings of the first native generation of English speakers in New Zealand. There are five PRICE vowel variants ([aɪ], [ɑɪ], [ɑ˔ɪ], [ɑ̝ɛ] and [ɑ˔ɛ]) and six MOUTH vowel variants ([ɜʉ], [ɛʉ], [ɛʊ], [ɛ˔ᶷ], [æʊ] and [æ˔ᵊ]) taken from nine different speakers (Trudgill 2004: 108).

Finally, apparent levelling is where features are not acquired by the new generation of speakers (Trudgill 2004: 109). It is distinct from the levelling in stage one, as features are not lost from a speaker's linguistic system, rather a feature is never acquired. Trudgill (2004: 110) suggests that there is some threshold that variants pass in order to be carried into the next generation.

The final stage occurs when the dialect has been focussed and there is a stable, generally uniform linguistic system acquired by the second native generation (and third generation overall). Children of the previous stage reduce some of the variability and linguistic forms and the resulting systems are much more homogeneous than before. The completion of stage three results in new-dialect formation.

The fundamental assumptions of the new-dialect formation approach are:

1. Dialect formation occurs over three stages
2. The three stages correspond to three consecutive generations
3. At each of these stages different processes occur
    (a) Stage 1: mixing, rudimentary levelling, and unmarking
    (b) Stage 2: interdialect development, apparent levelling, and reallocation
    (c) Stage 3: focussing

The new-dialect formation approach to the origins of PRICE and MOUTH patterns provides the following explanation:

1. More than one variant survives initial levelling
2. There is no clearly dominant variant, so the variants are not subsequently lost
3. These variants are then reallocated to phonetically plausible environments
4. This results in phonological-conditioned variation

Moreton and Thomas (2007) suggest that a potential weakness of this approach is that it does not account for PRICE and MOUTH phonologically-conditioned variation in varieties where dialect formation has not occurred at the same time as the PRICE and/or MOUTH pattern emerges. Some of the patterns that are presented in Moreton and Thomas (2007) are unlikely the result of new-dialect formation for this reason.

Furthermore, the dialect mixture situation in Canada would have been quite complex, similar to Liverpool. This suggests that there would have been many different realisations of PRICE and MOUTH in the dialect mixture in Canada. More detailed discussions of the variants that would have been present in the initial dialect mixture in Canada may be necessary to fully understand the origins of these patterns in Canadian English. In fact, Trudgill (1986) does suggest that raising patterns, like other sound changes, are complex and that new-dialect formation may only be a part of the process that is responsible for forming these types of patterns.

The current discussion of the origins of PRICE and MOUTH phonologically-conditioned variation in varieties of English demonstrates the complexity of determining the factors that contributed to the origins of these patterns. Therefore, a combined approach to the origins of PRICE and MOUTH phonologically-conditioned variation in LE provides a fuller understanding of the factors that potentially contribute to the formation of similar patterns.

CHAPTER 5

PILOT STUDY

The previous chapters provided a discussion of the history, development and characteristics of Liverpool English (LE) and the PRICE and MOUTH vowels in varieties of English. However, there is little information about phonologically-conditioned variation of PRICE and MOUTH in LE, as described in §3.3.3. The present thesis provides a systematic investigation of these vowels in LE using experimental methods, and quantitative and acoustic analyses. The current chapter discusses the methodology and analysis of the pilot study, which influenced the methodology for the main data collection.

The first section discusses limitations of previous work, and reasons for collecting new data and conducting an investigation of the PRICE and MOUTH vowels in LE (§5.1). As there is limited information about PRICE and MOUTH, I chose to run a pilot study with a small number of participants. The methodology, analysis, and results of the pilot study are presented in §5.2. Following this is a discussion of the implications of the pilot study for the main investigation (§5.3), as the results of this pilot study were used to determine what methods would be best suited for the main study.

5.1 JUSTIFICATION

Previous work on the PRICE and MOUTH vowels in LE indicates that these vowels show phonologically-conditioned variation. However, much of the information that is given is in the form of brief comments on the realisations of the vowels. Furthermore, there are methodological issues with some of the previous work. This section discusses some of the issues with previous studies and presents justification for the methodology used in the current study.

Knowles (1973) provides the first indication of phonological patterns involving the PRICE and MOUTH vowels in LE. He uses an auditory analysis with impressionistic judgements and encodes these in a system of 'focus'. As discussed in §3.3.3, this classification system relies on the relative prominence of the nucleus and offglide. Initial focus was recorded when the nucleus had prominence and end-focus was recorded when the offglide had prominence. Encoding the results using 'focus' rather than IPA symbols or phonetic realisations leads to some difficulties in interpreting the results. Knowles (1973: 311) writes "there are phonetically different things interpreted as 'focus' [...], e.g. end-focus in eye might be recognized by the centralization of /a/ [...] but by the duration of /ʊ/ in brown." In other words, the auditory realisation of 'focus' does not map straightforwardly onto phonetic categories. While Knowles' (1973) investigation provides evidence that there is phonological conditioning of PRICE and MOUTH realisations in LE, further research is required in order to determine the phonetic realisations of the target vowels. The use of formant plots in the current study helps to visualise the phonetic placement of vowel realisations in different environments within each speaker's vowel space.

Berry (2009) expands on previous work by using discrete phonetic categories in her auditory analysis. PRICE is categorised into either diphthongal or monophthongal realisations, while MOUTH is categorised into three phonetic variants ([aʊ], [aᵊ] and [aː]). Berry's (2009) study provides more detail about the realisations of PRICE and MOUTH than previous studies, but is also somewhat limited in the amount of detail that can be given because of the use of discrete categories. In the current study, the use of acoustic measurements and a quantitative analysis provides better evidence for the phonetic realisations of the target vowels.

Knowles (1973), Berry (2009) and Cardoso (2011b) conflate monosyllabic, disyllabic and morphologically complex lexical items in their studies. Given the discussion on voice-driven (VD) type patterns in varieties of English (see §3.3) and differences in phonetic realisations depending on the stress pattern and/or the foot structure of disyllabic lexical items, conflating these categories may mask potential conditioning environments. In order to determine the effects that number of syllables, morphological structure and stress have on the phonetic realisation of PRICE and MOUTH in LE, the pilot study includes these variables (see §5.2.3).

Given the limitations of the methodology of previous studies, they present unequal numbers of PRICE and MOUTH lexical items, and these lexical items are not balanced in terms of conditioning environments. These studies have approximately twice as many PRICE as MOUTH lexical items and there is a disproportionate representation of lexical items in certain conditioning environments. For example, in Knowles (1973) there are two lexical items of PRICE before voiced stops and in open syllables, but one before voiceless stops. Likewise, Berry (2009) has eight lexical items of PRICE in the pre-voiceless stop environment and three lexical items in open syllables. The current investigation uses a much larger sample, which has an equal number of lexical items for each vowel, as well as a balanced number of lexical items per environment.

The use of an acoustic analysis, rather than auditory analysis and impressionistic judgements, is less subjective and provides a more detailed view of the target vowels (Ladefoged 1996, Johnson 2011, Ladefoged and Johnson 2014). While auditory analysis can be a good starting point for research looking at finer phonetic details, an acoustic analysis provides a more reliable method of data analysis in these cases. Cardoso (2011b) uses an acoustic analysis on corpus data for this reason.

In Cardoso (2011b), I discuss the constraints of using corpus data or previously collected data from a number of sources, mainly the lack of lexical items of PRICE in certain environments. The data came from a number of online sources, such as the British Library *Archival Sound Recordings* (British Library 2010) and the data collected for Berry (2009). PRICE and MOUTH in monosyllabic words are particularly constrained in the potential consonants that may following them. Table 5.1 shows the possible following environments for PRICE and MOUTH in monosyllabic lexical items. In order to determine the possible following environments for the target vowels in the current study, the online *MRC Psycholinguistic Database* (Wilson 1988) and *CELEX* (Baayen et al. 1995) were used to search for monosyllabic lexical items of PRICE and MOUTH. Note that in Table 5.1 there is the possible following environment /r/, which is relevant for those varieties that are rhotic, but generally not for non-rhotic varieties, which is discussed in more detail below.

Environment	PRICE	MOUTH
voiceless stop	p, t, k	t
voiceless fricative	f, s	θ, s
voiceless affricate	-	tʃ
voiced stop	b, d, g	d
voiced fricative	v, ð, z	ð, z
voiced affricate	-	dʒ
nasal	m, n	n
/l/	l	l
/r/	r	r

Table 5.1: Possible codas of PRICE and MOUTH in monosyllabic lexical items

Table 5.1 demonstrates that the MOUTH vowel is particularly limited as to what coda consonants can follow it, as only coronal consonants follow MOUTH. This presents difficulties when coming up with lexical items for analysis, as discussed by Cardoso (2011b). Furthermore, spontaneous speech presents even more limited opportunities to study the behaviour of MOUTH in different contexts due to the phonotactic constraints on this vowel. This is relevant to the current thesis, as MOUTH is not investigated in the historical corpus of LE, *Origins of Liverpool English* (Watson and Clark forthcoming), partially for this reason (see Chapter 9). The methodological issues in previous work, such as Cardoso (2011b), the phonotactic constraints on PRICE and MOUTH, and the lack of tokens in spontaneous speech greatly influenced my decision to elicit new data for the current investigation. As a result of this decision, I have greater control over the conditioning environments included in the final analysis and the number of lexical items per environment and per vowel.

Previous work on PRICE and MOUTH in LE and other varieties of English influenced the design and development of my pilot study. The previous research indicates that the main issues surrounding phonological conditioning of these vowels are effects from the following environment, differences in monosyllabic and polysyllabic lexical items, differences depending on morpheme boundaries, and differences in speech style. The pilot study is used to refine the materials included in the main investigation and, therefore, must address these main issues. As a result, the pilot study is used to test the following hypotheses, which are proposed in §3.3.3:

1. PRICE and MOUTH in LE are phonologically conditioned by the following environment.

2. PRICE and MOUTH phonologically-conditioned variation in LE are separate, but related, patterns.

3. PRICE and MOUTH monosyllabic and disyllabic lexical items in LE have different phonologically-conditioned patterns.

4. Word list speech has different phonological conditioning of PRICE and MOUTH compared to casual speech in LE.

A discussion of the pilot investigation, its methodology (§5.2.1), analysis (§5.2.2) and results (§5.2.3) are presented in the following sections.

5.2 PILOT STUDY

The use of pilot or feasibility studies to evaluate experimental methodology and determine potentially significant variables is common practice in many research fields, such as medicine (Lancaster et al. 2004, Thabane et al. 2010), psychology (Self et al. 1993, Onyut et al. 2005), business and marketing (Richins 1983, Perrien and Ricard 1995) and sociology (Lang and Lang 1953, Townsend 1989). Pilot studies have also been used extensively in linguistics in the past (see, for example, Krashen and Seliger 1976, Bowker 1998 and Agirre et al. 2012).

A pilot study can be a useful tool for evaluating methodological choices, and using pilot studies in linguistic research provides a starting point for determining the potential conditioning environments and the degree of specificity required in the final analysis (Milroy and Gordon 2003). As there is little substantive information about the phonetic variants of PRICE and MOUTH in LE and the conditioning environments for these variants, the pilot study serves as an exploratory study to determine appropriate empirical methods and environments to include in the main study. This pilot study provides a small quantitative analysis of PRICE and MOUTH lexical items in a wide range of conditioning environments in the speech of five speakers from south Liverpool.

The structure of pilot studies in other fields, such as medical research, is widely discussed (see Lackey et al. 1998, van Teijlingen and Hundley 2002, Lancaster et al. 2004, Hertzog 2008 and Thabane et al. 2010). This has not traditionally been the case in linguistic pilot studies, even when pilot studies are discussed as in Milroy and Gordon (2003). As a result, there is little guidance on the appropriate procedures for pilot studies in linguistics. Therefore, in the following discussion on pilot study procedures, I occasionally default to the standards presented for other research fields.

5.2.1 Methodology

5.2.1.1 Participants

Determining an appropriate sample size for pilot studies has been widely debated, see Hertzog (2008) for a summary. However, it is generally accepted that pilot studies will have a much smaller sample size than the main study. The present pilot study has five participants. As the main investigation contains twenty-seven participants, the pilot sample size falls within the guideline of 10% of the final study size given by Lackey et al. (1998) for research in nursing. Furthermore, Milroy and Gordon (2008: 141) suggest that pilot studies in linguistic research “need not be ambitious in scope”, but do not provide a guideline for appropriate sample sizes.

These five participants had lived in Liverpool or the Merseyside region for almost their entire lives and self-identified as Scouse speakers. All of the participants’ parents and grandparents were also from the Liverpool area, with the exception of one male participant whose father was from Manchester. There were three male participants (age: 28, 45, 63) and two female participants (age: 35, 65). Participants over the age of 40 were classed as older and under the age of 40 as younger. Table 5.2 provides a summary of the participants. However, sociolinguistic variables were not considered in the analysis of the pilot investigation. Participants were recruited through the University of Liverpool and Edge Hill University, but were not all themselves students or staff at these universities.

Four of the participants were from south Liverpool and one from the

Participant ID	Gender	Age	Location	Location Category
LE1	female	older	Allerton	South
LE2	male	younger	Wirral	Wirral
LE3	female	younger	Woolton	South
LE4	male	older	Woolton	South
LE5	male	older	Dingle	South

Table 5.2: Participant Metadata for Pilot Study

Name	Definition	Values
spe	*speaker ID*	LE1 – 5
loc	*location of participant by ward*	e.g. *Allerton*
gen	*gender of participant*	m (male) f (female)
age	*age of participant*	o (older) y (younger)
fam	*parents' and grandparents' origins*	LP (all from Liverpool) other (not all from LP)

Table 5.3: Variables participants are coded for in the Pilot Study

Figure 5.1: Location of pilot study participants and previous work participants

Wirral. Figure 5.1 shows the location of the pilot study participants, as well as the location of participants in Knowles' (1973) and Berry's (2009) studies. The pilot study sample includes both older and younger speakers as well as males and females. This ensures that the results of the pilot study are not biased to any one age or gender group. However, only southern Liverpool and Wirral speakers are in the pilot study.

In the data analysis, I coded for the speaker-specific variables shown in Table 5.3.

5.2.1.2 Materials

The pilot study consisted of a word list and an interview with each speaker given in three sections, as described in the procedures (§5.2.1.4). Two different speech styles were used in order to determine the effect that speech style has on the realisations of PRICE and MOUTH in LE. The word list lexical items are discussed first and then the interview questions.

Word list lexical items are useful as they afford greater control over the different conditioning environments included in the investigation. Given the limitations on PRICE and MOUTH lexical items in general, it would be difficult to elicit all of the possible environments included in the word list in spontaneous speech, as has been shown in previous work (Cardoso 2011b). That being said, phonetic realisations of the PRICE vowel in LE have also been shown to interact with speech style for some speakers (Cardoso 2011b), as mentioned in §3.3.3. The results suggest that some speakers use less local realisations of PRICE and/or show less phonetic variation in word list data compared to reading passage or conversation data. A number of other studies corroborate these results (Labov 1963, Nakatani et al. 1995, Hume 2001, Schafer et al. 2005, Cole and Hasegawa-Johnson 2012). Llisterri (1992) suggests that there are two general types of speech style in linguistic studies: connected or elicited speech, which involves previously prepared materials that participants read, and spontaneous or casual speech, which does not involve read/prepared speech.

Phonological processes have been shown to be affected by speech style. For a summary of some of these findings see Llisterri (1992), Labov (1994) and Labov (2001).[1] It has been suggested that casual speech produces the greatest amount of inter-speaker and intra-speaker variability and therefore, is likely more similar to everyday speech (Cole and Hasegawa-Johnson 2012). Cole and Hasegawa-Johnson (2012) further suggest that elicited speech can be 'hyper-articulated' and may exhibit different phonetic qualities to those in casual speech. Elicited speech has been shown to have a slower speech rate, which affects the phonological realisation of vowels in a number of different languages, such as English (Gay 1968, Pitermann 2000), Dutch (Van Son and Pols 1992) and Japanese (Hirata 2004). Gay (1968) studied the effects of speech rate on diphthong formant movement and found that diphthongs tended to have undershoot of the offglide and shorter nucleus steady states in faster speaking rates. Given the wide body of research on the effects of speech style on phonetic realisations and the indication that some speakers produce different PRICE vowel realisations in LE (Cardoso 2011b), the pilot study included an interview portion as well as a word list.

In the pilot study word list lexical items consisted of PRICE, MOUTH and distractor words with TRAP and DRESS (see Table 5.4). As previously mentioned, there are a number of different conditioning environments encoded in the pilot study. These categories range from very detailed, such as following consonant, to very general, such as monosyllabic. Table 5.4 shows the number of lexical items in the word list portion of the pilot study cross-classified by number of syllables and morphological structure. Some of the lexical items were repeated in the study in order to ensure a similar number of stimuli in each category, as some of the conditioning environments had fewer available lexical items than others. For instance, MOUTH is fairly constrained in some following environments. There are nine monosyllabic lexical items with MOUTH before nasals (*brown, clown, crown, down, drown, frown, gown, noun, town*), but at least twenty six monosyllabic lexical items with PRICE before the alveolar nasal alone according to the *MRC Psycholinguistic Database* (Wilson 1988).

Distractor lexical items are used to prevent the participant from knowing what the investigation is about. Gries (2013) suggests that there should be minimally as many distractor lexical items as target lexical items, but two

[1] While there are other approaches to stylistic variation in linguistics, such as Schilling-Estes (1998), speech style in the current thesis is used in a way similar to Labov (1972b) and Llisterri (1992).

Vowel	Syllables	Morphology	Examples	No.
Analysed				
PRICE	monosyllabic	monomorphemic	*kite, time, buy*	112
	disyllabic	monomorphemic	*python, minus*	63
		polymorphemic	*diver, mileage*	25
				200
MOUTH	monosyllabic	monomorphemic	*loud, ounce, cow*	112
	disyllabic	monomorphemic	*chowder, thousand*	45
		polymorphemic	*mousy, owlish*	43
				200
Distractors				
TRAP	monosyllabic	monomorphemic	*sack, bag, gal*	100
	disyllabic	monomorphemic	*addict, cavern*	65
		polymorphemic	*tangy, marriage*	23
DRESS	monosyllabic	monomorphemic	*speck, fen, tell*	100
	disyllabic	monomorphemic	*feather, berry*	70
		polymorphemic	*leggings, teller*	18
				376

Table 5.4: Word List Lexical Items

or three times as many distractors is better. The pilot study contains at least two, or potentially three times as many distractors, if PRICE lexical items are included as distractors for MOUTH and vice versa. However, the TRAP and DRESS distractors were not analysed and will not be discussed in the pilot study results.

Only monosyllabic and disyllabic lexical items were used in the pilot study. An investigation including tokens of more than two syllables would have been unmanageable in terms of controlling for different environments and for the length of time for each of the participant's data collection.

Previous studies on PRICE and MOUTH phonologically-conditioned variation in LE are either limited primarily to monosyllabic words, or polysyllabic words are not analysed separately from monosyllabic words, as discussed in §3.3.3. In Cardoso (2011b), I mention that due to the constraints of using a corpus phonology approach there was a limited number of disyllabic tokens in the corpus sample, which prevented any substantial analysis of the difference between realisations of PRICE in monosyllabic and disyllabic tokens. Therefore, there is no information on the effect that the number of syllables has on the realisation of PRICE and MOUTH in LE. It is possible that disyllabic tokens behave differently from monosyllabic tokens, as this has been shown to be the case for other varieties of English with phonologically-conditioned variation of PRICE and MOUTH (see §3.3). The current pilot investigation is in part used to determine whether LE has similar conditioning.

The disyllabic lexical items are controlled in a number of different ways. All disyllabic words have the target vowels in the first syllable, which always has primary stress, and the consonant following the target vowel can always be syllabified in the onset of the following syllable. Controlling the structure of the disyllabic lexical items to a large extent ensures that confounding effects are kept to a minimum.

A consequence of keeping the structure of disyllabic tokens uniform in this pilot study is that some factors which may influence the production of PRICE and MOUTH in LE cannot be discussed. One of these factors is whether the following consonant is in coda or onset position. For example, in *python, diver, chowder* and *mousy* the following consonant is in the onset of the second syllable, which is the type of item used in the pilot study. However, in *lightning, nightly, outrage* and *stoutness* the following consonant is in the coda of the same syllable as PRICE or MOUTH. Such tokens are not included in the current investigation. The majority of PRICE and MOUTH disyllabic lexical items with the following consonant in the coda of the same syllable as the target vowel are also polymorphemic. Therefore, even if I had included such forms, there would still be a confound. It would not be possible to determine from the results whether differences are due to morphological complexity or syllable position.

As a result of the decision to have all following consonants in disyllabic lexical items be part of the onset of the second syllable, all lexical items which have a coda consonant are necessarily monosyllabic. In other words, it is not possible to tell whether differences between the monosyllabic and disyllabic lexical items result from number of syllables or syllabic position. Therefore, while the pilot study results refer to the number of syllables, it is possible that syllabic position (coda versus onset) of the following consonant may also be affecting the realisations of the target vowels. It would be interesting to find out if there are differences between the results for number of syllables and syllabic position separately, but this must be left for future research.

Previous studies, such as Chambers (1989) and Bermúdez-Otero (2004), debate whether prosodic and/or foot structure is responsible for the differences found in PRICE and MOUTH patterns for monosyllabic lexical items compared to polysyllabic lexical items, as described in §3.3.1.1. I have not included lexical items of more than two syllables for reasons previously mentioned. An analysis of the relationship between the realisations of the target vowels in polysyllabic lexical items and the foot structure of those lexical items (similar to the analysis provided for Canadian Raising by Bermúdez-Otero 2004) requires lexical items of at least three syllables. As a result, it is not possible to analyse the influence of foot structure on the conditioning of PRICE and MOUTH in disyllabic lexical items in the pilot study. However, given that the second syllable in disyllabic lexical items either has secondary stress or is unstressed, it is possible to test if there is a difference in the realisation of PRICE and MOUTH depending on whether the following consonant is in a syllable with secondary stress or an unstressed syllable.

To date few studies on PRICE and MOUTH phonologically-conditioned variation have analysed disyllabic monomorphemic words and disyllabic polymorphemic words separately. The present pilot study codes these separately in order to determine whether morphological complexity contributes to the variation of PRICE and MOUTH in LE. In dialects with SVLR, morphological boundaries are a conditioning environment for monosyllabic lexical items (e.g. *tide* versus *tied*), there is a potential phonemic split in disyllabic monomorphemic lexical items of PRICE (e.g. *nitro*), and disyllabic polymorphemic lexical items (e.g. *mighty*) produce the same pattern as the monosyllabic monomorphemic lexical items (see §3.3.2). Given these observations about SVLR, it may be possible that disyllabic monomorphemic words and disyllabic polymorphemic words behave differently in LE. It is important to note that the consonant following the target vowel is generally not part of the second morpheme, but the first morpheme in the disyllabic polymorphemic lexical items in the pilot study. For example, in *doubter* the /t/ is part of the first morpheme and not the second. This is different from the SVLR morpheme boundary context in that the following consonant is part of the second morpheme, such as the /d/ in *sighed*. Therefore, the pilot study can determine whether there is a difference between the realisations of the target vowels in disyllabic monomorphemic and disyllabic polymorphemic lexical items as is found for SVLR, but not the morpheme boundary conditioning environment generally described for monosyllabic lexical items in SVLR patterns. However, SVLR type morphological conditioning of monosyllabic lexical items is included in the main investigation, as discussed in §6.1.

As mentioned previously, the lexical items vary in terms of their segmental environment. Previous studies on PRICE and MOUTH in LE suggest that we should at least distinguish between the following broad conditioning environments: before voiceless obstruents, before voiced obstruents, before nasals, and in word-final open syllables, as discussed in §3.3.3. However, there is little information about other possible following environments. There are brief mentions that there may be differences in phonetic realisation of the target vowels before /l/ and /r/ in LE (Knowles 1973, Berry 2009). Similarly, previous work on other varieties of English shows that /l/ and /r/ can affect the realisation of PRICE and MOUTH; see §3.3. Nasal-obstruent clusters have been shown to induce raising of the target vowels in varieties of English (see §3.3). Therefore, the pilot investigation includes a wide range of possible following environments: before voiceless stops, voiceless fricatives, voiced stops, voiced fricatives, nasals, nasal-voiceless obstruent clusters, nasal-voiced obstruent clusters, /l/, /r/, [ɹ], vowels, and in open syllables (see Table 5.5 for examples and labels used in the results). The /r/ and [ɹ] environments are differentiated from each other because LE is a non-rhotic variety. The /r/ environment represents lexical items that have an etymological ‘r’, but are not produced with a rhotic consonant. On the other hand, [ɹ] is where the etymological ‘r’ is produced, such as in *pirate* and *maori*. Furthermore, the environment described as ‘in open syllables’ only includes lexical items where the PRICE vowel is in an open syllable, i.e. no coda consonant, and is word final, such as *sigh* and *sow*.

One of the obvious differences between some of the lexical items used in the study is their frequency. For example, there is a clear difference between the frequency of *down* versus that of *cowrie*. It is clear that *down* is much more frequent than *cowrie*. Frequency effects are reported widely within

Environment	Label	Examples		
		Monosyllabic (mono)	Disyllabic monomorphemic (di)	Disyllabic polymorphemic (morph)
voiceless stop	vl_st	*kite, scout*	*title*, -	*mighty, outing*
voiceless fricative	vl_fr	*life, louse*	*bison, cowslip*	*dicey, mousey*
voiced stop	vd_st	*side, loud*	*tiger,powder*	*tigress, cloudy*
voiced fricative	vd_fr	*dive, blouse*	*ivy, thousand*	*fiver, lousy*
nasal	na	*time, down*	*climax*, -	*timing, downer*
/l/	la	*pile, fowl*	*nylon, cowling*	*mileage, owlet*
/r/	ure	-	*tire,power*	-
open syllable	op	*die, cow*	-	-
[ɹ]	re	-	*tyrant, cowrie*	-
vowel	vo	-	*bias, coward*	*mayan*, -

Table 5.5: Pilot Study – Word List Following Environments

linguistic research and can refer to a number of different types of effects (for a summary of some frequency effects see Bybee and Hopper 2001, Hay and Jannedy 2003 and Bybee 2006). Recent work on frequency effects has shown that word frequency can affect a wide range of different phonetic and phonological processes, including, but not limited to, phonological reduction (Hooper 1976, Pierrehumbert 2001) and sound change (Phillips 1984, Bybee 2002). Furthermore, frequency has been shown to be a factor in PRICE monophthongisation (Hay et al. 1999) and for the NURSE/SQUARE merger in Lancashire Englishes (Barras et al. 2007).

Word frequencies used in the pilot study came from the CELEX corpus, which calculates frequency data from a 17.9 million token written corpus (Baayen et al. 1995). The frequencies used are those that measure the number of times each token of a lexical item occurs in a million words. For example, *down* has a frequency of 1231 per million, while *cowrie* has 1 per million. In order to be able to analyse frequency in linear mixed effects models, log frequencies were calculated in R (R Core Team 2013). Using log frequencies helps to mitigate skewed frequency distributions (Sosa 2008, Podesva and Sharma 2014).

Prior to the study, lexical items were randomised using a python script (by Márton Sóskuthy), which ensured that no item was presented twice in a row. This was the order in which every participant read the word list. All of the stimuli were presented in a carrier sentence of the form "Say x". This method of using a carrier sentence is a common practice in elicited speech studies using word lists to counteract the effects of list intonation and changes in stress, which can results from list reading (Agutter 1988, Rutter 2011, Ball and Muller 2014, Podesva and Sharma 2014). Chelliah and de Reuse (2010: 252) discuss the issues with word lists read in isolation, suggesting that "list intonation can obscure natural pronunciation" but that carrier sentences "circumvent the list intonation effects."

The interview was intertwined with the word list in three sections, as described in §5.2.1.4. Each participant was asked ten questions in the three interview sections and the interviews for each participant ranged in length from approximately 600 words to 1450 words (overall total is approximately 4550 words). These questions were divided into three types of questions: questions about the participant and their family, questions about the city of Liverpool, and questions about Scouse or the Liverpool dialect. See the appendix (§A.1.1) for a list of the precise questions asked to each participant. These questions were used to compare word list speech to casual speech, as previously discussed.

As shown in §5.2.3, the sociolinguistic interviews provided few PRICE and MOUTH tokens, which made it difficult to determine the effects of speech style and led to changes in the methodology for the main investigation.

5.2.1.3 Ethics

The pilot study and the main investigation received ethics approval from the department of English Language and Linguistics at the University of Edinburgh under the online LEL Ethics Submissions programme and were confirmed to conform to the standards of good practice established by the British Association for Applied Linguistics (BAAL) (British Association for Applied Linguistics 2006). According to these standards, the main ethical concerns for students related to the current investigation are: informed consent, respecting a decision not to participate, confidentiality and anonymity, and preventing deception (British Association for Applied Linguistics 2006). For a detailed review of ethical issues that relate to linguistics fieldwork see Rice (2006).

The principle of informed consent is to ensure that participants "voluntarily agree to participate in the research" and that they "know what their participation entails" (Milroy and Gordon 2003: 79). Confidentiality and anonymity entails ensuring that participants cannot "be identifiable in any way (confidentiality)" and that participants real name is not used (anonymity) (British Association for Applied Linguistics 2006: 1) if the participant chooses to remain anonymous. Finally, preventing deception entails ensuring that participants know what the study is about. According to British Association for Applied Linguistics (2006: 2), it is acceptable "to tell them the general purpose of the research without revealing specific objectives" if a linguist believes that informants are likely to alter their speech.

Both the pilot study and the main study conform to the standards established by BAAL by the following ways: asking the participants to sign a consent form for their involvement in the project; explicitly stating that the participants may stop their participation in the study at any time without consequence; providing an information sheet about the project to participants; housing the participants' data in a secure location; and only using the assigned ID numbers to refer to the participants. The consent form detailed the potential uses of participant recordings, including possibly being used in lectures or conferences as sound files to exemplify linguistic aspects of LE.

The information sheet described the current investigation as a study of phonological and phonetic properties of LE. It did not include that the investigation was specifically looking at PRICE and MOUTH, as this may have influenced the participants' productions. The sheet also included information about the procedures involved in the data collection and explicitly included the following statement to ensure that participants were aware of their rights:

> "You may decide to opt out of the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn/destroyed. You have the right to omit or refuse to answer or respond to any question that is asked of you."

Therefore, the pilot and main studies have conformed to ethical standards.

5.2.1.4 Procedure

Experimental conditions were the same for each participant: the data collection was done in the same location in the same room and with the same set-up. Participants were asked to sit in front of a laptop and put on a ShureSM10 head-mounted microphone connected to a Marantz PMD 661 recording device. Instructions were given both orally and presented on the computer screen at the beginning of the study. The participants were asked to read aloud a randomised word list + carrier sentence, as described above. There was a test section with three example lexical items[2] in order to allow the participants to familiarise themselves with the task and to ask any questions about the data collection procedure.

There were three breaks during the data collection and the entire procedure took between thirty and forty five minutes (see list 1 for the data collection procedure). Word list lexical items were divided equally between the three sections (Section 1: 259 lexical items, Section 2: 259 lexical items, Section 3: 258 lexical items). The researcher remained in the room for the practice examples, but left the room when it was clear that participants were confident in the task. The end of each section of the word list was indicated on the screen.

Participants were presented with a screen containing only one carrier sentence + item, as in Figure 5.2. At the beginning of the data collection, they were instructed to read each sentence aloud as it is seen on the computer screen at a natural pace. The participant then changed to the next screen using the SPACE key and was again presented with one carrier sentence + item. They would continue the task until they reached the end of each section, which was denoted by a coloured screen with "End of Part #". At the end of each section participants were told to retrieve the researcher from the hall and were provided with more water and a break if they wished.

[2] The example lexical items were not PRICE and MOUTH words.

Figure 5.2: Example of the word list screens in the pilot study

The setting of being in a room by oneself at a desk reading sentences off of a screen is an unnatural setting. However, this procedure ensured that the participants could read the word list in their own time without feeling uncomfortable as a result of someone they do not know listening to them in the room. Therefore, I decided that having the researcher in the room during the word list reading portion of the data collection would make the participants more nervous than being alone reading the word list.

The data collection had three parts which included one section of the word list followed by some interview questions, as described in list 1. As previously mentioned, word list lexical items were divided equally between the word list sections, in order to maintain a consistent time period for each of the parts. Furthermore, alternating sections of the word list with interview questions helped to keep the participant focussed on the task and also prevented the participant from getting bored reading the word list lexical items.

Part 1: Word List - Section 1
Interview Questions: Participant metadata - 1, 2, 3

Part 2: Word List - Section 2
Interview Questions: Questions about Liverpool - 4, 5

Part 3: Word List - Section 3
Interview Questions: Questions about Scouse - 6, 7, 8, 9, 10

List 1: Data collection procedure

The importance of Scouse identity and its link to the Liverpool dialect was discussed in §2.1. This is relevant for the present purposes, as some of the interview questions directly related to Scouse identity and dialect. It is possible that these questions would have affected the phonetic and phonological properties of the speakers depending on whether they orient towards the Scouse identity or away from it. Furthermore, previous studies have established that the Liverpool dialect is a well recognised and often-stigmatised variety (Giles 1970, Trudgill 1990a, Coupland and Bishop 2007, Honeybone 2007, Montgomery 2007, Watson and Clark 2011), as discussed in §2.1. Some of the interview questions in the third section of the data collection asked about language attitude towards Scouse, which may also have affected the speakers' productions (see for example Schilling-Estes 1998, Preston 1999 for a discussion of the effects of language attitudes on perception and production). I wanted to be able to elicit word list lexical items with as few confounds as possible. Therefore, the questions which were directly related to Scouse identity and dialect were asked at the very end of the study (see List 1) after all sections of the word list have been completed.

After the completion of the data collection, data for each participant was saved separately as a 48kHz wav file and tokens were coded for the variables shown in Table 5.6.

The results for the pilot study presented in §5.2.3 often reference the variables shown in Table 5.6. For example, **voiclass** refers to the variable that encodes both voicing and manner of articulation of the following consonant. In other words, **vl_st** refers to target vowels before voiceless stops and **na** refers to target vowels before nasals. Likewise, **cat** refers to the variable that encodes the distinction between monosyllabic, disyllabic monomorphemic, and disyllabic polymorphemic lexical items and **mono** refers to monosyllabic lexical items. Therefore, in the results of the pilot study, **voiclass** and **cat** are sometimes used to describe voicing and manner of articulation of the following consonant, and number of syllables and morphological make-up, respectively, rather than using the long description related to these labels.

Name	Definition	Values
wor	*lexical item*	e.g. *kite*
vow	*vowel type*	PRICE, MOUTH
pre	*segment preceding the vowel*	any consonant, - (no preceding consonant)
fol	*segment following the vowel*	any consonant, vo (vowel), - (open syllable and word final)
voiclass	*voicing and manner of articulation of the following consonant*	e.g. vl_st (voiceless stop), vd_fr (voiced fricative)
stress	*stress pattern of token*	e.g. s-us (primary stressed-unstressed)
cat	*syllable & morphological structure of token*	mono (monosyllabic), di (disyllabic monomorphemic), morph (disyllabic polymorphemic)
fre	*lexical frequency of token*	a number
con	*speech style*	y (interview data) n (word list data)
step	*measurement points*	number between 1 – 50

Table 5.6: Variables that the tokens are coded for in the pilot study

5.2.2 Data analysis

The sound files were manually segmented in PRAAT (Boersma and Weenink 2013) and fifty equally spaced measurements of f1, f2 and f3,[3] and a duration measurement were taken for each token using a PRAAT script (provided by Márton Sóskuthy and Dániel Szeredi). The PRAAT settings for the number of formants to track were manually encoded in each of the tokens. Therefore, the number of formants tracked in PRAAT ranged between three and six and varied depending on the speaker and the token.

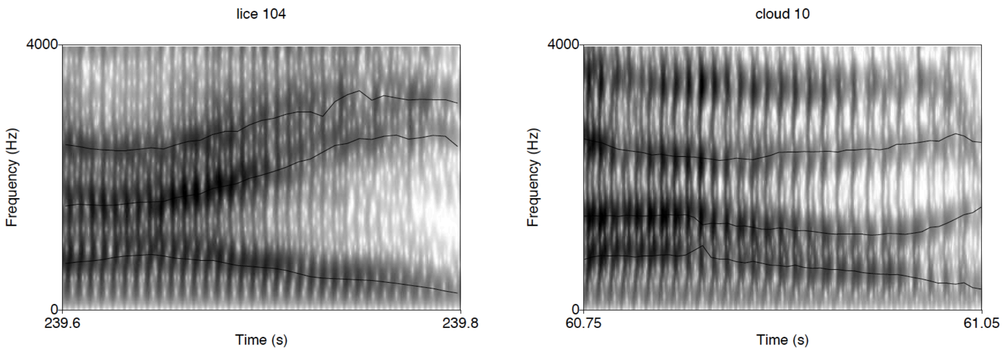
Past research has often analysed diphthongs using only two or three measurements – nucleus, midpoint or transition and offglide – (Gay 1968, Wright and Nichols 2009). However, more recently taking measurements at various points along the trajectory of diphthongs has become more common,

[3]While f3 measurements were taken, these measurements are not included in the analysis.

as it can provide a better understanding of the acoustic characteristics of diphthongs than two/three measurements (Thomas 2010, Haddican et al. 2013). Di Paolo and Yaeger-Dror (2011) discuss different methods of taking multiple measurements along a vowel, one of which is the 'proportional distance approach'. This approach advocates for taking a number of measurements at similar distances along their trajectories. Its main advantages are that it adjusts for duration differences in the vowels, remains consistent on the location of formant measurements and allows for dynamic vowel features to be observed and consistently analysed (Di Paolo and Yaeger-Dror 2011: 93). Di Paolo and Yaeger-Dror (2011) use the example of three measurement points for this method. However, Thomas (2010) suggests that measuring vowel trajectories requires measurements at a number of time points, particularly when measuring diphthongs and triphthongs. According to Thomas (2010), depending of the purposes of the investigation an indeterminate number of measurements along the vowel may be taken. There does not seem to be a standard number of measurement points. For example, Johnson and Martin (2001) use ten equally spaced measurements, Williams and Escudero (2014) use thirty equally spaced measurements and Wood (2011) uses sixty equally spaced measurements. Therefore, in order to provide an in-depth analysis of the target diphthongs trajectories, I used the proportional distance approach (Di Paolo and Yaeger-Dror 2011), taking into account Thomas' (2010) recommendations for measuring vowel trajectories: I took fifty equally spaced measurements for each token.

Vowels segmentations included the entirety of the vowel, so transitions are also included in the measurements but not in the analysis. This was done to ensure that the measurements taken along the vowel trajectory were all at the same time points within the vowels, i.e. measurement 15 would always be at 30% of the way through the vowel. Consonant transitions may be different lengths depending on the consonant. Therefore, if vowels had been segmented without the consonant transitions, measurements could potentially begin at different time points within the vowel. This would remove some of the advantages of using the proportional distance approach.

The vowel edges were determined by visual inspection of the spectrogram and auditory judgment. If the environment at the vowel edge was a voiceless



(a) Trajectories for *lice* (b) Trajectories for *cloud*

Figure 5.3: Example spectrogram pdfs from the PRAAT script: *lice, cloud*

consonant or a pause, then vowel edges were taken as the onset/ending of voicing, excluding aspiration. If the environment was a voiced obstruent then amplitude and periodicity of the waveform and the visible start/end of f1 and f2 were used as cues. Finally, if the environment was a sonorant then amplitude changes in the waveform and the spectrogram and formant changes in the spectrogram were used as cues.

As a result of using a script to take formant measurements, it is possible for measurement error to occur. In order to mitigate this, the PRAAT script produced a pdf snapshot of each token's spectrogram (see Figure 5.3 for examples). These spectrogram pdfs were visually inspected to verify that there were no major formant measurement errors. Furthermore, f1 and f2 vowel measurements were visually inspected in R (R Core Team 2013) to verify that there were no major measurement errors. As there were a negligible number of measurement errors, all measurements are included in the analysis.

Formant measurements were then analysed using R (R Core Team 2013) within the R Studio interface (RStudio 2012).The figures presented in §5.2.3 were all created using R (R Core Team 2013) and the ggplot2.R package (Wickham 2009). In order to ensure that transitions from the preceding and into the following segments were not included in the formant plots, measurements between 0 - 19% and 81% - 100% are not included when reporting on formant measurements.

All formant measurements were normalised using the modified Watt and Fabricius method (Watt and Fabricius 2002) using the Vowels.R package

(Kendall and Thomas 2009–2014) in R (R Core Team 2013). Normalisation is a mathematical technique used to adjust formant measurements in a way that reduces anatomical differences between speakers but retains the phonological differences between the vowels. The main purpose of normalising data is "that through normalized data one can directly and quantitatively compare speakers' and speaker groups' vowel productions with one another" (Di Paolo and Yaeger-Dror 2011: 111).

As described in Watt and Fabricius (2002), the modified Watt and Fabricius method uses mean values of f1 and f2 minima and maxima to calculate the outer limits of the vowel space. The f1 and f2 minima and maxima are calculated as follows:

1. f1 minimum for a speaker is calculated from the averaged f1 values for the FLEECE vowel
2. f1 maximum is calculated from the averaged f1 values for the TRAP vowel
3. f2 minimum is the same as the f1 maximum
4. f2 maximum is calculated from the averaged f2 values for the FLEECE vowel

These measurements arguably correspond to the limits of the vowel space in that: f1 minimum and f2 maximum are the highest and frontest part of the vowel space (FLEECE), f1 minimum and f2 minimum are the highest and backest part of the vowel space (GOOSE), and the f1 maximum is the lowest part of the vowel space (TRAP). This normalisation technique has been used to normalised British English speech and been shown to be effective in eliminating inter-speaker variation based on physiological characteristics while maintaining vowel contrasts (Fabricius et al. 2009).

The formant plots in the following sections were based on these normalised measurements. Most of the formant values presented in the plots are averaged formant measurements across all tokens and all speakers in the specified environments unless otherwise specified. This method of averaging token measurements has been used in acoustic analyses of diphthongs (Thomas 2001) and is discussed as an appropriate technique for vowel visualisation in Thomas (2010). The white squares with black outlines in formant plots represent the average values of FLEECE, GOOSE and TRAP at the midpoint measurement in order to orient the trajectories of PRICE and MOUTH in phonetic space. Vowel measurements for a small number of FLEECE, GOOSE and TRAP tokens were taken for each speaker from a combination of word list speech and spontaneous speech.

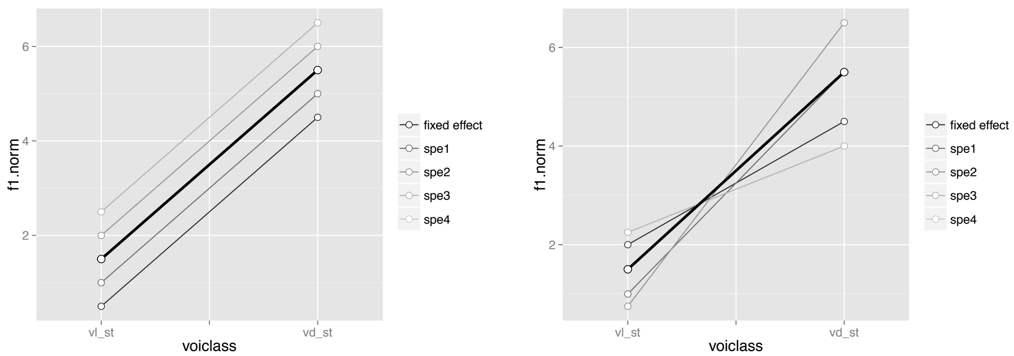
The amount of diphthongisation is operationalised as the Euclidean distance (ED) between the formant values for the nucleus and the offglide. The nucleus measurement was taken at 20% and the offglide measurement was taken at 80%. This is a commonly used method for taking nucleus and offglide measurements for diphthongs (Harrington and Cassidy 1994, Tsukada 2008, Wright and Nichols 2009, Yusuf and Pillai 2013). The Euclidean distance indicates the degree of diphthongisation by determining the difference in phonetic space between the nucleus and offglide. Therefore, if the difference between the nucleus and offglide is very small then that token is more monophthongal and if it is larger then the token is more diphthongal. This measurement is not generally used in analyses of PRICE and MOUTH phonologically-conditioned variation, but as shown in §7, it is a integral tool in understanding the conditioning environments of these vowels in LE. It is also recommended in more recent guides on acoustic analysis to investigate differences between the nucleus and offglide in phonetic space (Di Paolo and Yaeger-Dror 2011).

Statistical tests, such as linear mixed effects models, were used on some of the measurements in order to determine the significant predictors and therefore the factors that influence the variation found in PRICE and MOUTH. Mixed effects models are regression models which contain both fixed effects and random effects. This method has been demonstrated to provide more reliable results than traditional fixed effects regression models (Barr et al. 2013). Mixed effect models can either be logistic regression or linear regression models (Drager and Hay 2010). Given that the dependent variables in the pilot study, such as normalised f1 measurements, are continuous variables the pilot study results used linear mixed effects regression models (Drager and Hay 2010).

Fixed effects are independent variables that are of primary interest and are repeatable (Baayen 2008, Seltman 2012) and may also be called predictors. Random effects are independent variables that are randomly sampled from a larger population and are not repeatable (Baayen 2008). For example, in the current pilot investigation fixed effects are variables like the preceding and following environments, while random effects are speakers and words. If the study were to be run again, the following environment would be a repeatable factor: we could investigate the same following environments again. Also, in the current investigation the following environment is predicted to have an influence on vowel productions, so it is a predictor of primary importance. On the other hand, speakers were randomly sampled from the population of Liverpool and lexical items were chosen from all the possible PRICE and MOUTH vowel lexical items. If the study were to be repeated, it is unlikely that the same subjects and words would be used, but this would not affect the conclusions of the study. Fixed and random effects have levels, which are the different categories within the variable. For example, following environment (**voiclass**) has the levels before voiceless stop (**vl_st**), before voiced stop (**vd_st**), before nasal (**na**), etc. and word has the levels *light, mouth* and *die*, etc.

Fixed effects are variables used to explain some of the variation found in the dependent variable. For example, the following environment explains a good portion of the variation in the production of PRICE and MOUTH. Random effects are used to explain variation in the data beyond what would be predicted by the fixed effects. In order to clarify this, take an example where the dependent variable is Euclidean distance, the fixed effect is following environment and the random effect is speaker. While the f1 and f2 values to calculate Euclidean distance would have been normalised there will still be a small amount of variation in the Euclidean distance values for the different speakers. When random effects are used the model calculates the overall effect that each level in the following environment variable has on the variation within Euclidean distance and then estimates the amount of variation beyond that, which is due to individual speakers.

There are different types of random effects: random intercepts and random slopes. Random intercepts capture variation across speakers independently of other predictors: for instance, some speakers may simply have higher Euclidean distance values than others. The effect of random intercepts is illustrated in Figure 5.4a. It is also possible to include random slopes for specific variables. This captures variation in the precise influence of a given variable across speakers. For instance, it is possible that one speaker will show



(a) Random Intercepts (b) Random Slopes

Figure 5.4: Schematised depiction of random intercepts and random slopes for mixed effects models. Grey lines represent random effects and the black line represents the fixed effect

higher Euclidean distance values before voiceless stops, while another speaker will not show the same effect. This is illustrated in Figure 5.4b.

Finally, interactions have also been used in mixed effects models. Interactions are "when the effects of two predictors are not independent" (Baayen 2008: 154). That is to say, when two of the fixed effects are linked together, an interaction can be used in the model to show this. For example, the following environment (**voiclass**) and speech style may interact with each other: it is possible that differences between voiced and voiceless stops are more marked in certain speech styles than others.

A practice of using stepwise regression to find the best fit models has emerged in linguistics (Baayen 2008). A stepwise regression method entails that all possible predictor variables are initially included in the model and removed step-by-step in subsequent models if they do not show a significant effect on the dependent variable. Another potential method is the 'all-variables together' or 'full' model approach (Gelman and Hill 2006, Mundry and Nunn 2009), which is often used in ecology and behavioural sciences. In this approach all possible predictor variables are included in one model and are not removed at any point (Gelman and Hill 2006). In statistics and other scientific fields of research there is a lively debate about the use of stepwise regression (see Hegyi and Garamszegi 2011). While there are issues with both methods, some authors have recommended that stepwise regression should be abandoned completely, as a result of the many issues that surround this practice (see Whittingham et al. 2006, Richards et al. 2011). For example, Derksen and Keselman (1992) find that a stepwise method frequently fails to include all pertinent variables and also frequently includes variables that do not influence the dependent variable. On the other hand, the use of a full model method can increase random noise for parameter estimates, which may result in a weakening or strengthening of effects (Ginzburg and Jensen 2004). For the current thesis, I have chosen to use a full model method in order to avoid issues relating to the inclusion/exclusion of variables. In other words, the models described throughout the thesis include both significant and non-significant effects.

The Lme4.R package (Bates et al. 2012) was used to calculate linear mixed effects models in R (R Core Team 2013) which does not provide p-values, but does provide t-values.[4] The p-values were subsequently calculated from the t-values using the formula presented in Baayen (2008: 248), as seen below. In this formula *pt* refers to a function that calculates the distribution of t-values, *abs* computes the absolute values, *mt* is the model t-values, *no* is the number of observations and *fep* is the number of fixed effects parameters.

$$2*(1 - \text{pt}(\text{abs}(\text{mt}), \text{No} - \text{fep}))$$

I used an alpha level of 0.05, meaning that only results with a p-value lower than 0.05 were deemed statistically significant. This is standard practice in linguistic research (Milroy and Gordon 2003).

5.2.3 Pilot study results

The current section discusses the results of the pilot investigation and an evaluation of the methodology, which resulted in changes to the methodology for the main investigation (see §5.3). I do not discuss here findings pertaining to the specific phonetic realisations of PRICE and MOUTH, but rather the results that provide evidence for the inclusion and exclusion of certain environments in the main investigation.

[4] As a result of p-values not being provided by the package used, p-values are not included in summary tables.

Vowel	Overall	By **Cat**		
		Mono	**Di**	**Morph**
PRICE	988	564	305	119
MOUTH	1000	557	225	218

Table 5.7: Number of tokens in the pilot study by number of syllables and morphemes within the token

The results for PRICE and MOUTH are discussed separately, similar to previous chapters. This is to ensure that differences between the findings for PRICE and MOUTH are not masked by analysing them together. Based on the results of the pilot investigation and previous work, PRICE and MOUTH phonologically-conditioned variation in LE are separate, but related patterns.

Overall there were 2235 tokens of PRICE and MOUTH collected in the word list and interview data over the five speakers. See Tables 5.7 and 5.8 for the distribution of tokens by **cat** and following environment (**voiclass**). Of the 2235, 160 tokens of PRICE and half as many (87 tokens) of MOUTH occurred in the interview data. As mentioned in Cardoso (2011b), casual speech produces few instances of PRICE and even fewer instances of MOUTH. In that study, there were enough tokens of PRICE in a sufficiently diverse range of following environments that it was possible to investigate some aspects of PRICE phonologically-conditioned variation in LE using interview speech. However, it was not possible to investigate MOUTH. These results greatly influenced the decision not to investigate MOUTH in historical corpus data (see Chapters 8 and 9).

I only present word list data for the pilot study (1998 tokens), as it is not possible to generalise results for casual speech based on so few tokens. The only exception is in the explicit comparison of speech styles where all of the 2235 tokens are analysed. The limited PRICE and MOUTH tokens in casual speech resulted in a revision of the pilot study methodology for the main study, as discussed further in §5.3.

Furthermore, in Cardoso (2015) I present a detailed analysis of PRICE and MOUTH before nasal-obstruent clusters based on the same data set. Therefore, the results for nasal-obstruent clusters will not be presented in the following section. A summary of these results is discussed in §3.3.3. However, a brief

Environment	**Voiclass** Label	PRICE	MOUTH
voiceless stop	vl_st	102	99
voiceless fricative	vl_fr	100	108
nasal-voiceless obstruent cluster	vl_nast	40	81
voiced stop	vd_st	100	100
voiced fricative	vd_fr	89	98
nasal-voiced obstruent cluster	vd_nast	81	40
nasal	na	121	122
/l/	la	120	119
in an open syllable & word final	op	60	55
/r/	ure	61	59
vowel	vo	53	60
[ɹ]	re	60	60

Table 5.8: Number of tokens in the pilot study by following environment

description of the findings of this study is that PRICE and MOUTH have different phonological conditioning before obstruent clusters, which interacts with the phonetic realisation of the nasal-obstruent clusters. For example, PRICE before nasal-voiceless obstruent clusters has a raised nucleus, which is similar to the realisations found for PRICE before voiceless stops. In Cardoso (2015), I suggest that this is the result of frequent nasal deletion in nasal-voiceless stop clusters, which subsequently conditions PRICE as if it were before a voiceless stop. As a result of the complex interaction found between the target vowel realisations and variation in the nasal-obstruent clusters, I decided not to include consonant clusters in the main study. It is clear from Cardoso (2015) that consonant clusters must be looked at in great detail in future research. An investigation on the effects of consonant clusters on the production of PRICE and MOUTH in LE should include an analysis of the variation of the consonant clusters and the target vowels. However, this is outside the scope of the current thesis.

The following discussion of the results for PRICE and MOUTH in the pilot study starts with discussing the findings based on more specific divisions, such as specific following consonants, and works towards broader divisions, such as number of syllables in the lexical items. It is done in this way in order to be able to conflate more specific following environment categories into broader ones when no differences are found between the results.

5.2.3.1 Results for PRICE

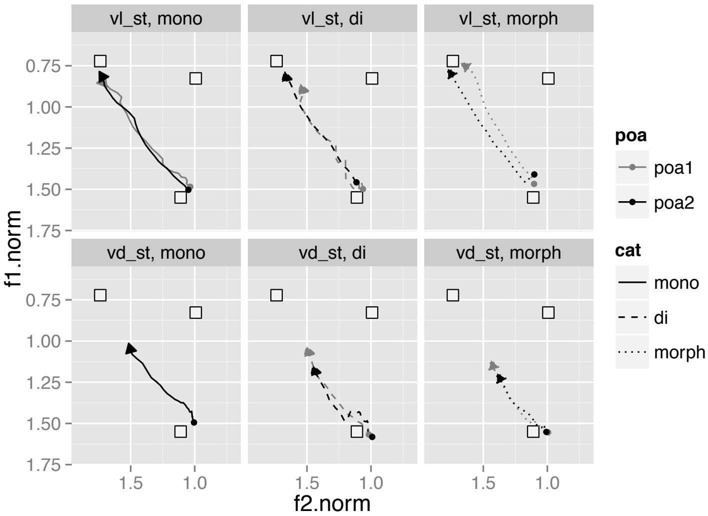
Previous research on PRICE phonologically-conditioned variation generally discusses the effect that groups of following consonants have on the vowel productions, but generally does not consider whether specific following consonants produce differences in the phonetic realisation of PRICE. Labov (1972b) does discuss the hierarchy of raising depending on the place of articulation of the following consonant, as well as **voiclass** (§3.3.1), but few other studies look at the pattern in as much detail. This is in part due to the inclusion of alveolar stops only in much of the previous research, so that /t/ is only used in pre-voiceless lexical items and /d/ in the pre-voiced ones. The current pilot included consonants at different places of articulation when possible, for example, PRICE before nasals includes /m/ (*time*) and /n/ (*dine*). While this has not been discussed in detail in most other studies, in principle it is possible that the place of articulation of the following consonant also has an effect on the realisation of PRICE, as found by Labov (1972b). In order to investigate this possibility and to ensure that no conditioning environments are being obscured, I ran statistical tests on the normalised f1 and f2 values for the nucleus (20%) and offglide (80%) and the Euclidean distance measurements. It is important to note that only some of the levels in **voiclass** had more than one place of articulation in PRICE, i.e. before voiceless stops, voiceless fricatives, voiced stops, voiced fricatives and nasals. Therefore, the model only includes word list data of all speakers for these levels within **voiclass**.

It was difficult to determine with any certainty using the formant plots whether differences existed between the realisations of PRICE based on the place of articulation of the following consonant, as shown in Figure 5.5. Therefore, five mixed effects models were used to determine whether place of articulation is a statistically significant predictor of differences in vowel realisations. These models correspond to the five dependent variables tested: normalised f1 (f1.norm) at the nucleus and offglide, normalised f2 (f2.norm) at the nucleus and offglide, and Euclidean distance (ED). All of the fixed and random effects were kept the same for the models, only the dependent variable changed.

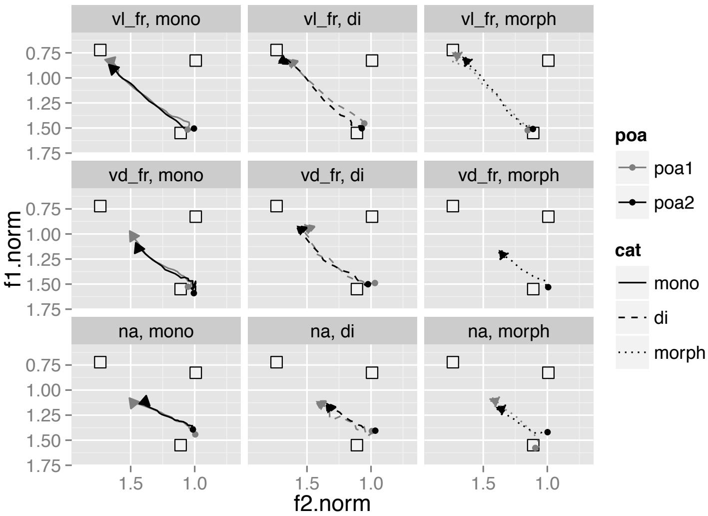
As a result of the size and number of variables of the mixed effects models, place of articulation had to be turned into a binary variable, in this case called 'poa1' and 'poa2'. These labels do not necessarily correspond to phonetically similar categories, but simply serve to group places of articulation into two sets. Most of the levels in **voiclass** had two places of articulation except for before voiceless fricatives and voiced fricatives, which had three. For example, /k/ is in 'poa1' and /t/ is in 'poa2' in the pre-voiceless stop level (**vl_st**) of **voiclass**, in order to test the difference between the target vowel before these consonants. In the pre-fricative case, /s/ and /z/ were in 'poa1' and /f, v, θ/ and /ð/ were all placed into the 'poa2' level. Similarly, for the pre-nasal environment /n/ is in 'poa1' and /m/ is placed in 'poa2'. Note that this arbitrary division in each case has no wider significance and is only used to expedite the analysis.

The division between the labiodental/(inter)dental fricatives and the alveolar fricatives was based on phonetic and phonological characteristics of these sounds. The sibilant sounds, of which /s/ and /z/ are a part, form a natural class of sounds and often pattern together as a group and differently from other sounds (Ladefoged 1996, Hayes 2008). Examples of such patterns are the English plural suffix, where only final sibilant consonants induce vowel insertion, and sibilant harmony found in many languages and as a substitution process by children (Hayes 2008). Sibilants have different articulatory and acoustic characteristics from other fricatives, such as the airflow hitting the teeth to produce a high amplitude noise that results in higher amplitude aperiodic waves and darker spectral energy than other fricatives (Johnson 2011, Ladefoged and Johnson 2014). On the other hand, labiodental and (inter)dental fricatives are generally difficult to distinguish from one another in acoustic analysis and are produced in similar places in the mouth and with similar mechanisms (Ladefoged 1996, Johnson 2011).

The main effects included in the models were place of articulation (poa), following environment (**voiclass**) and number of syllables + morphological complexity (**cat**). Moreover, I added interactions between place of articulation × **voiclass** and place of articulation × **cat**. It may have been slightly problematic that 'poa1' and 'poa2' do not correspond to the same place of articulation in each of the levels of **voiclass**. More specifically, alveolar consonants are



(a) PRICE vowel trajectories before voiceless stops (top pane) and voiced stops (bottom pane) by place of articulation ('poa1': *grey line* & 'poa2': *black line*) and **cat** (in columns)



(b) PRICE vowel trajectories before voiceless fricatives (top pane), voiced fricatives (middle pane) and nasals (bottom pane) by place of articulation ('poa1': *grey line* & 'poa2': *black line*) and **cat** (in columns)

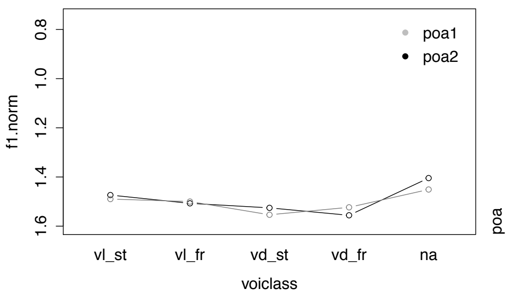
Figure 5.5: PRICE vowel trajectories by place of articulation of the following consonants divided by following environment (**voiclass**) and monosyllabic (**mono** - first column: *solid lines*), disyllabic monomorphemic (**di** - second column: *dashed lines*) and disyllabic polymorphemic (**morph** - third column: *dotted lines*)

included in the 'poa1' group for fricatives and nasals, but in the 'poa2' group for stops. However, the inclusion of an interaction term between place of articulation and **voiclass** mitigates this, as it separates the effects of 'poa1' and 'poa2' in different environments. None of the levels in **cat** by place of articulation were significant. In all of the models used throughout the main investigation, speakers and words were used as random effects. The random effects structure is the same for all models, except where a difference is explicitly specified. That structure is random slopes for the fixed effects in the model by speakers and random intercepts included for speakers and words. For example, in the current models there are random slopes for speakers by **voiclass** and place of articulation and random intercepts for speakers and words.

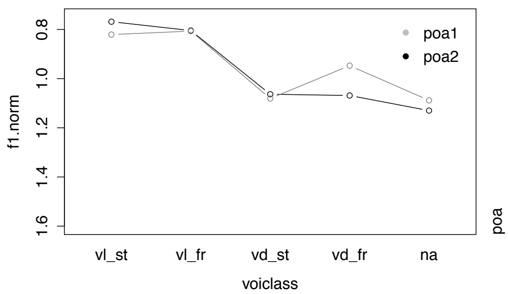
The mixed effects models show that the place of articulation of the following consonant does not have a significant impact on the realisation of PRICE. The predictions of the mixed effects models are shown in Figure 5.6 for each of the dependent variables. These types of figures are essentially visual summaries of the predictions of the mixed effects models. Using the figures in the place of summary tables is an effective way to visualise the predictions of the models and are practically the only efficient way to interpret interactions within the mixed effects models. Throughout the remainder of this thesis, this type of visualisation is used to represent the predictions of the mixed effects models often rather than summary tables, which are included in appendix (§A.2).

Only the f1 offglide measurements showed a significant effect of place of articulation, and only in voiced fricatives, which is seen in the comparison between the results of the mixed effects model in Figures 5.6a and 5.6b. The differences between the normalised f1 nucleus values for 'poa2', which includes dental and labiodental consonants, and 'poa1', which includes alveolar consonants, in Figure 5.6a are very small, while Figure 5.6b shows a larger difference between normalised f1 offglide values before voiced fricatives (**vd_fr**).

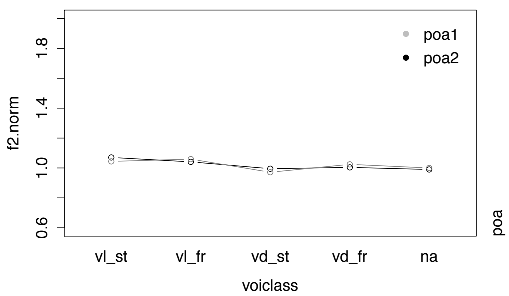
It is unlikely that this is the result of a false positive due to the number of different statistical tests performed, as mixed effects models mitigate against false positives, to some extent, if random slopes are used in the models (Barr et al. 2013). An alternative suggestion is that the significant difference between different places of articulation of voiced fricatives in the f1 offglide measurements may be the result of a longer transition period for certain voiced



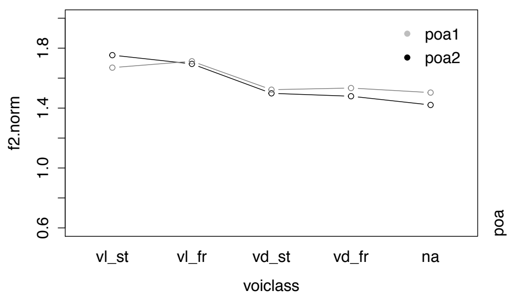
(a) Normalised f1 nucleus measurements (f1.norm) by place of articulation and **voiclass**



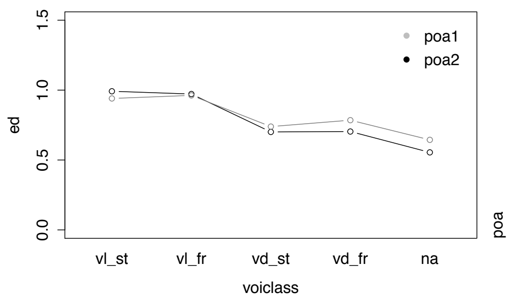
(b) Normalised f1 offglide measurements (f1.norm) by place of articulation and **voiclass**



(c) Normalised f2 nucleus measurements (f2.norm) by place of articulation and **voiclass**

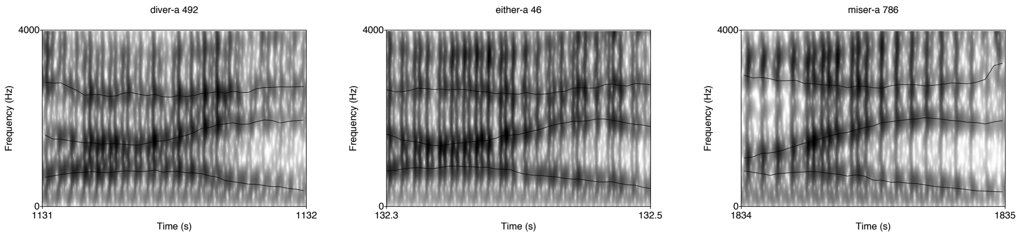


(d) Normalised f2 offglide measurements (f2.norm) by place of articulation and **voiclass**



(e) Euclidean distance measurements (ed) by place of articulation and **voiclass**

Figure 5.6: Mixed effects model predictions for place of articulation ('front': *black line* & 'back': *grey line*) by **voiclass** on the five dependent variables: normalised f1 at the nucleus and offglide (f1.norm), normalised f2 at the nucleus and offglide (f2.norm), and Euclidean distance (ed)



(a) Trajectory for *diver* (b) Trajectory for *either* (c) Trajectory for *miser*

Figure 5.7: Differences in transitions depending on place of articulation of the following voiced fricative

fricative consonants, as demonstrated by Figure 5.7. When measurements less than 75% of the way through the vowel were tested, place of articulation of the following consonant in **vd_st** was no longer found to be a significant predictor, suggesting that the transition may be responsible for the supposed difference.

Due to these results, the remainder of the discussion on the results for PRICE in the pilot study focuses on **voiclass**, rather than specific following consonants. Furthermore, this influenced the decision in the main investigation to include alveolar consonants only in the lexical items, as discussed in §5.3.

In the preceding discussion, voicing and manner of articulation were conflated. Despite previous work on VD phonologically-conditioned variation suggesting that the productions of PRICE are similar before stops and fricatives of the same voicing, it is possible that the effect on PRICE is not the same for fricatives and stops. Therefore, it is useful to look at this specific interaction in more detail. This analysis must necessarily focus on voiceless and voiced obstruents, as they are the only environments that have the same voicing but more than one manner of articulation. Figure 5.8 demonstrates the trajectories of PRICE before voiceless obstruents (*black lines*) in the first row and voiced obstruents (*grey lines*) in the second row. The different columns represent the different levels of **cat**, so that along the first row the formant plots demonstrate the PRICE vowel trajectory before voiceless obstruents (**vl_obs**) in monosyllabic tokens (**mono**) in the first plot, disyllabic monomorphemic tokens (**di**) in the second plot, disyllabic polymorphemic tokens (**morph**) in third plot.

Figure 5.8 indicates that there may be a difference between normalised

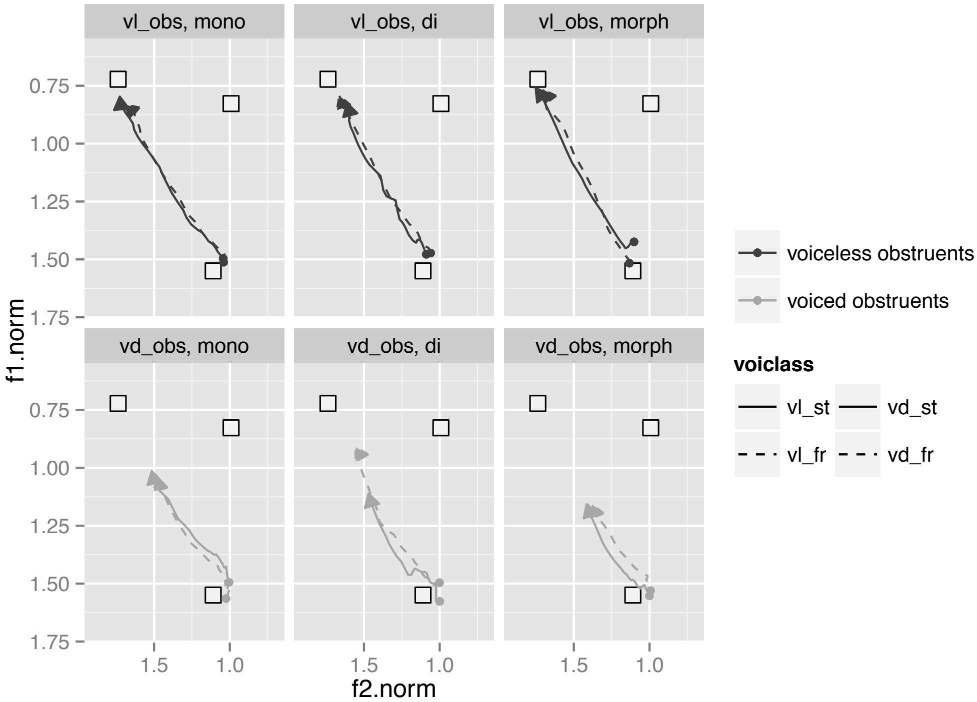


Figure 5.8: Formant plots of PRICE vowel trajectories for voiceless and voiced obstruents by **cat** and manner of articulation

f1 measurements of the nucleus before voiceless stops (**vl_st**, *solid line*) and voiceless fricatives (**vl_fr**, *dashed line*) in disyllabic polymorphemic (**morph**) tokens, but not in monosyllabic (**mono**) or disyllabic monomorphemic (**di**) tokens. Similarly, there may be a difference in normalised f1 measurements of the nucleus between PRICE before voiced stops (**vd_st**, *solid line*) and voiced fricatives (**vd_fr**, *dashed line*) in monosyllabic (**mono**) and disyllabic monomorphemic (**di**) tokens, but not disyllabic polymorphemic (**morph**) tokens. Finally, there appears to be a large difference in normalised f1 measurements at the offglide between PRICE before voiced stops and fricatives in the disyllabic monomorphemic tokens.

As before, I ran five different mixed effects models on a subset of the word list data, including PRICE followed by obstruents only. The dependent measures were voicing, manner of articulation and **cat** and the random effects structure was as described above. There was also a three-way interaction between the independent variables. The mixed effects models demonstrate that there are no significant differences between stops and fricatives of the same voicing, except in the normalised f1 and f2 offglide measurements for voiced obstruents in disyllabic monomorphemic tokens. Given that in almost all cases stops and fricatives do not differ, only stops are included in the main investigation as described in §6.1. Furthermore, the remaining discussion of PRICE looks at only those results pertaining to stops for ease of presentation, but these results are generalisable for the most part to fricatives as well.

These models also evaluate whether PRICE tokens before voiced and voiceless obstruents are significantly different. While there was no difference in the nucleus measurements, normalised f1 and f2 measurements at the offglide and Euclidean distance were found to be significantly different between pre-voiced and voiceless obstruent tokens, ($p=0.003$, $p<0.001$, $p=0.006$ respectively). Therefore, the main investigation includes following voiceless and voiced obstruents separately.

Previous research indicates that LE speakers are less likely to raise PRICE in the voiceless obstruent environment in word list speech than casual speech (Cardoso 2011b). Furthermore, three of the five speakers in the pilot study were in an older age group. As shown in the results of the main investigation (§7), some older speakers do not have a difference in the realisation of the nucleus of PRICE before voiced and voiceless stops. Therefore, the absence of a statistically significant difference between the nucleus of PRICE before voiced and voiceless obstruents may result from other aspects of the pilot data, such as speaker age.

The number of syllables and number of morphemes in tokens (**cat**) were also found to have an effect on the PRICE vowel in some environments. The following environments cannot be included in the discussion of **cat**: in open syllables, /r/, [ɹ], and before vowels. These following environments do not have some of the levels in the **cat** variable. For example, the open syllable environment only occurs in monosyllabic tokens.

Figure 5.9 shows that monosyllabic tokens (**mono**, *solid line*) and disyllabic polymorphemic tokens (**morph**, *dotted line*) pattern together before voiceless stops and /l/ as opposed to disyllabic monomorphemic tokens (**di**, *dashed line*). This is perhaps not surprising given the structure of the disyllabic polymorphemic lexical items. Often, these lexical items corresponded to the

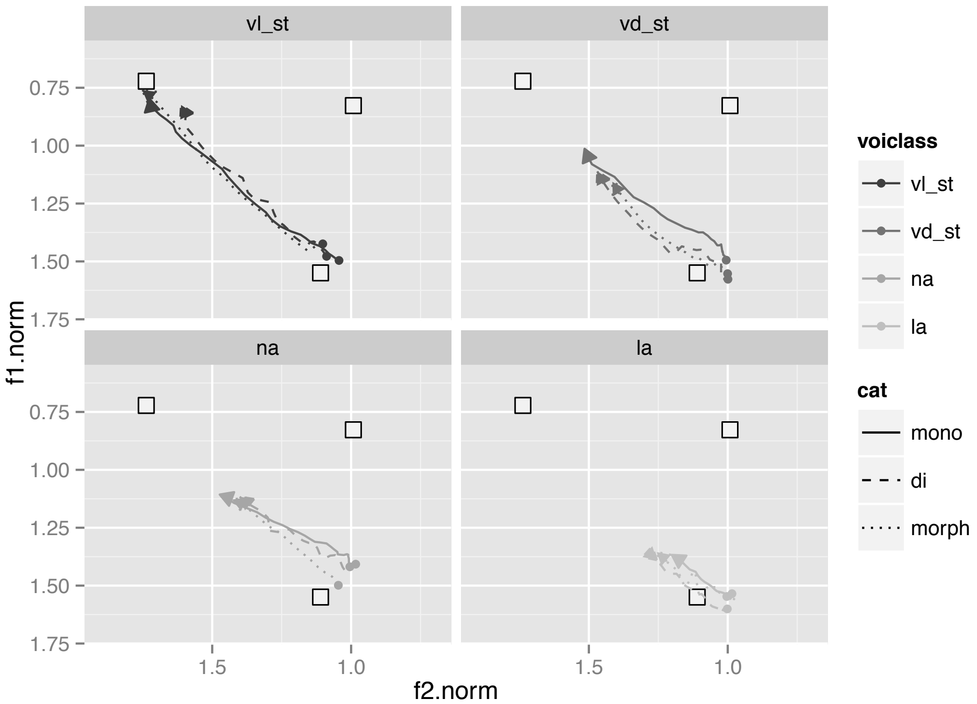


Figure 5.9: Effect of **cat** on PRICE vowel trajectories divided by the following environment

monosyllabic lexical items with the addition of a suffix, for example *drive* and *driver*.

Before voiced obstruents, disyllabic monomorphemic and disyllabic polymorphemic tokens behaved similarly and monosyllabic tokens behave differently. This is again not a surprising result, as the disyllabic tokens regardless of number of morphemes show similar results. The most unexpected result and the only significant difference found in the mixed effects models is that the nucleus of PRICE before nasals is different in the disyllabic polymorphemic tokens, but similar for monosyllabic and disyllabic monomorphemic tokens. Monosyllabic and disyllabic monomorphemic forms do not share morphemes (*time* vs. *climax*) and in one category the following consonant is in coda position (monosyllabic) and in the other category it is in the onset of the second syllable.

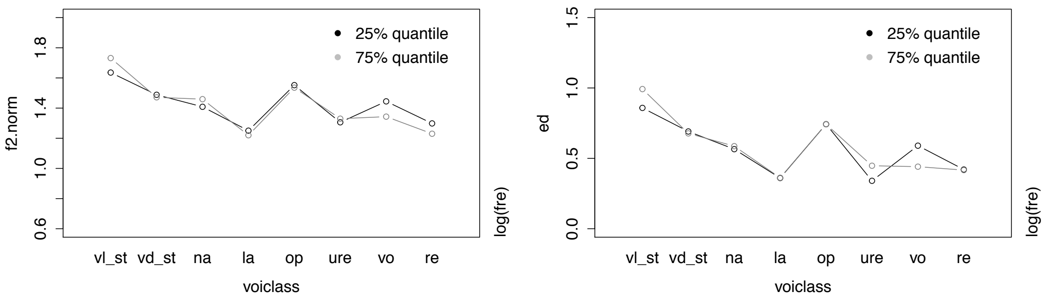
The mixed effects models included following environment (**voiclass**) and **cat** in an interaction term as the fixed effects and random effects structure was the same as previous models on word list data. While Figure 5.9 may suggest differences based on the number of syllables and morphemes in some of the following environments, this is generally not borne out by the mixed effects models. Normalised f1 measurements at the nucleus and offglide of PRICE before nasals is a significant predictor of the model. This suggests that the only statistically significant difference between the lexical items based on number of syllables and morphemes occurs in the pre-nasal environment. However, as only monosyllabic lexical items are included in the main investigation, this must be left for future research.

The final aspect of the pilot study that is discussed is frequency. Some previous research looking at frequency effects has used cutoffs for high frequency and low frequency lexical items, such as Bybee (2002). Bybee (2002) looks at the frequency effects of the deletion of /t/ and /d/ with high frequency lexical items being defined as those lexical items that occur 35 times or more per million and low frequency lexical items are those that occur 35 times or less per million. This cutoff is used as it is the median frequency value of English plurals, which is an environment that Bybee (2002) investigates.

The current study does not use cutoffs, as there was no principled way to make a division within the current data. Furthermore, there is no straightforward way to visualise frequency without using a model and, therefore, results for frequency are only reported in terms of the mixed effects models. A new set of models needed to be run as a result of non-convergence if frequency was included in the full model. Fixed effects in the models were following environment (**voiclass**) and log frequency and random effects structure was the same as previous models.

The results suggest that frequency is a significant predictor in these models for normalised f2 measurements at the offglide and Euclidean distance, both of which indicate that log frequency is a significant predictor of variation ($p<0.001$ and $p=0.002$ respectively). Figure 5.10 shows the predictions of the models for the 25% quantile and 75% quantile of log frequency for the models that have a significant effect of frequency.

For the model that had normalised f2 offglide measurements as the dependent variable, the interaction of following environment and log frequency is significant for all levels within the following environment variable (**voiclass**),



(a) Normalised f2 offglide measurements (f2.norm) by log frequency and **voiclass**

(b) Euclidean distance measurements (ed) by log frequency and **voiclass**

Figure 5.10: Mixed effects model predictions for log frequency ('25% quantile': *black line* & '75% quantile': *grey line*) by **voiclass** on normalised f2 at the offglide (f2.norm) and Euclidean distance (ed)

except for PRICE before nasals (**na**) and /r/ (**ure**) (see Figure 5.10a). On the other hand, the Euclidean distance model had log frequency as a main effect, but the interaction between log frequency and before voiced stops (**vd_st**), /l/ (**la**), and vowels (**vo**) were the only significant predictors (Figure 5.10b). It is possible that the frequency effects found relate to offglide undershoot and the observation that high frequency words tend to be shorter in duration (Bybee 2002). However, a more detailed investigation of the effects of frequency is require in order to determine what the possible reasons for the frequency effects on normalised f2 offglide measurements and Euclidean distance measurements are. As even the basic pattern of PRICE variation in LE has not been investigated in detail until the current study, a detailed look at frequency effects is beyond the scope of the current thesis.

Finally, there were no differences between realisations of PRICE based on the stress patterns, as seen in Figure 5.11. The first syllable always has primary stress, as this is always the syllable with the target vowel. The second syllable, which always included the consonant following the target vowel, either had secondary stress (**s-ss**, *solid line*) or was unstressed (**s-us**, *dashed line*). There does not appear to be a difference in the production of PRICE depending on whether the following consonant is in a secondary stressed syllable or an unstressed syllable. As previously mentioned, the number of conditions in the pilot study needed to be constrained in some ways, one of

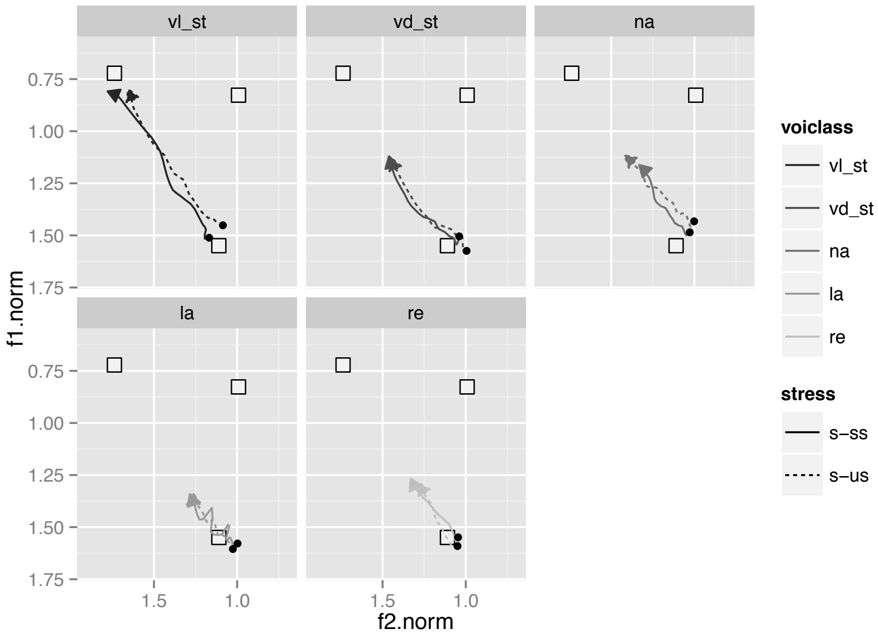


Figure 5.11: PRICE vowel trajectories in disyllabic tokens by stress

which is that the target vowel was always in the first syllable and that syllable always had primary stress. Future research should investigate whether there is a difference in the realisation of PRICE depending on other stress patterns, such as PRICE in a secondary stressed or unstressed syllable and the following consonant in a primary stressed syllable. However, this is outside the scope of the current investigation.

One of the purposes of the present thesis is to present a detailed analysis of the PRICE and MOUTH vowels and their phonological conditioning. Disyllabic lexical items have been shown to introduce many different variables into the analysis, which are difficult to control for. To provide a principled discussion of disyllabic lexical items, the following features should be investigated both on their own and in concert with each other: frequency, number of morphemes, and all possible combinations of stress patterns. In order to obtain reliable statistical analyses and a detailed description of the different effects found for disyllabic lexical items of PRICE in LE, the number of tokens would have to be increased substantially. Furthermore, it may be difficult to find lexical items for each possible combination of categories and if the lexical items are too infrequent one may run into other issues, such as word recognition and

Variable	Tested in Pilot Study	Significant Factor for PRICE	Included in Main Study
place of articulation	yes	no	no
manner of articulation of obstruents	yes	no	**stops only**
voicing of obstruents	yes	yes	**yes**
cat	yes	yes	**mono only**
frequency	in some variables	maybe	no
speech style	in some variables	yes	**yes**
coda versus onset	no	unknown	no
morpheme boundaries	no	unknown	**yes**

Table 5.9: Summary of findings for pilot study variables pertaining to PRICE

non-sense word effects. Therefore, I decided to use only monosyllabic lexical items in the main investigation. As a result, the following environments must be excluded from the main data collection as they do not occur in monosyllabic lexical items of PRICE and MOUTH: before vowels, /r/, [ɹ].

A summary of the findings with reference to the variables included in the pilot study are presented in Table 5.9. This table also specifies (i) whether the variable is a conditioning environment for PRICE variation and (ii) whether it was included in the main study.

5.2.3.2 Results for MOUTH

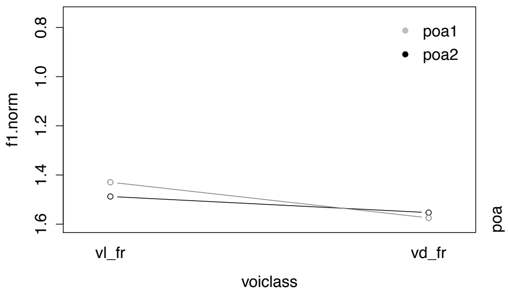
The discussion of the results for MOUTH follows the same structure as that presented for PRICE. As previously mentioned, MOUTH is much more constrained than PRICE in the consonants that can follow it. As a result, only voiceless fricatives (**vl_fr**) and voiced fricatives (**vd_fr**) show more than one place of articulation after MOUTH. The formant plots did not provide a clear picture of whether MOUTH was significantly affected by the place of articulation of the following consonant. Therefore, mixed effects models were used again, including only the word list data. The fixed effects were following environment (**voiclass**), **cat** and place of articulation and random effects structures were the same as described for PRICE in §5.2.3.1. None of the measurements (normalised f1 and f2 at the nucleus and offglide, and Euclidean distance) show a statistically significant effect of place of articulation, as shown in Figure 5.12.

The next feature is whether there is a difference between MOUTH vowel trajectories before voiced and voiceless obstruents. Figure 5.13 demonstrates that there is no difference between voiced obstruents across monosyllabic (**mono**), disyllabic monomorphemic (**di**) and disyllabic polymorphemic (**morph**) tokens. However, there may be a difference in MOUTH realisations before voiceless obstruents in monosyllabic, disyllabic monomorphemic and disyllabic polymorphemic tokens. According to the results of the mixed effects models, the voicing of the following obstruent is not a significant predictor of MOUTH realisations. Given that only monosyllabic lexical items were used in the main investigation, this issue will be left unresolved for the time being.

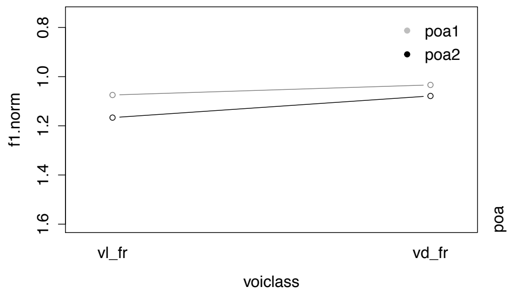
Since MOUTH did not differ before fricatives and stops of the same voicing in monosyllabic tokens, the remainder of the analysis discusses stops only. This is the same for the pilot study results for PRICE. Furthermore, the main investigation includes MOUTH lexical items before stops only to ensure the same experimental design for PRICE and MOUTH. This should not affect the results of the main study, as manner of articulation did not have an effect on monosyllabic tokens.

The mixed effects models could not be run when an interaction term between following environment (**voiclass**) and **cat**, due to the underrepresentation of certain combinations of levels from these two predictors in the MOUTH dataset. Fixed effects of following environment and **cat** are included and the random effects structure is the same as in previous models. The predictions of the models suggest that for the majority of measurements MOUTH tokens do not differ based on number of syllables and morphological complexity. The only exception is for the normalised f1 offglide measurements. Disyllabic polymorphemic tokens of MOUTH were significantly different ($p=0.004$) from monosyllabic and disyllabic monomorphemic tokens for the normalised f1 offglide measurements.

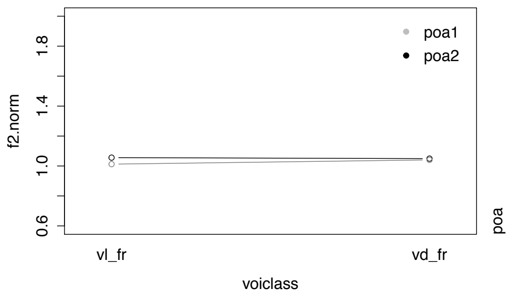
Frequency within MOUTH was difficult to assess as a result of frequency strongly correlating with a number of other factors, such as type of speech, particular following environments and **cat**. For example, only frequent lexical items occur in the spontaneous speech and only infrequent MOUTH lexical items exist before [r] (*maori* and *cowrie*). On the other hand, before voiceless



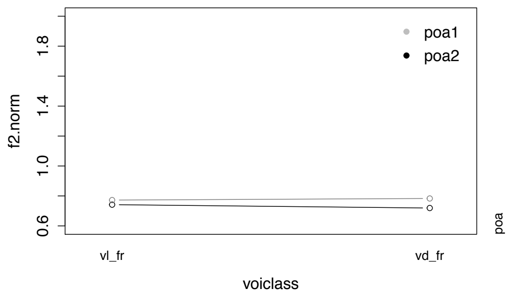
(a) Normalised f1 nucleus measurements (f1.norm) by place of articulation and **voiclass**



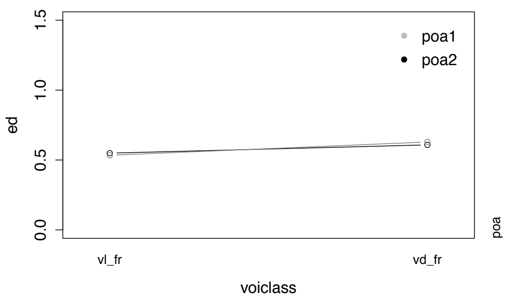
(b) Normalised f1 offglide measurements (f1.norm) by place of articulation and **voiclass**



(c) Normalised f2 nucleus measurements (f2.norm) by place of articulation and **voiclass**



(d) Normalised f2 offglide measurements (f2.norm) by place of articulation and **voiclass**



(e) Euclidean distance measurements (ed) by place of articulation and **voiclass**

Figure 5.12: Mixed effects model predictions for place of articulation ('front': *black line* & 'back': *grey line*) by **voiclass** on the five dependent variables: normalised f1 at the nucleus and offglide (f1.norm), normalised f2 at the nucleus and offglide (f2.norm), and Euclidean distance (ed)

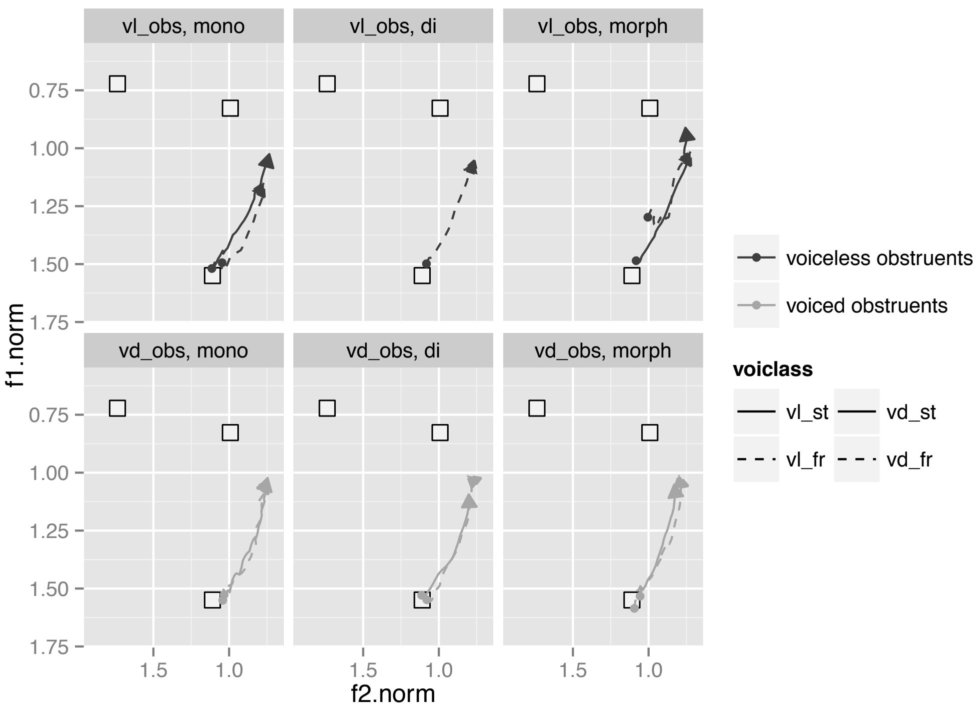


Figure 5.13: MOUTH vowel trajectories before voiceless and voiced obstruents by **cat**

stops, nasals and in open syllables MOUTH lexical items range in frequency. It would be difficult, and in some cases not possible, to control for many of the factors that affect frequency of MOUTH lexical items and would likely result in an unmanageable data collection task for participants or a poor experimental design where there are many confounds. Therefore, frequency was also excluded from the main investigation.

Stress patterns in disyllabic MOUTH lexical items was difficult to analyse, as the lexical items in the word list data were all a primary stressed syllable followed by unstressed syllable. This was done to ensure consistency in other dimensions, as well as a result of the limited lexical items available for MOUTH. There were some conversation tokens with other stress patterns, but there were so few of them that an analysis of them would not be reliable.

Overall, including disyllabic tokens of MOUTH raises a range of issues, due to the paucity of lexical items exemplifying the relevant conditioning environments and the low frequency of many lexical items. As a result of

Variable	Tested in Pilot Study	Significant Factor for MOUTH	Included in Main Study
place of articulation	yes	no	no
manner of articulation of obstruents	yes	no	**stops only**
voicing of obstruents	yes	no	**yes**
cat	yes	yes	**mono only**
speech style	no	unknown	**yes**
frequency	no	unknown	no
coda versus onset	no	unknown	no
morpheme boundaries	no	unknown	**yes**

Table 5.10: Summary of findings for pilot study variables pertaining to MOUTH

these issues and those relating to disyllabic lexical items of PRICE, disyllabic lexical items were not included in the main investigation.

A summary of the findings of the pilot study for the MOUTH vowel is presented in Table 5.10. The variables that were tested in the pilot study and their effects on realisation of MOUTH are included. Table 5.10 also shows whether the variables are included in the main investigation.

5.3 IMPLICATIONS FOR THE MAIN INVESTIGATION

As mentioned in §5.2, the pilot study had three main goals: to refine the original hypotheses, to evaluate the conditioning environments to include in the main investigation and to evaluate the methodology and experimental design. This section discusses each of the objectives of the pilot study in turn, in order to refine the procedures and methodology for the main data collection.

One of the main advantages of using the pilot study was that it provided an opportunity to evaluate the relevant factors for PRICE and MOUTH phonologically-conditioned variation. This was useful both in terms of determining which environments might be important to include in the main investigation and in terms of evaluating the feasibility of including specific pertinent factors.

Firstly, number of syllables and morphological structure were found to influence the production of PRICE and MOUTH in some cases. While it was found that in some cases disyllabic tokens behaved differently from monosyllabic tokens within both PRICE and MOUTH, it was also clear that some of these effects resulted from a complex interaction with other variables or limitations on lexical item availability. Therefore, I decided to include only monosyllabic lexical items in the main study. The exclusion of disyllabic lexical items means that stress and coda versus onset cannot be evaluated in the main investigation. A number of conditioning environments must also be excluded as a result of this, such as lexical items before vowels, /r/ and [ɹ]. Further study on the effects of syllable number on the productions of PRICE and MOUTH is required, but is left for future research.

There were also some issues with the form of disyllabic polymorphemic lexical items included in the pilot study, as these lexical items did not accurately reflect the morpheme boundary conditioning environment for SVLR. However, the differences in morphological structure of PRICE and MOUTH disyllabic lexical items did reflect the same structure as previous research on the effects of morphological complexity in disyllabic tokens in SVLR patterns. For a detailed discussion of this previous work see §3.3.2. Morpheme boundaries of the monosyllabic SVLR conditioning environment type (*tide* versus *tied*) were included in the main study to determine whether morpheme boundaries have a similar effect on PRICE and MOUTH in LE as they do in SVLR patterns. As only monosyllabic lexical items were included, the morpheme boundary occurred between the target vowel and the following consonant, similar to the conditioning environment generally described for SVLR type patterns. It was, therefore, possible to compare lexical items like *side, sigh* and *sighed* in the main investigation.

I also decided to exclude frequency from the main investigation, as a result of the lack of high-frequency MOUTH lexical items in certain environments and some confounds for PRICE lexical items and frequency effects. Mainly, there are some environments for MOUTH where no high frequency lexical items occur. That being said, further research on the interaction between frequency and PRICE and MOUTH phonologically-conditioned variation in LE is needed, but is outside the scope of the current study.

Both place of articulation and manner of articulation were tested in the pilot study in the pertinent following environments (within voiced and voiceless obstruents). It was found that place of articulation of the following consonant within the same **voiclass** did not produce differences in the production of the target vowels. As a result, the main investigation includes only alveolar consonants. This is to ensure that the results are generalisable, while limiting the number of possible confounds, such as co-articulation effects. Furthermore, fricatives and stops with the same voice specification did not differ. This resulted in the inclusion of voiced and voiceless stops only in the main study. In summary, the conditioning environments that are included in the main investigation are:

1. monosyllabic monomorphemic lexical items of PRICE and MOUTH before:
   (a) vl_st (/t/)
   (b) vd_st (/d/)
   (c) na (/n/)
   (d) la (/l/)
   (e) open
2. monosyllabic with a morpheme boundary - past tense morpheme, e.g. *died* and *vowed*

The pilot study was also used to evaluate the methodology and refine hypotheses for the main study. One of the hypotheses was that PRICE and MOUTH have separate, but related patterns of phonologically-conditioned variation in LE, as indicated by previous studies (Berry 2009, Cardoso 2011b). The pilot study corroborated this finding. There were many similarities between the two target vowels, which demonstrates that these patterns are likely related. For example, place of articulation does not have a significant effect on the productions of the target vowels and stops and fricatives of the same voicing specification do not influence the target vowel productions differently. However, there were also differences between the results of the pilot study for PRICE and MOUTH, which indicates that the patterns are separate. One example of this is the difference between voiced and voiceless obstruents. PRICE has a different production before voiceless obstruents compared to voiced obstruents, while MOUTH does not show a difference before voiced and voiceless obstruents. Similarly, there were differences between PRICE and MOUTH in monosyllabic, disyllabic monomorphemic, and disyllabic polymorphemic tokens. Finally, productions of PRICE were found to be heavily influenced by the type of speech, but MOUTH was not influenced to the same extent. However, this may have resulted from the small number of tokens in casual speech, which leads to issues surrounding the experimental design.

The main motivation for including both a word list and a small sociolinguistic interview was to investigate the extent to which speech style affects PRICE and MOUTH phonologically-conditioned variation in LE. Using a sociolinguistic interview did not produce a sufficient number of tokens of the target vowels in casual speech for a reliable analysis of the effects of speech style. There were 160 PRICE and 87 MOUTH tokens in the approximately 4550 words in the interview data and out of over two thousand tokens in the whole pilot study dataset. Therefore, the main investigation relies on a more controlled conversational task, which is explained in detail in §6.1. Furthermore, the types of tokens that are found in conversation speech for the PRICE vowel varied across the different following environments to a much greater extent than the MOUTH vowel tokens. This suggests that it may be possible to attain a sufficiently diverse range of PRICE tokens if an even longer stretch of casual speech is used. However, this is not the case for the MOUTH vowel. The tokens of MOUTH in the interview data occurred primarily before voiceless obstruents, nasals, and in open syllables. There were no tokens before /l/ and only one token before a voiced stop. On the other hand, PRICE tokens in interview data had at least one token in all of the following environments with the majority of the tokens occurring before voiceless obstruents, voiced obstruents, nasals, and in open syllables. As a result of this difference between the distributions of the two target vowels in casual speech and other constraints on the MOUTH vowel, I only investigate PRICE and not MOUTH in the *Origins of Liverpool English* corpus (Watson and Clark forthcoming), which is the historical corpus data used to look at the PRICE realisations and conditioning environments for speakers born much earlier than the speakers in the main investigation.

As a result of the exclusion of certain environments and the results of the pilot study, it was also possible to refine the original hypotheses (see §5.1 for the original hypotheses). The revised hypotheses for the main investigation are:

1. PRICE and MOUTH in LE are phonologically conditioned by the following

environment (**voiclass**).

2. PRICE and MOUTH phonologically-conditioned patterns of variation in LE are separate, but related, patterns.

3. Word list speech has different phonological conditioning of PRICE and MOUTH compared to casual speech in LE.

The pilot study results provide good evidence that place of articulation of the following consonant does not affect the production of the target vowels, but voicing + manner of articulation (**voiclass**) does. There are effects related to the numbers of syllables and morphemes, but these may be confounded with other factors in the data and require a future detailed investigation. It was not possible to pursue this in the main investigation and only monosyllabic lexical items were collected. Interview style tasks do not provide an adequate number of MOUTH tokens to investigate and also only provide a limited number of PRICE tokens. Therefore, a word list and more controlled casual speech task are used in the main data collection (see §6.1.2).

CHAPTER 6

MAIN INVESTIGATION: METHODOLOGY

The current chapter discusses the methodology and data analysis techniques used for the main investigation. This investigation provides an in-depth analysis of the contemporary PRICE and MOUTH phonologically-conditioned variation in LE using twenty seven participants from different areas of Liverpool. Due to the varied and large number of participants, a controlled yet comprehensive experimental design and a larger number of lexical items, the results of this investigation provide a fuller view of PRICE and MOUTH phonologically-conditioned variation in LE in monosyllabic words.

Section 6.1 discusses the methods for the data collection, which is followed by a discussion of the data analysis procedures for the main investigation in §6.2.

6.1 METHODOLOGY

6.1.1 Participants

Participants self-identified as 'Scousers' and had lived in Liverpool for most, if not all, of their lives. There were originally twenty-eight participants recorded for the study, but one had to be discarded because they were not suitable for the current investigation. By the end of the word list task, it became clear that this participant had great difficultly reading the word list, with many errors or omissions. They would often skip words that they could not read. As a result, it was not possible to analyse enough of the tokens for

Gender	Age		Location			
	Younger	Older	South	North	Wirral	Knowsley
male	10	2	3	8	1	0
female	11	4	3	7	3	2

Table 6.1: Participant metadata for the main investigation

this speaker and so they were removed.

Most of the participants' parents were from Liverpool, with the exception of four. Two of these participants had one parent from Liverpool and the other parent from elsewhere in the United Kingdom and the Republic of Ireland. The other two participants had both parents from elsewhere in the United Kingdom and the Republic of Ireland. There were twelve male and fifteen female participants, mostly under the age of 30 at the time of recording (ranging between the ages of 18 – 66). Six of the participants were above the age of 40, with no participants between the ages of 30 and 40. Therefore, if participants were under the age of 40 they were classed as younger and 40 or above were classed as older in the analysis.

As mentioned in §2.3 speakers were divided into categories depending on which ward they indicated they were from. The four categories used were north, south, Wirral and Knowsley.[1] Figure 6.1 shows the ward that each participant indicated that they were from. The colours indicate the categorisation of the participants into the four locations based on the divisions discussed in §2.3 and the size of the dot indicates the number of participants from that area. In other words, a bigger dot shows that there were more participants from that ward. West Derby had the most participants from a single ward, with five participants coming from West Derby.

Table 6.1 provides a summary of the number of participants by gender, age and location. Participants were found by either a call for participants at the three universities in Liverpool (Liverpool Hope University, Liverpool John Moores University and the University of Liverpool) or by approaching passers-by at the different universities. The data was collected over one week in Liverpool travelling between the three universities.

[1]Note that most participants had lived in a number of different wards in Liverpool throughout their lives.

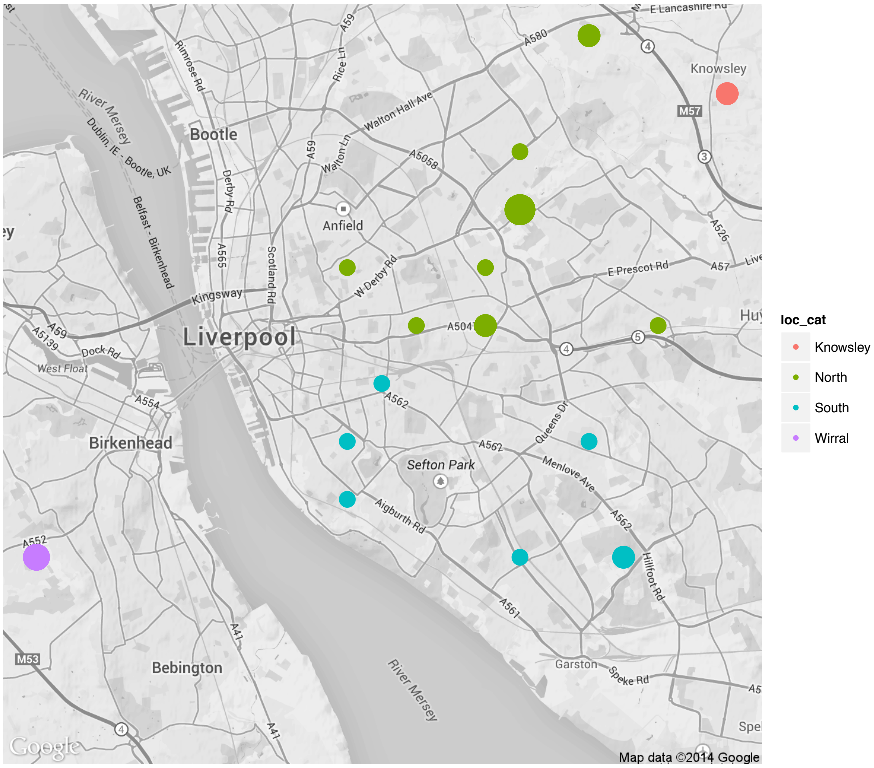


Figure 6.1: Location of participants in main investigation

Table 6.1 demonstrates that males and females are distributed fairly evenly across different locations. However, due to participants coming mostly from universities the sample is unbalanced for age, with a larger portion of the participants in the younger category. Aside from age, gender and location, participants were also coded for a number of other variables, as shown in Table 6.2. All of the participants were university students or staff. While it is difficult to determine the socio-economic status of the participants, the background of some of the participants may suggest that they would be classified as 'working-class', mostly based on parents' occupation. Parents' occupations were recorded in order to gain a better understanding of the background of the participants and their socio-economic status. However, there were a number of complications in categorising participants into working or middle class. For example, a number of participants had one parent in a 'working-class' occupation and the other in a 'middle-class' one. Occupations were classified loosely based on the system used for national statistics in

Name	Definition	Values
spe	*speaker ID*	LE1 – 5
loc	*location of speaker by ward*	e.g. *Allerton*
loc_cat	*location of speaker by categories*	n (north), s (south) w (wirral), k (Knowsley)
gen	*gender of participant*	m (male) f (female)
age	*age of participant*	o (older) y (younger)
fam	*where parents are from*	e.g. LP (all from Liverpool) 1other (1 parent not from LP)
gen_par	*gender of partner in map task*	sam (same gender) dif (different gender)

Table 6.2: Variables participants are coded for in the main investigation

the United Kingdom, as described in Office for National Statistics (2014). Furthermore, categorising the participants based solely on a few features may be problematic and in sociolinguistic research there are a number of different schema used to classify speakers in different socio-economic categories (see Ash 2002 for a detailed discussion of social class). Given the difficulties with classification, that much of the information needed to classify the speakers in a more sophisticated way is not accessible, and that this investigation is not focussing on sociolinguistic variation, socio-economic status of speakers is not considered in the current analysis.

Where appropriate, participants' metadata may be referred to in the results if a particular individual or set of individuals produce different results from the main cohort of participants.

6.1.2 Materials

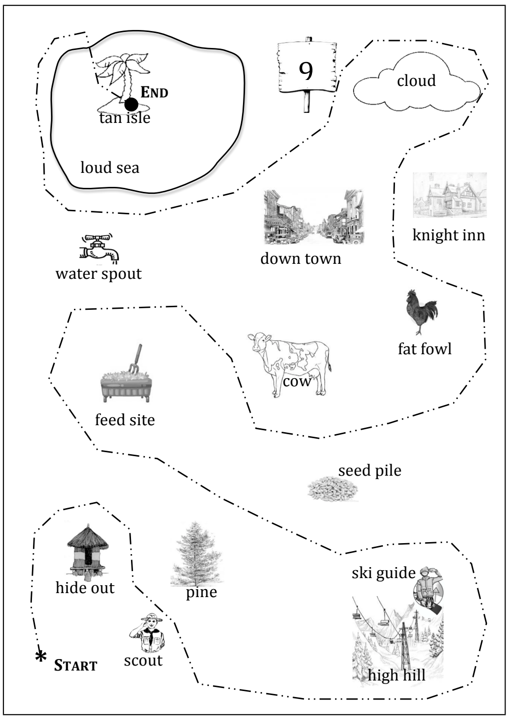
The main study consisted of a word list and a conversation task in the form of map tasks. As discussed in §5.3, it was not possible to discuss the relationship between vowel productions in different speech styles in the pilot study because of issues with using a sociolinguistic interview format.

The current investigation still seeks to verify the hypothesis that there are differences in the production of the target vowels depending on speech style, as it has been discussed in previous work on PRICE and MOUTH realisations in LE. A word list provides a more formal speech style, while the map tasks provide a somewhat controlled conversational task, as described below. In the data collection, the map tasks were conducted first and word list second in order to allow the participants to produce more natural speech before reading the word list.

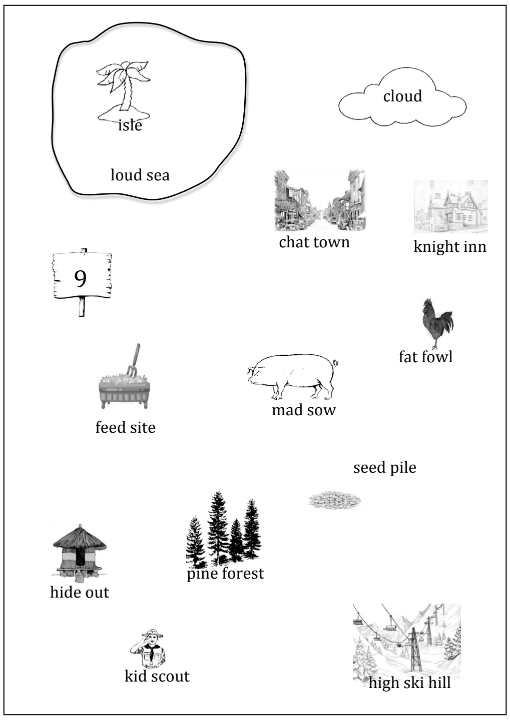
The casual speech data was gathered through the use of map tasks. Map tasks have been used in various linguistic studies, generally in the fields of pragmatics and semantics (Anderson et al. 1991). However, the method was appropriate for the present purposes, as it allowed for a certain amount of control over the lexical items used by participants whilst ensuring that participants were producing more natural speech. The map tasks are paired conversation tasks, where each of the participants is given a map with a number of different labelled pictures. The two maps differ slightly from each other in order to ensure that many of the labels and pictures are used by the participants when navigating around the maps. The two sets of maps used in the main investigation are shown in Figure 6.2. A path is shown on one of the maps in the set (Figure 6.2a and 6.2c), which is the map held by the 'director' of the task. The second map does not have a path (Figures 6.2b and 6.2d) and it is held by the 'follower' of the task.

The director in the map task is meant to guide the follower along the same path that is given on their map. The small differences between the maps are meant to make the task slightly longer and harder and to help to ensure that participants use each of the pictures and labels multiple times. The follower has a pencil and draws the path as the director indicates. The only restriction imposed on the participants is that they cannot look at each other's maps.

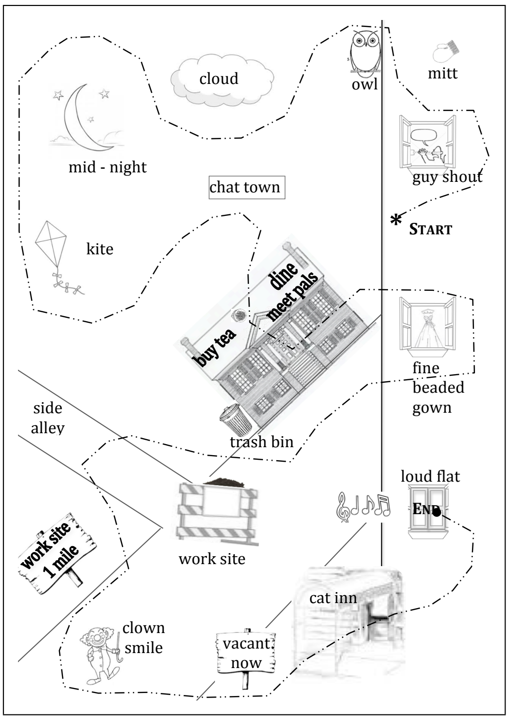
PRICE and MOUTH lexical items before voiceless stops, voiced stops, nasals, /l/ and in open syllables were included in the picture labels on the maps, as were distractor lexical items with FLEECE, KIT and TRAP vowels. An additional small pilot study conducted at the University of Edinburgh, prior to the main data collection in Liverpool, was used to determine whether map tasks were a more appropriate method for casual speech data collection in the



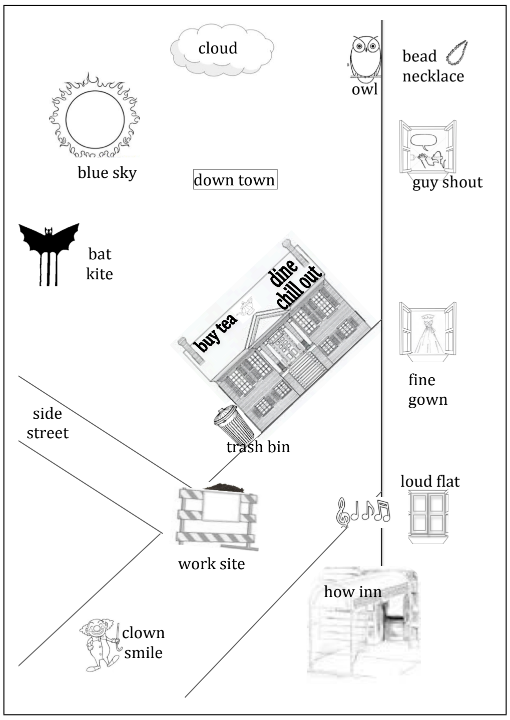
(a) Map set 1: 'director' map



(b) Map set 1: 'follower' map



(c) Map set 2: 'director' map



(d) Map set 2: 'follower' map

Figure 6.2: Map task materials for the main investigation

main investigation than the interview style used in the pilot study. It was found that participants in this second pilot study used PRICE and MOUTH lexical items from the labels as well as other PRICE and a small number of MOUTH lexical items when negotiating the maps. The pilot study was also used to ensure that participants would not be aware of what the map tasks were focussing on and that none of the labels were too unusual for the participants. None of the pilot study volunteers were aware of the aims of the map tasks or mentioned that the picture labels were too unusual. This second pilot study showed map tasks to be a much better methodology for the current purposes, and so the maps in Figure 6.2 were used in the main study.

Word list lexical items consisted of PRICE, MOUTH and distractor words. The word list lexical items consist of monosyllabic monomorphemic words, such as *tide* and *loud*, and monosyllabic bimorphemic words, such as *tied* and *vowed*. The monosyllabic bimorphemic words are of the form that target vowels are in the first morpheme and the consonant following the target vowel is in the second. In order to remain consistent with the other categories following PRICE and MOUTH, the past tense morpheme was used in the lexical items with a morpheme boundary. Table 6.3 shows the number of word list lexical items by environment. As with the pilot study, some lexical items needed to be repeated in the main investigation in order to ensure a similar number of stimuli in each category. For example, there are very few monosyllabic words with MOUTH followed by a /d/ and so these words were repeated in order to have the same number as in all other conditioning environments.

Distractor lexical items are used in the same way as in the pilot study, to prevent the participant from knowing what the investigation is about. Monosyllabic lexical items with the FLEECE, KIT or TRAP vowels are used as distractors. The main data collection contains more than twice as many distractors as target lexical items. In the main investigation, MOUTH lexical items were counted as distractors for PRICE and vice versa. While the distractor lexical items are not analysed in the main study, some of the distractors were used in order to normalise the data.

The tokens were randomised using the same python script that was used in the pilot study, so that no lexical item occurred twice in a row. Therefore, each participant read the word list in the same order. The stimuli were embedded

Vowel	Environment	**Voiclass**	Example	No.
Analysed				
PRICE	voiceless stops	vl_st	*kite*	20
	voiced stops	vd_st	*tide*	20
	nasals	na	*mine*	20
	/l/	la	*file*	20
	word final open syllable	op	*buy*	20
	morpheme boundaries	m_bound	*sighed*	10
				110
MOUTH	voiceless stops	vl_st	*pout*	20
	voiced stops	vd_st	*cloud*	20
	nasals	na	*down*	20
	/l/	la	*scowl*	20
	word final open syllable	op	*cow*	20
	morpheme boundaries	m_bound	*vowed*	10
				110
Distractors				
TRAP		n/a	*pat, ban, shall*	22
FLEECE		n/a	*bead, tee, keyed*	52
KIT		n/a	*sit, bin, chill*	46
				120

Table 6.3: Word list lexical items in the main investigation

in a carrier sentence of the form "Say x here."

6.1.3 Procedure

As the main data collection took place over a week at three different campuses, it was not possible to conduct the study in the same room for each participant. Various different rooms were used on the three campuses, the only requirement being that the two participants would be comfortable and that the area was relatively quiet. Participants put on a ShureSM10 head-mounted microphone connected to a Marantz PMD 661 recording device. Instructions were given both orally at the beginning of the map tasks, and both orally and on a computer screen for the word list portion of the study.

The map tasks were done in pairs. Prior to participating in the study, informants were asked to bring someone of the same gender, a similar age and from a similar location. All of the participants completed the map tasks with someone of a similar age. However, some informants brought opposite gender partners with them. Overall, eight of the participant pairs were same gender and six were different genders. Whether the pairing was same or different gendered is coded for each speaker, as mentioned in §6.1. Each pair completed two map tasks with each participant being the director once and the follower once.

Participants were told that their maps were similar but that there may be some small differences between them. Both the director and follower were informed that they could say anything that was relevant to task, along with describing or reading the labels on the map. Once the first set of maps were completed, the participants would get the second set and change roles.

After the map tasks were completed, one of the participants was asked to leave the room while the other completed the word list portion of the data collection. Participants were asked to read out a randomised word list. The test section contained three example lexical items[2] in order to allow the participants to familiarise themselves with the task and to ask any questions about the study. The researcher was present in the room for the test section and then joined the other participant outside once the test section was complete. When the first participant had completed reading the word list, they were asked to fetch the researcher. Then the second participant would complete the same task, while the first participant and the researcher remained outside the room.

The procedure for the word list section of the data collection was similar to the procedure for the word list in the pilot study. Participants were presented with one carrier sentence + item ("Say x here") at a time and would freely change to the next screen by pressing either SPACE or the arrow key. The end of the word list was indicated by a screen thanking the participant for participating in the study.

Data for each participant was saved separately as a 48kHz wav file and tokens were coded for the variables shown in Table 6.4.

Similar to the results presented for the pilot study in §5.2.3, results of

[2]The example lexical items were not PRICE and MOUTH words.

Name	Definition	Values
wor	*lexical item*	e.g. *kite*
vow	*vowel type*	PRICE, MOUTH
voiclass	*voicing and manner of articulation of the following consonant*	e.g. vl_st (voiceless stop), na (nasal)
cat	*token with or without a morpheme boundary*	momorph (no morpheme boundary) bimorph (morpheme boundary)
conv	*speech style*	y (map task data) n (word list data)
step	*measurement points*	number between 1 – 11
start	*time within speech sample that the token occurred*	a number in seconds

Table 6.4: Variables tokens are coded for in the main investigation

the main investigation may use the labels for the variables shown in Table 6.4. For example, **cat** refers to whether the item has a morpheme boundary in the form described above or not. In other words, monomorphemic lexical items are referred to as **momorph** and bimorphemic lexical items are referred to as **bimorph**.

As discussed in detail in §5.2.1.3, the pilot study and main investigation received ethics approval from the department of English Language and Linguistics at the University of Edinburgh under the online LEL Ethics Submissions programme and were confirmed to conform to the standards of good practice established by the British Association for Applied Linguistics (British Association for Applied Linguistics 2006). Participants were also compensated £5 for their participation, which they received prior to beginning the map tasks.

6.2 DATA ANALYSIS

The data analysis for the main investigation was similar to that for the pilot investigation. Sound files were segmented in PRAAT (Boersma and Weenink 2013) manually and eleven equally spaced measurements of f1, f2 and f3,[3] and a

[3]While f3 measurements were taken, these measurements are not included in the analysis.

duration measurement were taken for each target vowel using a PRAAT script (by Márton Sóskuthy and Dániel Szeredi). While the pilot study used fifty measurements, eleven measurements were used in the main study. The main investigation has 9562 tokens of PRICE and MOUTH. Taking fifty measurements for each of these tokens would result in a large data file, which would have been difficult to handle in the data analysis software. Furthermore, the pilot study did not provide any indication that such a high resolution was necessary: there were no sudden movements in the vowel trajectories that would justify the use of such a large number of measurement points. Therefore, I decided to take eleven measurements, where the first measurement is taken at the beginning of the vowel and the eleventh one at the very end of the vowel. Eleven measurements were chosen so that measurements were taken at every 10% interval of the target vowel. This decision ensured that the analysis could refer to the nucleus (20%) measurement and offglide (80%) measurement, which are generally used for analysing diphthongs, but also the movement of the vowel from the nucleus to the offglide at every 10% interval. As discussed for the pilot study in §5.2.2, the measured portions of speech included the entirety of the vowel, including consonant transitions. The PRAAT script produced pdf snapshots of the token spectrograms, which were used to help verify the accuracy of formant measurements.

These measurements were then analysed using R (R Core Team 2013) within the R studio interface (RStudio 2012). Figures were created using the ggplot2.R package (Wickham 2009), which are presented in Chapter 7. In order to ensure that consonant transitions did not affect the results, measurements between 0 - 19% and 81% - 100% were not included in formant plots. The formant measurements were normalised using the modified Watt and Fabricius method (Watt and Fabricius 2002) in R (R Core Team 2013) using the Vowels.R package (Kendall and Thomas 2009–2014). All of the formant plots and box plots presented in the results are based on these normalised measurements. Similar to the results presented for the pilot study, formant values are often averaged for clarity in the formant plots. Captions on the formant plots indicate whether all of the speakers or individual speakers are presented in the figures. As with the pilot study results, the white boxes outlined in black on formant plots represent the average formant values at the midpoint of the FLEECE, GOOSE and TRAP vowels in order to orient the target vowels in phonetic space. These measurements were taken for each speaker from a small subset of the FLEECE, GOOSE and TRAP tokens produced in the word list and map tasks.

Duration measurements are normalised using z-scores. Lobanov (1971) used z-scores in linguistic research to normalise f1 and f2 measurements. However, it has been used to normalise vowel duration by Wang and Van Heuven (2006). Z-scores are calculated by taking the difference between the raw duration value and the speaker's average value and dividing the difference by the speaker's standard deviation (see formula 6.1 below). This produces positive and negative values, where 0 represents the speaker's average duration. Positive values indicate vowel durations that are longer than the speaker's average and negative values indicate vowel durations that are shorter than the speaker's average.

$$z\text{-}score = \frac{(raw\ duration - speaker's\ average\ duration)}{speaker's\ standard\ deviation} \tag{6.1}$$

Box plots are used to show the vowel durations. The line in the centre of the boxes indicates the median value of the vowel durations in that environment. Figure 6.3 demonstrates the use of notches in box plots. The notches in the sides of the boxes show whether the medians of the boxes differ. In other words, if two boxes' notches do not overlap that is taken as 'strong evidence' that their medians are different (Chambers et al. 1983). Therefore, Figure 6.3 shows that the median duration differs between the 'vl' environment and the two 'vd' environments, but not between 'vd' and 'vd2'. Note that the notches are only used as visual aids and effects are checked using standard statistical procedures described below.

Euclidean distance between the formant values for the nucleus and the offglide is again used as an indication of the amount of diphthongisation of the vowel. The nucleus measurement was taken at 20% and the offglide measurement was taken at 80%. Euclidean distances in the results are presented using density plots and violin plots. Density plots are similar to histograms, as the frequency distribution of a feature is shown along a continuous dimension. The density plots presented in Chapter 7 demonstrate the extent to which different degrees of diphthongisation are represented in the data set. The amount of diphthongisation is plotted along the x-axis and the y-axis is proportionate to the number of tokens (see Figure 6.4 for a schematised example).

Violin plots are used in situations where results would be difficult to interpret with density plots because of the large number of different groups. Violin plots are a combination of a box plot and density plot (Hintze and Nelson 1998), so that it is possible to see the distribution of Euclidean distances in each of the categories. In the violin plots for the current thesis, the amount of diphthongisation is plotted along the x-axis and the y-axis is the following environment in order to be consistent with the density plots (see Figure 6.5 for an example). Furthermore, the violin plot has a box plot inside showing the median, overlapping notches and the mean, which is represented by a white dot. Therefore, in Figure 6.5 the 'mono' group differs from both of the 'diph' groups, but 'diph' and 'diph2' do not differ convincingly as the notches of the box plots overlap. The 'mono' group is more monophthongal and the 'diph' groups are more diphthongal, and the mean and the median are not the same for any of the groups. Finally, Figure 6.5 shows that the distribution of 'diph' is much wider than that of 'diph2' and 'mono', and 'diph2' is more of a normal distribution than 'mono'.

The results in Chapter 7 provide evidence that allows us to evaluate the three hypotheses in §5.3, which are related to features of phonological patterns of PRICE and MOUTH described in §3.3. The graphical representations discussed so far are useful in understanding these features. However, Chapter 7 also provides a preliminary evaluation of the fundamental assumptions of the approaches to the origins of these patterns, as described in §4.2. In order to provide evidence related to the origins of these patterns two further graphical representations are required. These are used in Chapter 7, 9 and 10.

These diagrams are used to illustrate evidence for different aspects of approaches to the emergence of these features, specifically for the 'asymmetric assimilation' and the 'failure-to-lower' accounts. The first graphical representation shows formant trajectories (Figure 6.6a), using local smoothing (*loess*) from the ggplot2.R package (Wickham 2009). The x-axis is *measurement points*, which represents the position along the trajectory, so that each 10% measure is one tick along the axis. Only measurement points between 20% and 80% are displayed on these figures in order to exclude the consonant

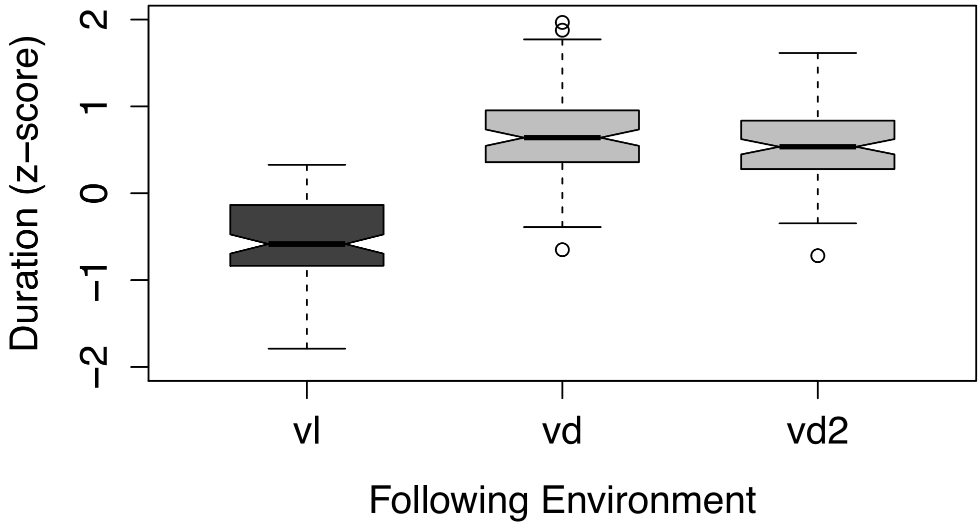


Figure 6.3: Example of box plots with notches showing z-scores for normalised duration measurements: shorter tokens (*dark grey*) median is unlike 'vd' categories, longer tokens (*light grey*)

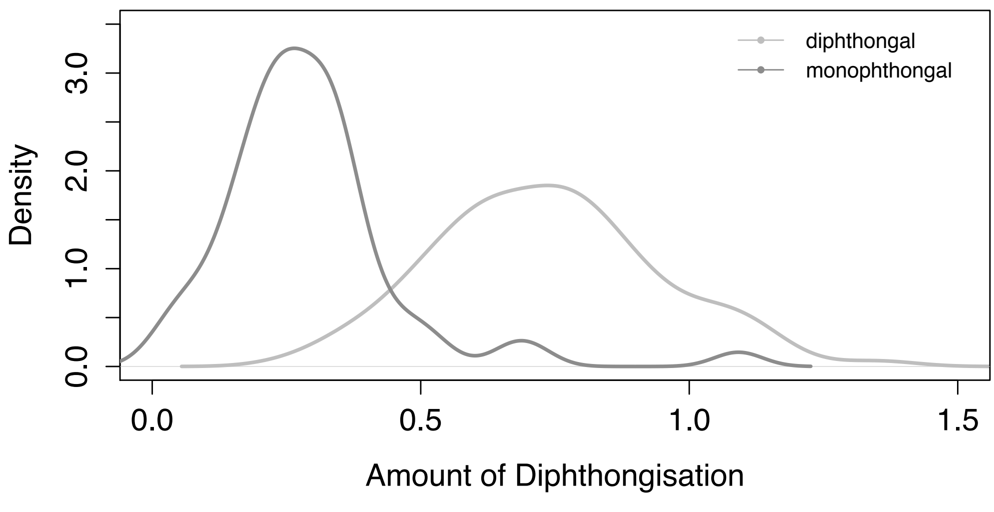


Figure 6.4: Example of density plots showing the amount of diphthongisation of tokens: more monophthongal tokens (*dark grey*) and more diphthongal tokens (*light grey*)

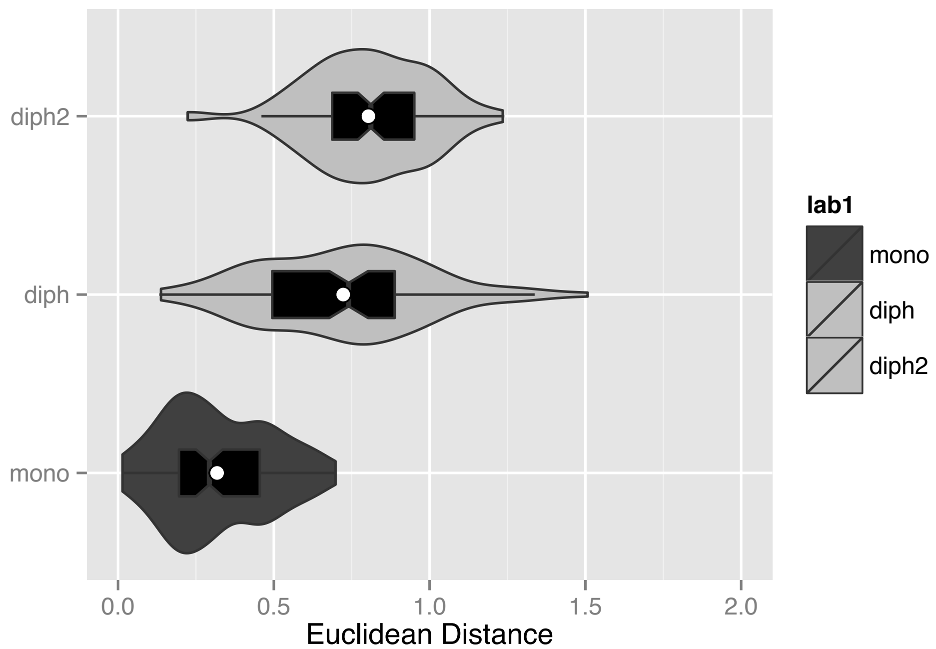
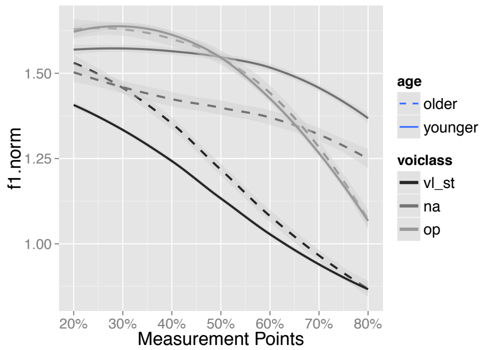


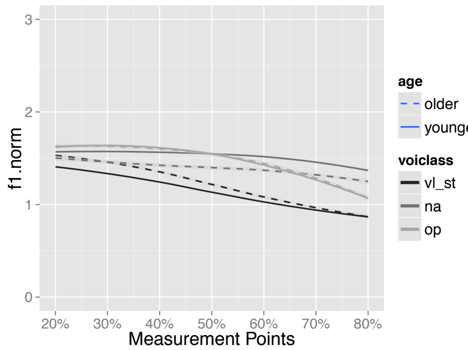
Figure 6.5: Example of violin plots showing the amount of diphthongisation of tokens: more monophthongal tokens (*dark grey*) and more diphthongal tokens (*light grey*)

transitions. The y-axis shows the normalised formant measurements. As these figures demonstrate the vowel trajectories similar to those seen in spectrograms, figures do not have a reversed axis for either f1 or f2. Therefore, figures that show f1 demonstrate differences in the height of the vowel along the vowel trajectories. In other words, lower values, which are lower on the axis, represent a higher vowel quality and higher values, which are higher on the axis, represent a lower vowel quality. On the other hand, figures that show f2 demonstrate differences in vowel backness along the vowel trajectories. Points along the vowel trajectories that have a more back quality are represent by lower values, which are lower on the axis, and points that have a more fronted quality are represented by higher values, which are higher on the axis.

This type of diagram is useful in determining at which measurement point PRICE and MOUTH begin to move towards the offglide (this will be referred to as the 'inflection point') and the heights of the starting points of the trajectories across different conditions. It is important to be able to establish these two features in order to evaluate the predictions of 'failure-to-lower' and



(a) Graph Type 1: trajectory plot where the y-axis scale is not fixed. The inflection points are clearer, but the dynamics of the trajectory are not accurately represented



(b) Trajectory plot where the y-axis scale is fixed. It depicts the actual dynamic movement of the trajectory, but does not clearly show the inflection points

Figure 6.6: Demonstration of the visual difference between smoothed trajectory plots where y-axis values are not fixed (Figure 6.6a) compared to fixed (Figure 6.6b). In the current thesis, the Figure 6.6a type is used, as inflection points are clearer

'asymmetric assimilation'. The inflection point is used to operationalise the relative durations of the nucleus and offglide in the target vowels. For example, if the inflection point is at approximately 20%, then the nucleus makes up a smaller proportion of the vowel production and the offglide makes up a larger proportion. In other words, the nucleus is short and the offglide is long in this example, which is an indication of offglide peripheralisation (Moreton and Thomas 2007). Similar measures of offglide peripheralisation are used by Moreton and Thomas (2007), but those measures generally focus on the offglide proportion alone. It should be noted that inflections points may occur even before the 20% measurement, but that this would not change the overall results. In other words, an inflection point before the 20% measurement still indicates offglide peripheralisation.

Note that the scales for this type of figure may differ between the different figures in order to best show the inflection points of the target vowels in certain environments. This results in some of the trajectory curves looking more dynamic than they are. For example, productions that are monophthongal may appear to have changes between the nucleus and the offglide as a result of the expanded scale (see Figure 6.6).

The second graphical representation shows nucleus or offglide acoustic

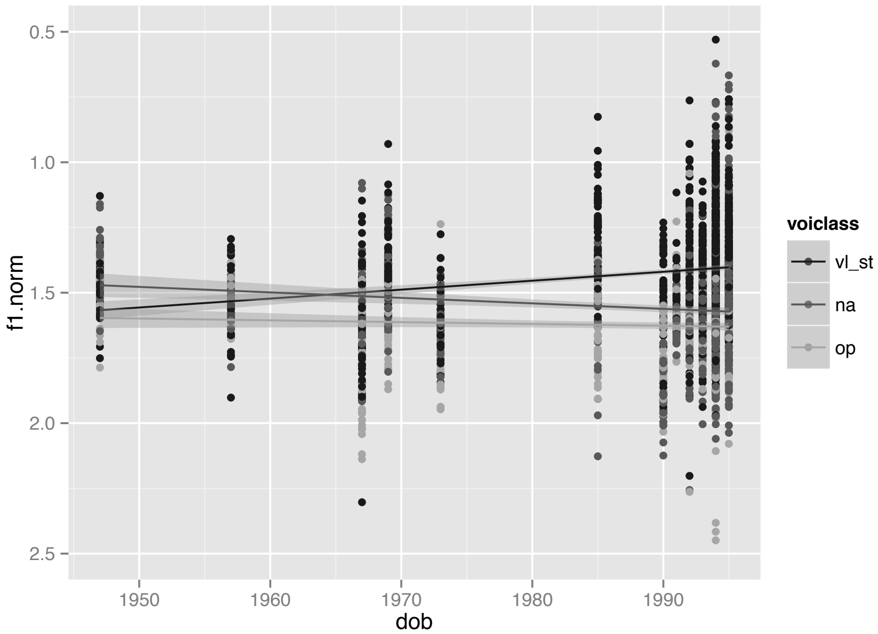


Figure 6.7: Graph Type 2: Nucleus/Offglide phonetic position across date of birth used to show changes in nucleus or offglide height from older to younger speakers

measurements on the y-axis and date of birth on the x-axis with a smoothed line, using the ggplot2.R package (Wickham 2009) linear smoothing (*lm*) function. These graphs all use the same scale on the y-axis, so that differences in older speakers' f1 and f2 values at the nucleus may be compared to younger speakers across different conditioning environments. Figures that show f1 along the y-axis have a reversed axis, so that it is easier to see the height of the nucleus. In these graphs, points that are higher in the graph represent more raised productions (but lower f1 values). Figures that show f2 along the y-axis are not reversed. Points that are higher in the graph represent fronter productions (higher f2 values). Graph type 2 is particularly helpful to evaluate evidence in support of or against the 'failure-to-lower' approach. Furthermore, it represents the changes from older speakers to younger speakers in the nucleus and offglide height and backness (see Figure 6.7 for an example).

Mixed effects models were again used in the analysis of the main investigation. For a detailed description of mixed effects models and their features see §5.2.2. However, the details related to specific mixed effects models, such as the variables included as fixed effects, are presented at the point where those model predictions are discussed in Chapter 7.

As discussed in detail in Chapter 7 there are a small subset of speakers who do not exhibit the overall patterns of variation for PRICE and MOUTH found for the majority of the speakers in the sample. While it has not been established as a common practice in linguistics, a principled way of identifying speakers who deviate from the overall patterns is to run mixed effects models including all speakers of the sample and inspect the random intercepts and slopes. Therefore, I ran six mixed effects models for each of the dependent variables (normalised f1 and f2 at the nucleus and offglide, Euclidean distance, and normalised duration) to determine the amount of inter-speaker variability in the current sample. The independent variables for these models were **voiclass** and speech style with an interaction between the two variables. The random effects structure was random intercepts for speakers and words and random slopes for speakers by **voiclass** and speech style. Random slopes for speaker by **voiclass** were plotted and visually inspected for outliers. Those speakers that were clearly outliers are not included in the overall models, but instead are discussed in the sections on inter-speaker variation (§7.1.1.1 and 7.2.1.1).

The current chapter has discussed the experimental design and methodology of the main data collection. The pilot study results found that interview style tasks do not provide an adequate number of MOUTH tokens to investigate and also only provide a somewhat limited number of PRICE tokens. Therefore, map tasks and a word list are used in the main investigation. The use of multiple measurement techniques, such as normalised f1 and f2 measurements at the nucleus and offglide, vowel trajectories, and Euclidean distance help to provide a better understanding of the realisations of PRICE and MOUTH. These measurements along with duration are used in the main investigation. Finally, the use of mixed effects models to determine factors that explain the variation found in the production of PRICE and MOUTH is an effective technique to evaluate production differences of the target vowels in a principled way.

CHAPTER 7

MAIN INVESTIGATION: RESULTS

The current chapter centres around the three hypotheses presented in §5.3, which relate to the general characteristics of PRICE and MOUTH patterns in varieties of English (§3.3). These hypotheses are used to explore the specific details of PRICE and MOUTH phonologically-conditioned variation in Liverpool English (LE) and how these patterns relate to similar patterns reported in other varieties of English. The hypotheses that are addressed in the current chapter are as follows:

1. PRICE and MOUTH in LE are phonologically conditioned by the following environment (**voiclass**).
2. PRICE and MOUTH phonologically-conditioned patterns of variation in LE are separate, but related, patterns.
3. Word list speech has different phonological conditioning of PRICE and MOUTH compared to casual speech in LE.

The amount of inter-speaker variation is also discussed with regards to each vowel (§7.1.1.1 and 7.2.1.1) and is presented in relation to the general patterns of PRICE and MOUTH variation that are found for the majority of speakers in the current sample. Most speakers within the sample have similar patterns of variation, so that specific phonetic realisations of PRICE and MOUTH are only found in certain phonetic contexts for most speakers. However, a small subset of speakers deviate from this general pattern. There are six speakers that differ from the general pattern for PRICE phonologically-conditioned variation (§7.1.1.1). Five of these speakers demonstrate two alternative patterns from the one found for the majority of speakers. The sixth speaker appears to be

Speech Style	PRICE	MOUTH
Word List	3078	2887
Map Task	2137	1460
TOTAL	**5215**	**4347**

Table 7.1: Number of tokens of PRICE and MOUTH in the main investigation

an outlier in the dataset. There are eight speakers that differ from the general pattern for MOUTH phonologically-conditioned variation (§7.2.1.1). Seven of these speakers show three alternative patterns to the one found for the majority of speakers. The final speaker is an outlier and is the same speaker that appears to be an outlier for the PRICE pattern.

Furthermore, the results of the main investigation are used to try and understand what the possible origins of these patterns in LE are, which is one of the main aims of this thesis. By presenting a detailed discussion of the features of PRICE and MOUTH phonologically-conditioned variation in contemporary LE and in the historical dataset (Chapter 9), we can gain a better understanding of the features that emerged as a result of new-dialect formation and those that are later developments. An investigation of the inflection points of PRICE and MOUTH by following environment is particularly useful for the discussion of the 'asymmetric assimilation' approach (see §6.2). In order to present the results that are most relevant for the discussion of origins of PRICE and MOUTH phonologically-conditioned variation in LE, the inflection points are only given for the patterns of PRICE and MOUTH that occur for the majority of speakers and for any older speakers that deviate from the general pattern.

As mentioned in §6.1, the main investigation includes a word list and map tasks in order to assess the difference between formal and casual speech styles. The pilot study was not able to account for speech style effects, as there were too few tokens in the casual speech style. However, the main investigation has a much larger number of tokens in casual speech (see Table 7.1) than the pilot study, as a result of the use of map tasks in the data collection. Table 7.1 shows the number of tokens in the word list, map tasks and overall totals of the target vowels.

In total PRICE has 5215 tokens and MOUTH has 4347. While the word list tokens contain only those environments that were mentioned in §6.1, the map tasks include some others. As a summary, the word list data contains PRICE and MOUTH before voiceless stops (**vl_st**), voiced stops (**vd_st**), nasals (**na**), /l/ (**la**), morpheme boundaries (**m_bound**) and in word final open syllables (**op**). As place of articulation was not found to be a significant predictor of the variation in PRICE and MOUTH measurements in the pilot study, the main investigation includes only alveolar consonants in the voiceless stop, voiced stop and nasal environments. This is done to limit other factors that could potentially influence the acoustic measurements, such as length of transition and co-articulatory effects, and it provides greater consistency across lexical items.

As the map tasks produced casual speech, tokens in other environments than the ones under investigation occurred. There were 161 PRICE tokens and 52 MOUTH tokens that occur in other environments, such as before voiceless fricatives, voiced fricatives and vowels. These tokens are not included in the results of the current investigation, as there were too few to provide reliable results. Furthermore, these tokens did not occur across all speakers in the sample.

Note that there is still a larger difference between the number of tokens of MOUTH in the word list and map tasks than for PRICE. Furthermore, in the map tasks there were thirty four lexical items of PRICE in environments that are currently under investigation which were not labels on the map tasks, but only eleven for MOUTH. These results further strengthen the decision not to investigate MOUTH at this juncture in the historical corpus, the *Origins of Liverpool English* (OLIVE) (Watson and Clark forthcoming).

The results for the PRICE and MOUTH vowels are presented separately, which is the same structure as in other chapters in this thesis. This decision is corroborated by the results of the pilot study, which found that PRICE and MOUTH patterns of variation differ from each other. Therefore, the current chapter is divided into results pertaining to PRICE (§7.1), results pertaining to MOUTH (§7.2), a comparison of the two patterns to answer hypothesis 2 (§7.3) and a summary of the results for the main investigation (§7.4).

I use phonetic symbols as convenient labels to identify typical/major variants, but it should be remembered that these are cover symbols for ranges of f1 and f2 values. A similar use of phonetic transcriptions is given by Thomas (2001). The phonetic transcriptions in this and subsequent chapters follow the conventions of the International Phonetic Alphabet (International Phonetic Association 1999) and are based on the inflection points and the six measurements (f1 and f2 at the nucleus and offglide, Euclidean distance, and duration) used in the analysis of the target vowels. Furthermore, to arrive at these transcriptions, the normalised f1 and f2 values at the nucleus and offglide were compared with normalised f1 and f2 values of a small subset of tokens with other vowels measured for normalisations purposes or orientation in the vowel space in the datasets. The averaged raw f1 and f2 values of the nucleus and offglide were also compared to reported values for southern British English monophthongs and diphthongs separated by gender (Deterding 1997, Williams 2013) in order to further substantiate the phonetic transcriptions used to represent the realisations of the target vowels in the main and historical investigations.

7.1 RESULTS FOR PRICE

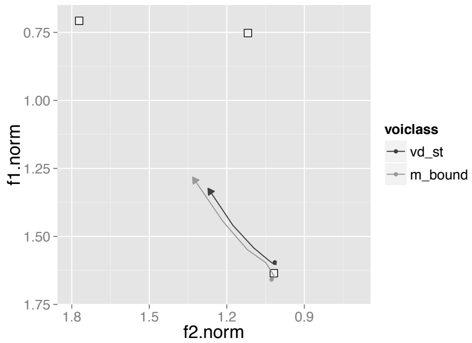
The results section for the PRICE vowel is subdivided into results pertaining to hypothesis 1 regarding the effects that different following environments have on the realisations of PRICE (§7.1.1), and results pertaining to hypothesis 3 regarding the effect of speech style on the patterns of variation found for PRICE (§7.1.2). The results for hypothesis 1 (§7.1.1) initially examine the PRICE realisations and the following environments where they occur for the majority of speakers and then turns to the inter-speaker variation or alternative patterns of variation of PRICE observed in a small subset of speakers in the current sample (§7.1.1.1). Note that the six speakers in §7.1.1.1 who are shown to differ from the majority of the speakers are not included in the discussion or presentation of results pertaining to the general pattern found for hypothesis 1. Furthermore, these speakers are excluded from all of the mixed effects models regarding the general pattern. Those speakers excluded from the results of the general pattern are: ‘Sc05’, ‘Sc09’, ‘Sc16’, ‘Sc17’, ‘Sc18’, ‘Sc23’. Five of these speakers demonstrate two alternative patterns of variation of the PRICE vowel. These alternative patterns are in many ways the same as the results found for the majority of the speakers, as discussed in §7.1.1.1. Speaker 'Sc23' produces an idiosyncratic pattern.

7.1.1 Hypothesis 1: PRICE in LE is phonologically conditioned by the following environment

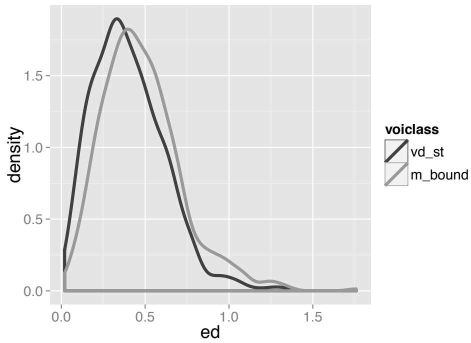
Previous research suggests that the main conditioning environments for realisations of PRICE are before voiceless stops, voiced stops, nasals and in open syllables, as discussed in §3.3.3. Furthermore, I investigate the effects of the pre-/l/ environment and morpheme boundaries on the realisations of the PRICE vowel.

In order to facilitate the presentation of the results pertaining to the realisations of the PRICE vowel in different following environments, let us first establish whether there is a difference between the PRICE realisations before morpheme boundaries. In the pilot study the polymorphemic tokens did not represent PRICE and MOUTH tokens before morpheme boundaries of the type that are described as a conditioning environment of SVLR phonologically-conditioned variation. Therefore, the main investigation included monosyllabic tokens with the past tense morpheme, such as *died* and *vowed*, to establish whether the LE phonologically-conditioned variation of PRICE and/or MOUTH resembled the SVLR morpheme boundary conditioning environment. As Scottish varieties of English were likely involved in the dialect mixture of LE, it is important to determine whether aspects of SVLR influenced the resultant patterns.

Given that the past tense morpheme is used to represent tokens with a morpheme boundary, these tokens are always followed by a voiced stop. Therefore, it is possible to compare PRICE and MOUTH realisations before voiced stops without a morpheme boundary, such as *tide*, to realisations before voiced stops with a morpheme boundary, such as *tied*. The results demonstrate that these two environments do not differ for PRICE, which suggests that the following voiced stop influences the realisation of the target vowel and not the morpheme boundary. Figure 7.1 demonstrates the formant trajectories and amount of diphthongisation of PRICE before voiced stops without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**) across all



(a) PRICE trajectories before voiced stops with (*grey line*) and without morpheme boundaries (*black line*)



(b) PRICE amount of diphthongisation before voiced stops with (*grey line*) and without morpheme boundaries (*black line*)

Figure 7.1: PRICE realisations before voiced stops with a morpheme boundary (**m_bound**, *grey line*) and without a morpheme boundary (**vd_st**, *black line*)

speakers.

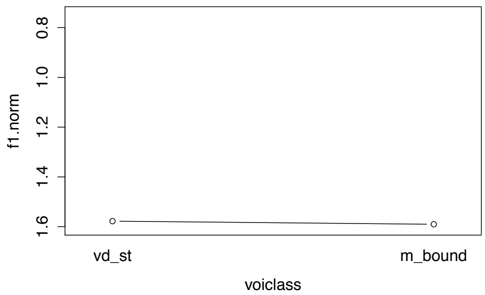
Mixed effects models were used on normalised f1 and f2 at the nucleus (20% measurement) and offglide (80% measurement), Euclidean distance and normalised duration measurements, in order to determine whether productions of PRICE before voiced stops with a morpheme boundary (**m_bound**) were significantly different from productions of PRICE before voiced stops without a morpheme boundary (**vd_st**). Fixed effects in the models were following environment (**voiclass**), age, gender, and location. I added interactions between **voiclass** × age, **voiclass** × gender, and **voiclass** × location. The random effects were a random slope for the following environment by speaker and random intercepts for speakers and words.

The predictions of the mixed effects models indicate that **voiclass** alone does not account for variation in the PRICE vowel before voiced stops based on the presence/absence of a morpheme boundary, as shown in Figure 7.2 (see summary tables in §A.2.2.1). In other words, PRICE realisations before voiced stops with morpheme boundaries do not differ from PRICE realisations without morpheme boundaries on the six measurements used in this analysis. However, the interaction of following environment and age is significant for both the normalised f1 and f2 offglide measurements, and duration. The results suggest that there is no difference for younger speakers in any of the measurements between the tokens of PRICE where the target vowel is before voiced stops with or without morpheme boundaries. The older speakers have a slightly raised and fronted offglide in the tokens of PRICE before voiced stops with morpheme boundaries (*tied*) compared to those without (*tide*). This effect does not appear to be strong. However, the difference between the duration of the PRICE vowel before voiced stops with and without morpheme boundaries is a robust effect. The PRICE tokens with a morpheme boundary are longer than the ones without.

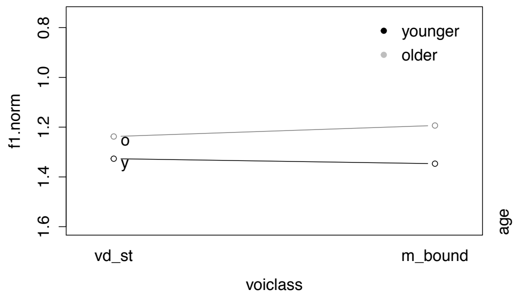
The mixed effects models predictions with regards to the offglide values should be taken as tentative, as the effect is rather weak and there are few older speakers in the current sample. There are only six older speakers and four of these speakers differ from the general pattern of variation found for the PRICE vowel in LE. A larger speaker sample of older speakers is required to verify these results. The most robust difference between the PRICE vowel before voiced stops with and without a morpheme boundary occurs in the normalised duration measurements for older speakers. This is an interesting result, as it potentially demonstrates vowels durations being affected by the morpheme boundary. This is similar to what is reported in varieties of English with SVLR patterns. That being said, Agutter (1988) and Scobbie et al. (1999a) present evidence that vowel durations are longer in tokens with a morpheme boundary regardless of whether the vowel participate in SVLR. Specifically, there are longer vowel durations of the PRICE vowel before the past tense morpheme compared to before /d/ even in speakers of RP.

Furthermore, the duration difference found in the present investigation does not coincide with a quality difference. One of the main differences between other vowels that participate in SVLR (mainly /iː/ and /ʉː/) and the PRICE vowel is that the duration difference is joined by a quality difference for the PRICE vowel in SVLR patterns. Given that in the mixed effects models with nucleus and Euclidean distance measurements as the dependent measure, age is not a significant predictor, PRICE is likely produced similarly before all voiced stops. As a result of this and the current thesis' focus on qualitative differences between the realisations of PRICE in different following environments, PRICE before all voiced stops are analysed as one category regardless of the presence/absence of morpheme boundaries.

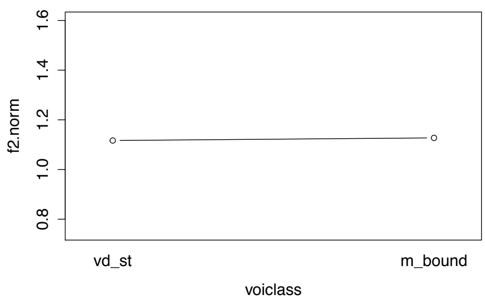
For the majority of the speakers in the current sample, these results indicate



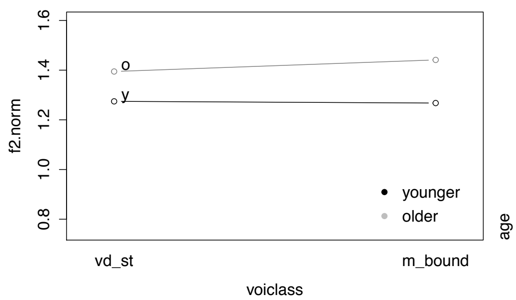
(a) Normalised f1 nucleus measurements (f1.norm) of PRICE



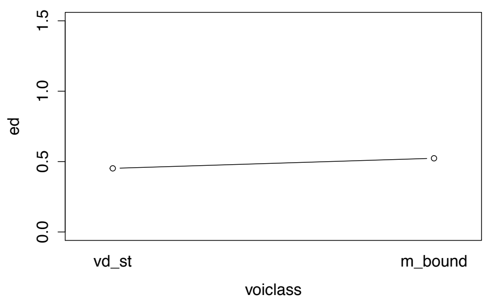
(b) Normalised f1 offglide measurements (f1.norm) of PRICE by age



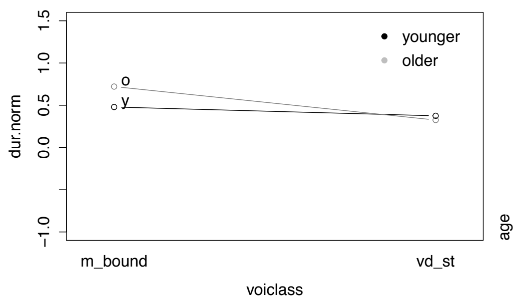
(c) Normalised f2 nucleus measurements (f2.norm) of PRICE



(d) Normalised f2 offglide measurements (f2.norm) of PRICE by age



(e) Euclidean distance measurements (ed) of PRICE



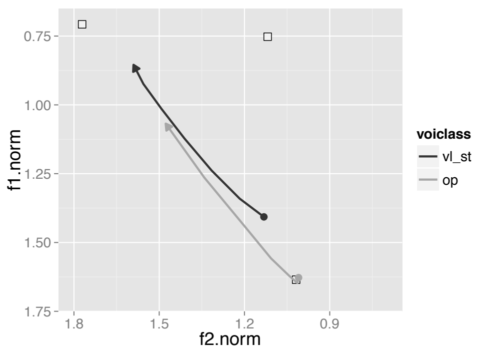
(f) Normalised duration measurements (dur.norm) of PRICE by age

Figure 7.2: Mixed effects model predictions for PRICE before voiced stops without morpheme boundaries (**vd_st**) and with morpheme boundaries (**m_bound**) on the six dependent variables: normalised f1 (f1.norm) and f2 (f2.norm) at the nucleus and offglide, Euclidean distance (ed), and normalised duration (dur.norm)

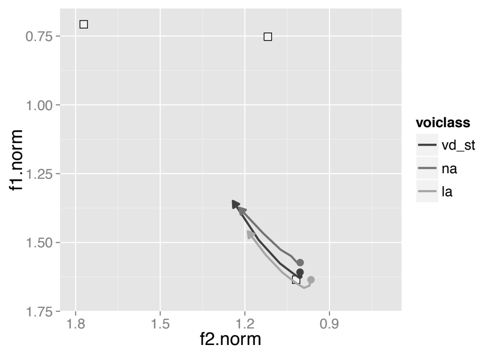
that the realisation of PRICE does not differ when followed by voiced stops regardless of whether the voiced stops are part of the same morpheme as the target vowel or a second morpheme. On the other hand, the older speakers appear to have some differences between the tokens of PRICE followed by voiced stops with and without a morpheme boundary, as shown in Figure 7.2. This is mostly realised in the duration of the vowel, which is longer when followed by the past tense morpheme (*tied*) compared to when followed by voiced stops within the same morpheme (*tide*), as shown in Figure 7.2f. The duration difference seems to be joined by a slight quality difference in the offglide for these older speakers. Older speakers produce the PRICE vowel with a slightly raised and fronted offglide before morpheme boundaries compared to the offglide position before voiced stops without a morpheme boundary (Figures 7.2b and 7.2d). This quality difference is not a very robust effect. Therefore, the influence that SVLR patterns in the speech of immigrants from Scotland, parts of northern Ireland and the Republic of Ireland on PRICE phonologically-conditioned variation in LE cannot be concluded on the basis of the current data. It is revisited in Chapter 10 after the results from the investigation of the OLIVE corpus (Watson and Clark forthcoming) are discussed (§9.1.2).

The remainder of this section examines the details of PRICE phonologically-conditioned variation and those following environments that condition the realisations of PRICE for the majority of speakers. While there are inevitably small differences between each of the environments and within each of the following environments, the main conditioning environments for the realisations of PRICE are before voiceless obstruents, before /l/, before non-/l/ voiced consonants and in open syllables. Figure 7.3 demonstrates the formant trajectories, normalised nucleus (20%) f1 and f2 values, indicated by shapes, and normalised offglide (80%) f1 and f2 values, indicated by arrowheads, for the twenty-two speakers that represent the same general pattern for the PRICE vowel.

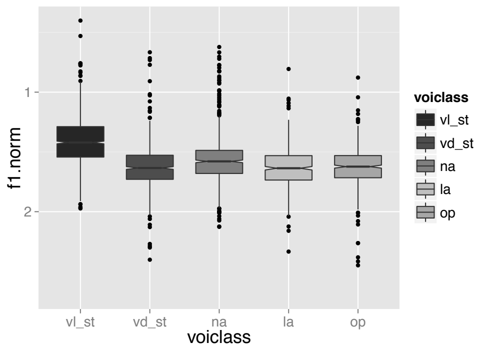
Vowel trajectories in Figures 7.3a and 7.3b demonstrate the similarity between PRICE before voiced stops (**vd_st**), nasals (**na**), and /l/ (**la**) in terms of the nucleus and offglide and the difference between the nucleus of PRICE before voiceless stops (**vl_st**) compared to realisations in open syllables (**op**).



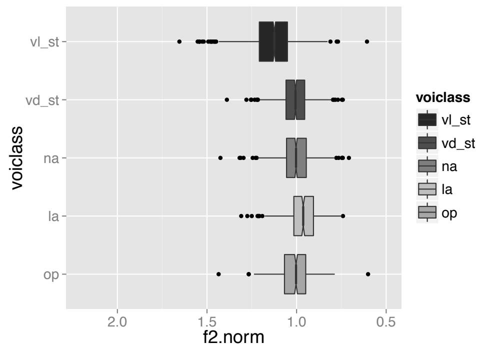
(a) Formant plot of PRICE vowel trajectories before voiceless stops (*dark grey*) and in open syllables (*light grey*)



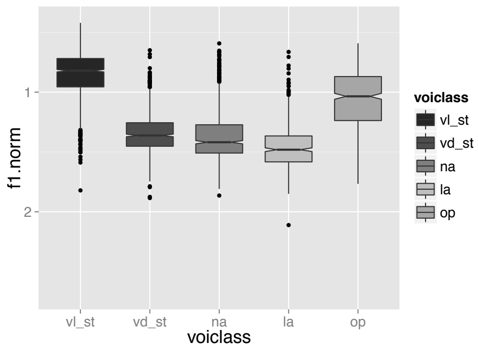
(b) Formant plot of PRICE vowel trajectories before voiced stops (*grey*), nasals (*medium grey*) and /l/ (*very light grey*)



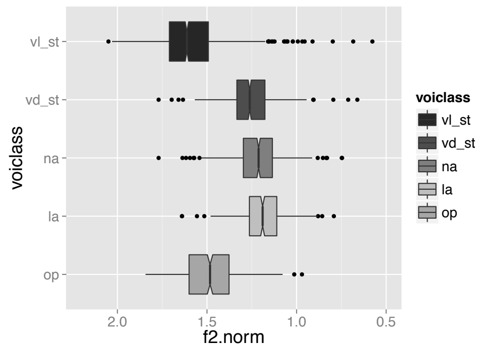
(c) PRICE nucleus normalised f1 measurements in all environments



(d) PRICE nucleus normalised f2 measurements in all environments

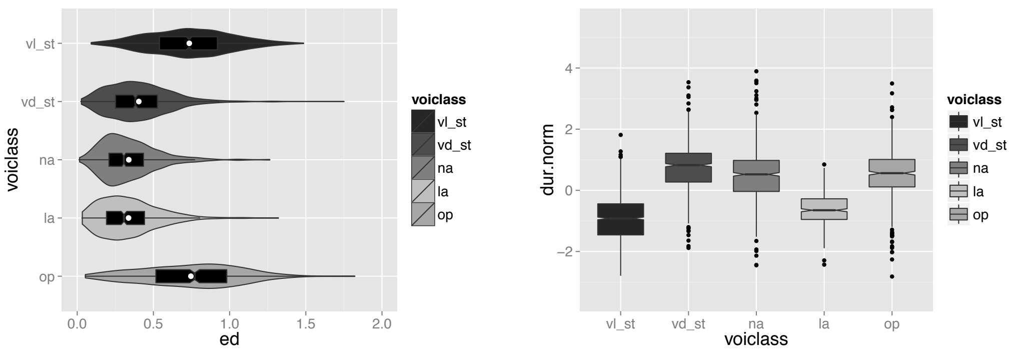


(e) PRICE offglide normalised f1 measurements in all environments



(f) PRICE offglide normalised f2 measurements in all environments

Figure 7.3: PRICE vowel results for normalised f1 (f1.norm) and f2 (f2.norm) measurements by the following environment (**voiclass**)



(a) PRICE Euclidean distance (ed) measurements by following environment

(b) PRICE normalised duration measurements (dur.norm) by following environment

Figure 7.4: PRICE vowel results for Euclidean distance (ed) and normalised duration measurement (dur.norm) by following environment (**voiclass**)

The realisation of the nucleus of PRICE before voiceless stops is raised and fronted in comparison to the other environments, as further demonstrated in Figures 7.3c and 7.3d. Figures 7.3c and 7.3d indicate that the realisation of PRICE in open syllables is the same as before voiced consonants at the nucleus measurement and Figures 7.3a and 7.3b shows that this realisation is in a similar position to the TRAP vowel. Furthermore, Figures 7.3e and 7.3f provide evidence for the difference in the production of the offglide in open syllables compared to voiced consonants. This difference reflects the difference between the PRICE productions as either monophthongs or diphthongs, as seen in Figure 7.4a.

The amount of diphthongisation is shown in Figure 7.4a, which suggests that the PRICE vowel is produced as more diphthongal before voiceless stops and in open syllables and more monophthongal elsewhere. Finally, Figure 7.4b demonstrates that phonetic realisations of the nucleus and amount of diphthongisation do not relate to duration in the way that has been suggested in previous work. In other words, PRICE tokens before voiced stops and nasals have a longer duration and PRICE tokens before /l/ have a shorter duration, but monophthongal productions occur in these environments, while PRICE tokens before voiceless stops have a shorter duration but are more diphthongal. Furthermore, PRICE has a shorter duration before voiceless stops and /l/, but the nucleus of PRICE is only raised and fronted before voiceless stops not before /l/.[1] The comparison of these figures provides visual evidence for the main environments that condition the realisations of PRICE: before voiceless obstruents, before /l/, before non-/l/ voiced consonants and in open syllables. The predictions of the mixed effects models corroborate these findings. As previously mentioned, note that the following mixed effects models exclude the six speakers, who differ from the overall patterns for the PRICE vowel and are discussed in §7.1.1.1. The mixed effects models presented here differ from the previous ones in that PRICE followed by a voiced stop without (**vd_st**) and with a morpheme boundary (**m_bound**) have been conflated into one level in **voiclass**, which was not the case previously.

The fixed effects in the mixed effects models were following environment (**voiclass**), speech style and gender. Interactions between **voiclass** and speech style, and **voiclass** and gender are also included. The independent variables for age and location could not be included in the current models, as a result of excluding the six speakers that produce different patterns from the general pattern. Any results obtained for age or location would be unreliable as they would have been representing one or two speakers in some cases. Random effects were random slopes for **voiclass** by speakers and random intercepts for words and speakers.

Note that speech style was found to be a significant predictor both as a main effect in some models and as an interaction term with some of the following environments, but those results are discussed in detail in §7.1.2. Speech style does not affect the general pattern found for the PRICE vowel, but rather casual speech is found to enhance some of the processes that occur as part of the general pattern. For example, a nucleus raising process is found before voiceless stops in both the word list and map task data, but the amount that the nucleus is raised in the map task data is greater than the word list data (see an example of this in Figure 7.5). Gender was not found to be a significant predictor either as a main effect or as an interaction with the following environments in any of the models.

Figure 7.6 demonstrates that PRICE tokens before voiceless stops are significantly different ($p<0.02$ in all models) from all other environments in

[1] To date, I am not aware of any property of LE /l/, which may account for these results. However, further research on LE /l/ is required to confirm this.

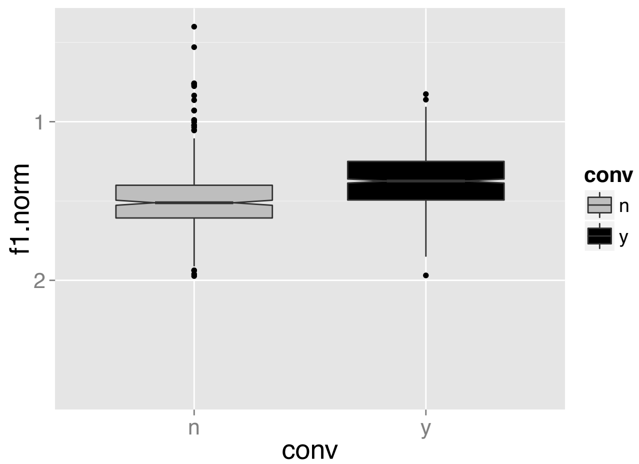
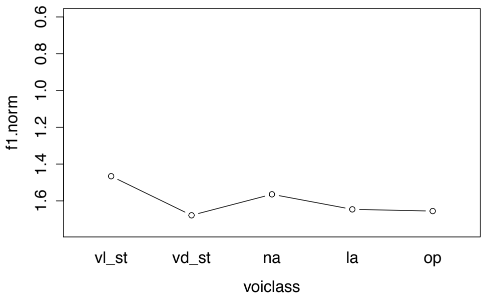


Figure 7.5: Demonstration of pattern enhancement as a result of speech style: PRICE normalised nucleus f1 measurements (f1.norm) before voiceless stops comparing word list (*n*) and map task (*y*) data

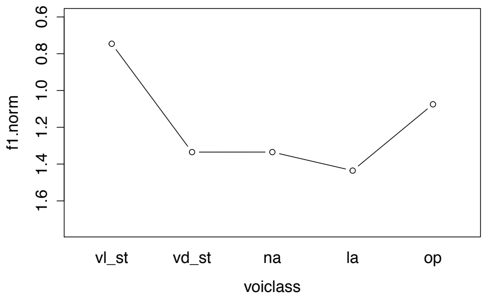
the six measurements (f1 and f2 at nucleus and offglide, Euclidean distance and duration) with one exception. Duration measurements are not significantly different for PRICE realisations before voiceless stops and before /l/ (p=0.72), as shown in Figure 7.6 and Table 7.5. Given the overwhelming evidence that PRICE productions before voiceless stops are different from the other environments in the majority of measurements, the results suggest that PRICE is produced as a diphthong with a raised and front nucleus before voiceless obstruents, which is represented as [ɜ̟ɪ̟] (see Tables 7.2, 7.3, 7.4 and 7.5).

PRICE tokens in open syllables are significantly different (p<0.01 in all three models) from the other conditioning environments in the normalised f1 and f2 offglide measurements (also see summary tables in §A.2.2.1) and Euclidean distance (Table 7.4). However, the nucleus measurements do not differ from the other following environments included in the model with the exception of the nucleus values of PRICE before voiceless stops. These results suggest that the second conditioning environment for the realisations of PRICE is open syllables, which is represented as [aɪ].

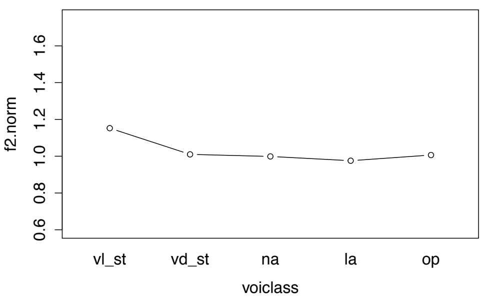
Finally, PRICE tokens before voiced stops, nasals and /l/ do not differ in the nucleus, offglide and Euclidean distance measurements in the mixed effects models. PRICE realisations in these environments do not have a raised or fronted nucleus and are mostly monophthongal. One evident difference between



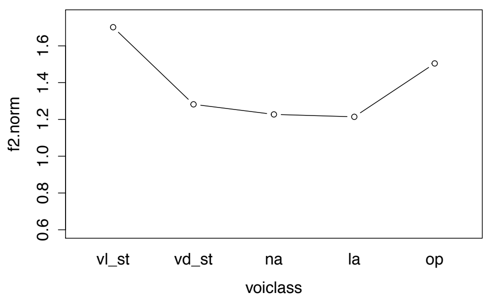
(a) Normalised f1 nucleus measurements (f1.norm) of PRICE by **voiclass**



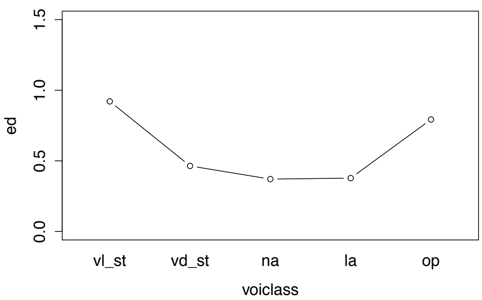
(b) Normalised f1 offglide measurements (f1.norm) of PRICE by **voiclass**



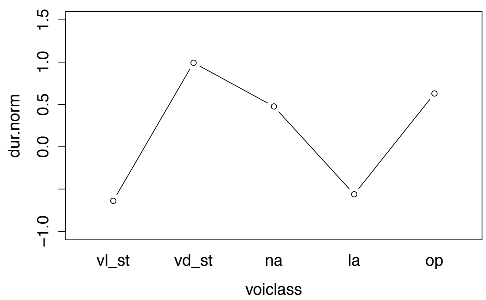
(c) Normalised f2 nucleus measurements (f2.norm) of PRICE by **voiclass**



(d) Normalised f2 offglide measurements (f2.norm) of PRICE by **voiclass**



(e) Euclidean distance measurements (ed) of PRICE by **voiclass**



(f) Normalised duration measurements (dur.norm) of PRICE by **voiclass**

Figure 7.6: Mixed effects models predictions for PRICE by following environments (**voiclass**) on the six dependent variables: normalised f1 at the nucleus and offglide (f1.norm), normalised f2 at the nucleus and offglide (f2.norm), Euclidean distance (ed), and normalised duration (dur.norm)

	Estimate	Std. Error	t value
(Intercept)	1.65	0.03	56.99
voiclassna	-0.08	0.04	-2.27
voiclassop	0.01	0.02	0.42
voiclassvd_st	0.03	0.02	1.54
voiclassvl_st	-0.18	0.04	-5.12
convy	-0.01	0.03	-0.26
genm	-0.03	0.03	-0.84
voiclassna:convy	0.01	0.03	0.42
voiclassop:convy	-0.06	0.03	-2.33
voiclassvd_st:convy	-0.06	0.03	-2.47
voiclassvl_st:convy	-0.08	0.03	-3.21
voiclassna:genm	0.03	0.05	0.70
voiclassop:genm	-0.01	0.02	-0.42
voiclassvd_st:genm	-0.03	0.02	-1.83
voiclassvl_st:genm	0.07	0.05	1.50

Table 7.2: Summary table for PRICE nucleus normalised f1 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	0.98	0.02	52.70
voiclassna	0.02	0.02	1.35
voiclassop	0.03	0.02	1.99
voiclassvd_st	0.03	0.02	2.17
voiclassvl_st	0.18	0.02	7.80
convy	-0.01	0.01	-0.58
genm	-0.00	0.02	-0.21
voiclassna:convy	-0.04	0.01	-2.93
voiclassop:convy	0.01	0.01	0.42
voiclassvd_st:convy	-0.01	0.01	-1.09
voiclassvl_st:convy	0.01	0.01	1.01
voiclassna:genm	0.03	0.01	2.62
voiclassop:genm	0.00	0.01	0.02
voiclassvd_st:genm	0.02	0.01	1.97
voiclassvl_st:genm	-0.04	0.03	-1.29

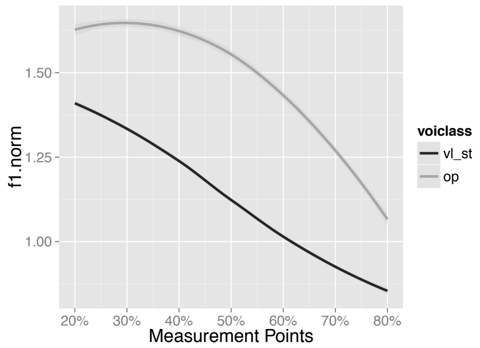
Table 7.3: Summary table for PRICE nucleus normalised f2 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	0.38	0.04	9.41
voiclassna	-0.01	0.04	-0.16
voiclassop	0.41	0.06	6.89
voiclassvd_st	0.09	0.04	1.95
voiclassvl_st	0.54	0.05	11.20
convy	-0.07	0.04	-1.92
genm	-0.11	0.05	-2.03
voiclassna:convy	0.01	0.03	0.32
voiclassop:convy	0.01	0.03	0.23
voiclassvd_st:convy	-0.06	0.03	-1.69
voiclassvl_st:convy	-0.10	0.03	-3.21
voiclassna:genm	0.14	0.06	2.41
voiclassop:genm	0.06	0.08	0.67
voiclassvd_st:genm	0.07	0.06	1.23
voiclassvl_st:genm	0.07	0.07	1.02

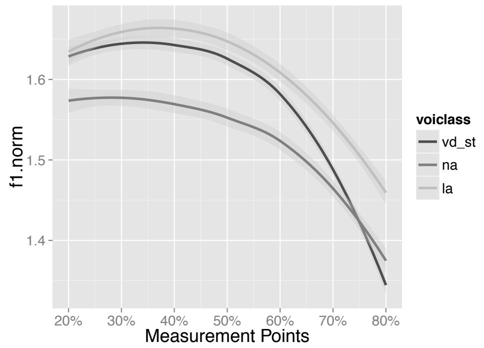
Table 7.4: Summary table for PRICE Euclidean distance mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	-0.56	0.11	-4.96
voiclassna	1.04	0.14	7.21
voiclassop	1.19	0.14	8.31
voiclassvd_st	1.55	0.14	11.46
voiclassvl_st	-0.08	0.13	-0.62
convy	-0.34	0.12	-2.92
genm	0.09	0.13	0.69
voiclassna:convy	0.00	0.11	0.04
voiclassop:convy	-0.48	0.11	-4.19
voiclassvd_st:convy	-0.43	0.11	-3.94
voiclassvl_st:convy	-0.05	0.11	-0.43
voiclassna:genm	-0.24	0.14	-1.66
voiclassop:genm	-0.16	0.16	-0.99
voiclassvd_st:genm	-0.17	0.13	-1.31
voiclassvl_st:genm	-0.08	0.11	-0.71

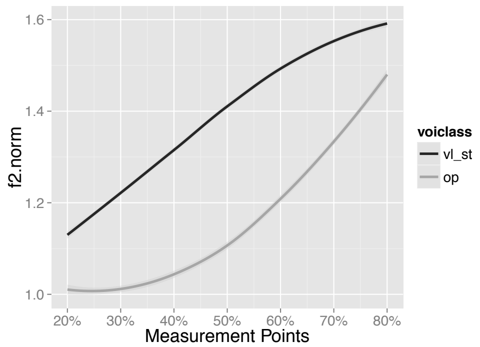
Table 7.5: Summary table for PRICE normalised duration mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)



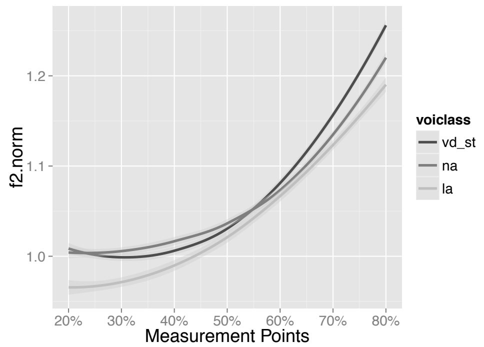
(a) PRICE inflection points for f1 before voiceless stops (*dark grey*) and in open syllables (*light grey*)



(b) PRICE inflection points for f1 before voiced stops (*grey*), nasals (*medium grey*) and /l/ (*light grey*)



(c) PRICE inflection points for f2 before voiceless stops (*dark grey*) and in open syllables (*light grey*)



(d) PRICE inflection points for f2 before voiced stops (*grey*), nasals (*medium grey*) and /l/ (*light grey*)

Figure 7.7: PRICE trajectories demonstrating inflection points by following environments (**voiclass**)

PRICE productions in these environments is that longer vowel durations occur before voiced stops and nasals and shorter vowel durations are found before /l/ (see Figure 7.6f and Table 7.5). Given all of the other similarities found in these environments, I suggest that PRICE is also conditioned by /l/ and other voiced consonants. These realisations are almost identical with length being the only difference. The pre-/l/ PRICE realisation is represented as [a] and before other voiced consonants it is [aː].

In order to provide an even fuller understanding of the target vowel realisations and to help with the understanding of the origins of this pattern in LE, inflection points are also investigated in the current study, as described in

§6.2. Figure 7.7 demonstrates that the inflection point of PRICE before voiceless stops (**vl_st**) for the f1 and f2 trajectories is around the 20% measurement. This suggests that the nucleus of the diphthong is very short and so the phonetic transcription may be more accurately represented as [ɜ̟̆ɪ̞]. On the other hand, PRICE in open syllables (**op**) is at approximately the 40% measurement, which suggests that [aɪ] is generally an accurate representation of this vowel variant. Finally, PRICE before voiced consonants (**vd_st, na** and **la**) has an inflection point that is at the 50% or farther measurement, which demonstrates that there is some movement of the formants. This movement occurs well into the vowel and is generally not drastic, which again suggests that the monophthongal transcriptions of [a] before /l/ and [aː] before voiced stops and nasals are generally accurate.

The results pertaining to the inflection point of the PRICE vowel in different following environments are discussed further in the evaluation of the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation in new-dialect formation in Chapter 10.

Therefore, according the results in the current section the most common pattern of PRICE phonologically-conditioned variation in LE is:

1. Before voiceless obstruents: [ɛ̟̆ɪ̞] (raised/fronted short nucleus diphthong with a short overall duration)
2. Word finally in open syllables: [aɪ] (long diphthong)
3. Before /l/: [a] (short monophthong)
4. Before voiced stops and nasals: [aː] (long monophthong)

In other words, there seems to be two processes that occur raising and fronting of the nucleus of PRICE and monophthongisation.

7.1.1.1 Inter-speaker variation

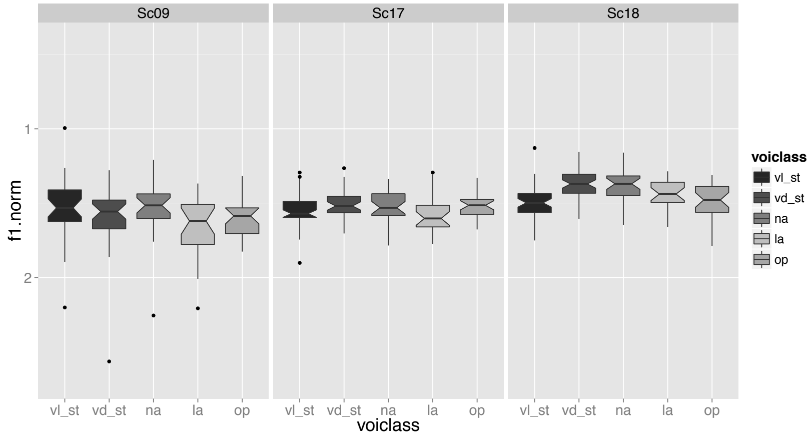
There are six speakers in the current sample who differ slightly from these overall findings. These speakers exhibit two alternative patterns of variation for the PRICE vowel, which deviate from the general pattern in two different features: raising and fronting of the nucleus and amount of diphthongisation.

Note that these six speakers do not fit into any specific sociolinguistic category. In other words, the speakers who exhibit alternate patterns of variation for the PRICE vowel are males and females, older and younger, and are from northern and southern Liverpool and Knowsley.

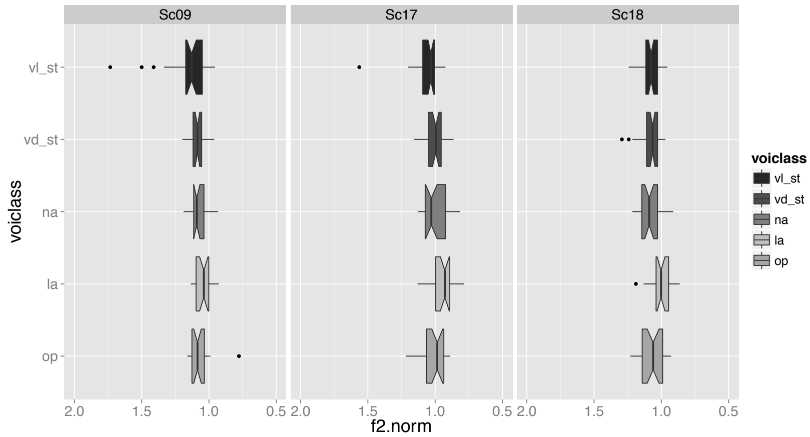
There are two clear alternative patterns that emerge from five of these six speakers. One group of speakers ('Sc09', 'Sc17', and 'Sc18') does not raise or front the nucleus of PRICE before voiceless stops, but does monophthongise PRICE before voiced consonants (see Figure 7.8). Therefore, the pattern for these three speakers is diphthongal ([aɪ]) realisations before voiceless stops and in open syllables, short monophthongs ([a]) before /l/, and long monophthongs ([aː]) before voiced stops and nasals. Two of these speakers ('Sc17' and 'Sc18') are the older male participants and one is a younger male participant ('Sc09'). These are the only two older male speakers in the sample, so it is difficult to determine whether the pattern that they have is representative of older male speakers in Liverpool. However, the results of the investigation of the OLIVE corpus provides some insights into PRICE phonologically-conditioned variation for older LE speakers (Chapter 9).

While the two older male speakers do not show raising or fronting of the nucleus of PRICE before voiceless stops, they do have a difference in the PRICE inflection points before voiceless stops compared to other environments. Figure 7.9 demonstrates that the inflection point of PRICE before voiceless stops occurs before 35% of the way through the vowel for these speakers. The f1 and f2 inflection points for PRICE before voiceless stops is between the 30% and 35% measurements. On the other hand, the inflection points of the trajectory of PRICE before voiced stops occurs between the 40% and 50% measurements. Chapter 10 discusses how the differences between the inflection points for the majority of speakers and the older speakers helps us to understanding the development of PRICE nucleus raising and fronting in LE.

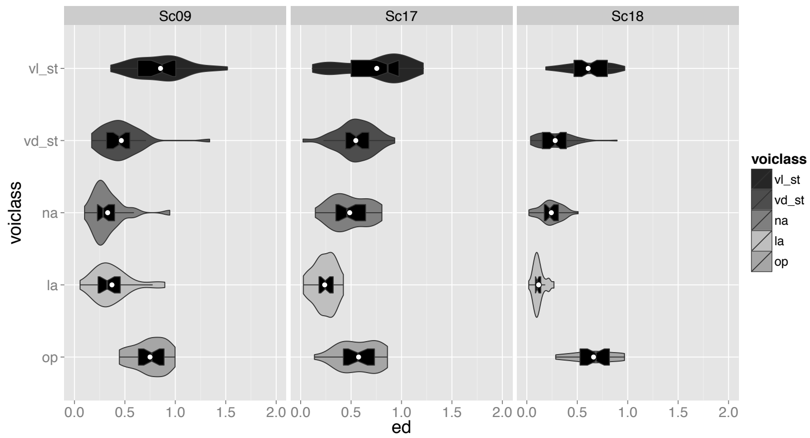
The second group of speakers ('Sc05' and 'Sc16') fronts the nucleus of PRICE only before voiceless stops, but also raises in more than just the voiceless stop environment (see Figure 7.10). These speakers maintain the differences in the amount of diphthongisation between the different following environments in the general pattern. In other words, monophthongs occur before voiced consonants and diphthongs occur before voiceless stops and in open syllables (Figure



(a) PRICE normalised f1 nucleus measurements (f1.norm) for speakers who do not raise the nucleus before voiceless stops

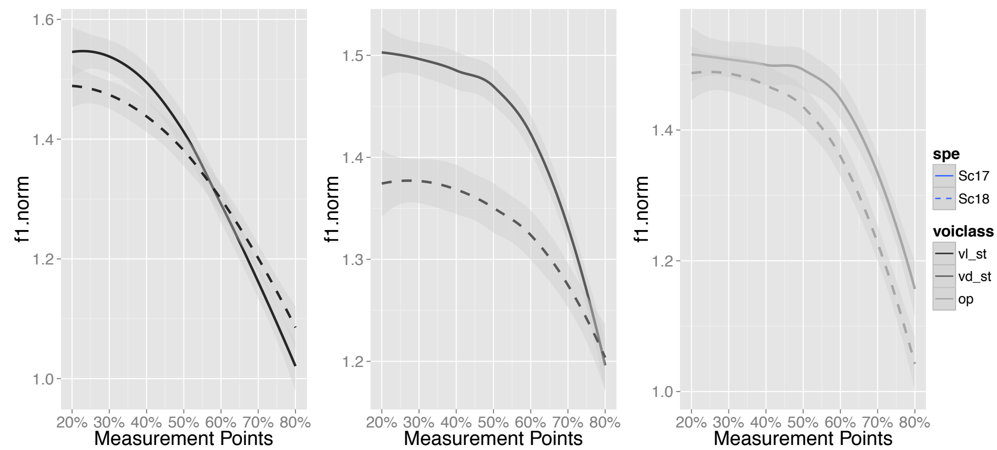


(b) PRICE normalised f2 nucleus measurements (f2.norm) for speakers who do not front the nucleus before voiceless stops

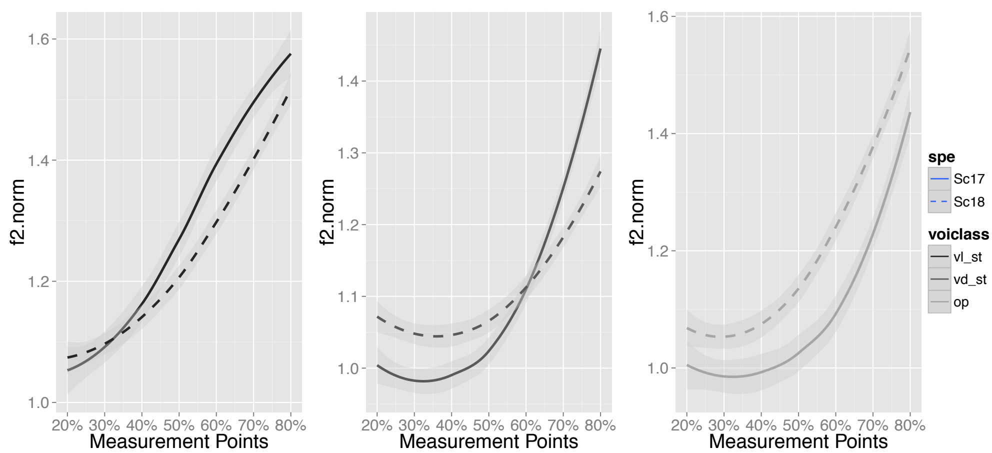


(c) PRICE Euclidean distance (ed) by following environment

Figure 7.8: Normalised f1 and f2 nucleus box plots and Euclidean distance violin plot for speakers 'Sc09', 'Sc17' and 'Sc18', who do not raise or front the nucleus of PRICE before voiceless stops

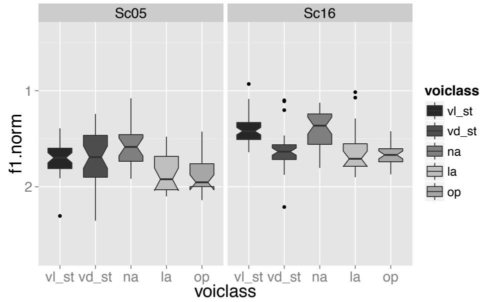


(a) PRICE inflection points for f1 before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)

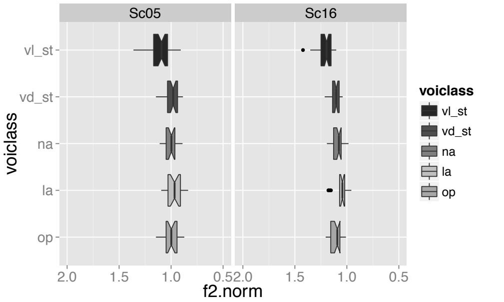


(b) PRICE inflection points for f2 before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)

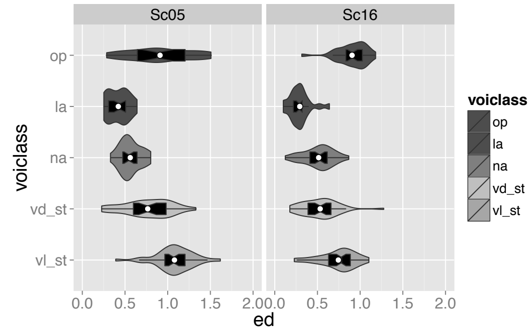
Figure 7.9: Inflection points for the PRICE vowel trajectories by following environments (**voiclass**) for the older speakers 'Sc17' and 'Sc18' who do not raise or front the nucleus of PRICE before voiceless stops



(a) PRICE normalised f1 nucleus measurements (f1.norm) by following environment



(b) PRICE normalised f2 nucleus measurements (f2.norm) by following environment



(c) PRICE Euclidean distance (ed) by following environment

Figure 7.10: Normalised f1 and f2 box plots and Euclidean distance violin plots for speakers who raise the nucleus of PRICE in more than one environment, but only front before voiceless stops: 'Sc05', 'Sc16'

7.10c). Speaker 'Sc05' raises at the nucleus measurement of PRICE before voiceless stops, voiced stops and nasals compared to the other environments, while speaker 'Sc16' raises at the nucleus measurement before voiceless stops and nasals compared to the other environments. It should be noted that these speakers are older female participants from northern Liverpool and Knowsley. There is one other older female from northern Liverpool and one from southern Liverpool who produce the pattern described in §7.1.1 that is found for the majority of speakers.

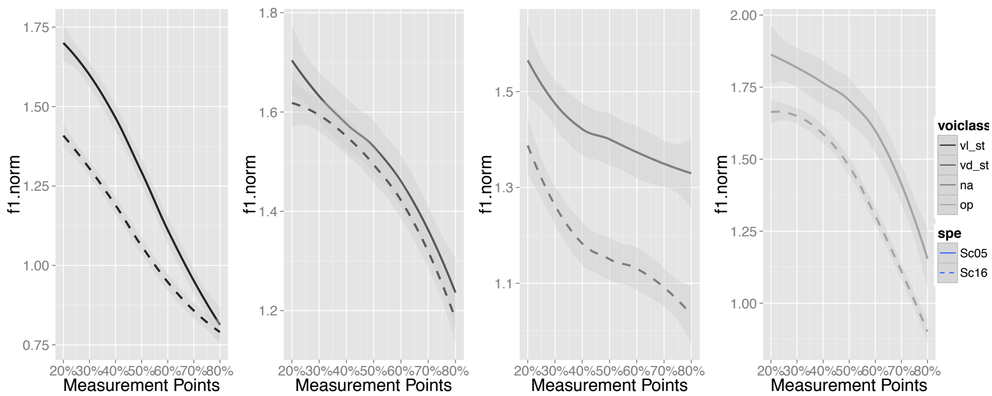
Furthermore, the inflection points for these speakers demonstrate the pattern predicted by the 'asymmetric assimilation' approach, discussed in detail in Chapter 10. That is to say, the environments that have realisations of PRICE as raised at the nucleus measurement have an inflection point that is earlier in the vowel trajectory than the other environments. The f1 inflection points for

PRICE before voiceless stops, voiced stops, and nasals are at approximately the 20% measurement for speaker 'Sc05' (Figure 7.11a), but at approximately the 30% measurement in open syllables. Speaker 'Sc16' demonstrates a later f1 inflection point of PRICE before voiced stops (approximately 30%) compared to speaker 'Sc05'. For this speaker, the nucleus measurement of PRICE is not raised before voiced stops compared to other environments. Figure 7.11b demonstrates that for both speakers the f2 inflection points for PRICE is at approximately the 20% measurement before voiceless stops, which is the only fronting environment. The other following environments show a later f2 inflection point.

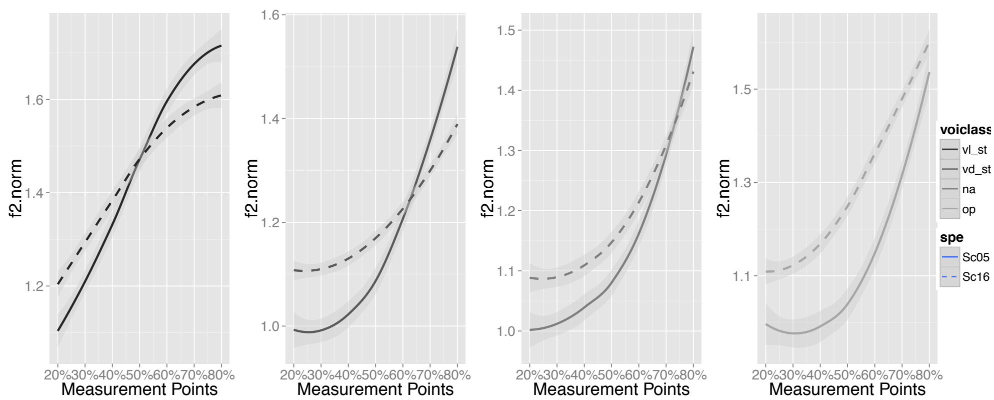
It should be noted that the current analysis appears to show raising in these environments for the two older female speakers. However, when the results of the OLIVE corpus presented in Chapter 9 are taken into account this apparent raising may actually be a non-lowering.

Finally, speaker 'Sc23' realises PRICE as monophthongal only before /l/ and as diphthongal elsewhere, as shown in Figure 7.12. This participant is a younger male from northern Liverpool. He is the only participant to have spent more than three years outside of Liverpool during his entire life, which may account for this difference. Otherwise, this speaker produces a similar pattern to the majority of the speakers. He raises and fronts the nucleus of PRICE before voiceless stops and does not in any of the other environments. Given that none of the other speakers demonstrated the pattern found for 'Sc23', it is possible that the mostly diphthongal productions used by speaker 'Sc23' are related to levelling as a result of living away from Liverpool and not necessarily a pattern generally found in LE.

The current section found that the majority of speakers produce a PRICE phonologically-conditioned pattern that encompasses two processes: raising and fronting of the nucleus of PRICE and monophthongisation. Monophthongisation occurs before voiced consonants and raising and fronting of the nucleus of PRICE occurs before voiceless stops. A small subset of speakers differ from this general pattern. One group produces monophthongs before voiced consonants, but does not raise and front the nucleus of PRICE before voiceless stops. The second group continues to use both the process of monophthongisation and raising/fronting, but extends the environments

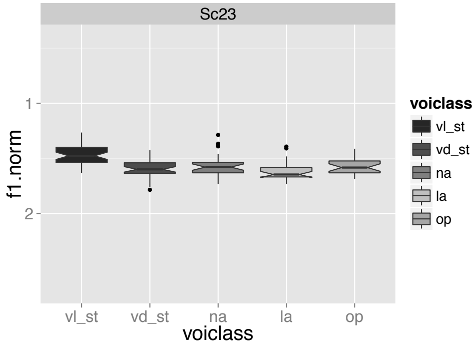


(a) PRICE inflection points for f1 before voiceless stops (*dark grey*), voiced stops (*grey*), nasals (*medium grey*) and in open syllables (*light grey*)

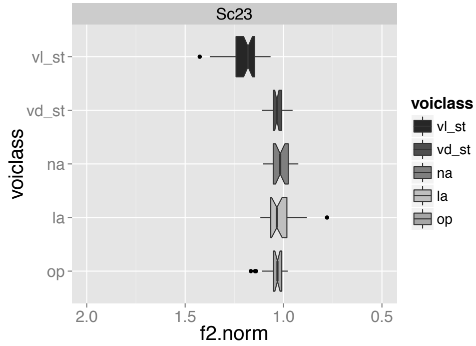


(b) PRICE inflection points for f2 before voiceless stops (*dark grey*), voiced stops (*grey*), nasals (*medium grey*) and in open syllables (*light grey*)

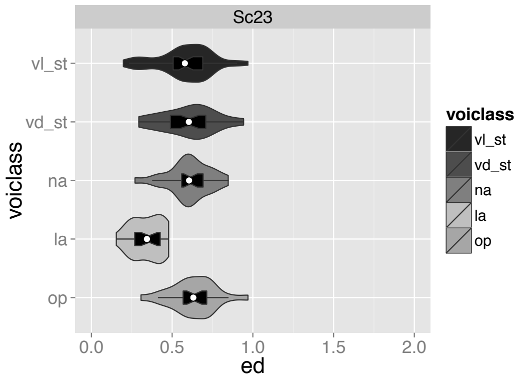
Figure 7.11: Inflection points for the PRICE vowel trajectories by following environments (**voiclass**) for speakers 'Sc05', 'Sc16' who raise at the nucleus measurement of PRICE in a number of environments



(a) PRICE normalised f1 nucleus measurements (f1.norm) by following environment



(b) PRICE normalised f2 nucleus measurements (f2.norm) by following environment



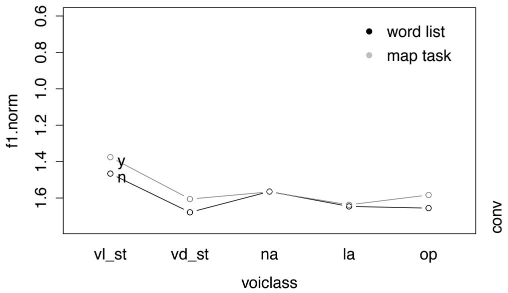
(c) PRICE Euclidean distance (ed) by following environment

Figure 7.12: Normalised f1 and f2 box plots and Euclidean distance violin plots for speaker 'Sc23', who does not produce monophthongs before voiced stops and nasals

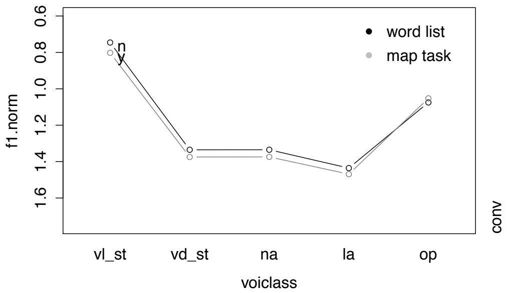
where the raising process occurs.

7.1.2 Hypothesis 3: Word list speech has different phonological conditioning of PRICE compared to casual speech in LE

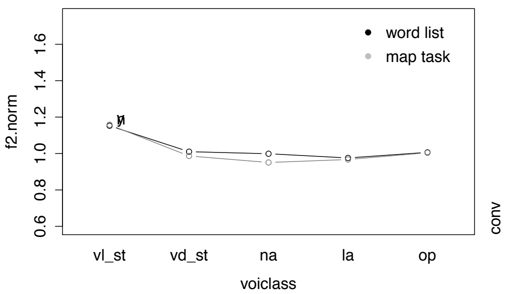
As discussed in §3.3.3 and §5.2, speech style has been found to affect the production of PRICE in phonologically-conditioned variation. Furthermore, in the mixed effects models presented in §7.1.1, speech style is a significant predictor in all of the measurements tested as either a main effect or as an interaction with the following environment. Figure 7.13 demonstrates the predictions of the mixed effects models in relation to the speech style.



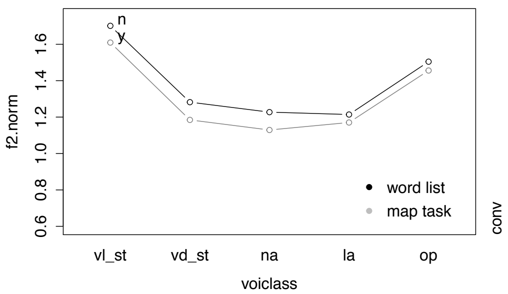
(a) Normalised f1 nucleus measurements (f1.norm) of PRICE by **voiclass** and speech style (**conv**)



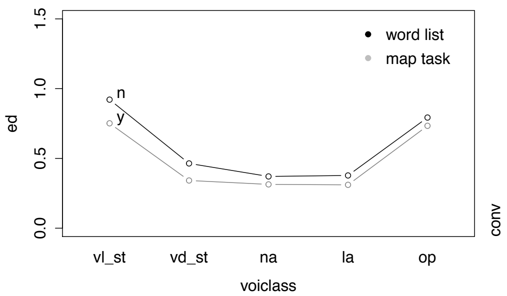
(b) Normalised f1 offglide measurements (f1.norm) of PRICE by **voiclass** and speech style (**conv**)



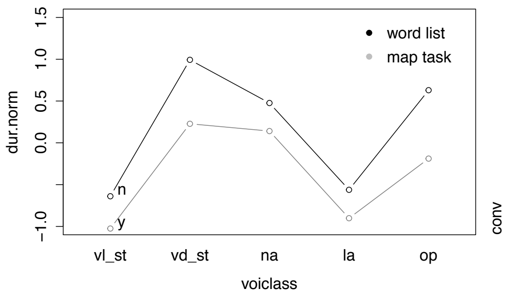
(c) Normalised f2 nucleus measurements (f2.norm) of PRICE by **voiclass** and speech style (**conv**)



(d) Normalised f2 offglide measurements (f2.norm) of PRICE by **voiclass** and speech style (**conv**)



(e) Euclidean distance measurements (ed) of PRICE by **voiclass** and speech style (**conv**)



(f) Normalised duration measurements (dur.norm) of PRICE by **voiclass** and speech style (**conv**)

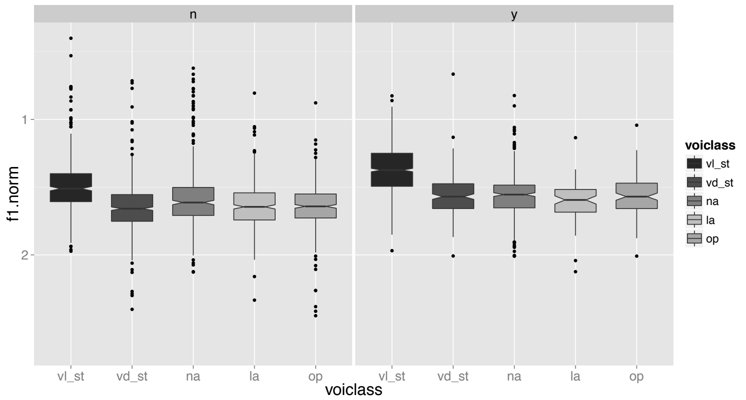
Figure 7.13: Mixed effects models predictions for PRICE by following environment (**voiclass**) and speech style (**conv**) on the dependent variables: normalised f1 (f1.norm) and f2 (f2.norm) at the nucleus and offglide, Euclidean distance (ed) and normalised duration (dur.norm)

However, speech style does not affect the conditioning of PRICE phonologically. In other words, the realisations of PRICE and conditioning environments found for the majority of speakers does not change due to speech style. Casual speech style merely enhances some of the characteristics found in the general pattern. In word list speech PRICE has a raised and fronted nucleus before voiceless stops. The nucleus of PRICE in the map tasks is found to be fronted to a similar degree as the word list (Figures 7.13c and 7.14b), but is more raised in casual speech than in the word list (Figures 7.13a and 7.14a). Figure 7.14 demonstrates the comparison between the normalised f1 and f2 nucleus measurement in word list (*n*) and map task data (*y*). It also shows that the realisations of PRICE at the nucleus values and the conditioning environments remain the same regardless of speech style.

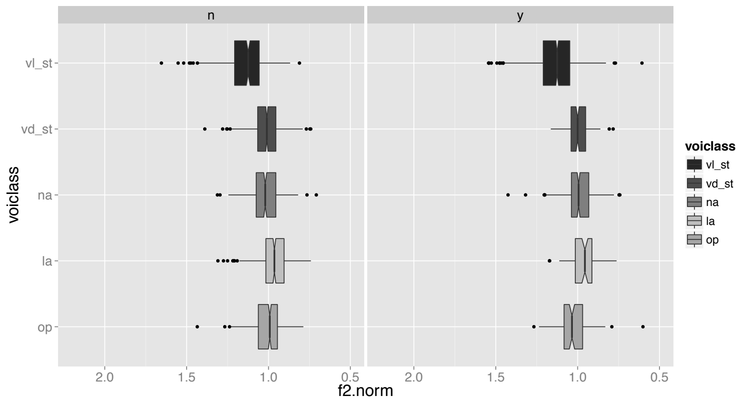
Furthermore, speech style affects the amount of diphthongisation of the PRICE vowel realisations, as shown in Figures 7.13e and 7.15. In word list speech PRICE is mostly monophthongal before voiced consonants, while in map task speech PRICE is even more consistently monophthongal in these environments (see Figure 7.15). Figure 7.15 further demonstrates that PRICE before voiceless stops and in open syllables is diphthongal in both speech styles, but is slightly more diphthongal in word list speech.

Finally, normalised duration of PRICE is shorter in all environments, as shown in Figures 7.13f and 7.16. Similar to the results for normalised f1 and f2 measurements and amount of diphthongisation, normalised duration of PRICE does not deviate from the general pattern as a result of different speech styles. PRICE is short before voiceless stops and /l/, and long before voiced stops, nasals and in open syllables in both speech styles.

The findings of the current investigation suggest that speech style does not affect the main processes involved in PRICE phonologically-conditioned variation in LE. PRICE nucleus raising and fronting before voiceless obstruents and PRICE monophthongisation before voiced consonants occur in both formal and casual speech styles. Shorter vowel durations and enhancement of the processes are predicted to occur in casual speech, as described in §5.2.1. This finding suggests that the processes that compose PRICE phonologically-conditioned variation in LE are likely well-established, which may indicate that these are not new processes in LE.



(a) PRICE normalised nucleus f1 measurements (f1.norm) comparing word list (n) and map task (y) data



(b) PRICE normalised nucleus f2 measurements (f2.norm) comparing word list (n) and map task (y) data

Figure 7.14: Comparison of speech style for PRICE by following environment (**voiclass**)

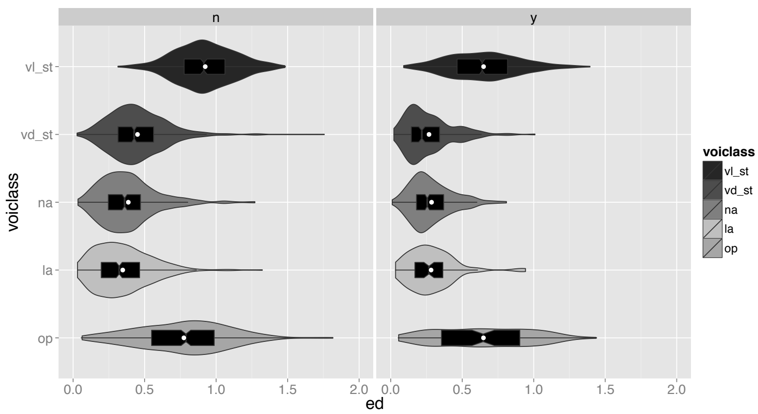


Figure 7.15: Comparison of the amount of diphthongisation of PRICE in word list (n) and map task data (y)

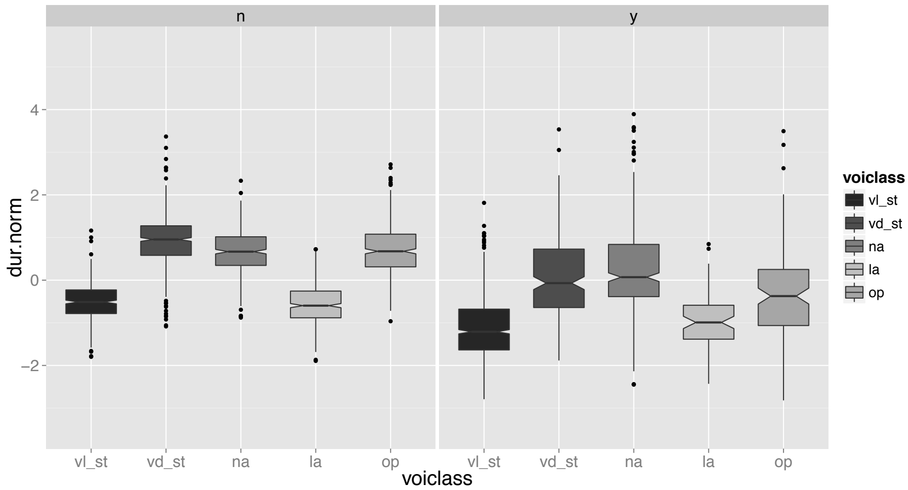
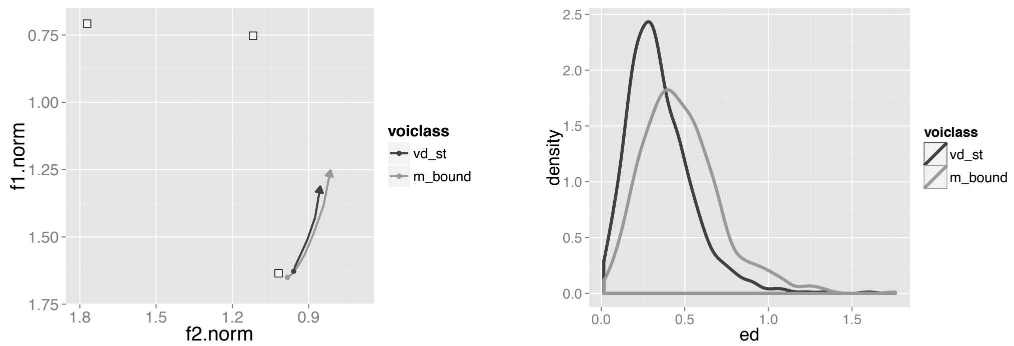


Figure 7.16: Comparison of the normalised duration measurements of PRICE in word list (*n*) and map task data (*y*)

It is important to note that the current investigation coded for other possible conditioning variables, such as age, gender and location. Gender for the younger speakers and location over all speakers does not influence the PRICE pattern found in LE. As discussed in §7.1.1.1 the two older male speakers do not raise or front the nucleus of PRICE before voiceless stops, but do monophthongise PRICE before voiced consonants. Two of the four older females appear to raise and front PRICE at the nucleus measurement before voiceless stops and some voiced consonants and monophthongise PRICE before voiced consonants. These results in conjunction with the results of the OLIVE corpus provide evidence for the features that emerged from new-dialect formation and those that are later developments of PRICE phonologically-conditioned variation in LE (Chapter 9).

7.2 RESULTS FOR MOUTH

The results for the MOUTH vowel follow the same format as the results for PRICE in the previous section. The current section is subdivided into results that pertain to hypothesis 1 or the realisations of MOUTH that occur in different following environments (§7.2.1). Within this section there are four patterns discussed: one which occurs with the majority of the speakers and



(a) MOUTH trajectories before voiced stops with (*grey line*) and without morpheme boundaries (*black line*)

(b) MOUTH Euclidean distance (ed) before voiced stops with (*grey line*) and without morpheme boundaries (*black line*)

Figure 7.17: MOUTH realisations before voiced stops with a morpheme boundary (**m_bound**) and without a morpheme boundary (**vd_st**)

three alternative patterns that occur for a subset of speakers (§7.2.1.1). Finally, the results that pertain to hypothesis 3 regarding speech style effects, are discussed in §7.2.2.

7.2.1 Hypothesis 1: MOUTH in LE is phonologically conditioned by the following environment

Let us first examine whether there is a difference between the realisation of MOUTH before voiced stops without a morpheme boundary, such as *loud*, and before voiced stops with morpheme boundaries, such as *vowed*. Figure 7.17 demonstrates that across all speakers the realisations of MOUTH before voiced stops without (**vd_st**) and with morpheme boundaries (**m_bound**) are similar in terms of the vowel trajectories and the amount of diphthongisation.

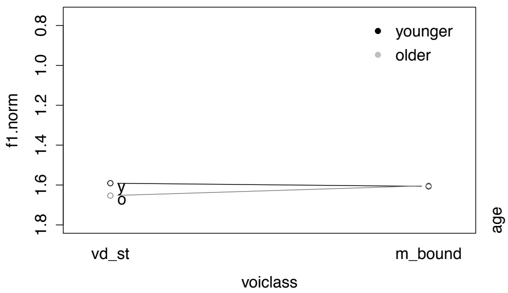
The mixed effects models predictions somewhat support the suggestion that MOUTH realisations are similar before voiced stops regardless of the presence/absence of morpheme boundaries. Note that the mixed effects models presented in the current section excluded the eight speakers who do not follow the general patterns for MOUTH. Furthermore, the mixed effects models used to determine whether morpheme boundaries affect the realisation of MOUTH included tokens of MOUTH before voiced stops only. Fixed effects in these models were following environment (**voiclass**), age, gender, and location.

Additionally, interactions between **voiclass** × age, **voiclass** × gender, and **voiclass** × location were in the models. The random effects are random slope for following environment by speakers and random intercepts for words and speakers. Figure 7.18 shows the mixed effects models predictions, which demonstrate that younger speakers produce MOUTH the same before all voiced stops, regardless of the presence/absence of morpheme boundaries (also see summary tables in §A.2.2.2). Older speakers' realisations of MOUTH before voiced stops with and without morpheme boundaries do not differ for the dependent measure of Euclidean distance and normalised duration. However, the older speakers demonstrate slight differences between the realisations of MOUTH before voiced stops with and without morpheme boundaries in the normalised f1 and f2 values at the nucleus and offglide ($p=<0.037$ in all four models).

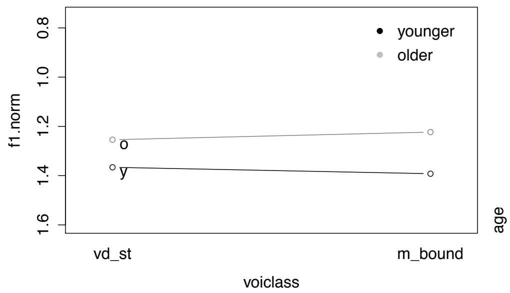
Only a small subset of the older speakers are included in the speakers who produce the most common pattern for the MOUTH vowel. Therefore, in this section MOUTH vowel realisations followed by any voiced stop are analysed together, regardless of whether the following voiced stop is in the same morpheme as the target vowel on in a second morpheme. However, MOUTH before voiced stops without morpheme boundaries (**vd_st**) and with morpheme boundaries (**m_bound**) are kept as separate following environments for the two older male speakers presented in §7.2.1.1, who produce differences in the patterns of variation of the MOUTH vowel from the majority of speakers.

The remainder of this section discusses the results for the MOUTH vowel for the majority of speakers, which excludes the seven speakers with alternate patterns: 'Sc03', 'Sc07', 'Sc10', 'Sc11', 'Sc17', 'Sc18', 'Sc27', and 'Sc23'. The results pertaining to these speakers are discussed in detail in §7.2.1.1.

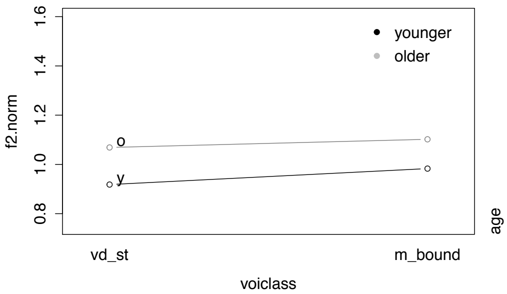
Similar to the findings for PRICE phonologically-conditioned variation in LE, MOUTH phonologically-conditioned variation in LE also has two different processes: raising at the nucleus measurement and monophthongisation. According to the results of the current investigation, the MOUTH vowel is produced as a raised nucleus short diphthong before voiceless stops (**vl_st**), raised long monophthong before nasals (**na**), short monophthong before /l/ (**la**) and diphthong before voiced stops (**vd_st**) and word final in open syllables (**op**). Figure 7.19 demonstrates the vowel trajectory, normalised f1 and f2



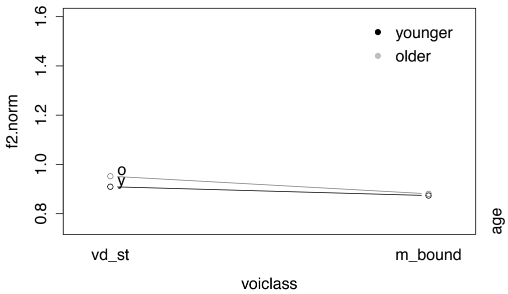
(a) Normalised f1 nucleus measurements (f1.norm) of MOUTH by age



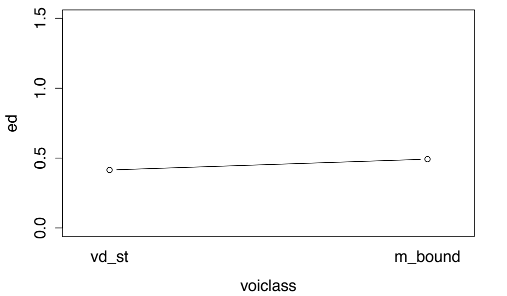
(b) Normalised f1 offglide measurements (f1.norm) of MOUTH by age



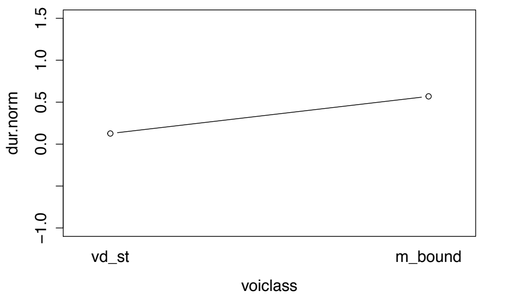
(c) Normalised f2 nucleus measurements (f2.norm) of MOUTH by age



(d) Normalised f2 offglide measurements (f2.norm) of MOUTH by age



(e) Euclidean distance measurements (ed) of MOUTH



(f) Normalised duration measurements (dur.norm) of MOUTH

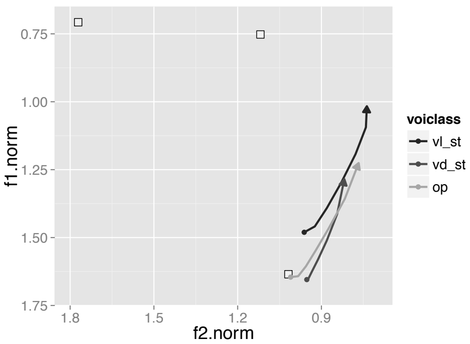
Figure 7.18: Mixed effects models predictions for MOUTH before voiced stops without morpheme boundaries (**vd_st**) and with morpheme boundaries (**m_bound**) on the six dependent variables: normalised f1 (f1.norm) and f2 (f2.norm) at the nucleus and offglide, Euclidean distance (ed), and normalised duration (dur.norm)

values of the nucleus and offglide of the MOUTH vowel for twenty one speakers who produce the most common pattern.

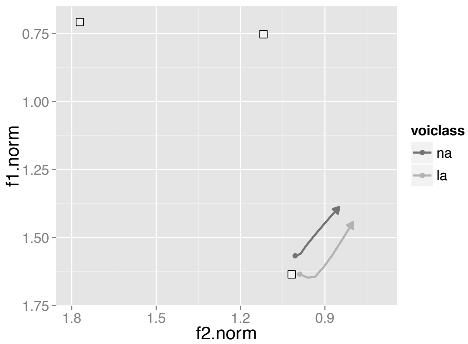
Figure 7.19a demonstrates the similarity between the trajectories of MOUTH before voiced stops and in open syllables. Furthermore, it shows that the vowel trajectories of MOUTH before voiced stops and in open syllables differ from the vowel trajectories of MOUTH before voiceless stops. The vowel trajectories of MOUTH before nasals and /l/ are also similar, as shown in Figure 7.19b. In addition, nucleus raising occurs before voiceless stops and the monophthongal realisation of MOUTH is raised before nasals, which is demonstrated in Figure 7.19c. This raising process is not found in any of the other following environments and realisations of MOUTH at the nucleus measurement are not differentiated in the front-back dimension for any of the following environments, as shown in Figure 7.19d. Finally, Figures 7.19e and 7.19f demonstrate the differences in the offglide values across the different following environments. These offglide values generally indicate the realisations of MOUTH that are mostly monophthongal and mostly diphthongal, which is further demonstrated in Figure 7.20a.

The amount of diphthongisation is demonstrated in Figure 7.20a, which shows that MOUTH realisations are the most diphthongal before voiceless stops followed by in open syllables and voiced stops, and MOUTH realisations are more monophthongal before nasals and /l/. Finally, the normalised duration values show similar results to those found for the PRICE vowel. Figure 7.20b shows that the duration of the MOUTH vowel is shorter before voiceless stops and /l/, and longer before voiced stops, nasals and in open syllables. These findings suggest that duration is not straightforwardly related to the amount of diphthongisation of the vowel realisations or the processes of raising in a way that has been previously proposed. For example, the duration of MOUTH before voiceless stops is short and before nasals it is long, but both are realised as raised. Furthermore, MOUTH has a long duration before nasals and a short duration before /l/, but the realisations of MOUTH in both environments are monophthongal. If there were a straightforward relationship between duration and processes that affect the realisations of the target vowels, these conflicting results would not be found.

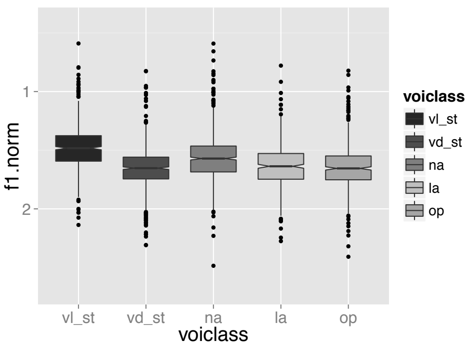
Further evidence for the difference in realisations of MOUTH conditioned



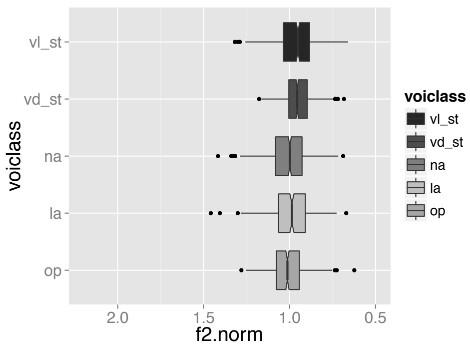
(a) Formant plot of MOUTH vowel trajectories before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)



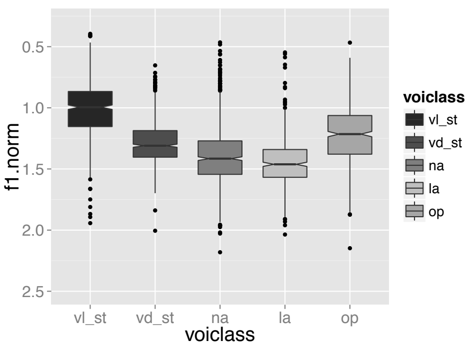
(b) Formant plot of MOUTH vowel trajectories before nasals (*medium grey*) and /l/ (*very light grey*)



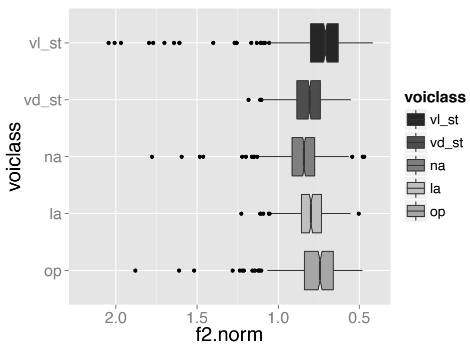
(c) MOUTH nucleus f1 measurements in all environments



(d) MOUTH nucleus f2 measurements in all environments

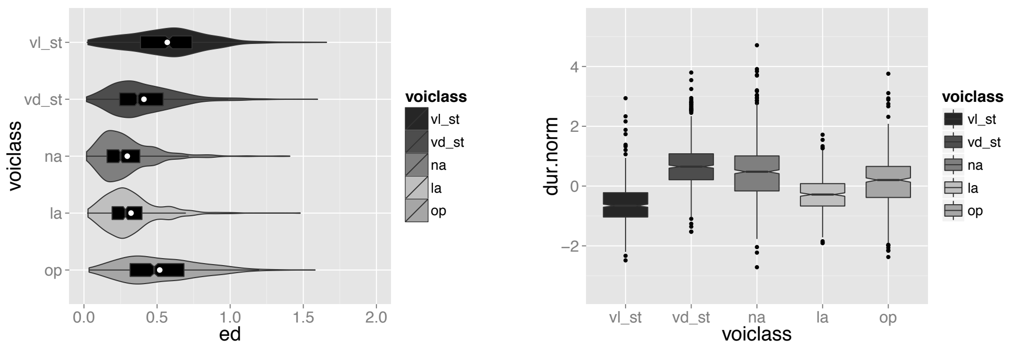


(e) MOUTH offglide normalised f1 measurements in all environments



(f) MOUTH offglide normalised f2 measurements in all environments

Figure 7.19: MOUTH vowel results for normalised f1 (f1.norm) and f2 (f2.norm) measurements by following environment (**voiclass**)



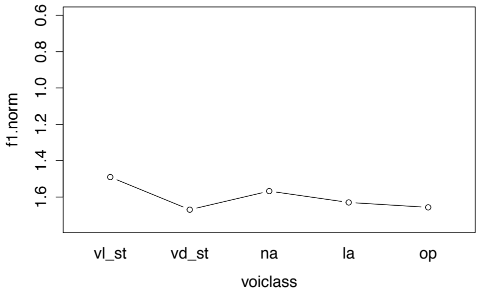
(a) Amount of diphthongisation of MOUTH by following environment (**voiclass**)

(b) MOUTH normalised duration measurements by following environment (**voiclass**)

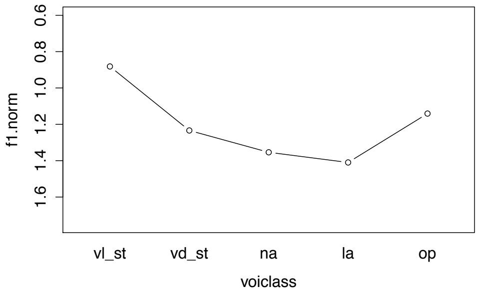
Figure 7.20: MOUTH vowel results for Euclidean distance (ed) and normalised duration measurements (dur.norm) by following environment (**voiclass**)

by following environments is gained through statistical analysis of the vowel realisations. I again used mixed effects models for the statistical analysis of the realisations of MOUTH in different following environments. These models excluded the eight speakers who do not follow the general patterns for MOUTH. MOUTH before voiced stops with and without morpheme boundaries was conflated into one level in **voiclass** as per the results discussed above. The fixed effects of the models are following environment (**voiclass**), speech style (**conv**), and gender. There are also interaction terms included in the models for following environment and speech style, and following environment and gender. The random effects of the models are random slopes for following environment by speaker and random intercepts for words and speakers. The predictions of the mixed effects models are shown in Figure 7.21. Gender was not found to be a significant predictor as a main effect or as interactions with any of the following environments for any of the dependent measures. Speech style was found to be a significant predictor as either a main effect or an interaction with the following environments in all of the models. The results pertaining directly to speech style are discussed in detail in §7.2.2.

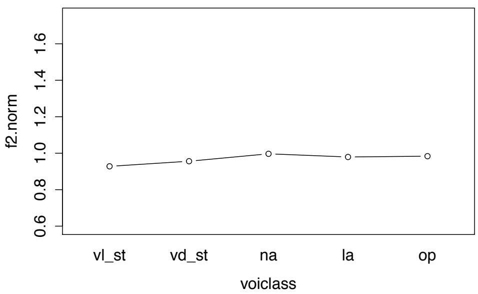
Figure 7.21 demonstrates that MOUTH before voiceless stops is produced as a raised nucleus short diphthong. The models suggest that the production of MOUTH before voiceless stops differ from the other environments in all dependent measures ($p<0.03$ in all pertinent models), with four exceptions (see Tables 7.6, 7.7 and 7.8 and summary tables in §A.2.2.2). Normalised f2



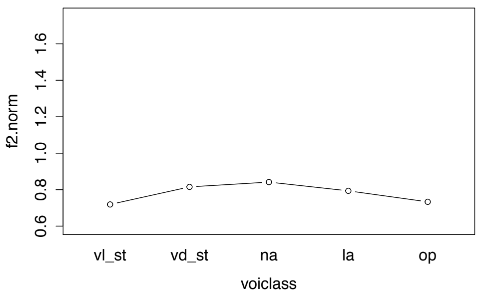
(a) Normalised f1 nucleus measurements (f1.norm) of MOUTH by **voiclass**



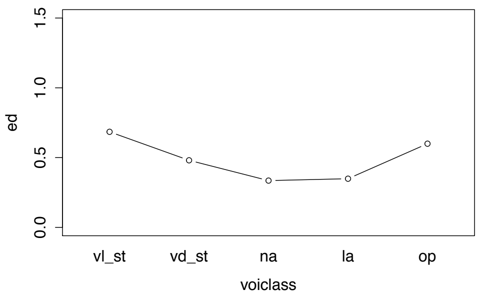
(b) Normalised f1 offglide measurements (f1.norm) of MOUTH by **voiclass**



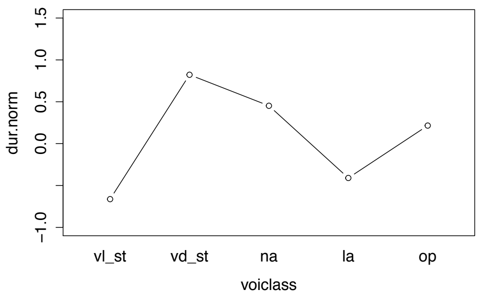
(c) Normalised f2 nucleus measurements (f2.norm) of MOUTH by **voiclass**



(d) Normalised f2 offglide measurements (f2.norm) of MOUTH by **voiclass**



(e) Euclidean distance measurements (ed) of MOUTH by **voiclass**



(f) Normalised duration measurements (dur.norm) of MOUTH by **voiclass**

Figure 7.21: Mixed effects models predictions for the MOUTH vowel by following environment (**voiclass**) on the six dependent variables: normalised f1 at the nucleus and offglide (f1.norm), normalised f2 at the nucleus and offglide (f2.norm), Euclidean distance (ed), and normalised duration (dur.norm)

	Estimate	Std. Error	t value
(Intercept)	1.64	0.04	42.35
voiclassna	-0.06	0.04	-1.73
voiclassop	0.03	0.03	0.99
voiclassvd_st	0.04	0.03	1.39
voiclassvl_st	-0.14	0.03	-4.31
convy	-0.05	0.04	-1.52
genm	-0.02	0.05	-0.45
voiclassna:convy	0.04	0.03	1.32
voiclassop:convy	0.07	0.03	2.24
voiclassvd_st:convy	0.03	0.03	0.96
voiclassvl_st:convy	-0.04	0.03	-1.20
voiclassna:genm	0.03	0.04	0.59
voiclassop:genm	-0.05	0.03	-1.69
voiclassvd_st:genm	-0.03	0.02	-1.25
voiclassvl_st:genm	0.04	0.04	1.18

Table 7.6: Summary table for MOUTH nucleus normalised f1 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	0.35	0.04	8.37
voiclassna	-0.01	0.04	-0.14
voiclassop	0.24	0.05	4.47
voiclassvd_st	0.13	0.04	2.92
voiclassvl_st	0.33	0.05	7.36
convy	-0.02	0.03	-0.77
genm	-0.07	0.05	-1.35
voiclassna:convy	-0.03	0.03	-0.91
voiclassop:convy	-0.10	0.03	-2.90
voiclassvd_st:convy	-0.02	0.03	-0.66
voiclassvl_st:convy	-0.13	0.03	-3.88
voiclassna:genm	0.06	0.05	1.23
voiclassop:genm	0.01	0.07	0.13
voiclassvd_st:genm	-0.02	0.05	-0.34
voiclassvl_st:genm	0.03	0.05	0.50

Table 7.7: Summary table for MOUTH Euclidean distance mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

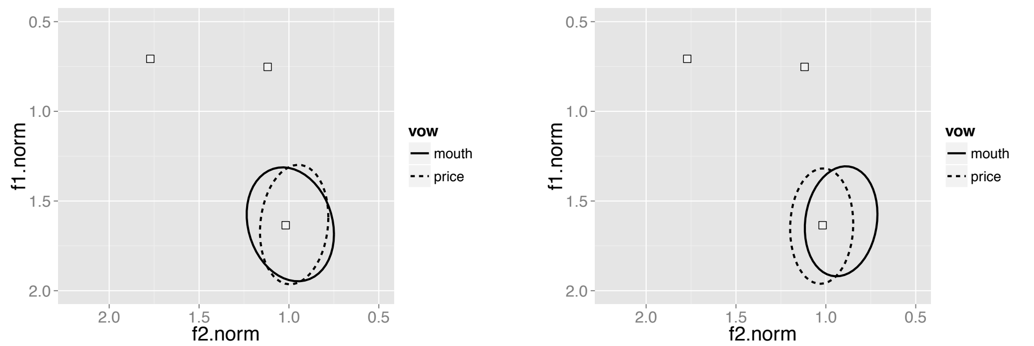
	Estimate	Std. Error	t value
(Intercept)	-0.42	0.14	-3.02
voiclassna	0.84	0.17	5.02
voiclassop	0.62	0.19	3.23
voiclassvd_st	1.25	0.17	7.25
voiclassvl_st	-0.26	0.18	-1.45
convy	0.18	0.15	1.22
genm	0.33	0.14	2.32
voiclassna:convy	-0.26	0.13	-2.01
voiclassop:convy	-0.49	0.14	-3.48
voiclassvd_st:convy	-0.03	0.13	-0.23
voiclassvl_st:convy	-0.21	0.14	-1.47
voiclassna:genm	-0.30	0.13	-2.23
voiclassop:genm	-0.32	0.19	-1.69
voiclassvd_st:genm	-0.36	0.14	-2.57
voiclassvl_st:genm	-0.11	0.19	-0.59

Table 7.8: Summary table for MOUTH normalised duration mixed effects model by speech style (**conv**) and gender (**gen**)

nucleus values for MOUTH do not differ for any of the following environments. The normalised f1 nucleus values for MOUTH before voiceless stops and nasal are not significantly different (p=0.062). No difference is found between the normalised f2 offglide values for MOUTH before voiceless stops and in open syllables (p=0.53), but there is a difference in the normalised f1 offglide values between these two environments (p<0.01). Finally, the duration of the MOUTH vowel before voiceless stops and /l/ does not differ (p=0.15). Given these results, MOUTH before voiceless obstruents is realised as a short duration raised nucleus diphthong, which is represented by [ə̝ʊ].

Turning to the results for the realisation of MOUTH before nasals, it is found that both raising and monophthongisation occurs (Tables 7.6 and 7.7). Figure 7.21a indicates that MOUTH is raised before nasals and Figure 7.21e demonstrates that this production is mostly monophthongal. While normalised f1 values for MOUTH before voiceless stops and nasals are not found to be significantly different, Figures 7.19c and 7.21a indicate that the height of these productions are not exactly the same. Therefore, the realisation of MOUTH before nasals is represented as [a̝ː], which is a raised long monophthong.

Short monophthongal productions of MOUTH are found to occur before



(a) Comparison of the realisations of PRICE (*dashed line*) and MOUTH (*solid line*) before /l/ at the 20% measurement

(b) Comparison of the realisations of PRICE (*dashed line*) and MOUTH (*solid line*) before /l/ at the 50% measurement

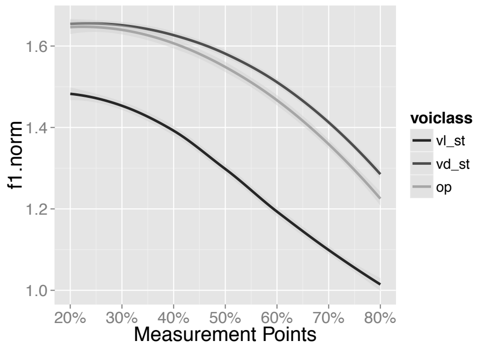
Figure 7.22: Comparison of the realisations of PRICE (*dashed line*) and MOUTH (*solid line*) before /l/

/l/, which is demonstrated in Figure 7.21. This realisation is represented as [a]. Therefore, the results of the current investigation suggest that the realisations of PRICE before /l/ and MOUTH before /l/ overlap to a large extent, as shown in Figure 7.22.

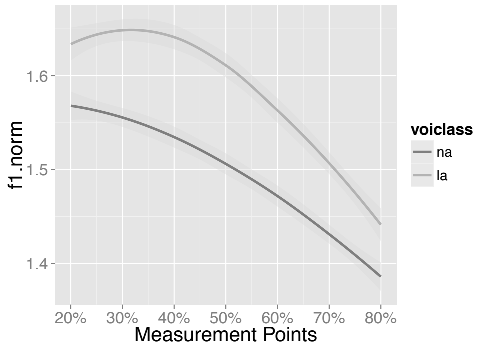
The final conditioning environment is before voiced stops and word finally in open syllables. MOUTH is realised as a diphthong in these environments, which is best represented as [aɔ]. As shown in Figures 7.19e and 7.21b, the offglide of MOUTH before voiced stops and in open syllables is not as phonetically high as the offglide of MOUTH before voiceless stops, but there is little difference in the backness of the offglide of MOUTH in these three environments.

An investigation of the inflection points of the target vowels is necessary to fully understand the vowel productions, as previously discussed. Furthermore, an analysis of the inflection points of the target vowels aids in our understanding of the origins of these patterns. Figure 7.23 demonstrates the differences in inflections points for the realisations of MOUTH by following environments.

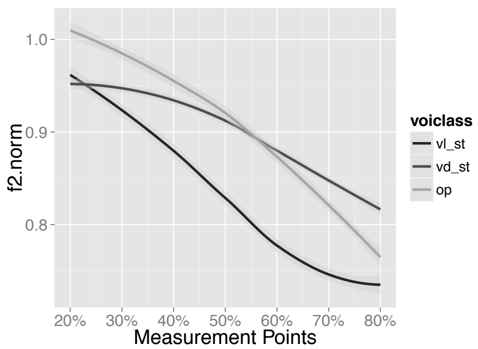
As shown in Figures 7.23a and 7.23b, the f1 inflection points for MOUTH are at approximately the 20% measurement before voiceless stops and nasals. The inflection points are at approximately the 30% measurement before voiced stops and in open syllables. Finally, the f1 inflection point for MOUTH before /l/ occurs at approximately 40%. With regards to the f2 inflection points,



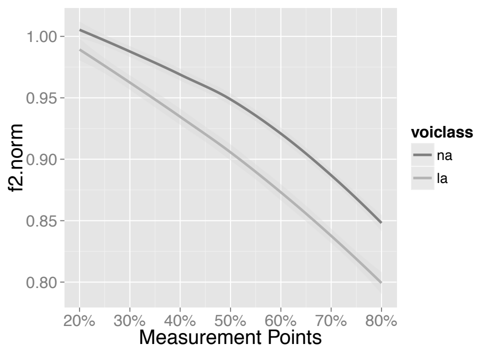
(a) MOUTH inflection points for f1 before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)



(b) MOUTH inflection points for f1 before nasals (*medium grey*) and /l/ (*very light grey*)



(c) MOUTH inflection points for f2 before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)



(d) MOUTH inflection points for f2 before nasals (*medium grey*) and /l/ (*very light grey*)

Figure 7.23: MOUTH trajectories demonstrating inflection points by following environments (**voiclass**)

there appears to be no difference between any of the following environments with the exception of before voiced stops. The f2 inflection point for MOUTH before voiced stops occurs at approximately the 30% measurement and it occurs at approximately the 20% measurement for all other environments. As a result of these findings, the phonetic transcription for the realisation of MOUTH before voiceless stops should be adjusted to [ə̞̆ʊ]. The results pertaining to the inflection points for MOUTH and what these findings indicate about the possible origins of MOUTH phonologically-conditioned variation in LE are discussed in Chapter 9.

In summary, the results of the current section suggest that for the majority of speakers in the current sample, the most common pattern for MOUTH phonologically-conditioned variation in LE is:

1. Before voiceless obstruents: [ə̝̆ʊ] (raised short nucleus diphthong with a short duration)

2. Before voiced stops and word finally in open syllables: [aɔ] (long diphthong)

3. Before /l/: [a] (short monophthong)

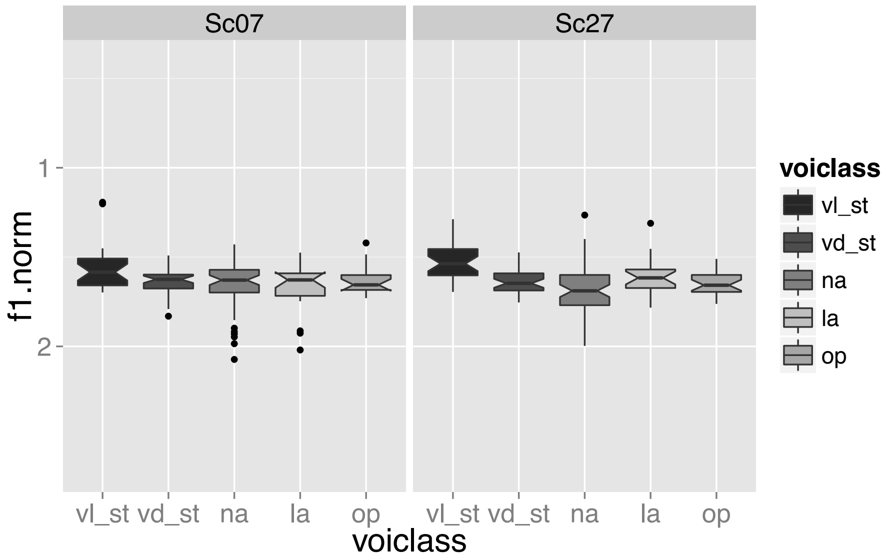
4. Before nasals: [a̝ː] (raised long monophthong)

There are two process that make up the patterns of variation found for the MOUTH vowel: raising before voiceless stops and nasals and monophthongisation before sonorants.

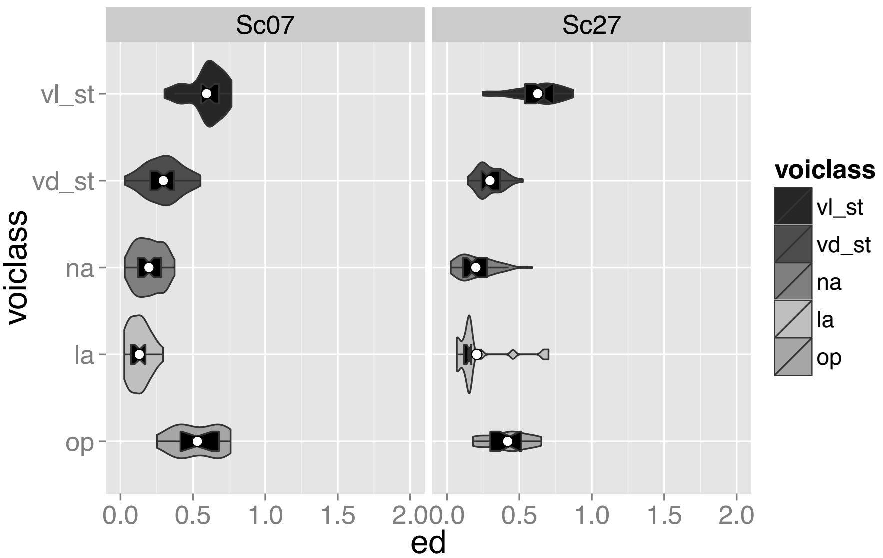
7.2.1.1 Inter-speaker variation

There are seven participants in the current sample who produce three alternative patterns of the MOUTH vowel from the general pattern discussed in §7.2.1. These patterns differ from the results for the majority of speaker with regards to the raising process and the monophthongisation process. Note that these seven speakers do not fall into any social categories and most of these speakers are different from the speakers who produced an alternative pattern of the PRICE vowel, discussed in §7.1.1.1. The seven participants discussed here are males and females, younger and older, and from north and south Liverpool, and Knowsley.

The first group of participants who produce an alternative pattern from the general one found for the MOUTH vowel, have the same pattern for the MOUTH vowel as they do for the PRICE vowel. In other words, MOUTH is realised with a raised nucleus diphthong before voiceless stops, but not a raised monophthong before nasals. Furthermore, for these speakers MOUTH is diphthongal before voiceless stops and in open syllables, but monophthongal before all voiced consonants. These two young male and female participants ('Sc07' and 'Sc27') are from north and south Liverpool. In the MOUTH pattern



(a) MOUTH nucleus f1 measurements for speakers who raise before voiceless stops, but not before nasals



(b) MOUTH Euclidean distance for speakers who raise before voiceless stops, but not before nasals

Figure 7.24: Normalised f1 nucleus box plot and Euclidean distance violin plot for speakers 'Sc07' and 'Sc27', who raise the nucleus of MOUTH before voiceless stops, but do not raise MOUTH before nasals

used by these speakers, MOUTH is realised as a raised nucleus diphthong ([ə̞̆ʊ]) before voiceless stops, a long monophthong ([aː]) before voiced stops and nasals, a short monophthong ([a]) before /l/, and a diphthong ([aɔ]) in open syllables. The lack of raising before nasals is shown in Figure 7.24a. Figure 7.24b demonstrates that these speakers have mostly diphthongal realisations of MOUTH before voiceless stops and in open syllables, and mostly monophthongal realisations before voiced stops, nasals and /l/.

The two older male participants ('Sc17' and 'Sc18') form another subset of speakers with an alternative pattern. These participants have a raised realisation of MOUTH before nasals, but do not raise the nucleus of MOUTH before voiceless stops. As shown in Figure 7.25, for these speakers MOUTH is realised as a raised monophthong ([a̝ː]) before nasals, a monophthong ([a]) before /l/, and a diphthong ([aɔ]) before obstruents, morpheme boundaries and in open syllables. Therefore, both a raising process and monophthongisation process are found, but the conditioning environments for the raising process differs from the conditioning environments in the general pattern of MOUTH variation. The monophthongisation of MOUTH occurs in the same following environments as the majority of speakers, i.e. before sonorants. However, the raising process occurs in a more restricted set of environments, i.e. only before nasals.

For these two older male participants, the results for the inflection points of MOUTH suggest that f1 inflection points of MOUTH are between the 30% and 50% measurements regardless of the following environment (Figure 7.26a). Similarly, the f2 inflection points for MOUTH occur between the 30% and 50% measurements, as shown in Figure 7.26b. Therefore, for these speakers the raising of MOUTH before nasals does not neatly map onto differences in inflection points.

The third group of participants with an alternative pattern for the MOUTH vowel are the younger speakers: 'Sc03', 'Sc10', 'Sc11'. These younger male and female participants from Knowsley and north Liverpool do not raise the realisation of MOUTH or the nucleus of MOUTH in any following environment (Figure 7.27). However, their realisations of MOUTH before voiced consonants are mostly monophthongal and before voiceless stops and in open syllables are mostly diphthongal. Therefore, these speakers demonstrate the monoph-

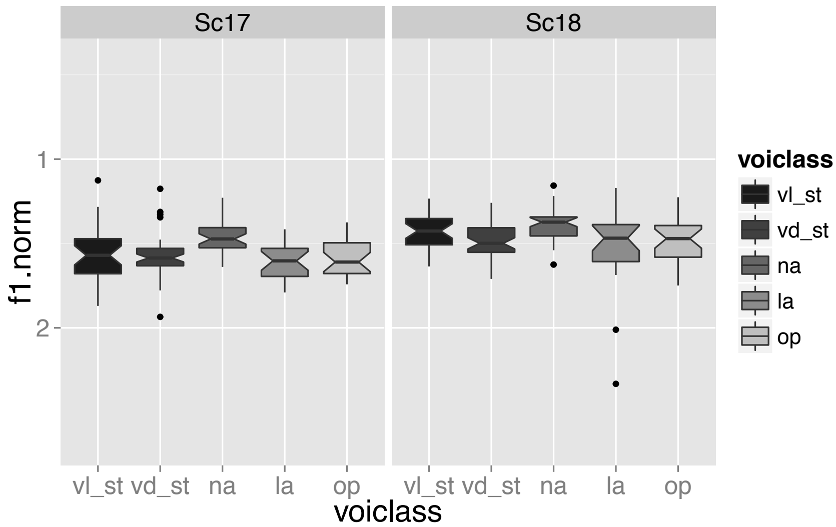


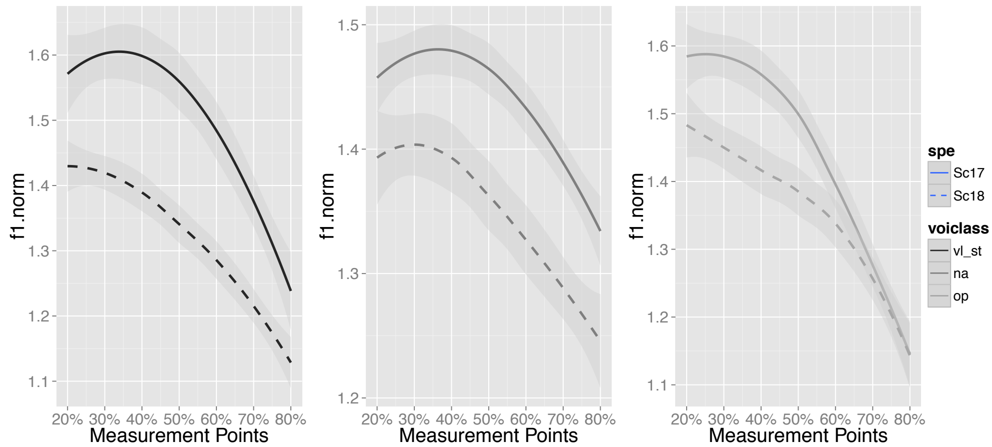
Figure 7.25: MOUTH normalised f1 nucleus measurements (f1.norm) for speakers 'Sc17' and 'Sc18', who raise MOUTH before nasals, but do not raise the nucleus of MOUTH before voiceless stops

thongisation process for the MOUTH vowel, but not raising processes.

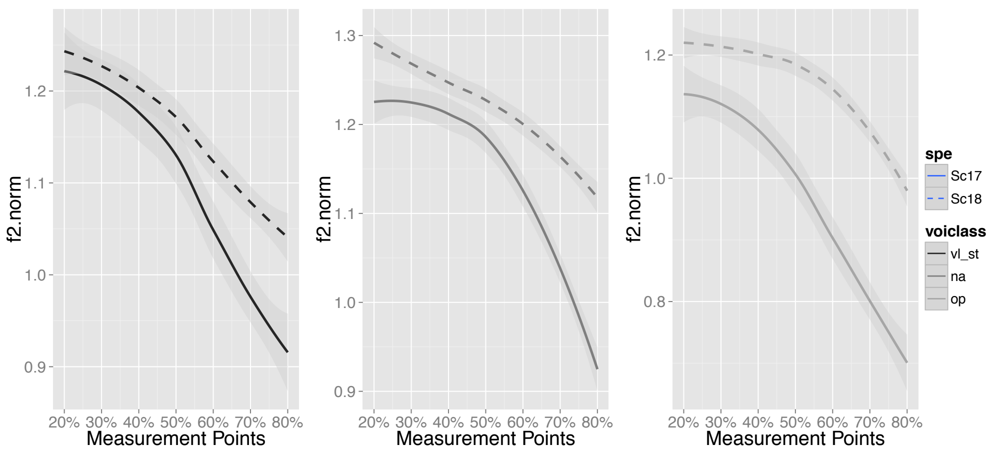
Finally, participant 'Sc23' produces MOUTH as mostly monophthongal in all environments, as shown in Figure 7.28b. It should be noted that the same participant produced PRICE as mostly diphthongal. Therefore, this speaker does not exhibit the monophthongisation process in the PRICE vowel and extends the monophthongisation process in the MOUTH vowel to a larger set of following environments. Participant 'Sc23' does exhibit the raising processes that occur with the MOUTH vowel. He raises MOUTH before voiceless stops and nasals compared to the other following environments, as shown in Figure 7.28a.

These results are likely due to levelling, as participant 'Sc23' lived away from Liverpool for more than three years. Given that there are no other speakers who have similar MOUTH phonologically-conditioned variation in the current sample, it is likely that this is not a common pattern found in LE.

The results of the current investigation indicate that for the majority of speakers MOUTH phonologically-conditioned variation in LE involves two processes: raising of MOUTH at the nucleus measurement and monophthongisation. Monophthongisation occurs before sonorants (nasals and /l/) and raising

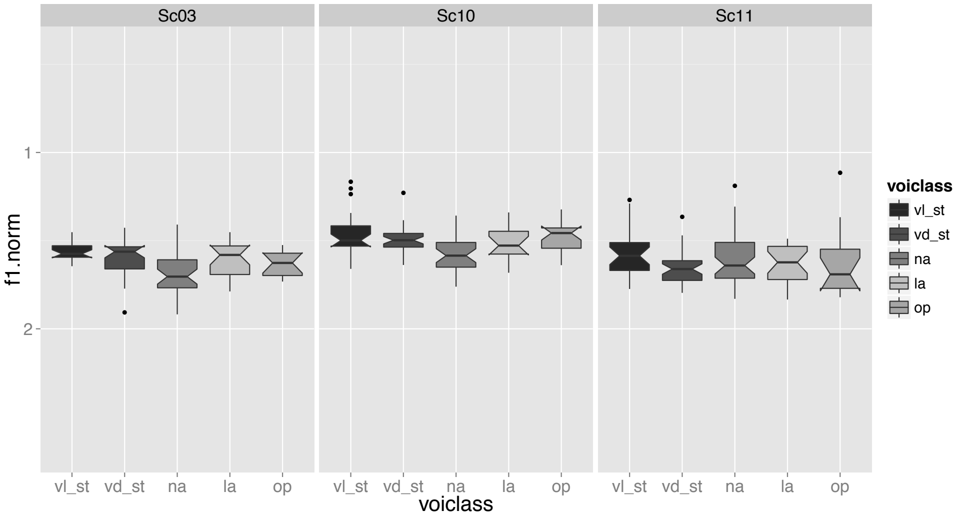


(a) MOUTH inflection points for f1 before voiceless stops (*dark grey*), nasals (*medium grey*) and in open syllables (*light grey*)

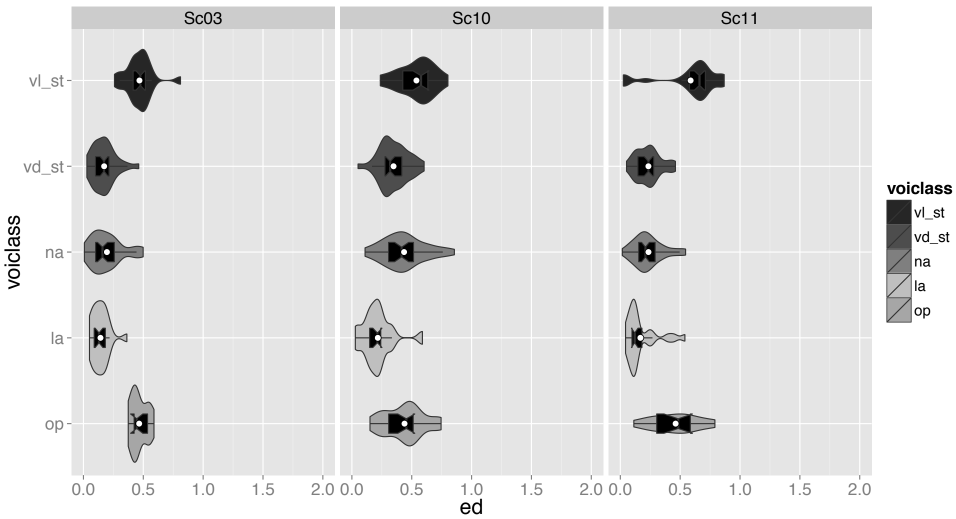


(b) MOUTH inflection points for f2 before voiceless stops (*dark grey*), nasals (*medium grey*) and in open syllables (*light grey*)

Figure 7.26: Inflection points for the MOUTH vowel trajectories by following environments (**voiclass**) for speakers 'Sc17', 'Sc18' who raise MOUTH before nasals, but do not raise the nucleus of MOUTH before voiceless stops

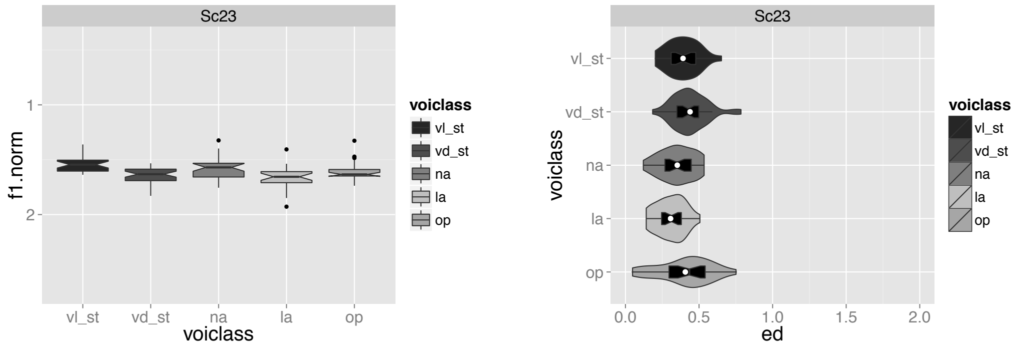


(a) MOUTH normalised f1 nucleus measurements (f1.norm) for speakers who do not raise in any environment



(b) MOUTH Euclidean distance measurements (ed) for speakers who do not raise in any environment

Figure 7.27: Normalised f1 nucleus box plot and Euclidean distance violin plot for speakers 'Sc03', 'Sc10' and 'Sc11', who do not raise the nucleus of MOUTH before voiceless stops or raise MOUTH before nasals



(a) MOUTH normalised nucleus f1 measurements (f1.norm) for speaker 'Sc23' in all environments

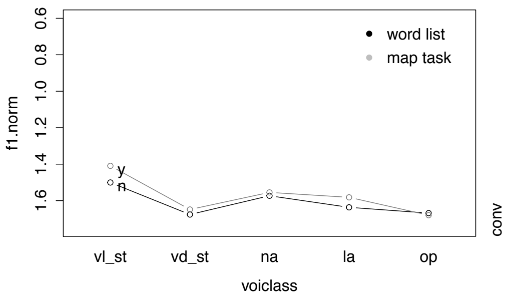
(b) Amount of Diphthongisation of MOUTH for speaker 'Sc23' by **voiclass**

Figure 7.28: Normalised f1 nucleus box plot and Euclidean distance violin plot for speaker 'Sc23', who produces monophthongal MOUTH in all environments

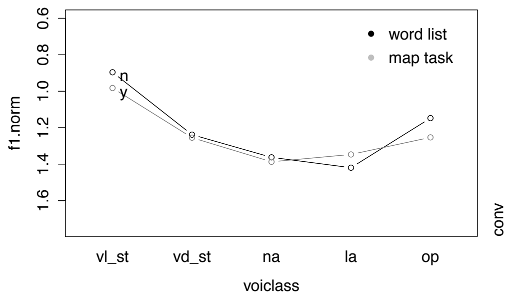
occurs before voiceless stops and nasals. Furthermore, there is a subset of speakers who differ from this general pattern. Two subsets of speakers restrict the environment of the raising process: one group raises the nucleus of MOUTH only before voiceless stops and the other group raises MOUTH only before nasals. The group of speakers that only raise the nucleus of MOUTH before voiceless stops also have extended the environment of the monophthongisation process of MOUTH from before sonorants to before all voiced consonants. Finally, one group of speakers does not produce the raising process, but does produce the monophthongisation process.

7.2.2 Hypothesis 3: Word list speech has different phonological conditioning of MOUTH compared to casual speech in LE

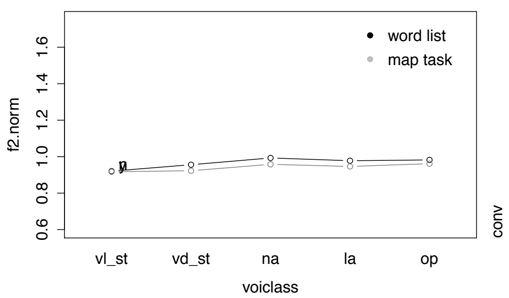
The current investigation found that realisations of MOUTH and the environments that condition these realisations differ between the word list and map task data. The predictions of the mixed effects models indicate that speech style is a main effect ($p<0.01$ in all three models) for normalised f1 measurements at the nucleus and offglide and Euclidean distance measurements. Furthermore, speech style was found to be a significant predictor ($p<0.02$ in all pertinent models) in a number of interactions with following environments, as shown in Figure 7.29.



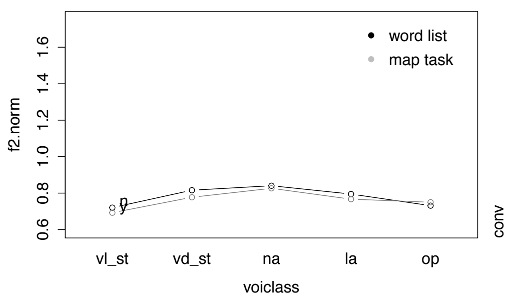
(a) Normalised f1 nucleus measurements (f1.norm) of MOUTH by **voiclass** and **conv**



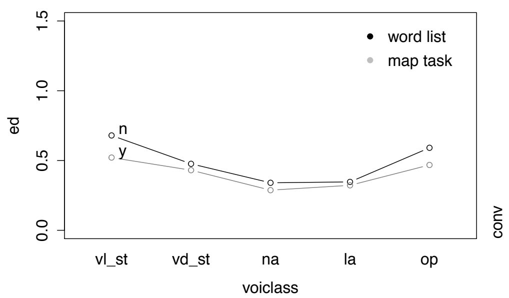
(b) Normalised f1 offglide measurements (f1.norm) of MOUTH by **voiclass** and **conv**



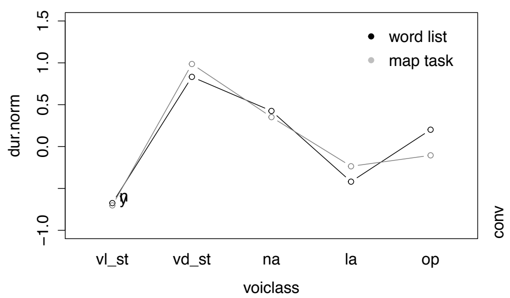
(c) Normalised f2 nucleus measurements (f2.norm) of MOUTH by **voiclass** and **conv**



(d) Normalised f2 offglide measurements (f2.norm) of MOUTH by **voiclass** and **conv**



(e) Euclidean distance measurements (ed) of MOUTH by **voiclass** and **conv**



(f) Normalised duration measurements (dur.norm) of MOUTH by **voiclass** and **conv**

Figure 7.29: Mixed effects models predictions for MOUTH by following environment (**voiclass**) and speech style (**conv**) on the dependent variables: normalised f1 (f1.norm) and f2 (f2.norm) at the nucleus and offglide, Euclidean distance (ed) and normalised duration (dur.norm)

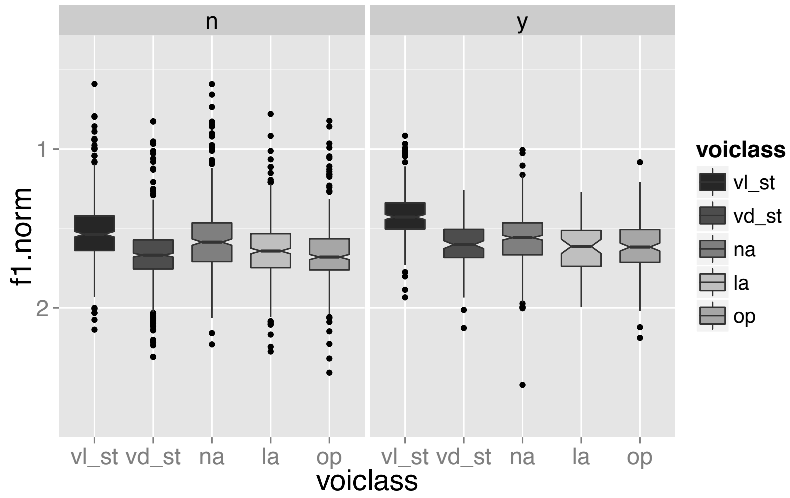


Figure 7.30: Comparison of MOUTH normalised f1 measurements (f1.norm) at the nucleus in the word list data (*n*) and map task data (*y*)

Results from the word list data suggest that MOUTH is produced as a raised nucleus diphthong (ə̯̆ʊ) before voiceless stops, a raised long monophthong ([a̝ː]) before nasals, a short monophthong ([a]) before /l/ and a diphthong ([aɔ]) before voiced stops and in open syllables. However, the results from the map task data suggest that MOUTH is produced as a raised nucleus diphthong (ə̆ʊ̯) before voiceless stops, a long monophthong ([aː]) before nasals, a short monophthong ([a]) before /l/, and a diphthong ([aɔ]) before voiced stops and in open syllables. In other words, the production of MOUTH before nasals differs depending on the speech style. Figure 7.30 compares the nucleus f1 values in word list data (*n*) and map task data (*y*). In particular, the change from MOUTH raising before nasals in the word list and not raising before nasals in the map task is shown.

Figure 7.31 shows the amount of diphthongisation for MOUTH in the word list and map task data. The realisations of MOUTH before voiced stops are more diphthongal in the word list and more monophthongal in the map tasks, but the predictions of the mixed effects models indicate that MOUTH realisations before voiced stops are still similar to those in open syllables, as shown in Figure 7.29e. On the other hand, the realisation of MOUTH before /l/ is more monophthongal in the word list and more diphthongal in the map tasks. Again the mixed effects models predictions suggest that MOUTH before

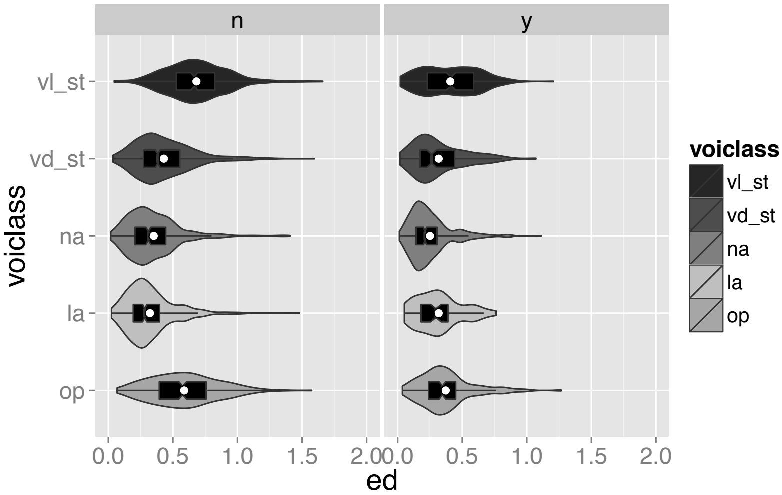


Figure 7.31: Comparison of the amount of diphthongisation of MOUTH in the word list data (*n*) and map task data (*y*)

/l/ is mostly monophthongal in both speech styles.

MOUTH phonologically-conditioned variation in LE does appear to differ depending on the speech style. While both the raising and the monophthongisation processes occur in word list and map task data, the environments where the raising process occurs differ by speech style. In word list speech raising of MOUTH at the nucleus measurement occurs before voiceless stops and nasals, but only before voiceless stops in casual speech. Monophthongisation occurs before nasals and /l/ in both speech styles.

Finally, according to the results of the current investigation, the realisations of MOUTH do not consistently differ depending on age, gender or location. A detailed examination of possible sociolinguistic conditioning of PRICE and MOUTH in LE is beyond the scope of the current study and left for future investigations.

7.3 PRICE AND MOUTH: RELATED BUT SEPARATE PATTERNS OF VARIATION

As previously suggested in §3.3.3, PRICE and MOUTH in LE show separate, but related patterns. The results of the current study suggest that there are some similarities between the features that make up PRICE and MOUTH phonologically-conditioned variation in LE, but there are also some differences. Therefore, the results of the current investigation confirm hypothesis 2 for the majority of speakers.

While both PRICE and MOUTH phonologically-conditioned variation in LE exhibit two processes, the exact implementation of these processes and the following environments that condition the realisation of the target vowels differ. The nucleus of PRICE is raised and fronted before voiceless stops and the nucleus of MOUTH is raised before voiceless stops. Furthermore, MOUTH is raised before nasals. Similarly, both target vowels exhibit a monophthongisation process, which occurs before voiced consonants for PRICE and before sonorants for MOUTH. Therefore, the main differences between the target vowels is that PRICE does not raise before nasals and MOUTH does not monophthongise before voiced stops.

However, if speech style is taken into account then PRICE and MOUTH phonologically-conditioned variation is less similar in word list data and more similar in map task data. As described in §7.1.2 and 7.2.2, the PRICE vowel processes are not affected by speech style, but the MOUTH vowel processes are. In casual speech the nucleus of MOUTH is raised before voiceless stops, but MOUTH is not raised before nasals. Therefore, in the map task data the nucleus of PRICE and MOUTH are both raised before voiceless stops. The environment where monophthongisation occurs does not differ for either vowel by speech style.

Finally, there are two participants ('Sc07' and 'Sc27') who exhibit the same patterns of variation for PRICE and MOUTH. These speakers raise (and front) the nucleus of the target vowels before voiceless stops and monophthongise the target vowels before voiced consonants.

Given these results, it is evident that PRICE and MOUTH phonologically-conditioned variation in LE are related patterns of variation. In some instances, the processes that make up these patterns have slightly different conditioning environments between the two vowels.

7.4 SUMMARY

The main findings of the current investigation suggest that both PRICE and MOUTH are phonologically conditioned by the following environment in LE and, therefore, confirm hypothesis one. For the majority of speakers in the current sample, there are two processes that occur: raising (and fronting) and monophthongisation. The results of the current investigation can be summarised by the following generalisations for PRICE and MOUTH phonologically-conditioned variation in LE:

PRICE

Before voiceless obstruents: [ɛ̝̆ɪ̞] (raised/fronted short nucleus diphthong with a short overall duration)

Word finally in open syllables: [aɪ] (long diphthong)

Before /l/: [a] (short monophthong)

Before voiced stops and nasals: [aː] (long monophthong)

MOUTH

Before voiceless obstruents: [ə̝̆ʊ] (raised short nucleus diphthong with a short duration)

Before voiced stops and word finally in open syllables: [aɔ] (long diphthong)

Before /l/: [a] (short monophthong)

Before nasals: [a̝ː] (raised long monophthong)

These results further suggest that PRICE and MOUTH are separate, but related patterns, which confirms hypothesis two. While there are two processes found to occur with both PRICE and MOUTH for the majority of speakers, the environments where these processes occur differ between PRICE and MOUTH.

The findings of the current investigation also suggest that a small subset of speakers deviate from the general patterns found for PRICE and MOUTH. For the PRICE vowel, there are six participants who differ from the majority of speakers. Two alternate patterns are found to occur in the data for five of these speakers. Two older male participants and one younger male participant do not exhibit the raising and fronting process, but do produce the monophthongisation process. On the other hand, two older female participants produce both processes, but extend the environment where raising occurs to before some voiced consonants. With regards to the MOUTH vowel, there are eight participants who differ from the majority of speakers. Seven of these participants produce three alternate patterns of variation for the MOUTH vowel. Two younger speakers produce both the raising and monophthongisation process. These speakers restrict the environments of the raising process to only before voiceless stops, and extend the environments of the monophthongisation process to before all voiced consonants. Therefore, these speakers have the same patterns for both PRICE and MOUTH. Another subset of three younger participants produces only the monophthongisation process and not the raising process. Finally, the two older male participants produce both the raising and monophthongisation process, but restrict the raising process to only before nasals.

Participant 'Sc23' differs from the majority of speakers in both the PRICE and MOUTH vowels. This speaker had been away from Liverpool for more than three years and produces a pattern with less conditioning by environment. The speaker raises and fronts the nucleus of PRICE before voiceless stops similar to the general pattern. However, monophthongisation of PRICE only occurs before /l/ and PRICE is diphthongal in all other environments. For MOUTH, raising occurs before voiceless stops and nasals, but monophthongisation occurs in all environments. Given that no other speaker produces this pattern and that this speaker spent some time outside of Liverpool, his idiosyncratic (according to the current dataset) vowel patterns are not discussed in the remainder of the thesis.

Note that the speakers who demonstrate a different pattern from the majority of speakers in the target vowels do not generally overlap, with the exception of the two older male participants and participant 'Sc23'. In other words, producing an alternate pattern for PRICE phonologically-conditioned variation does not entail a similar divergent pattern in MOUTH.

Finally, it is found that speech style affects the environments where the raising process occurs for MOUTH, but not for PRICE. In casual speech, raising occurs before voiceless stops, but not nasals. The monophthongisation process does not differ depending on speech style.

CHAPTER 8

ANALYSING THE SED AND OLIVE DATA SETS: METHODOLOGY

The results presented in Chapter 7 provide a detailed description of the contemporary phonologically-conditioned variation of PRICE and MOUTH in Liverpool English (LE). However, in order to further our understanding of the way that these patterns emerged and developed in LE, it is important to determine what these patterns may have been shortly following dialect formation and to distinguish between processes that occur prior to new-dialect formation, processes that emerge from new-dialect formation and processes that develop after new-dialect formation. The current investigation is able to do just that by looking at data from a time closer to new-dialect formation. In other words, processes that are likely the result of dialect formation should be attested in the historical datasets and processes that are likely later developments are likely not to be found in the historical dataset.

The current investigation examines two historical datasets that provide evidence for the origins of PRICE and MOUTH patterns in LE: *The Survey of English Dialects* (SED) (Orton and Dieth 1962–1971) and the *Origins of Liverpool English* (OLIVE) corpus (Watson and Clark forthcoming). The SED provides information about the realisations of PRICE and MOUTH in the past in areas surrounding Liverpool. As a result of methodological choices in the SED (§8.1), this data represents archaic speech from traditional dialects, which may be taken as a proxy for speech much earlier than the 1950s when it was collected. This invaluable resource helps determine some of the past variants of PRICE and MOUTH in the dialects of the surrounding areas of Liverpool, many of which may have been present in the dialect mixture in the formation of LE (see Chapter 2). Liverpool was not surveyed in the SED, as it is an urban variety. Such urban areas were mostly eschewed in the survey (see Orton and Dieth 1962–1971: 15). However, there are some areas in southwest Lancashire and north Cheshire that are near to or currently part of the area where LE is spoken, which were surveyed as part of the SED.

The second resource is the OLIVE corpus (Watson and Clark forthcoming), which contains recordings from speakers born between 1890 and 1994 (Watson and Clark forthcoming). The corpus was formed as part of the Economic and Social Research Council (ESRC) funded project – RES-061-25-0458 – titled 'Phonological levelling, diffusion & divergence in Liverpool and its hinterland'. Section 8.2 discusses the methodology of the corpus and the data analysis used in the current thesis. OLIVE has the oldest known recordings of LE (Watson and Clark forthcoming) at the time of writing and provides a good reference point for speakers who were born shortly after new-dialect formation in Liverpool. The current thesis analyses the PRICE vowel in a portion of the corpus with the oldest speakers to gain insights into any differences that occur between the historical and contemporary PRICE patterns in LE. As described in detail in previous chapters (see §5.3 and Chapter 7), corpus data and spontaneous speech do not have enough MOUTH lexical items in enough environments for a substantial analysis. Therefore, in the current investigation MOUTH is not analysed in the OLIVE corpus.

The use of these two historical datasets helps to differentiate between variants that are present in the PRICE and MOUTH phonological patterns as a results of new-dialect formation and those resulting from later developments.

8.1 SED METHODOLOGY AND DATA ANALYSIS

The SED was a large scale traditional dialect survey conducted in the 1950s under the direction of Harold Orton and Eugen Dieth (Orton and Dieth 1962–1971). One of the main aims of the SED was to collect the most traditional dialect features, which is demonstrated by the methodological decisions of the SED. These decisions included the type of informants, and data collection method and materials.

Informants were specifically chosen to have the most traditional features with the least external influences. Most of the informants were older, rural males who had been employed in farming trades:

> "The kind of dialect chosen for the study was that normally spoken by elderly speakers of sixty years of age or over belonging to the same social class in rural communities, and in particular by those who were, or had formerly been, employed in farming, for it is amongst the rural populations that the traditional types of vernacular English are best preserved to-day." (Orton 1962: 14).

With regards to data collection methods and materials, fieldworkers conducted a lengthy interview with informants that consisted of indirect questions, such as *What do you call your animals that give milk? And one of them?* (Question III.1.1.) and *What do you call the skin of a cow?* (Question III.11.7). This question style was meant to elicit natural speech without the need to prompt the informant or influence their pronounciations. The questionnaire consisted of phonological, morphological, syntactic and lexical questions and was design to reflect an English rural lifestyle. Interviews were phonetically transcribed on the spot by the fieldworker with short audio recordings made at many of the locations, though not, notably and unfortunately, at the location nearest to Liverpool.

Dialect reaches a stable state in early adolescence (Labov 1994), which would suggest that this data represents speech in Lancashire and Cheshire from the late nineteenth century. However, the dialect variants recorded in the SED were likely to predate the late nineteenth century given the overall goals and methodological decisions. The SED aimed to preserve and record the most archaic or traditional forms of the rural varieties. Variants described in the SED are meant to represent speech of a time period before that of the twentieth century (for an more in-depth discussion of the methodology see Chambers and Trudgill 1980, Petyt 1980 and Maguire 2007). Milroy and Gordon (2003: 12) discuss the differences between methods of traditional dialectology, like the SED, and most contemporary linguistic research:

> "the field methods of traditional dialectology were not devised to survey patterns of contemporary language use as an end in itself, but to offer a means of answering questions about the earlier history of language."

Furthermore, the SED focused on rural localities, as a result of the differences between dialect development in urban centres versus rural centres. Previous research has shown that rural varieties tend to have more traditional dialect features and lag in terms of linguistic change (see Trudgill 1983, Britain 2002 and Kerswill 2003). Therefore, I suggest that the dialect forms recorded in the SED approximate earlier pronunciation than the late nineteenth century, which would be just prior to or around the time of the final stages of new-dialect formation for LE.

Dialect variants from five localities in the southwest of Lancashire and three localities in the north of Cheshire closest to Liverpool form the basis for my discussion of the SED.[1] The localities were chosen based on their close proximity to Liverpool and that Lancashire and Cheshire varieties likely contributed to the dialect mixture in LE (see Chapter 2). These localities are La10 (Marshside), La11 (Eccelston), La12 (Harwood), La13 (Bickerstaffe), La14 (Halewood), Ch1 (Kingsley), Ch3 (Sweetenham) and Ch4 (Farndon), which are shown on Figure 8.1. Stanley Ellis was the fieldworker who collected the data at all of these localities between 1954 and 1957 (Orton and Halliday 1962, Orton and Barry 1969).

There were 24 informants in these locations between the ages of 59 – 81 with an average age of 72 at the time of data collection (see Table 8.1 for further details about the informants in these areas). Therefore, informants were born from approximately 1873 – 1898. The majority of the informants were males, but there are also two females in La12 and Ch1. SED fieldworkers often commented on the informant's dialect, including information about whether

[1] Some of the results presented here are discussed in Cardoso (2011a,b). For an in-depth survey of voice-driven type patterns in the UK using SED data see Maguire et al. (in progress).

Figure 8.1: SED localities in southwest Lancashire (*purple dots*) and north Cheshire (*blue dots*) closest to Liverpool (*red dot*) (Orton and Dieth 1962–1971), which are analysed in the current investigation

the speaker had a broad dialect or was bidialectal.[2] Many of the speakers who were surveyed in these localities were described as having broad dialects.

The current analysis uses 592 tokens across 72 PRICE lexical items surveyed from the SED. The lexical items were chosen if there was at least one realisation recorded for most of the localities.[3] However, there may have been more than one realisation recorded per locality. Other PRICE lexical items in the SED

[2]As mentioned in §4.2.4, bidialectalism refers to speakers that have two productive dialects, with one generally being a standard and the other a traditional variety, see also Smith and Durham (2012). None of the speakers in the current analysis were recorded as being bidialectal, so this issue is not pursued in the current investigation.

[3]For a list of the PRICE lexical items included in the current investigation and the question number where the lexical items occurred in the SED materials see Table A.1 in Appendix A.1.2.

Locality	Informant Metadata			Interviewer Notes	
	ID	Age	Occupation	General Notes	Dialect Notes
La. 10	S. R.	70	farmer	lifelong resident	
	J. W.	65	farmer	lifelong resident	
	P. W.	68	shrimper	lifelong resident; very good informant	very broad
	P. W.	70	sailmaker	lifelong resident; good informant	very broad
La11	T. H.	79	coal-miner, mill-worker, carter	lifelong resident	very broad
	T. M.	81	farmer	lifelong resident; good informant on farm terms	broad
	G. H.	79	builders' labourer	lifelong resident	very broad
La12	P. M.	72	farm-worker, charwoman	female; long resident; excellent informant	very broad
	P. K.	71	factory worker	very old local family	
La13	R. S.	75	farm-labourer	lifelong resident	
	R. B.	73	farmer	lifelong resident	
La14	J. L.	78	farmer	lifelong resident	
	T. T.	81	rail engine driver, farmer	very long resident	
	F. C.	65	blacksmith	long resident	broad
Ch1	J. L.	76	farmer, cobbler	good informant	broad
	A. L.	63	wheelwright, farm-labourer, refuse lorry driver	good informant	quite broad
	L. H.	n/k	n/k	female; good informant	
	A. H.	73	council workman	lifelong resident; good informant	fairly broad
Ch3	T. D.	67	farmer	lifelong resident; good informant	broad
	A. G.	71	small-holder, roadman	lifelong resident; good informant	fairly broad
	W. L.	59	miller, small farmer	lifelong resident; excellent informant	broad
Ch4	W. D.	66	farmer	very good informant	
	T. W.	75	blacksmith, dairy farmer, milkman	good informant	quite broad
	J. H.	n/k	n/k		

Table 8.1: SED informants for the five southwest Lancashire localities (Orton and Halliday 1962) and three north Cheshire localities (Orton and Barry 1969)

Environment	Example	Abbrev.	No. tokens	% tokens
ME /ix/ words	*night*	ME /ix/	112	19%
ME /ei/ words	*die*	ME /ei/	89	15%
voiceless stop	*wipe*	vl_st	74	13%
voiceless fricative	*wife*	vl_fr	59	10%
voiced stop	*hide*	vd_st	69	12%
voiced fricative	*five*	vd_fr	58	10%
nasal	*time*	na	106	18%
word-final/open syllable	*sky*	op	25	4%

Table 8.2: PRICE tokens from the SED data used in the current analysis

were excluded from the analysis if more than three of the eight localities did not have at least one realisation recorded. The lexical items in the current analysis are found in a number of different phonetic contexts, as shown in Table 8.2. Aside from the following environments included in the current analysis (Table 8.2), PRICE lexical items before /l/, orthographic /r/ and vowels were also initially analysed. However, they were excluded from the final analysis as there were too few tokens in the three environments to make any judgments on the realisations of PRICE in these environments.

Likewise, 358 tokens across 46 lexical items of MOUTH were analysed from the SED in a number of different phonetic contexts (Table 8.3). These lexical items were selected on the same basis as the PRICE lexical items.[4] At least one realisation must be recorded for each of the localities and lexical items where three or more localities did not have a realisation were excluded from the current analysis. There were further MOUTH lexical items before /l/, orthographic /r/ and vowels initially collected for the data analysis, but these were excluded from the final analysis as there were too few.

Microsoft Excel for Mac 2011 was used to produce figures for the results of the SED analysis in §9.1.1 and §9.2. These figures combine the results across variants in the localities. If a particular lexical item has more than one realisation, both are recorded in the analysis.

It must be noted that the extent to which SED data can be generalised to

[4]For a list of the MOUTH lexical items included in the current investigation and the question number where the lexical items occurred in the SED materials see Table A.2 in Appendix A.1.2.

Environment	Example	Abbrev.	No. tokens	% tokens
voiceless stop	*out*	vl_st	58	16%
voiceless fricative	*mouse*	vl_fr	70	20%
voiced stop	*clouds*	vd_st	15	4%
voiced fricative	*eyebrows*	vd_fr	54	15%
nasal	*down*	na	133	37%
word-final / open syllable	*sow*	op	28	8%

Table 8.3: MOUTH tokens from the SED data used in the current analysis

the entire speech community has been debated (see Johnston 1985). However, it does, at the very least, provide evidence for the phonetic variation of some speakers in southwest Lancashire and north Cheshire prior to the twentieth century. These areas likely contributed to the dialect mixture situation in Liverpool at the time of dialect formation (see §2.1). Furthermore, one of the localities, Halewood (La14), is within the current boundaries of LE and contemporary data has been collected in this area (Berry 2009). In combination with the OLIVE data, it is possible to see differences in past realisation of the PRICE vowel from varieties likely contributing to LE to the realisations of PRICE in LE shortly following new-dialect formation.

8.2 OLIVE METHODOLOGY AND DATA ANALYSIS

The *Origins of Liverpool English corpus* (OLIVE) (Watson and Clark forthcoming) in its entirety contains interview, read and elicited speech data for 140 speakers from three localities – Liverpool, Skelmersdale, and St. Helens – born between 1890 and 1994 (Watson and Clark forthcoming: 10). The full corpus is divided into three subcorpora based on age divisions and source of recordings: 'archive', 'older', and 'teen' (Watson and Clark forthcoming). The current investigation analyses PRICE vowel tokens from speakers of the 'archive' subcorpus, which includes speakers born between 1890 and 1943. This ensures that the results for PRICE reflect patterns shortly after new-dialect formation of LE and, therefore, helps to provide a better understanding of the origins of the contemporary pattern. The 'archive' subcorpus consists of

Speaker	Date of Birth	Gender
F02	1912	female
F03	1919	female
F05	1905	female
F07	1930	female
M04	1935	male
M10	1900	male
M16	1909	male

Table 8.4: OLIVE speakers from the 'archive' subcorpus used in the current analysis

oral history interviews, which were donated by the North-West Sound Archive (Watson and Clark forthcoming: 10). Table 8.4 provides details of the speakers analysed for the current study. The current analysis includes four females and three males from Liverpool born between 1900 and 1935. Three speakers, one female (F06) and two males (M06, M07), within the original materials of the OLIVE 'archive' subcorpus were excluded from the final analysis as a result of issues with formant tracking and analysis in PRAAT.

The current analysis includes 539 tokens of PRICE from 60 lexical items (see Table 8.5 for number of tokens per following environment). These tokens did not include any instances of function words in the corpus, such as personal pronouns (*I* and *my*) and prepositions (*by*), or proper nouns, such as *Michael*, as lexical items within these categories can be produced with phonetic variants that are unrepresented in content words with the same target sound. Shattuck-Hufnagel and Veilleux (2000) examine the differences between function word realisations and content word realisations, and Bybee and Hopper (2001) discuss the reduction processes associated with function words, but not content words. Holmes (1994) and Stuart-Smith and Timmins (2006) provide evidence for the exclusion of proper nouns, as they exhibit different characteristics from other lexical items. All instances of *like* are included in the final analysis, as previous evidence demonstrated that realisations of the PRICE vowel in discourse marker *like* and non-discourse marker *like* are not statistically significantly different (Cardoso 2011b).

Note that some of the lexical items in the environments before voiceless

Environment	Example	Abbrev.	No. tokens	% tokens
voiceless stop	*fight, bike*	vl_st	204	38%
voiceless fricative	*spice, wife*	vl_fr	56	10%
voiced stop	*hide, pride*	vd_st	39	7%
voiced fricative	*five, dive*	vd_fr	44	8%
nasal	*time, nine*	na	109	20%
/l/	*file, pile*	la	15	3%
word-final, open syllable	*fly, high*	op	46	9%
morpheme boundary	*tried, died*	bimorph	26	5%

Table 8.5: PRICE tokens from the OLIVE data used in the current investigation

Environment	Subclass	Abbrev.	No. tokens	% tokens
voiceless stop	ME /iː/	not_ME /ix/	99	18%
	ME /ix/	ME /ix/	105	20%
open syllable	ME /iː/	not_ME /ei/	27	5%
	ME /ei/	ME /ei/	19	4%
morpheme boundary	ME /ei/ + past tense	bimorph	26	5%

Table 8.6: PRICE tokens divided by ME subclasses from the OLIVE data used in the current investigation

stops, morpheme boundaries and in open syllables belong to the ME /ix/ and ME /ei/ subclasses of the PDE PRICE vowel (Table 8.6). In §9.1.2, I demonstrate that these lexical items no longer demonstrate differences from other PDE PRICE lexical items, which is found in the SED data. Therefore, the ME /ix/ and ME /ei/ lexical items are included within the following environments based on their realisations in the corpus, i.e. ME /ix/ is included in PRICE before voiceless stops, as that is the contemporary following environment.

The OLIVE corpus is fully time-aligned and searchable (Watson and Clark forthcoming), so all instances of the PRICE vowel were extracted for me from the 'archive' subcorpus and, where necessary, token segmentations were manually corrected by me in PRAAT (Boersma and Pater 2007). Similar to the methodology used for the analysis of the data described in §6.1, eleven equally spaced measurements of f1, f2 and f3, and a duration measurement were taken for each token of the target vowel using a PRAAT script.

R (R Core Team 2013) with the R studio interface (RStudio 2012) was used for analysis and ggplot2.R package (Wickham 2009) was used to produce the figures in §9.1.2 for the OLIVE dataset. Similar to the formant plots presented in Chapter 7, consonant transitions – measurements between 0% - 19% and 81% - 100% – are not included and all formant and box plots are based on normalised formant values. The modified Watt and Fabricius method (Watt and Fabricius 2002), using the Vowels.R package (Kendall and Thomas 2009–2014) in R (R Core Team 2013), was used to normalise the formant data. Midpoint values of FLEECE, GOOSE and TRAP (represented as white squares outlined in black in the formant plots) are used to orient the formant values within the phonetic space. Euclidean distance between the 20% and 80% measurements is calculated to demonstrate the amount of diphthongisation. These normalised Euclidean distances are presented in either violin plots or density plots, as described in §6.2. Duration measurements were normalised using z-scores, which is the same technique as described in §6.1. Finally, linear mixed effects models are used for statistical analysis of PRICE formant measurements, amount of diphthongisation and duration in the current analysis of the OLIVE corpus data, similar to the analysis of the newly collected data (see §5.2.2).

Watson and Clark (forthcoming) have used the OLIVE corpus data to explore the formation of LE and its relationship to new-dialect formation, in the sense of the Trudgill (1986) model. The 'archive' subcorpus is well-suited to examining aspects of new-dialect formation in LE, as the oldest speaker from Liverpool in the 'archive' subcorpus (born 1897) would be expected "to be taking part in the early processes of koineisation, including levelling and the development of interdialect forms." (Watson and Clark forthcoming: 11) and the youngest speakers would be expected to be "following the process of focussing" (Watson and Clark forthcoming: 11). The evidence presented in Chapter 2 suggests that the oldest speakers are more likely to represent a time around or shortly following focussing and the younger speakers would represent a time shortly after the formation of LE. Regardless, this data provides the only corpus of LE available that is near the time of dialect formation, and is an invaluable resource in looking at features in LE as a result of new-dialect formation.

Examining PRICE phonologically-conditioned variation using a combination of the SED, OLIVE 'archive' subcorpus, and the newly collected dataset (§7.1) and MOUTH phonologically-conditioned variation using the SED and the newly collected dataset (§7.2), provides a fuller understanding of the mechanisms involved in the emergence of these phonological patterns, which are discussed in §10.

CHAPTER 9

ANALYSING THE SED AND OLIVE DATA SETS: RESULTS

The current chapter describes the results of the analysis of the *Survey of English Dialects* (SED) and *Origins of Liverpool English* (OLIVE) corpus data. Section 9.1 presents the results of the SED and OLIVE data analysis for PRICE and §9.2 discusses the results of the SED data for MOUTH. As discussed in Chapter 8, the analysis of these two datasets helps to differentiate between variants and processes that are present in PRICE and MOUTH phonologically-conditioned variation as a result of new-dialect formation and those resulting from later developments. The results of the analysis of the SED and OLIVE data in conjunction with the results of the main investigation demonstrate the necessity for an approach to the origins of PRICE and MOUTH phonologically-conditioned variation in LE that combines aspects of the previously proposed approaches, as no one approach alone can account for the emergence and development of these patterns.

9.1 PRICE IN THE SED AND OLIVE

The current section begins with the results from the analysis of the SED materials (§9.1.1). An analysis of each individual locality is initially presented and then the combined results generalised across the different localities. Each locality has slightly different variants and patterns from the other localities and, therefore, presenting them separately ensures that specific features in each of the localities are not overshadowed by the overall variation found in these eight localities. Section 9.1.2 discusses the results from the analysis of the

OLIVE data. This discussion begins with an analysis of the differences between the Middle English (ME) subclasses that developed into present-day English (PDE) PRICE or in the case of some of the SED localities in some lexical items did not develop into PDE PRICE. This is followed by the main discussion of the results of the analysis of the OLIVE data, which focuses on the following environments that condition different realisations of the PRICE vowel.

9.1.1 PRICE in the SED

The results from the SED data indicate that the number of possible realisations of the PRICE lexical items varies greatly between localities in the current investigation. The fewest number of realisations in any one locality is five, which occurs in La10 ([ɑɪ], [aɪ], [ɛɪ], [iː] and [ə]) and Ch1 ([ɑɪ], [aɪ], [ɛɪ], [iː] and [ɪ]). La14, the locality closest to Liverpool, has the most number of realisations. There are ten realisations of the lexical items in La14 ([ɑɪ], [ɑ̃ɪ], [ɑ̃ɪ̃], [aɪ], [ãɪ], [ɛɪ], [iː], [ɛ], [ɪ] and [ɑ̃ː]).

As described in §3.2.1, there are certain realisations of PRICE in the SED localities that stand out as common realisations of the PRICE vowel. Some of the realisations are found across most or all of the localities, such as [ɑɪ], [aɪ] and [ɛɪ], and other realisations only occur in one locality, such as [ɑ̃ɪ] and [ɑ̃ɪ̃]. However, the prevalence of each of the realisations in each locality varies. For example, [ɑɪ] is by far the most common realisation for the PRICE lexical items in La10, La13, Ch1, and Ch4, but [aː] is by far the most common realisation in La12.

Before describing the results for each of the localities, it is important to remove those realisations that are not directly related to the PRICE vowel. This provides a clearer picture of the patterns of the PRICE vowel in these localities. There are a number of short vowel realisations that are found in the lexical items, such as [ɪ], [ɛ] and [ə]. These realisations occur relatively infrequently in the current dataset and are not likely variants of the PRICE vowel, but reductions based on other factors. For example, *ivy, frightened* and *rind* are all produced with [ɪ] in one or more localities. In total there were 25 short vowel realisations recorded in the PRICE lexical items, which are removed from the following results, as they are not realisations of the PRICE vowel.

As described in §4.1.1, ME /ix/ and ME /ei/ developed differently from ME /iː/ in many varieties of English. The current analysis finds evidence of this in the SED localities surveyed. The phonetic realisations [iː], [ɪiː] and [ɛiː] occur exclusively in the PRICE lexical items that would have originated from ME /ix/ and ME /ei/. These realisations account for 75 of the 201 realisations recorded in the ME /ix/ and ME /ei/ environments, but are more prevalent in the ME /ix/ subclass with 49% of the ME /ix/ tokens recorded as [iː]. These realisations are also excluded from the following results, as they are not realisations of the PRICE vowel. However, a number of other realisations that demonstrate different stages of development from ME /iː/ to the PRICE vowel are also found, such as [ɛɪ]. These realisations are included in the following analysis. As a result of excluding these realisations, the results presented here are based on 492 tokens of the 592 tokens initially analysed from the SED data.

The results focus on the specific localities and overall dialect areas of southwest Lancashire and north Cheshire, and their realisations of the PRICE lexical items that are related to the PRICE vowel that diphthongised as part of historical processes (see §4.1.1). Localities in southwest Lancashire are described first and then the north Cheshire localities. Approximate distance from Liverpool ('Dist.') given in the table for each locality was calculated using the shortest distance provided by the Google Maps (@2015 Google) directions function.

La10 (Marshside) has three PRICE realisations ([ɑɪ], [aɪ] and [ɛɪ]) as shown in Table 9.1 and Figure 9.1. The most frequent realisation of PRICE recorded in this locality is [ɑɪ] with only three tokens that have other realisations. Therefore, nucleus retraction occurs frequently across all environments. Furthermore, fronted and/or raised nucleus diphthongs [ɛɪ] and [aɪ] are only found before voiceless stops. For the [ɛɪ] realisation this includes ME /ix/ lexical items (see Figure 9.1). Therefore, one process in La10 of nucleus retraction occurs in all environments.

The second locality to the east of La10, La11 (Eccleston), has five PRICE vowel realisations recorded. There are three diphthongs ([ɑɪ], [aɪ] and [ɛɪ]) and two monophthongs ([ɑː] and [aː]), as shown in Table 9.2 and Figure 9.2. The realisation that occurs the most is [ɑː], which occurs in all environments except

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
35	[ɑɪ]	1	6	7	7	9	6	12	4
	[aɪ]	–	–	1	–	–	–	–	–
	[ɛɪ]	1	–	1	–	–	–	–	–

Table 9.1: La10 phonetic realisations of PRICE by following environment

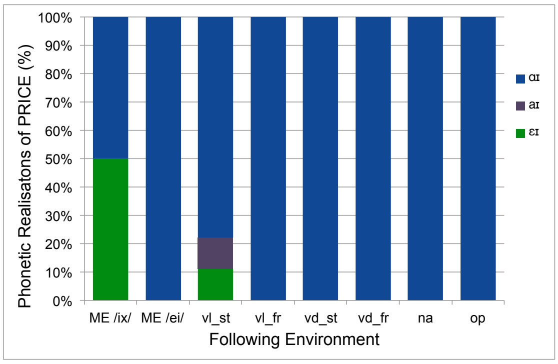


Figure 9.1: La10 phonetic realisations (%) of PRICE by following environment

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
37	[ɑɪ]	–	3	3	2	4	–	3	3
	[aɪ]	–	–	1	–	–	–	–	–
	[ɛɪ]	2	–	1	–	–	–	–	–
	[ɑː]	–	5	4	3	2	8	8	–
	[aː]	–	1 –	1	1	–	–	–	

Table 9.2: La11 phonetic realisations of PRICE by following environment

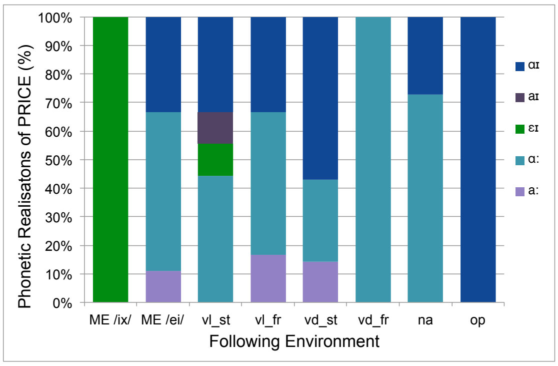


Figure 9.2: La11 phonetic realisations (%) of PRICE by following environment

ME /iː/ lexical items and in open syllables (see Figure 9.2). The backed nucleus diphthong [ɑɪ] also occurs frequently and is found in all environments except before voiced fricatives and in ME /iː/ lexical items. Similar to results for La10, [ɛɪ] and [aɪ] only occur before voiceless stops. Furthermore, [ɛɪ] is the only PRICE vowel realisation in ME /iː/ lexical items.

The results for La11 suggest that monophthongisation occurs in all environments except in ME /iː/ lexical items and in open syllables. There is a secondary process of nucleus retraction or vowel retraction which occurs in all environments except in ME /iː/ lexical items.

La12 (Harwood) is the farthest of the southwest Lancashire localities from Liverpool and is the locality that differs most from the other southwest Lancashire localities. There are four realisations recorded in this locality: two diphthongs ([aɪ] and [ɛɪ]) and two monophthongs ([ɑː] and [aː]). Table 9.3 and Figure 9.3 demonstrate that the most frequent realisation is a monophthong ([aː]), which can occur in all environments except ME /iː/ lexical items. Monophthongal realisations occur mostly before nasals, but also frequently occur before voiced obstruents. Furthermore, more than 50% of the realisations before voiceless stops and in open syllables are monophthongs. The raised and fronted nucleus realisation [ɛɪ] occurs before voiceless obstruents, voiced stops and in ME /iː/ and ME /ei/ lexical items. However, it is most frequent in the ME /iː/ and ME /ei/ words.

There appears to be the following processes in La12: monophthongisation and retraction. Monophthongisation occurs in all environments except in ME /iː/ lexical items, but is least frequent before voiceless obstruents and in ME /ei/ lexical items. Finally, retraction occurs only before nasals and is not a common process.

The next locality, La13 (Bickerstaffe), has five realisations of the PRICE vowel. There are four diphthongs ([ɑɪ], [ɑˑɪ], [aɪ] and [ɛɪ]) and one monophthong ([ɑː]). The most common realisation is [ɑɪ], which occurs in all environments, as shown in Table 9.4 and Figure 9.4. The raised and fronted nucleus realisation [ɛɪ] occurs before all voiceless stops, including in the ME /iː/ lexical items. The [aɪ] realisation occurs before voiceless stops and nasals. Before nasals there is also an [ɑˑɪ] realisation recorded in La13. Finally, the monophthongal realisation occurs only once and it is in the open syllable environment (see

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
56	[aɪ]	–	3	1	1	2	–	1	1
	[ɛɪ]	1	3	2	2	–	1	–	–
	[ɑː]	–	–	–	–	–	–	1	–
	[aː]	–	1	6	3	5	4	11	2

Table 9.3: La12 phonetic realisations of PRICE by following environment

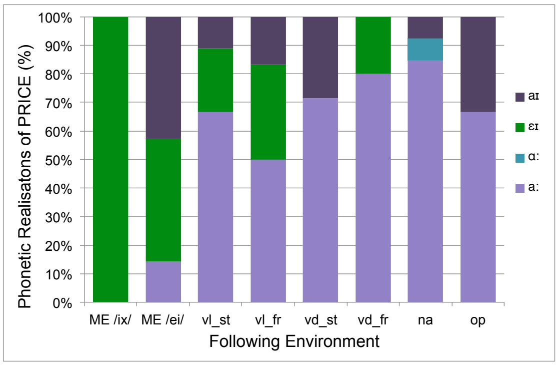


Figure 9.3: La12 phonetic realisations (%) of PRICE by following environment

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
23	[ɑɪ]	1	8	7	7	8	8	10	3
	[ɑˑɪ]	–	–	–	–	–	–	1	–
	[aɪ]	–	–	2	–	–	–	1	–
	[ɛɪ]	1	–	1	–	–	–	–	–
	[ɑː]	–	–	–	–	–	–	–	1

Table 9.4: La13 phonetic realisations of PRICE by following environment

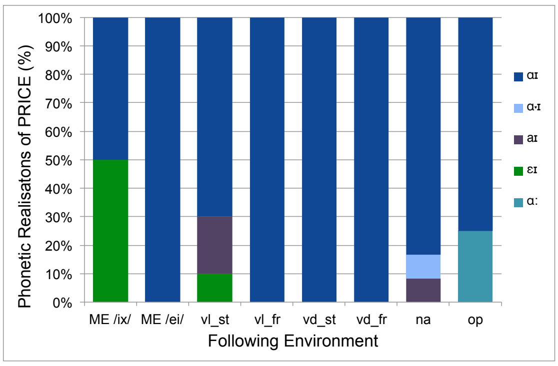


Figure 9.4: La13 phonetic realisations (%) of PRICE by following environment

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
14	[ɑɪ]	2	3	4	2	4	2	7	–
	[ɑ̃ɪ]	–	2	2	1	2	3	6	1
	[ɑ̃ɪ̃]	–	–	–	–	2	–	1	–
	[aɪ]	–	–	–	2	3	2	–	3
	[ãɪ]	–	–	–	1	–	–	–	–
	[ɛɪ]	2	–	1	–	–	–	–	–
	[ɑ̃ː]	–	–	–	–	–	1	–	–

Table 9.5: La14 phonetic realisations of PRICE by following environment

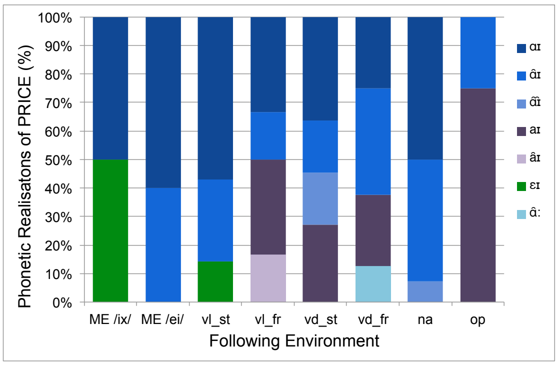


Figure 9.5: La14 phonetic realisations (%) of PRICE by following environment

Table 9.4).

In La13, there is a common process of nucleus retraction that occurs in all environments and an infrequent process of monophthongisation that occurs once in an open syllable.

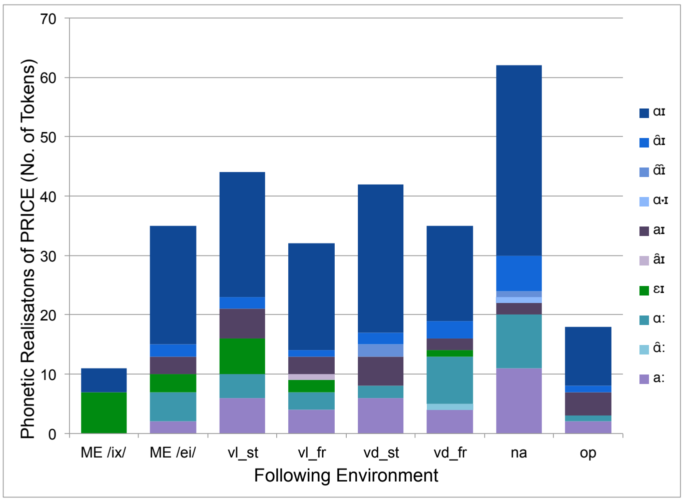
The final southwest Lancashire locality analysed in the current analysis is the one closest to Liverpool, La14 (Halewood). There are seven realisations, six of which are diphthongal ([ɑɪ], [ɑ̃ɪ], [ɑ̃ɪ̃], [aɪ], [ãɪ] and [ɛɪ]) and one monophthong ([ɑ̃ː]). As shown in Table 9.5 and Figure 9.5 the most common realisation is [ɑɪ], which occurs in all environments except in open syllables. The nasalised nucleus diphthong ([ɑ̃ɪ]) also occurs very commonly and is reported in all environments except in ME /ix/ lexical items.

The processes that occur in La14 are: nucleus retraction, nasalisation and monophthongisation. The [ɛɪ] realisation occurs in ME /ix/ words and once before a voiceless stop. Nucleus retraction occurs in all environments, but is least frequent in ME /ix/ lexical items and in open syllables. Monophthongisation is not a common process and only occurs once before a voiced fricative. On the other hand, nasalisation can occur across all environments except in ME /ix/ lexical items. Furthermore, the nasalisation process can affect the nucleus or the nucleus and the offglide.

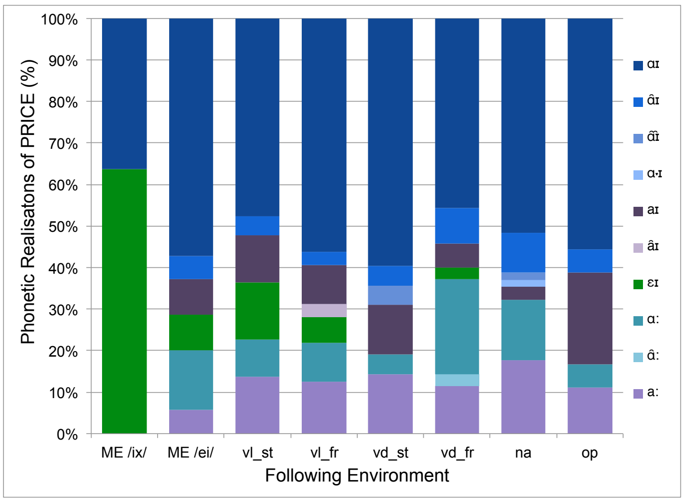
This locality was also investigated in the study by Berry (2009)[1], which analysed the contemporary variants of PRICE in LE through the speech of seven participants from Halewood (La14). Present-day Halewood lies within the boundary where LE is said to be spoken. It is, therefore, useful to compare the results of the SED analysis to those in Berry (2009). Cardoso (2011b) makes this comparison and finds that since the SED there have been a number of changes in Halewood. One of the main findings relevant to the current investigation is that there are more monophthongal realisations of PRICE in Berry's (2009) data, which account for a quarter of the overall realisations in 2009, compared to one instance in the SED. Berry (2009) finds that these monophthongs occur before all voiced consonants except /l/. This is different from the SED, as the monophthongal realisation occurs only before a voiced fricative. It appears that in the 2009 data the environments where monophthongisation occurs has extended and the process has become more pervasive. Furthermore, ME /ix/ and /ei/ lexical items are no longer found to have [ɛɪ] realisations in 2009. The results presented by Berry (2009) suggest that [ɛɪ] is no longer in use and that the PRICE variants in ME /ix/ and ME /ei/ lexical items are conditioned by the following environment rather than being a member of one of the ME subclasses.

While a number of different processes occur across the southwest Lancashire localities, the most common processes that occur across most of the localities are: nucleus retraction and monophthongisation. As shown in Figures 9.6a and 9.6b, nucleus retraction occurs frequently across all environments, but is reported least often in ME /ix/ lexical items. Monophthongisation occurs most before voiced consonants and is particularly frequently before voiced fricatives and nasals. Figures 9.6a and 9.6b also demonstrates that across all localities monophthongal realisations are not common before voiceless stops (both ME /ix/ and other pre-voiceless stop tokens) and in open syllables (both ME /ei/

[1]For a detailed discussion of Berry's (2009) results see §3.3.3



(a) Number of phonetic realisations of PRICE by environment across all southwest Lancashire localities



(b) Percentage of phonetic realisations of PRICE by environment across all southwest Lancashire localities

Figure 9.6: Phonetic realisations of PRICE by environment across all southwest Lancashire localities

and other PRICE tokens in open syllables). Raw values are provided in Figure 9.6a, whereas percentage of each realisation is provided in Figure 9.6b.

ME /ix/ and ME /ei/ lexical items in all localities provide evidence that the vowel in these environments developed differently from the ME /iː/ vowel. This can be seen in the [ɛɪ] realisation that is found most often in ME /ix/ and ME /ei/ lexical items. This realisation is also reported to occur less frequently before voiceless obstruents. As reported in Cardoso (2011a) and described in §3.2.1, some southwest Lancashire localities produce PRICE most frequently as the [ɑɪ] diphthong – La10, La13, La14 – and others realised PRICE predominantly as a monophthong – La11 ([ɑː]) and La12 ([aː]).

In order to present a clear picture of the processes that affect the PRICE vowel in southwest Lancashire, only relatively frequent processes are included in the summary. The results of the analysis for PRICE lexical items in southwest Lancashire localities in the SED may be summarised in the following way:

1. La10: [ɑɪ] is the most frequent realisation
    (a) Nucleus retraction ([ɑɪ]) in all environments
2. La11: [ɑː] is the most frequent realisation
    (a) Nucleus retraction ([ɑɪ]) or vowel retraction ([ɑː]) in all environments except in ME /ix/ words
    (b) Monophthongisation ([aː] or [ɑː]) in all environments except in ME /ix/ words and in open syllables
3. La12: [aː] is the most frequent realisation
    (a) Monophthongisation ([aː] or [ɑː]) in all environments except in ME /ix/ words
4. La13: [ɑɪ] is the most frequent realisation
    (a) Nucleus retraction ([ɑɪ]) in all environments

5. La14: [ɑɪ] is the most frequent realisation
    (a) Nucleus retraction ([ɑɪ]) in all environments
    (b) Nasalisation ([ɑ̃ɪ], [ɑ̃ɪ̃], [ãɪ] or [ɑ̃]) in all environments except ME /ix/

Let us now turn to the north Cheshire localities. Ch1 (Kingsley) is the closest locality to Liverpool in north Cheshire surveyed in the SED. There are three realisations recorded for the PRICE lexical items. These are all diphthongal ([ɑɪ], [aɪ] and [ɛɪ]). Table 9.6 and Figure 9.7 demonstrate that [ɑɪ] is the most common realisation which occurs in all environments. The fronted and raised nucleus realisation ([ɛɪ]) and [aɪ] occur before voiceless obstruents, voiced stops, and in ME /ix/ and ME /ei/ words. However, these realisations occur most before voiceless obstruents and ME /ix/ and ME /ei/ lexical items, as shown in Figure 9.7.

Therefore, Ch1 appears to have one process of nucleus retraction that occurs in all environments, but is most frequent before voiced consonants and in open syllables.

The farthest locality from Liverpool of the north Cheshire localities in the current investigation, Ch3 (Sweetenham), has four PRICE realisations recorded. Three of these realisations are diphthongal ([ɑɪ], [aɪ] and [ɛɪ]) and one is monophthongal ([ɑː]). As demonstrated in Table 9.7 and Figure 9.8, the most common realisation is [ɑɪ], which can occur in all environments except in ME /ix/ lexical items. The only PRICE realisation reported to occur in ME /ix/ lexical items is [ɛɪ]. This realisation also occurs frequently before voiceless obstruents and ME /ei/ and once before a voiced fricative and nasal (see Table 9.7).

The [aɪ] realisation occurs before voiceless obstruents and once before a voiced stop. Monophthongal [ɑː] is reported before voiceless fricatives and voiced consonants. Therefore, the processes that occur in Ch3 are: nucleus retraction and monophthongisation.

Finally, Ch4 (Farndon) has the largest number of realisations out of all the north Cheshire localities. Five realisations are reported: three diphthongs ([ɑɪ], [aɪ] and [ɛɪ]), one triphthong ([ɑɪə]) and one monophthong ([ɑː]). Similar to the other two localities, [ɑɪ] is the most common realisation, which can occur

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
37	[ɑɪ]	4	8	5	5	10	6	13	2
	[aɪ]	1	4	2	2	–	1	–	–
	[ɛɪ]	8	1	3	3	–	1	–	–

Table 9.6: Ch1 phonetic realisations of PRICE by following environment

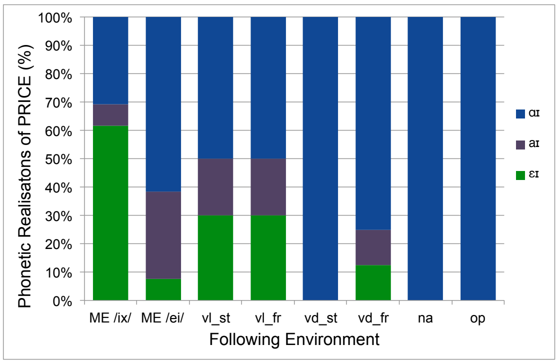


Figure 9.7: Ch1 phonetic realisations (%) of PRICE by following environment

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
68	[ɑɪ]	–	9	4	3	6	3	9	2
	[aɪ]	–	–	1	1	1 –	–	–	
	[ɛɪ]	11	4	5	4	–	1	1	–
	[ɑː]	–	–	–	2	2	1	1	–

Table 9.7: Ch3 phonetic realisations of PRICE by following environment

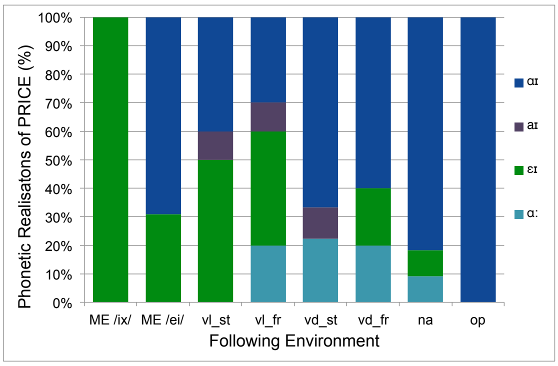


Figure 9.8: Ch3 phonetic realisations (%) of PRICE by following environment

Dist. (km)	Real.	Environment							
		ME /ix/	ME /ei/	vl_st	vl_fr	vd_st	vd_fr	na	op
45	[ɑɪ]	3	8	9	6	6	5	12	3
	[ɑɪə]	–	–	–	–	–	–	1	–
	[aɪ]	–	3	–	1	–	1	–	–
	[ɛɪ]	1	–	1	–	1	1	–	–
	[ɑː]	–	–	–	–	–	–	1	–

Table 9.8: Ch4 phonetic realisations of PRICE by following environment

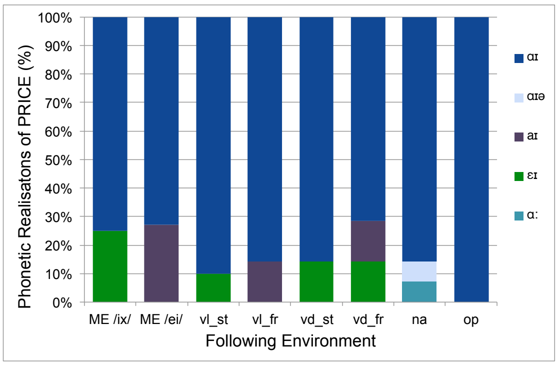


Figure 9.9: Ch4 phonetic realisations (%) of PRICE by following environment

in all environments. Table 9.8 and Figure 9.9 show the raised and fronted nucleus realisation ([ɛɪ]) occurs once before a voiceless stop, a voiced stop, a voiced fricative and in a ME /ix/ lexical items. The triphthong ([ɑɪə]) and monophthong ([ɑː]) occur once each before a nasal. These results suggest that nucleus retraction and, potentially, monophthongisation and triphthongisation occur in Ch4. Nucleus retraction occurs frequently across all environments, while vowel retraction occurs once before a nasal. Monophthongisation and triphthongisation are infrequent processes that occur once before a nasal.

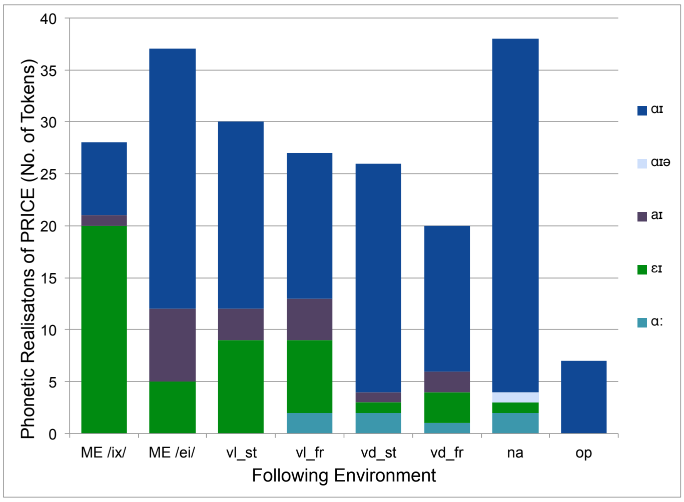
The results presented above suggest that the most common realisation in north Cheshire is [ɑɪ] in all localities. While there are a number of processes that occur in each of the localities nucleus retraction is the most common processes across all localities, as demonstrated in Figure 9.10. This occurs lease often in ME /ix/ words. Raw values are provided in Figure 9.10a, whereas percentage of each realisation is provided in Figure 9.10b. The [ɛɪ] realisation occurs often in ME /ix/ lexical items, which are likely the result of differences in the historical development of this vowel. However, it is also found less commonly in all other environments except in open syllables. This result may suggest that the north Cheshire localities have retained a separate /ɛɪ/ phoneme that overlaps with the PRICE vowel in some lexical items.

Finally, monophthongisation occurs in two of the localities generally before voiced consonants. This process is generally not common in the north Cheshire localities. The results of the current investigation of PRICE in the three SED localities in north Cheshire closest to Liverpool may be summarise as follows:

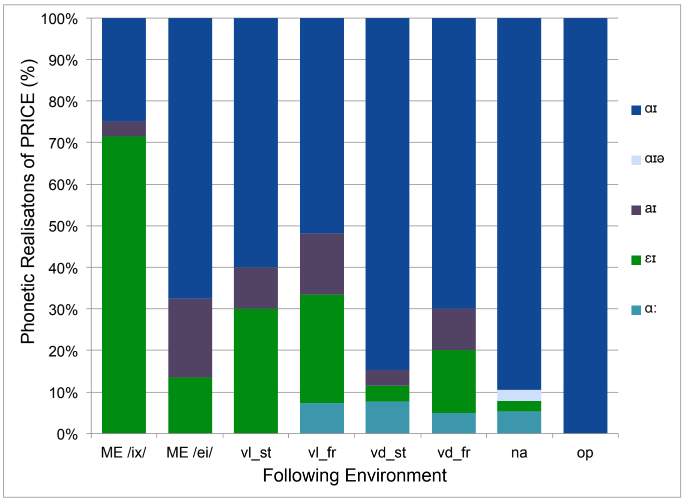
1. Ch1: [ɑɪ] is the most frequent realisation
   (a) Nucleus retraction ([ɑɪ]) in all environments
2. Ch3: [ɑɪ] is the most frequent realisation
   (a) Nucleus retraction ([ɑɪ]) and vowel retraction ([ɑː]) in all environments except in ME /ix/ words
   (b) Monophthongisation ([ɑː]) occurs before voiced consonants and voiceless fricatives
3. Ch4: [ɑɪ] is the most frequent realisation
   (a) Nucleus retraction ([ɑɪ]) in all environments

It should be noted that the [ɛɪ] realisation in ME /ix/ and ME /ei/ lexical items in the current analysis likely demonstrates that in many of the localities the ME /ix/ and ME /ei/ subclasses developed differently from ME /i:/ lexical items. For a more detailed discussion of the PRICE subclasses in Middle English see §4.1.1.

The results of the SED analysis for southwest Lancashire and north Cheshire demonstrate that both raised and fronted nucleus diphthongs and monophthongs are present in these localities. In many of the localities the raised and fronted nucleus diphthong realisation occurs before voiceless stops (ME /ix/ and other pre-voiceless stop tokens) and monophthongs occur before voiced consonants, particularly before nasals. The [ɛɪ] likely does not represent a process of nucleus raising and fronting as is found in the main investigation. Furthermore, the monophthongisation process that affects the PRICE vowel in



(a) Number of phonetic realisations of PRICE by environment across all north Cheshire localities



(b) Percentage of phonetic realisations of PRICE by environment across all north Cheshire localities

Figure 9.10: Phonetic realisations of PRICE by environment across all north Cheshire localities

these localities is not as robust a process as is found in the main investigation, as it does not affect all of the lexical times in the conditioning environment.

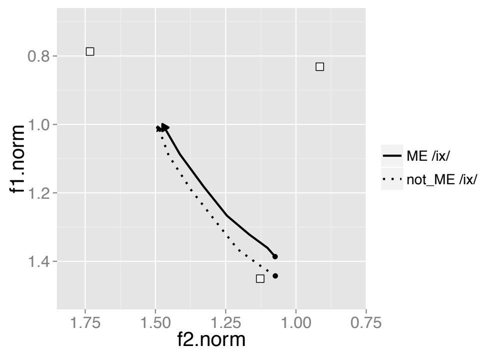
9.1.2 PRICE in the OLIVE 'archive' subcorpus

The results of the analysis of the OLIVE archive subcorpus indicate differences between the PRICE vowel variants in the OLIVE data and many of the localities in the SED analysis. The first difference between the SED and OLIVE data is related to the different subclasses of PRICE lexical items. In the SED, it is clear that some of the lexical items in the ME /ix/ and ME /ei/ subclasses followed a different development from the main class of PRICE lexical items. However, the OLIVE data suggests that there is no difference between the ME /ix/ and ME /ei/ subclasses and the PRICE lexical items with similar environments, i.e. we can assume that all PRICE words have been transferred to the most typical PRICE vowel, /aɪ/.

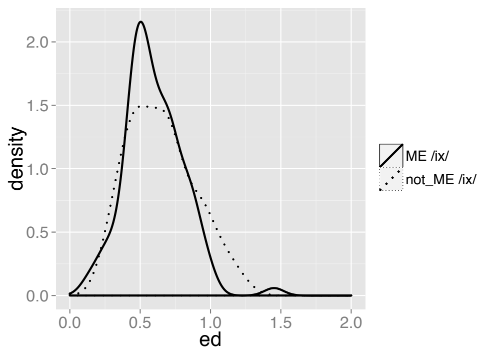
Figure 9.11 demonstrates that ME /ix/ tokens, such as *fight*, have very similar properties to other PRICE tokens before voiceless stops, such as *site*. The vowel trajectories and amount of diphthongisation are almost the same for ME /ix/ tokens and PRICE before voiceless stops (Figure 9.11). Therefore, the remainder of the results for the OLIVE data includes all ME /ix/ lexical items in the before voiceless stop environment (**vl_st**).

Similarly, in order to establish whether ME /ei/ tokens behave differently from other PRICE tokens in similar environments, ME /ei/ words, such as *die*, are compared to other PRICE tokens in word-final open syllables, such as *buy*. Figure 9.12a demonstrates the trajectory of PRICE in open syllables depending on the PRICE vowel subclass and gender. Female and male speakers are plotted separately, as there is a difference in the realisation of the PRICE vowel in these environments depending on gender. However, the results suggest that there is no difference between the ME /ei/ and other PRICE tokens in word-final open syllables within each gender. Amount of diphthongisation is also similar for ME /ei/ tokens and other PRICE tokens in word-final open syllables, as demonstrated in Figure 9.12b.

Note that other ME /ei/ lexical items occur in the OLIVE dataset where the PRICE vowel is followed by a morpheme boundary, such as *died*. As there is only

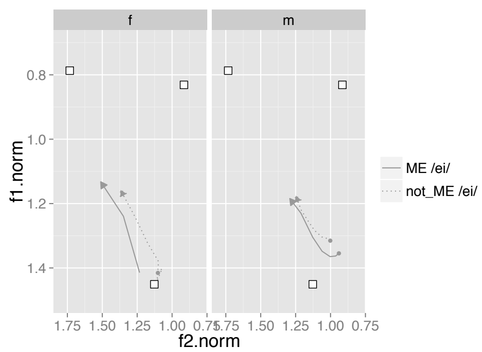


(a) PRICE trajectory for ME /ix/ (*solid line*) and other before voiceless stop (*dashed line*) tokens in the OLIVE dataset

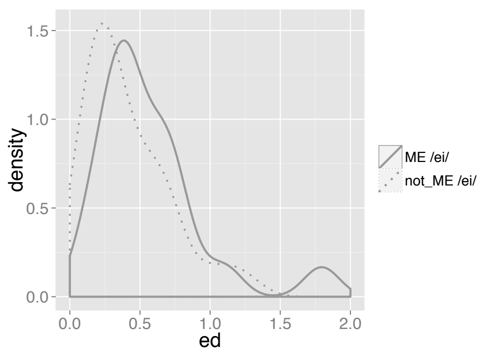


(b) PRICE amount of diphthongisation for ME /ix/ (*solid line*) and other before voiceless stop (*dashed line*) tokens in the OLIVE dataset

Figure 9.11: PRICE realisations in tokens before voiceless stops (**not_ME /ix/**) and ME /ix/ (**ME /ix/**) tokens

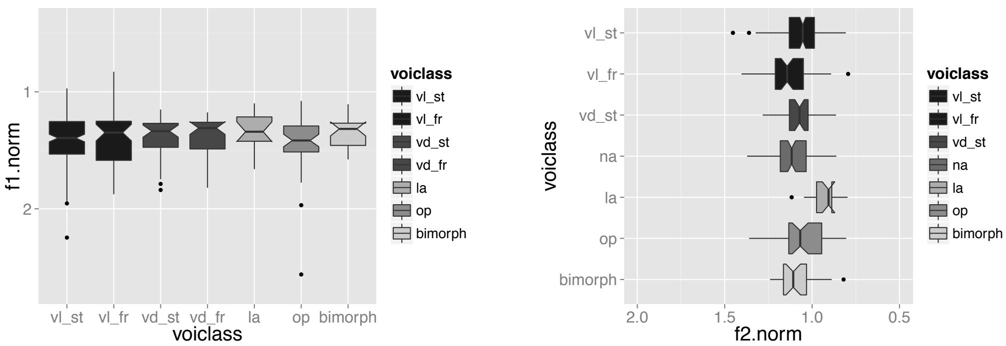


(a) PRICE trajectory for ME /ei/ (*solid line*) tokens and other tokens in open syllables (*dashed line*) in the OLIVE dataset



(b) PRICE amount of diphthongisation for ME /ei/ (*solid line*) tokens and other tokens in open syllables (*dashed line*) in the OLIVE dataset

Figure 9.12: Comparison of PRICE realisations in tokens in word-final open syllables (**not_ME /ei/**) and ME /ei/ (**ME /ei/**) tokens



(a) Normalised f1 measurements (f1.norm) at the nucleus, excluding before nasals (see 9.15a)

(b) Normalised f2 measurements (f2.norm) at the nucleus, excluding before voiced fricatives (see 9.15b)

Figure 9.13: PRICE normalised f1 and f2 measurements by following environment

one lexical item where PRICE is followed by a morpheme boundary that is not also a ME /ei/ lexical item, it is not possible to test whether there is a difference between these. As a result, all tokens where the PRICE vowel is followed by a morpheme boundary are included in the morpheme boundary environment (**morph**) regardless of which ME subclass they originated from.

The remainder of the current section discusses the results of the OLIVE data analysis for the PRICE vowel. The findings suggest that PRICE phonologically-conditioned variation in LE shortly after new-dialect formation resembles the results for the SED and for the main investigation (Chapter 7) in some ways and differs from both in other ways.

The results of the OLIVE data analysis demonstrate that there is no difference in the height or backness of the nucleus based on the following environment (**voiclass**), as shown in Figure 9.13. This is different from the result of the main investigation. The main investigation found that the nucleus of PRICE is raised and fronted before voiceless obstruents. In order to test whether there is a statistical effect of the following environment on the production of PRICE, mixed effects models are used. Fixed effects are the following environment (**voiclass**) and gender with an interaction between these variables. The random effects structure for all of the mixed effects models in the OLIVE investigation is random intercepts for speaker and words. Random slopes were not able to be calculated based on the size of the dataset and the number of levels in each of the variables (see summary tables in §A.2.3).

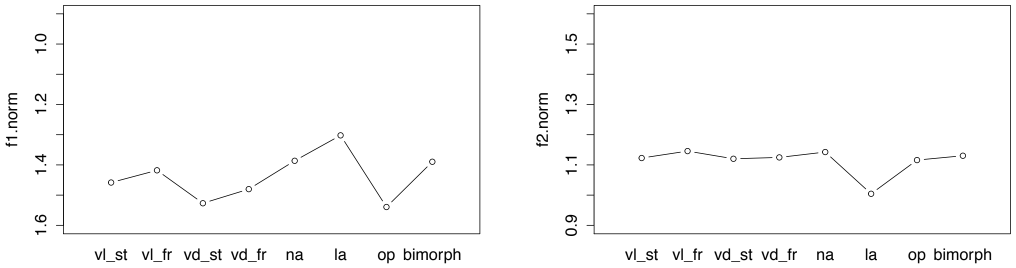
According to the predictions of the mixed effects models for normalised f1 and normalised f2 at the nucleus, following environment (**voiclass**) does not significantly affect the realisation of PRICE, with the exception of PRICE before /l/ (p=0.014). The nucleus of PRICE before /l/ is retracted compared to the other following environments (see Figure 9.14). The retraction of vowels before /l/ is a phonetic co-articulatory effect found across many languages and dialects (see Labov 1994 and Milroy and Gordon 2008). It is, therefore, possible that this is a phonetic effect as a result of f2 lowering for the following /l/.

Furthermore, as a result of the predictions of the mixed effects models, separate figures are presented for normalised f1 nucleus measurement of PRICE before nasals (Figure 9.15a) and for normalised f2 nucleus measurement of PRICE before voiced fricatives (Figure 9.15b).

There is a significant interaction between gender and following environment for the mixed effects models where normalised f1 and f2 nucleus measurements are the dependent variables (p=0.02 in both models). Figure 9.15a shows that the nucleus of PRICE is slightly raised for male speakers before nasals. Similarly, male speakers produce a retracted nucleus realisation of PRICE before voiced fricatives compared to female speakers (Figure 9.15b).

Despite there being no difference in the nucleus measurements before voiceless stops compared to other following environments, there are differences in the inflection points. The f1 inflection point of PRICE before voiceless stops is approximately at the 25% measurement, as shown in Figure 9.16a. Similarly, the f2 inflection point for PRICE before voiceless stops is at the 20% measurement (see Figure 9.16c). Before voiced stops, the f1 inflection point of PRICE is at approximately 50% of the way through the vowel and the f2 inflection point is at approximately the 40% measurement. PRICE in open syllables has an f1 inflection point at the 40% measurement. The f2 inflection point of PRICE in open syllables is approximately at the 35% measurement. The f1 inflection point of PRICE before nasals is well into the vowel trajectory at approximately the 60% measurement. Finally the f2 inflection point of PRICE before nasals is at approximately the 50% measurement point.

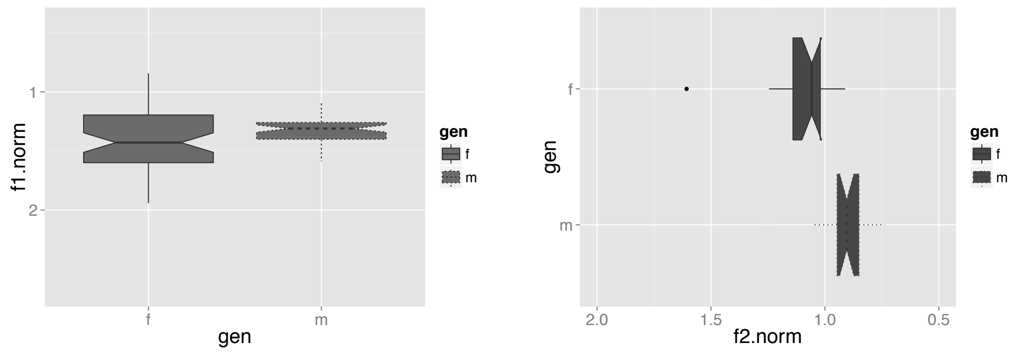
Similar to the findings of the main investigation and the SED, both diphthongal and monophthongal realisations of the PRICE vowel are attested



(a) PRICE normalised f1 measurements (f1.norm) at the nucleus

(b) PRICE normalised f2 measurements (f2.norm) at the nucleus

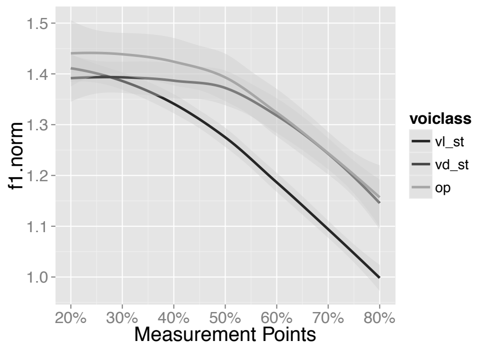
Figure 9.14: Mixed effect model predictions for PRICE realisations by following environment (**voiclass**) on the dependent variables: normalised f1 (f1.norm) and f2 (f2.norm) at the nucleus



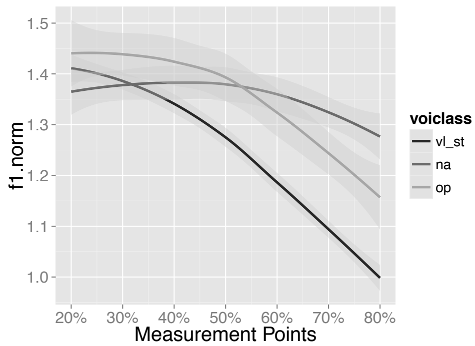
(a) Normalised f1 measurements at the nucleus before nasals by gender

(b) Normalised f2 measurements at the nucleus before voiced fricatives by gender

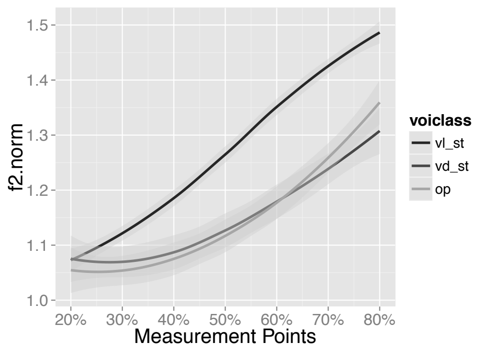
Figure 9.15: PRICE realisations before voiced fricatives (*grey*) and nasals (*medium grey*) by gender (females: *solid line*, males: *dashed line*)



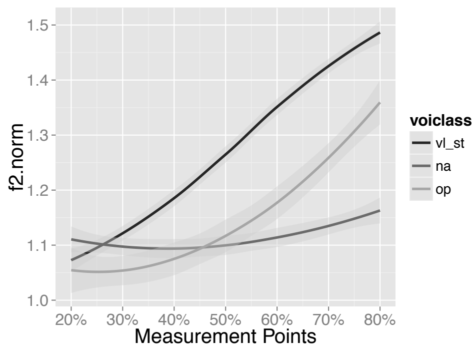
(a) PRICE inflection points for f1 before voiceless stops (*dark grey*), voiced stops (*grey*), and in open syllables (*light grey*)



(b) PRICE inflection points for f1 before voiceless stops (*dark grey*), nasals (*medium grey*), and in open syllables (*light grey*)

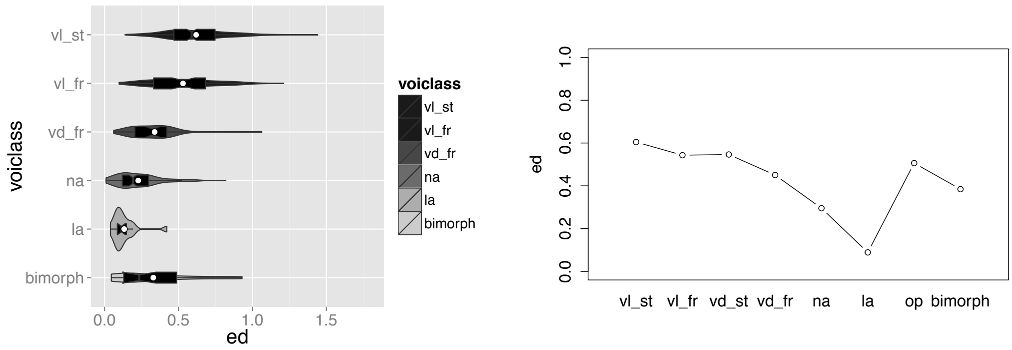


(c) PRICE inflection points for f2 before voiceless stops (*dark grey*), voiced stops (*grey*), and in open syllables (*light grey*)



(d) PRICE inflection points for f2 before voiceless stops (*dark grey*), nasals (*medium grey*), and in open syllables (*light grey*)

Figure 9.16: Inflection points of the PRICE vowel trajectories by following environment (**voiclass**)



(a) Amount of diphthongisation of PRICE by following environment, excluding before voiced stops and in open syllables (see figure 9.18)

(b) Mixed effects model predictions for PRICE by following environment on the dependent variable Euclidean distance (ed)

Figure 9.17: PRICE amount of diphthongisation by following environment (**voiclass**)

in the OLIVE data. As shown in Figure 9.17a, the realisation of PRICE is most diphthongal before voiceless stops and voiceless fricatives and more monophthongal before nasals and /l/. The most monophthongal PRICE realisations occur before /l/. Finally, PRICE realisations before voiced fricatives and morpheme boundaries are somewhere in the middle. The predictions of the mixed effects models confirm that PRICE realisations before nasals, /l/ and morpheme boundaries are significant predictors (see Figure 9.17b).

There is a significant interaction between gender and the following environment in the mixed effects model with Euclidean distance as the dependent variable (p=0.02). Figure 9.18 shows that female speakers have more diphthongal productions of PRICE before voiced stops and in open syllables than male speakers.

The results for duration values are similar to those found for the main investigation in Chapter 7. PRICE realisations before voiceless stops and /l/ are shortest, whereas PRICE realisations before voiced stops, voiced fricatives, morpheme boundaries,[2] and in open syllables have the longest durations (see Figure 9.19a). Unlike the results of the main investigation, PRICE realisations before nasals are slightly shorter than PRICE before voiced stops and in open

[2] PRICE before morpheme boundaries do not differ from voiced stops in the newly collected data and are, therefore, included in the voiced stop following environment.

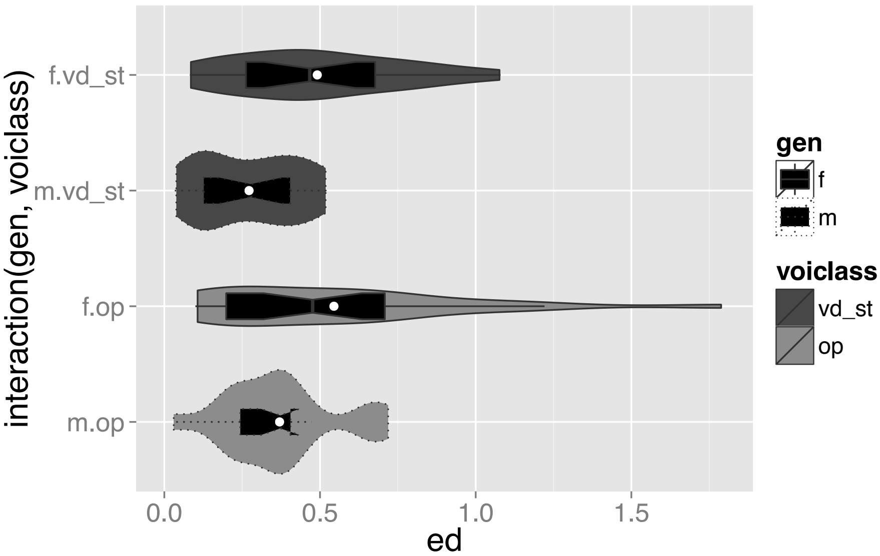
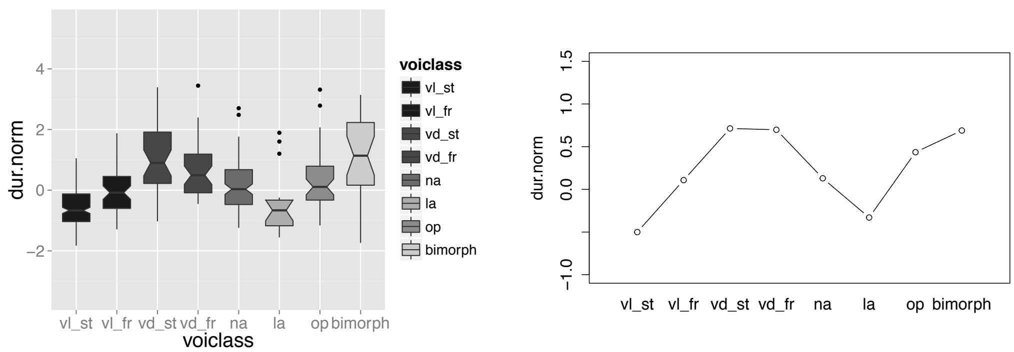


Figure 9.18: Amount of diphthongisation of PRICE before voiced stops (*grey*) and in open syllables (*light grey*) by gender (females: *solid line*, males: *dashed line*)



(a) Normalised duration measurements (dur.norm) of PRICE by following environment

(b) Mixed effects model predictions for PRICE by following environment on the dependent variable duration

Figure 9.19: PRICE normalised duration by following environment (**voiclass**)

syllables. Finally, before voiceless fricatives PRICE is longer than before voiceless stops, but shorter than before voiced consonants. The mixed effects model predictions suggest that PRICE vowel durations before voiceless stops do not differ from the PRICE vowel durations before /l/ (see Figure 9.19b). However, PRICE duration values before voiceless stops differ from all other environments. The PRICE duration values before voiceless consonants and voiced consonants are also found to be statistically different ($p<0.01$).

The results of the current investigation of the OLIVE dataset suggest that offglide weakening before voiced obstruents (including morpheme boundaries) and monophthongisation before nasals and /l/ occurred in LE shortly after new-dialect formation. The nucleus raising and fronting process reported in the main investigation (Chapter 7) is absent from the OLIVE data, despite [ɛɪ] being reported in the SED analysis (§9.1.1). That being said, there are differences found between f1 and f2 inflection points of PRICE before voiceless stops compared to PRICE in word-final open syllables. This result may suggest that there is already a small perceptual difference between PRICE before voiceless stops and PRICE in word-final open syllables (see §4.2.2) at this time. The following is a summary of the findings for the current analysis of the OLIVE archive subcorpus.

1. Diphthongal variant with no raised nucleus or offglide occurs:
   (a) [ă̝ɪ]: before voiceless stops & voiceless fricatives
   (b) [a̝ɪ]: in word-final open syllables (*females only*)
2. Long diphthongal variant with no raised nucleus, but a centralised offglide ([a̝ə]) occurs:
   (a) before voiced stops (*females only*), voiced fricatives & morpheme boundaries
   (b) in word-final open syllables (*males only*)
3. Monophthongal variant ([a̝ː]) occurs:
   (a) before nasals
   (b) before voiced stops (*males only*)

4. Retracted short monophthongal variant ([a̠])
    (a) before /l/
5. Other Findings
    (a) ME /iː/ and ME /ei/ tokens are now merged with the ‘typical’ PRICE vowel, unlike the findings of the SED
    (b) Monophthongisation process before nasals and /l/ occurs, like the SED and main investigation
    (c) Glide weakening process before voiced obstruents occurs, unlike the SED and main investigation
    (d) Nucleus raising and fronting process is not found before voiceless stops, unlike the main investigation
    (e) Some gender effects before nasals, voiced stops, voiced fricatives and in word-final open syllables, unlike the main investigation

The results of the SED and OLIVE analysis in concert with the results of the main investigation provide a better insight into the emergence and development of PRICE phonologically-conditioned variation in LE. From these results it is evident that monophthongisation before nasals and /l/ is a process that either occurred prior to new-dialect formation or as a result of it, while nucleus raising and fronting before voiceless obstruents is likely a later development. An in-depth discussion of the emergence and development of the PRICE pattern with reference to approaches to the origins of these types of patterns is presented in Chapter 10.

9.2 MOUTH IN THE SED

The number of possible realisations of the MOUTH lexical items in the current investigation differs by locality. Ch3 has five realisations recorded ([aʊ], [ɛ̈ʊ], [ɑɪ], [aɪ] and [ʊ]), the fewest of all the localities. The largest number of realisations, ten, occurs in Ch4 ([ɑʊ], [aʊ], [æʊ], [ɛʊ], [aɪ], [ɛɪ], [əiː], [aː], [ɔː] and [ʊ]). In each locality there are one or two realisations that are clearly dominant in that locality and occur most often. However, the realisations that occur most often may differ between the localities. For example, [aː] is the most common realisation in La10, La11, La13 and La14, whereas [aʊ] is the most common realisation in Ch4. These realisations are discussed in §3.2.2. Furthermore, while some realisations occur across most of the localities, such as [aʊ] and [aː], many of the realisations only occur once, such as [ɒʊ], [ɑʊ], [ᵃʊ], [əiː], [ɑː] and [ʊuː]. For example, La11 has nine realisations recorded for these lexical items, but only two of those are recorded more than once. La13 has the largest number of realisations recorded more than once with five of the nine realisations being recorded more than once.

Most of the realisations that are recorded in the lexical items chosen for the current investigation reflect possible MOUTH realisations. However, there are also some reduced and monophthongal realisations that are likely not related to the MOUTH vowel. These are removed in the current analysis in order to present a clearer picture of MOUTH realisations in southwest Lancashire and north Cheshire. There are short vowel realisations that are found in the lexical items, such as [ʊ]. A total of eight of these realisations occur across the 358 tokens in the current analysis, which are removed from the analysis. Secondly, there are realisations that did not diphthongise, such as [ʊː] and [üː]. There are nineteen realisations of this type in the SED data, which are removed from the current analysis. Therefore, 331 of the 358 tokens analysed in the investigation are presented in the current results.

The current section has the same structure as the results of the investigation of PRICE in the SED. In other words, each locality is discussed separately, starting with those localities in southwest Lancashire. Then the results for the localities in north Cheshire are described, which is followed by a summary. Finally, a summary of the overall findings of the investigation of MOUTH in the SED data is given.

The first southwest Lancashire locality, La10 (Marshside), has five realisations of MOUTH: three diphthongal realisations ([aʊ], [a˔ʊ] and [æ˔ə]) and two monophthongal realisations ([aː] and [æː]). The realisation that occurs most often and in all environments is [aː], as shown in Table 9.9 and Figure 9.20. Diphthongal realisations may occur in all environments. The most common diphthongal realisation is [aʊ], which occurs in all environments with the exception of before nasals. The diphthongal realisation that occurs before nasals has a fronted and lengthened nucleus and a weakened offglide ([æˑə]).

The processes that may occur in La10 are: monophthongisation, offglide weakening, nucleus lengthening, and nucleus fronting. Monophthongisation occurs in all environments, but is most common before nasals (Figure 9.20). The infrequent process of offglide weakening occurs once before a nasal. Nucleus lengthening occurs rarely before voiceless fricatives and nasals. Finally, fronting affects both the nucleus of diphthongs ([æˑə]) and monophthongs ([æː]). Fronting of the nucleus of a diphthong occurs once before a nasal and monophthong fronting occurs once in an open syllable.

La11 (Eccleston) has five MOUTH realisations in the current subset of SED data: two of which are diphthongs ([aʊ] and [eʊ]) and three are monophthongs ([ɑː], [aː] and [a̝ː]). As was reported for La10, the most common realisation is [aː], which may occur in all environments (Table 9.10 and Figure 9.21). The most common realisation of PRICE in this locality is [ɑː]. Therefore, the difference between PRICE and MOUTH vowels is not the quality of the offglide, which is commonly the case for varieties of English. As the most common realisations for both vowels are monophthongs, the backness of the monophthong differentiates PRICE and MOUTH lexical items from each other.

According to the results of the current investigation, there are three possible processes in La11: retraction, raising and monophthongisation. Monophthongisation is the most common of the three processes, which occurs in all environments (Figure 9.21). The monophthongal realisations are recorded least often in word-final open syllables. Raising of the monophthong ([a̝ː]) occurs infrequently before voiceless fricatives and nasals, and nucleus raising ([eʊ]) occurs once in an open syllable. Finally, retraction occurs once before a voiceless fricative ([ɑː]).

Similar to the result for PRICE in the SED, the results for MOUTH in La12 (Harwood) differ substantially from the other localities. There are four realisations of MOUTH in La12: three diphthongal realisations ([ɛʊ], [əʊ] and [ɛːᵊ]) and one monophthongal realisation ([ɛː]). As was found for the other southwest Lancashire localities thus far, a monophthongal realisation is the most common. The [ɛː] realisation may occur in all environments. Similar to the findings for La11, both the PRICE and MOUTH vowels are most

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
35	[aʊ]	2	5	1	2	–	1
	[a˙ʊ]	–	1	–	–	–	–
	[æ˙ə]	–	–	–	–	1	–
	[aː]	3	3	1	2	14	1
	[æː]	–	–	–	–	–	1

Table 9.9: La10 phonetic realisations of MOUTH by following environment

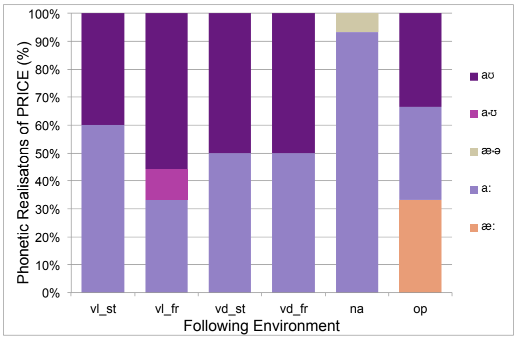


Figure 9.20: La10 phonetic realisations (%) of MOUTH by following environment

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
37	[aʊ]	–	–	–	1	–	–
	[eʊ]	–	–	–	–	–	1
	[ɑː]	–	1	–	–	–	–
	[aː]	5	7	2	5	14	1
	[a̠ː]	–	1	–	–	2	–

Table 9.10: La11 phonetic realisations of MOUTH by following environment

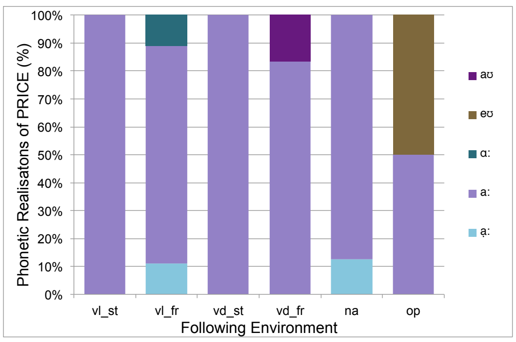


Figure 9.21: La11 phonetic realisations (%) of MOUTH by following environment

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
56	[ɛʊ]	–	–	–	1	–	–
	[əʊ]	–	1	–	–	1	–
	[ɛːᵊ]	–	–	–	–	1	–
	[ɛː]	4	7	3	5	15	2

Table 9.11: La12 phonetic realisations of MOUTH by following environment

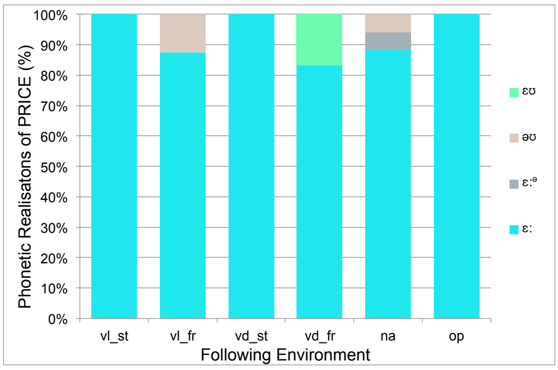


Figure 9.22: La12 phonetic realisations (%) of MOUTH by following environment

often realised as a monophthong, [aː] and [ɛː] respectively. As a result, the difference between PRICE and MOUTH lexical items is encoded in the quality of the monophthongal vowel.

Table 9.11 and Figure 9.22 demonstrate that there are four processes that may occur in La12: monophthongisation, raising, nucleus centralisation, and offglide weakening. Monophthongisation occurs in all environments and is categorical before voiceless stops, voiced stops and in open syllables. This process also occurs frequently before nasals. Nucleus raising ([ɛʊ] and [ɛːᵊ]) is not a common process, as it occurs once before a voiced fricative and a nasal. On the other hand, raising of the monophthong ([ɛː]) occurs in all environments. Other infrequent processes are offglide weakening ([ɛːᵊ]) and nucleus centralisation ([əʊ]). Offglide weakening occurs once before a nasal and nucleus centralisation occurs once before a voiceless fricative and once before a nasal.

There are six realisations of MOUTH recorded in La13 (Bickerstaffe). Two diphthongal realisations ([aʊ] and [ɛʊ]) and four monophthongal realisations

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
23	[aʊ]	2	–	–	–	–	1
	[ɛʊ]	4	3	–	1	1	–
	[aː]	4	5	1	3	14	1
	[a̝ː]	1	1	–	1	1	–
	[æː]	–	–	1	–	–	–
	[æ̝ː]	–	–	–	–	–	1

Table 9.12: La13 phonetic realisations of MOUTH by following environment

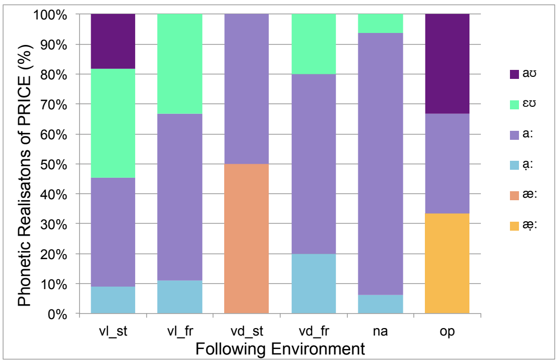


Figure 9.23: La13 phonetic realisations (%) of MOUTH by following environment

([aː], [a̝ː], [æː] and [æ̝ː]) are found in La13. The most common realisation is [aː], which occurs in all environments. As shown in Table 9.12 and Figure 9.23, there are four processes that occur in La13: monophthongisation, raising, raising and fronting, and fronting.

Similar to the other southwest Lancashire localities, monophthongisation occurs in all environments in La13, but is most frequent before nasals. The monophthong raising ([a̝ː]) and nucleus raising and fronting ([ɛʊ]) occur before voiceless obstruents, voiced fricatives and nasals. However, nucleus raising and fronting occurs more often than monophthong raising, especially before voiceless obstruents. Fronting ([æː]) occurs once before a voiced stop and monophthongal raising and fronting ([æ̝ː]) occurs once in word-final open syllables.

Finally, La14 (Halewood) has six realisations, three of which are diphthongs ([ɒʊ], [aʊ] and [ãʊ]) and three are monophthongs ([aː], [ãː] and [a̝ː]). The

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
14	[ɒʊ]	1	–	–	–	–	–
	[aʊ]	1	2	–	1	1	2
	[ãʊ]	–	1	–	–	–	–
	[aː]	5	7	2	7	14	3
	[ãː]	1	1	–	–	–	–
	[a̝ː]	–	–	–	–	2	–

Table 9.13: La14 phonetic realisations of MOUTH by following environment

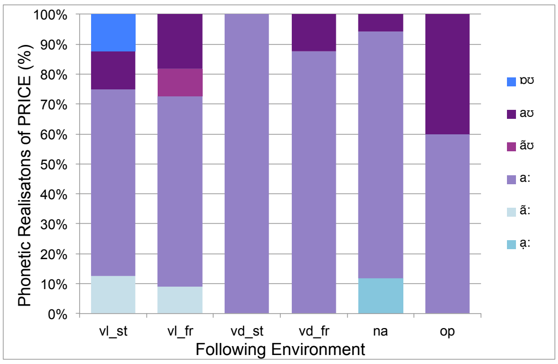


Figure 9.24: La14 phonetic realisations (%) of MOUTH by following environment

most common realisation is [aː], which is recorded in all environments. Table 9.13 and Figure 9.24 demonstrates that there are four processes that may occur for MOUTH in La14: monophthongisation, raising, nucleus retraction and rounding, and nasalisation.

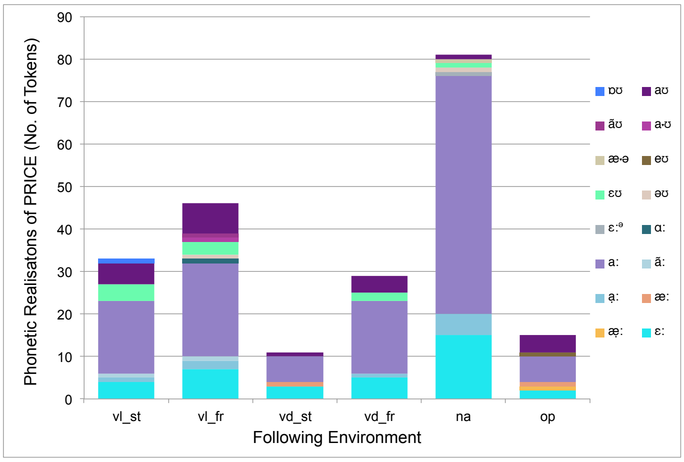
In La14 monophthongisation occurs in all environments, but this process interacts with other processes so that there are three different monophthongs that are found ([aː], [ãː] and [a̝ː]). The monophthong raising process ([a̝ː]), occurs before nasals. Nucleus retraction and rounding ([ɒʊ]) is found once before a voiceless stop. Finally, nasalisation ([ãʊ] and [ãː]) occurs rarely before voiceless obstruents.

As described in §9.1.1 for the analysis of the PRICE vowel in the SED, a comparison of Berry's (2009) investigation of PRICE and MOUTH in La14 (Halewood) provides some evidence for changes in the realisations of the target vowels over time. When examining the results for the MOUTH vowel, one evident difference between Berry's (2009) results and the SED data is the change from a monophthongal dominant system in the SED to a diphthongal one in 2009. Her investigation finds that diphthongal realisations occur most often in many of the following environments as opposed to monophthongal realisations.

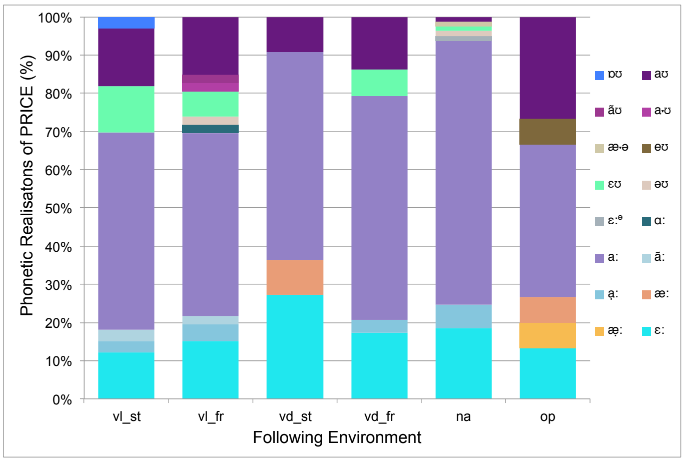
Berry (2009) suggests that [aʊ] consistently occurs before voiceless stops and in open syllables, whereas in the SED data diphthongs are recorded twice before voiceless stops and three times in open syllables. Furthermore, she finds that before dental fricatives and alveolar fricatives [aʊ] and [aᵊ] respectively are produced most often (Berry 2009). The SED data only includes voiceless dental fricatives and voiceless and voiced alveolar fricatives. However, the results of the SED differ from the 2009 data, with [aː] used four times and [aʊ] once before a dental fricative in Halewood in the SED data. Similarly, [aː] is recorded eleven times before alveolar fricatives and [aʊ] or [ãʊ] only three times. The diphthongal realisations reported in the SED in these environments are much less frequent than in Berry's (2009) contemporary study. Finally, the results for MOUTH before nasals and voiced stops are similar for the SED and Berry (2009). Berry (2009) finds that both [aᵊ] and [aː] are frequently used, while the SED shows only one diphthongal production before nasals and none before voiced stops. This comparison, therefore, suggests that Halewood has shifted from monophthongal realisations in most environments to diphthongal realisations with the exception of MOUTH before nasals and voiced stops, which has remained largely monophthongal.

The results of the analysis of MOUTH realisations in southwest Lancashire using the SED dataset suggests that each locality has a number of different processes. However, many of these processes occur rarely in the localities and are not shared between the localities. An exception to this is monophthongisation, which occurs in all of the localities and often in most or all of the environments. As seen in Figures 9.25a and 9.25b, monophthongisation occurs most before nasals and least in word-final open syllables. Raw values are provided in Figure 9.25a, whereas percentage of each realisation is provided in Figure 9.25b.

All of the localities with the exception of La12 produce MOUTH as [aː] most often, as described in §3.2.2. In La12 the most common production is [ɛː]. Unlike the findings for the PRICE vowel in southwest Lancashire, a



(a) Number of phonetic realisations of MOUTH by environment across all southwest Lancashire localities



(b) Percentage of phonetic realisations of MOUTH by environment across all southwest Lancashire localities

Figure 9.25: Phonetic realisations of MOUTH by following environment across all southwest Lancashire localities

monophthongal realisation of MOUTH is dominant in all of the southwest Lancashire localities.

As previously mentioned, there are a vast number of different processes that may affect the realisation of MOUTH in the southwest Lancashire localities. In order to provide a clearer picture of the processes that are likely to affect MOUTH, only those processes that are relatively frequent in each of the localities are included in the summary of the results presented below. The results of the analysis for MOUTH lexical items in southwest Lancashire localities in the SED may be summarised in the following way:

1. La10: [aː] is the most frequent realisation
    - (a) Monophthongisation ([aː] or [æː]) in all environments
        - i. Most frequent before nasals
2. La11: [aː] is the most frequent realisation
    - (a) Monophthongisation ([aː], [a̝ː] or [ɑː]) in all environments
    - (b) Monophthong raising ([a̝ː]) before voiceless fricatives and nasals
3. La12: [ɛː] is the most frequent realisation
    - (a) Monophthongisation ([ɛː]) in all environments
        - i. Categorical before voiceless stops, voiced stops and in open syllables
        - ii. Very frequent before nasals
    - (b) Monophthong raising and fronting in all environments
4. La13: [aː] is the most frequent realisation
    - (a) Monophthongisation ([aː], [a̝ː], [æː] or [æ̝ː]) in all environments
        - i. Most frequent before nasals
    - (b) Nucleus raising and fronting ([ɛʊ]) before voiceless obstruents, voiced fricatives and nasals
    - (c) Monophthong raising ([a̝ː]) before voiceless obstruents, voiced fricatives and nasals

5. La14: [aː] is the most frequent realisation

   (a) Monophthongisation ([aː], [ãː] or [a̝ː]) in all environments

      i. Most frequent before voiced consonants

   (b) Nasalisation ([ãʊ] or [ãː]) before voiceless obstruents

While similarities were found between PRICE realisations in southwest Lancashire and in north Cheshire, MOUTH realisations differ considerably between the two dialect areas. One of the biggest differences is the inclusion of PRICE-like realisations for MOUTH in the north Cheshire localities. As discussed in more detail below, in Ch1 and Ch3, MOUTH is realised most often as [aɪ]. The results of the analysis of PRICE in the SED data suggest that Ch1 and Ch3 realised PRICE most often as [ɑɪ]. Therefore, these two localities differentiate between PRICE and MOUTH lexical items not in the offglide, which is the more common pattern across varieties of English, but in the quality of the nucleus. However, it is possible that neutralisation between PRICE and MOUTH may occur in some of the environments, as [ɑɪ] and [aɪ] are reported in Ch1 and Ch3 for both PRICE and MOUTH. Any possible cases of neutralisations are mentioned in the following discussions. Note that these PRICE-type realisations never occur in MOUTH lexical items in word-final open syllables.

The first locality, Ch1 (Kingsley), has five MOUTH realisations. There is one MOUTH-type diphthongal realisation ([aʊ]), three PRICE-type realisations ([ɑɪ], [aɪ] and [ɛɪ]) and one monophthongal realisation ([aː]). The most common realisation is [aɪ], which may occur in all environments except in word-final open syllables (Table 9.14 and Figure 9.26). Given the results of the PRICE realisations in the SED presented in §9.1.1 for Ch1, there is a possibility that PRICE and MOUTH may be neutralised before voiceless obstruents and voiced fricatives. The same realisations for the PRICE and MOUTH vowels may occur in these environments.

The results of the current analysis suggest that the processes that occur in Ch1 are: nucleus retraction, offglide fronting and monophthongisation. With the exception of offglide fronting ([aɪ] or [ɛɪ]), each of these processes only occur once (Table 9.14). Nucleus retraction ([ɑɪ]) occurs before a voiceless stop, and

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
37	[aʊ]	2	2	–	1	2	1
	[ɑɪ]	1	–	–	–	–	–
	[aɪ]	5	5	1	4	12	–
	[ɛɪ]	–	–	–	1	–	–
	[aː]	–	–	–	–	1	–

Table 9.14: Ch1 phonetic realisations of MOUTH by following environment

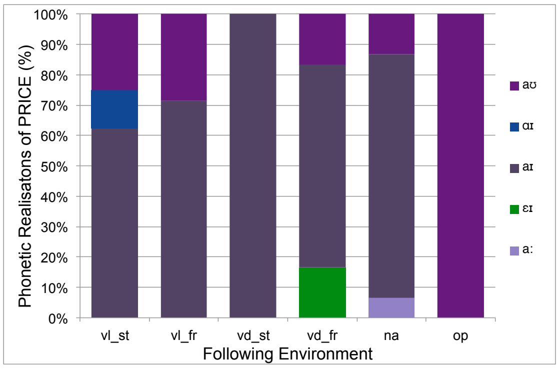


Figure 9.26: Ch1 phonetic realisations (%) of MOUTH by following environment

monophthongisation ([aː]) occurs before a nasal. On the other hand, offglide fronting occurs in all environments, but is most common before nasals.

Ch3 (Sweetenham) has four MOUTH realisations in the lexical items in the current investigation, which are all diphthongal. There are two PRICE-type diphthongs ([aɪ] and [ɑɪ]) and two MOUTH-type diphthongs ([aʊ] and [ɛ̈ʊ]), as shown in Table 9.15 and Figure 9.27. The most common realisation is [aɪ], which can occur in all environments except in word-final open syllables. The results from the PRICE vowel in the SED for Ch3 suggest that [aɪ] occurs before voiceless obstruents and voiced stops for the PRICE vowel as well. Therefore, it may be possible that in these environments the contrast between PRICE and MOUTH may be neutralised for some lexical items.

As shown in Figure 9.27, the processes that may occur for the MOUTH vowel in Ch3 are: nucleus centralisation, nucleus retraction and offglide fronting. Nucleus centralisation ([ɛ̈ʊ]) occurs before a voiceless stop, a voiced fricative and in an open syllable. There is only one instance of nucleus retraction ([ɑɪ]), which occurs before a voiceless stop. Offglide fronting ([ɑɪ] or [aɪ]) is

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
68	[aʊ]	1	2	–	–	1	–
	[ɛ̈ʊ]	1	–	–	1	–	1
	[ɑɪ]	1	–	–	–	–	–
	[aɪ]	3	6	1	5	13	–

Table 9.15: Ch3 phonetic realisations of MOUTH by following environment

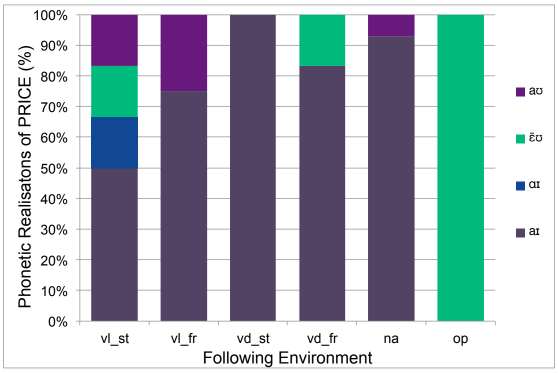


Figure 9.27: Ch3 phonetic realisations (%) of MOUTH by following environment

the most common of the processes and occurs in all environments except in word-final open syllables. This process is reported less frequently when the MOUTH vowel is followed by a voiceless stop.

The final north Cheshire locality, Ch4 (Farndon), differs from the other two north Cheshire localities. Firstly, the most common realisation is not a PRICE-type realisation, which was found for the two other north Cheshire localities in the current investigation. There are seven MOUTH realisations in Ch4. Four of these realisations are MOUTH-type diphthongs ([ɑʊ], [aʊ], [æʊ] and [ɛʊ]), two are PRICE-type diphthongs ([aɪ] and [ɛɪ]) and one is a monophthong ([aː]). The most common realisation is [aʊ], which occurs in all environments (see Table 9.16 and Figure 9.28).

There are five processes that occur in Ch4: nucleus raising and fronting, nucleus retraction, nucleus fronting, offglide fronting and monophthongisation. Three of these processes occur only once in this locality: nucleus retraction ([ɑʊ]) and monophthongisation ([aː]) occur once before a voiceless stop, and nucleus fronting ([æʊ]) occurs before a nasal. Nucleus raising and fronting

Dist. (km)	Real.	Environment					
		vl_st	vl_fr	vd_st	vd_fr	na	op
45	[ɑʊ]	1	–	–	–	–	–
	[aʊ]	4	6	1	7	13	1
	[æʊ]	–	–	–	–	1	–
	[ɛʊ]	–	2	–	–	–	–
	[aɪ]	–	–	–	1	1	–
	[ɛɪ]	–	–	–	1	–	–
	[aː]	1	–	–	–	–	–

Table 9.16: Ch4 phonetic realisations of MOUTH by following environment

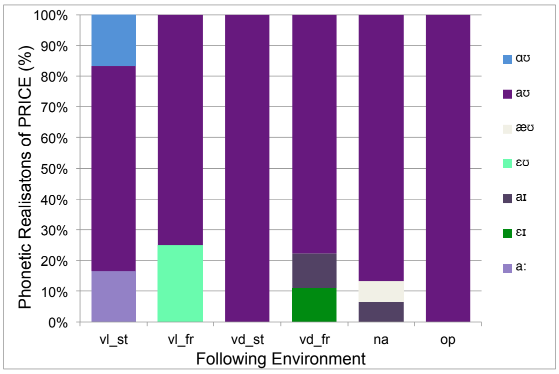
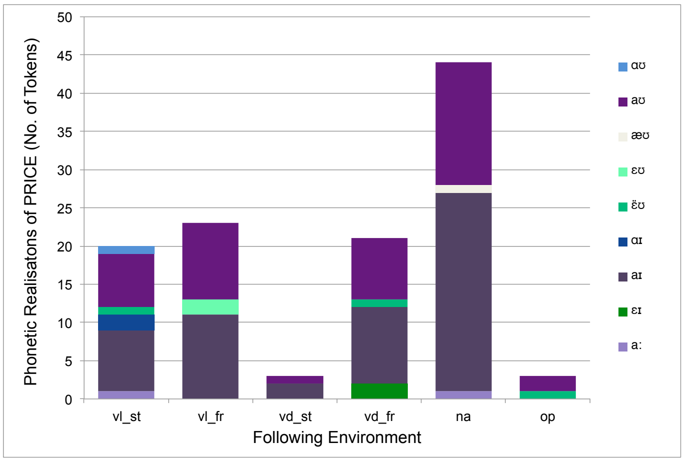


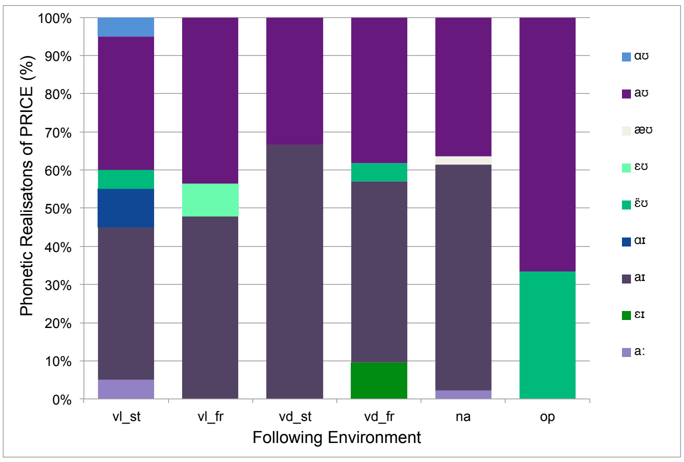
Figure 9.28: Ch4 phonetic realisations (%) of MOUTH by following environment

([ɛʊ]) occurs twice before fricatives. Finally, offglide fronting occurs before voiced fricatives and once before a nasal.

The results for the investigation of MOUTH realisations in the SED in southwest Lancashire indicated there are a number of different processes that occur, this findings is also borne out by the analysis of the MOUTH realisations in the north Cheshire localities. Many of these processes occur across two or all of the localities, such as nucleus retraction and monophthongisation. However, these processes are not very frequent. Offglide fronting is prevalent in Ch1 and Ch3, occurring in many of the environments included in the current investigation, as demonstrated in Figure 9.29. This process does not occur very frequently in Ch4. As described in previous sections, the raw values are provided in Figure 9.29a, whereas percentages are provided in Figure 9.29b. These figures clearly demonstrate the differences between Ch4 and the other two localities, as there are two dominant realisations: [aɪ] and [aʊ].



(a) Number of phonetic realisations of MOUTH by environment across all north Cheshire localities



(b) Percentage of phonetic realisations of MOUTH by environment across all north Cheshire localities

Figure 9.29: Phonetic realisations of MOUTH by environment across all north Cheshire localities

Nucleus centralisation is found in Ch3 and Ch4, but is not a common process in either locality. Only processes that are relatively common are included in the following summary of the results of MOUTH realisations in north Cheshire. The following is a summary of the findings for the MOUTH lexical items in the three north Cheshire localities included in the current investigation:

1. Ch1: [aɪ] is the most frequent realisation
   (a) Offglide fronting ([aɪ] or [ɛɪ]) in all environments
      i. Most frequent before nasals
2. Ch3: [aɪ] is the most frequent realisation
   (a) Offglide fronting ([ɑɪ] or [aɪ]) in all environments except in word-final open syllables
      i. Most frequent before voiced consonants
   (b) Nucleus centralisation ([ɛ̈ʊ]) before a voiceless stop, a voiced fricative and in a word-final open syllable
3. Ch4: [aʊ] is the most frequent realisation
   (a) Offglide fronting ([aɪ] or [ɛɪ]) before voiced fricatives and once before a nasal

The results of the current analysis of PRICE and MOUTH in the southwest Lancashire and north Cheshire localities demonstrate that the localities that behaved similarly in the analysis of the PRICE lexical items do not necessarily behave similarly for the MOUTH lexical items. La10, La13, Ch1, Ch4, and possibly Ch3 behave similarly in the analysis of the PRICE lexical items and La11 and La12 behave differently from each other and the other localities. However, in the MOUTH data all of the southwest Lancashire localities behave similarly with the exception of La12 and two of the three north Cheshire localities behave similarly (Ch1 and Ch3). Therefore, it appears that the Lancashire-Cheshire dialect divide is much more evident in the investigation of MOUTH in the SED than PRICE.

One substantial difference between the southwest Lancashire and north Cheshire localities is that MOUTH may be realised with a fronted offglide. This results in the realisations of the MOUTH lexical items being very similar to the possible realisations of the PRICE lexical items. It is found that in some environments this may result in neutralisation of the contrast between PRICE and MOUTH. However, this particular feature is not found in the results of the main investigation, and, therefore, likely did not survive levelling processes of new-dialect formation. The majority of other varieties did not have PRICE-type variants in MOUTH lexical items. Furthermore, these variants create the potential for cases of neutralisation between MOUTH and PRICE. These two factors may explain why these realisations were not retained for the MOUTH vowel in LE.

Chapter 7 discusses the differences between MOUTH and PRICE realisations in the contemporary data. The results suggest that the MOUTH vowel in LE is more monophthongal in general than the PRICE vowel. This observation is reflected in the results of the SED investigation. In the investigation of PRICE in southwest Lancashire and north Cheshire, many of the localities have a diphthongal realisation as their most common realisation. On the other hand, a monophthongal realisation of MOUTH is dominant in all of the southwest Lancashire localities. Therefore, the contemporary results may reflect the fact that historically MOUTH in southwest Lancashire was dominated by monophthongal variants and PRICE was generally not.

The current chapter has established the processes that are attested in the SED data in southwest Lancashire and north Cheshire for PRICE and MOUTH and PRICE phonologically-conditioned variation in the OLIVE data. There are two common processes that occur with the PRICE vowel in the SED: nucleus retraction and monophthongisation. Monophthongisation is also found in the OLIVE investigation, but nucleus retraction is not. The results for the MOUTH vowel suggests that the processes that occur in southwest Lancashire and north Cheshire differ. In southwest Lancashire, monophthongisation occurs across all localities, whereas offglide fronting occurs often in north Cheshire.

CHAPTER 10

THE ORIGINS OF PHONOLOGICALLY-CONDITIONED VARIATION IN PRICE AND MOUTH

The current chapter compares the results of the main investigation (see Chapter 7), the analysis of the *Survey of English Dialects* (SED) data, and the *Origins of Liverpool English* (OLIVE) analysis (see Chapter 9) in order to evaluate the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation (see §4.2) and propose an approach that accounts for the findings of the current thesis.

It should be noted that the set of phonological environments included in the contemporary data (Chapter 7) may differ from those included in the SED and OLIVE data (Chapter 9). One of the ways that the environments may differ is that the main investigation conflates some phonological environments as a result of the pilot study findings. For example, PRICE and MOUTH before stops in the main investigation represents the entire set of obstruents, including stops and fricatives. The results of the pilot study indicate that the realisations of PRICE and MOUTH before voiceless fricatives do not differ from those before voiceless stops and the realisations of the target vowels before voiced fricatives do not differ from those before voiced stops. However, these categories are kept separate in the SED and OLIVE data in order to assess all possible conditioning environments at an earlier time point. I could not assume that voiceless stops and voiceless fricatives in the SED and OLIVE data would affect the target vowels in the same way, just because voiceless obstruents act as a single conditioning environment in the main investigation. Furthermore, phonological environments may differ as a result of lack of tokens in the dataset. The SED did not have enough tokens before /l/ of either PRICE or MOUTH across all localities according to the criteria that I established, so this environment is not included in the final analysis. Table 10.1 lists the set of environments in each of the datasets for PRICE that are analysed in the current investigations. Likewise, Table 10.2 lists the set of environments in each of the datasets for the MOUTH vowel in the current investigations.

Furthermore, a caveat must be given that the current discussion provides some evidence for the processes involved in the emergence of the PRICE and MOUTH patterns in LE, but that this evidence cannot be taken as entirely conclusive given the size of the datasets. The informants from the SED localities range from between two and four informants per locality (see §8.1). The OLIVE corpus analysis includes seven speakers (see §8.2) and the main investigation includes a speaker sample of twenty-seven (see Chapter 6). That being said, the present investigation is the most comprehensive study to date on the PRICE and MOUTH vowels in LE. Therefore, the current discussion relies on the findings of the present investigation to provide a better understanding of the origins and development of PRICE and MOUTH phonologically-conditioned variation in LE.

The chapter begins with a comparison of the results of the analysis of PRICE and MOUTH phonologically-conditioned variation in the three datasets (§10.1). The differences between the historical and contemporary patterns allow us to distinguish between processes that are inherited as part of new-dialect formation and ones that are later developments. Despite small differences between the PRICE and MOUTH patterns in LE, it is found that similar processes affect both the vowels. It is likely that shared features of these vowel patterns emerged from the same origins. Therefore, the PRICE and MOUTH vowels are discussed in tandem for the remaining sections. Section 10.2 evaluates each of the approaches to the origins of these types of patterns in relation to the specific findings for the PRICE and MOUTH patterns in LE. I propose an approach that combines aspects of the different approaches to the emergence and development of PRICE and MOUTH phonologically-conditioned variation to account for the patterns reported in LE (§10.3). Finally, I discuss the synchronic PRICE and MOUTH patterns in LE and compare them with phonologically-conditioned variation in other varieties of English (§10.4).

Environment	Dataset		
	SED	OLIVE	Newly Collected
ME /ix/ words	yes	yes, but not separate	yes, but not separate
ME /ei/ words	yes	yes, but not separate	yes, but not separate
voiceless stop	yes	yes	yes
voiceless fricative	yes	yes	**no**
voiced stop	yes	yes	yes
voiced fricative	yes	yes	**no**
nasals	yes	yes	yes
/l/	**no**	yes	yes
in open syllables	yes	yes	yes
morpheme boundaries	**no**	yes	yes

Table 10.1: Summary of the phonological environments analysed for PRICE in the three datasets

Environment	Dataset	
	SED	Newly Collected
voiceless stop	yes	yes
voiceless fricative	yes	**no**
voiced stop	yes	yes
voiced fricative	yes	**no**
nasals	yes	yes
/l/	**no**	yes
in open syllables	yes	yes
morpheme boundaries	**no**	yes

Table 10.2: Summary of the phonological environments analysed for MOUTH in the two datasets

10.1 COMPARISON OF THE RESULTS FROM THE THREE DATASETS

10.1.1 PRICE phonologically-conditioned variation

There are a number of differences and similarities in PRICE phonologically-conditioned variation in LE found between the three datasets. A comparison of these results provides a principled basis for deciding which processes are inherited as part of new-dialect formation and those that are later endogenous developments. If a process is inherited as part of new-dialect formation, then this process should be found across the different datasets. On the other hand, if a process is a later endogenous development, then it should be found only in the contemporary data. The current section provides preliminary assessments as to which processes are inherited as part of new-dialect formation and which are later developments. These are further used to evaluate the different approaches to the origins of these types of patterns, as discussed in detail in §10.2.

One of the earliest changes is the lexical redistribution of the ME /ix/ and ME /ei/ words (Trudgill 1986). In many of the localities in the SED, there is evidence to suggest that ME /ix/ and /ei/ had remained a separate subclass of words for at least some lexical items. However, the results of the OLIVE corpus analysis find that ME /ix/ and ME /ei/ lexical items are not different from other PRICE lexical items with the same following environment.

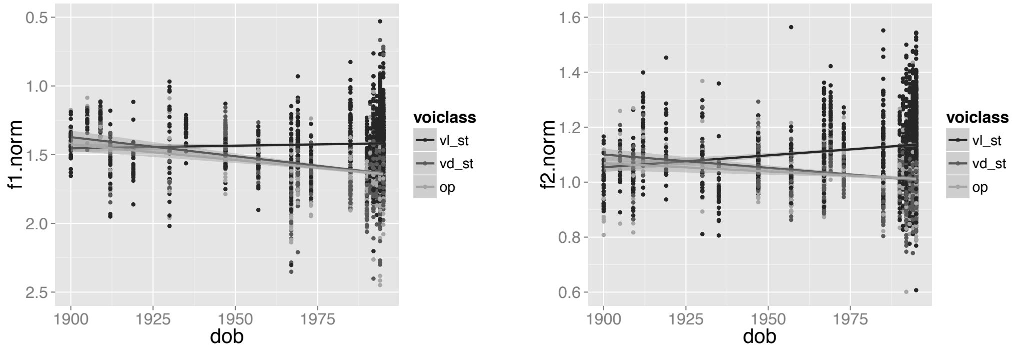
The results of the analysis of the contemporary dataset suggest that nucleus raising and fronting ([ɛ̟̆ɪ̟]) of PRICE occurs before voiceless stops in all participants with the exception of two older male participants and one younger male participant. On the other hand, the analysis of the OLIVE corpus does not find evidence for nucleus raising and fronting in the current dataset. The quality of the PRICE nucleus before voiceless obstruents is the same as before most of the other following environments. Despite a lack of a quality difference, the analysis of the OLIVE corpus and the two older male participants in the main investigation also indicates that the inflection points for PRICE realisations before voiceless obstruents differs from other environments. These results suggest that there may have been a small perceptual difference between PRICE realisations before voiceless obstruents and in other environments as a result of offglide peripheralisation and nucleus shortening even in the oldest participants in the current sample. Therefore, it is likely that nucleus raising and fronting is a later endogenous development and not inherited as part of new-dialect formation.

Chapter 6 introduces the graphical representation that is used to show differences in vowel realisations in apparent time, which is used in the current discussion. Normalised formant values are plotted along the y-axis and date of birth along the x-axis. These graphs represent data from the contemporary dataset and the OLIVE dataset, so that the year of birth runs from 1900 to 1995, with the OLIVE data from 1900 to 1935 and the contemporary data from 1947 to 1995. Furthermore, figures that plot normalised f1 values on the y-axis have a reversed y-axis to correspond with the vowel height.

Figure 10.1 demonstrates that the nucleus of PRICE before voiceless stops (*dark grey line*) has become more raised and fronted in apparent time. Therefore, nucleus raising and fronting is a later endogenous development, as the quality of the nucleus of PRICE for the oldest speakers in the present investigation is the same for PRICE before voiceless stops, voiced stops and in open syllables. A difference in the quality of the nucleus does not begin to occur until the mid-twentieth century, when the oldest speakers in the contemporary dataset were born. Furthermore, the nucleus of PRICE before voiced stops (*grey line*) and in open syllables (*light grey line*) pattern together across the entire sample, as shown in Figure 10.1.

The results of the main investigation show that mostly monophthongal realisations of PRICE occur before voiced obstruents. However, the OLIVE corpus analysis suggests that offglide weakening ([a̠̞ə]) and monophthongisation ([a̠̞ː]) occur before voiced obstruents. Only three of the localities in the SED data frequently have monophthongal realisations of PRICE before voiced obstruents. La11, La12 and Ch3 have mostly monophthongal realisations before voiced consonants ([ɑː] and [aː]). The remaining southwest Lancashire and north Cheshire localities in the SED have mostly diphthongal realisations ([ɑɪ]) of PRICE before voiced stops and voiced fricatives.

Furthermore, the analysis of the OLIVE corpus indicates that the interaction between gender and following environment is significant for the amount of diphthongisation of PRICE, which is partially driven by the effect of PRICE



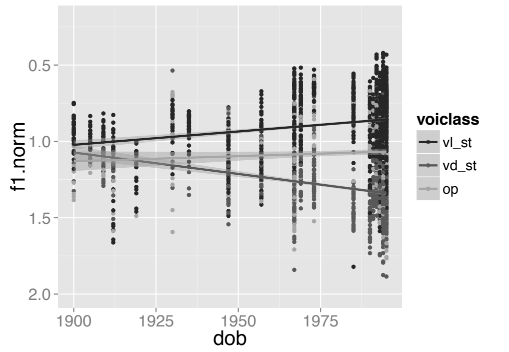
(a) PRICE nucleus height (**f1.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)

(b) PRICE nucleus backness (**f2.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)

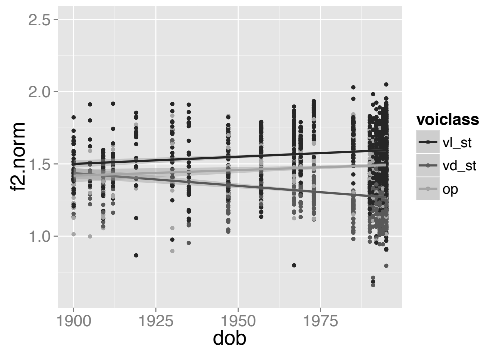
Figure 10.1: The quality of PRICE at the nucleus measurement before voiceless stops, voiced stops and in open syllables by date of birth

before voiced stops. Female speakers produce [a̝ə] most often in the OLIVE data and male speakers produce [a̝ː] most often in this dataset. On the other hand, PRICE before voiced fricatives is consistently realised as [a̝ə] in the OLIVE corpus. In the SED analysis, monophthongal realisations of PRICE are found frequently before voiced fricatives in many of the localities. PRICE lexical items before voiced fricatives were not included in the main investigation as the pilot study found no difference between the realisation of PRICE before voiced stops and voiced fricatives. If the results of the pilot study are taken as an adequate representation of PRICE phonologically-conditioned variation in LE, then monophthongal variants are likely to be found before voiced fricatives in the contemporary PRICE pattern.

These results suggest that monophthongisation of PRICE before voiced stops in the contemporary pattern is a later endogenous change for at least female speakers, but an older process inherited as part of new-dialect formation for male speakers. Figure 10.2 demonstrates that the offglide of PRICE before voiced stops (*grey line*) lowers and retracts over time. As the offglide lowers and retracts, it minimises the phonetic distance between the nucleus and offglide, which leads to more monophthongal realisations of PRICE before voiced stops, similar to the realisations of PRICE in other voiced consonant environments. However, the offglide of PRICE before voiceless stops (*dark grey line*) remains the same across the sample.



(a) PRICE offglide height (**f1.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)



(b) PRICE offglide backness (**f2.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)

Figure 10.2: The quality of PRICE at the offglide measurement before voiceless stops, voiced stops and in open syllables over date of birth

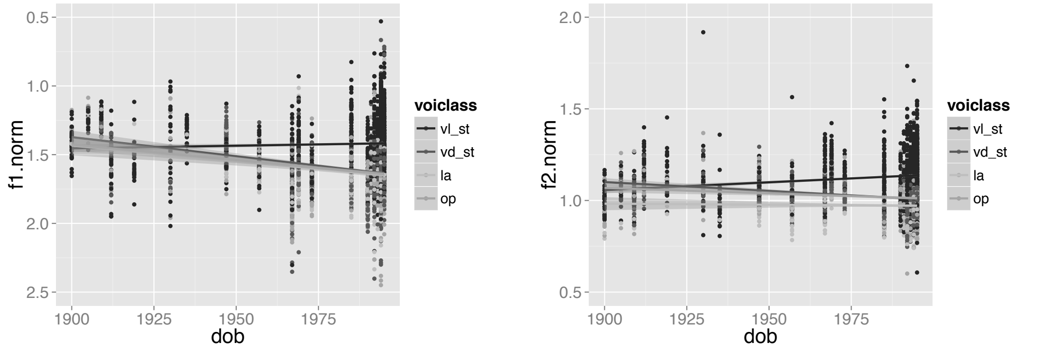
While sociolinguistic variables are not discussed at any length in this thesis, I note here some aspects of gender differences that have been observed in linguistic research about sound change. However, a more detailed discussion of the implications of the findings of the present thesis with regards to sound change and gender differences must be left for future study. There are a number of previous studies which suggest that women are innovators in unstable linguistics systems, but not in stable ones (Labov 1990, 1994). "[I]n most of the vowel shifts that we looked at, women are considerably more advanced than men" (Labov 1994: 156). Milroy et al. (1994) find that female informants are leading the change of glottal stop replacement of /t/ in Tyneside and Watt and Milroy (1999) suggest that females are also leading a change in the NURSE vowel in Newcastle. However, there are also reports of sounds changes that are lead by men, such as in the urban variety in Norwich (Trudgill 1972) and in Martha's Vineyard (Labov 1972a). Furthermore, one gender may have a stable variant and the other is changing towards the stable variant. This is found for pre-[ŋ] TRAP raising in San Francisco English, where women have a stable higher TRAP realisation before [ŋ] and men are changing in apparent time to this higher realisation (Cardoso et al. 2015).

The current results do not seem to support much of this work, as male participants have the stable variant, a monophthong before voiced stops, and females are changing in line with this realisation. In other words, males appear to ‘lead’ a sound change in an unstable linguistic system. However, note that this result is based on a small speaker sample in the OLIVE dataset and in order to confirm that males ‘lead’ this sound change, more data with older speakers is required. Therefore, the reason why males appear to have ‘lead’ a sound change even in an unstable linguistic system is outside the scope of the current investigation and must be left for further study.

Before nasals, the main investigation finds a monophthongal realisation of PRICE ([aː]). The results of the SED analysis demonstrate that monophthongal realisations of PRICE often occur before nasals, although diphthongal realisations are also found in this environment. In the OLIVE corpus, PRICE is monophthongal before nasals. Furthermore, the interaction between gender and following environment reported in the OLIVE corpus analysis is also partly due to the pre-nasal environment. Males have a more raised monophthongal realisation ([ɛː]) than females ([a̝ː]). In the main investigation, gender is not found to be a significant predictor, nor is the interaction between gender and following environment. This result aligns with previous reports of women leading sound change, as discussed above. Given that monophthongal realisations are found in southwest Lancashire and north Cheshire in the SED data and that a monophthongal variant occurs before nasals in the OLIVE dataset, PRICE monophthongisation before nasals is a process that is inherited as part of new-dialect formation.

PRICE before /l/ is not analysed in the SED, as there are too few tokens and realisations across the localities. However, monophthongisation of PRICE before /l/ occurs in both the OLIVE corpus and the contemporary dataset. Likewise, PRICE shortening before /l/ is found in both the OLIVE corpus and contemporary data. These results suggest that monophthongisation and shortening of PRICE before /l/ is inherited as part of new-dialect formation.

The quality of the PRICE variant before /l/ is retracted in comparison with the other environments in the OLIVE corpus. This quality difference is not found in the main investigation. Figure 10.3b shows that PRICE at the nucleus measurement before voiced stops (*grey line*) and in word-final open syllables (*light grey line*) retracts in apparent time to a similar quality as the PRICE realisation before /l/ (*very light grey line*). The PRICE nucleus also lowers in all following environments except before voiceless obstruents (*dark*



(a) PRICE nucleus height (**f1.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*), /l/ (*very light grey*) and in open syllables (*light grey*)

(b) PRICE nucleus backness (**f2.norm**) before voiceless stops (*dark grey*), before voiced stops (*grey*), /l/ (*very light grey*) and in open syllables (*light grey*)

Figure 10.3: The quality of PRICE at the nucleus measurement in all environments except before nasals

grey line), where it raises, as demonstrated in Figure 10.3a. Therefore, the lowering and retraction of PRICE monophthongs and the nucleus of PRICE diphthongs is a recent development, with the exception of retraction before /l/. The retraction of PRICE before /l/ is likely the result of a commonly reported phonetic coarticulatory effect of following /l/ (see Labov 1994, Hall-Lew 2011, Haddican et al. 2013 and Sóskuthy et al. 2015).

The results of the main investigation find that [aɪ] occurs in word-final open syllables. Likewise, PRICE in word-final open syllables in the SED is found to have mostly diphthongal productions ([aɪ] or [ɑɪ]) with one locality also reporting monophthongal productions ([aː]). The results of the analysis of the OLIVE corpus suggest that there are two possible realisations of PRICE in open syllables: [a̝ɪ] and [a̝ə]. The [a̝ə] realisation is generally produced by male speakers in the OLIVE corpus, while the [a̝ɪ] realisation is generally produced by female speakers. Gender is not a significant predictor of the mixed effects models as a main effect or in an interaction with the following environment in the main investigation. Therefore, the loss of offglide weakening for PRICE in word-final open syllables is the result of a later endogenous development for at least the male speakers. Again this may demonstrate a case where women are leading men in a sound change. As demonstrated in Figure 10.2, the offglide of PRICE in open syllables raises and fronts in apparent time, so that offglide weakening no longer occurs.

The main investigation finds that the realisation of PRICE before morpheme boundaries, i.e. the past tense morpheme, does not differ from the realisation of PRICE before voiced stops. Due to a lack of tokens, PRICE before morpheme boundaries was not analysed as a separate phonological environment in the SED analysis. However, the results of the OLIVE analysis concur with the results of the main investigation, as PRICE before morpheme boundaries patterns with PRICE before voiced obstruents. In other words, the realisation of PRICE before voiced obstruents, regardless of whether it is in the same morpheme as the target vowel or in a separate morpheme, is [a̝ə] in the OLIVE corpus and [aː] in the contemporary data. Therefore, all PRICE realisations before voiced obstruents, regardless of presence/absence of a morpheme boundary are included together in the discussion of the emergence and development of PRICE phonologically-conditioned variation in LE.

The results of the comparison between the investigations of the three datasets are summarised below:

1. Processes that are inherited as part of new-dialect formation:
   (a) offglide weakening before voiced stops (*female speakers*) and in word-final open syllables (*male speakers*)
   (b) monophthongisation before nasals and /l/
   (c) shortening before /l/
2. Processes that are later endogenous changes:
   (a) nucleus raising & fronting before voiceless obstruents
   (b) monophthongisation before voiced stops (*female speakers*)
   (c) loss of weakened offglide realisations in word-final open syllables (*male speakers*)

10.1.2 MOUTH phonologically-conditioned variation

The MOUTH vowel is investigated in the SED and the contemporary datasets, but not in the OLIVE corpus. The reasons for not investigating MOUTH in the

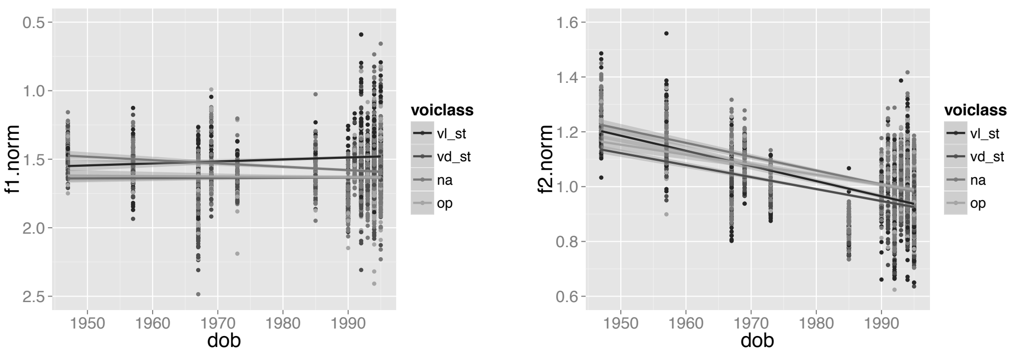
OLIVE corpus are described in detail in Chapters 5 and 8. However, this does somewhat limit the discussion of the emergence and development of MOUTH phonologically-conditioned variation in LE. Similar to the comparison of the results of the investigations of PRICE, there are differences between the results of the SED analysis and the main investigation of MOUTH phonologically-conditioned variation.

The results of the analysis of the SED data for MOUTH suggest that [aː] is the most common realisation in southwest Lancashire with the exception of in La12, which has [ɛː] as the most common realisation. The north Cheshire localities have mostly diphthongal realisations of MOUTH with differences in the quality of the offglide ([aɪ] in Ch1 and Ch3, and [aʊ] in Ch4). The results of the main investigation suggest that before obstruents and in word-final open syllables diphthongal realisations occur and monophthongal realisations occur before sonorants. However, overall the diphthongal MOUTH realisations are less diphthongal than the PRICE ones.

In the main investigation, nucleus raising of MOUTH ([ə̝̆ʊ]) occurs before voiceless obstruents. There are two localities in the SED (La13 and Ch3) that record cases of MOUTH nucleus raising and fronting or centralisation, which mostly occur before voiceless obstruents and voiced obstruents. Furthermore, monophthongisation is generally inhibited before voiceless obstruents in the southwest Lancashire localities in the SED data. The north Cheshire localities generally have diphthongal realisations of MOUTH ([aɪ] and [aʊ]) before voiceless obstruents.

While it is not possible to compare vowel duration or inflection points directly between the SED and contemporary data, the results of the main investigation suggest that the nucleus of MOUTH is short before voiceless obstruents. Some evidence from older speakers in the contemporary data suggests that while nucleus raising and fronting occurs in the SED data, nucleus raising before voiceless obstruents in LE may be a more recent endogenous development. Figure 10.4 demonstrates that the nucleus of MOUTH before voiceless stops is raising in apparent time. This suggests that MOUTH nucleus raising before voiceless stops was likely not inherited as part of new-dialect formation, but it is a later endogenous development.

In the contemporary data, offglide weakening of MOUTH is reported before



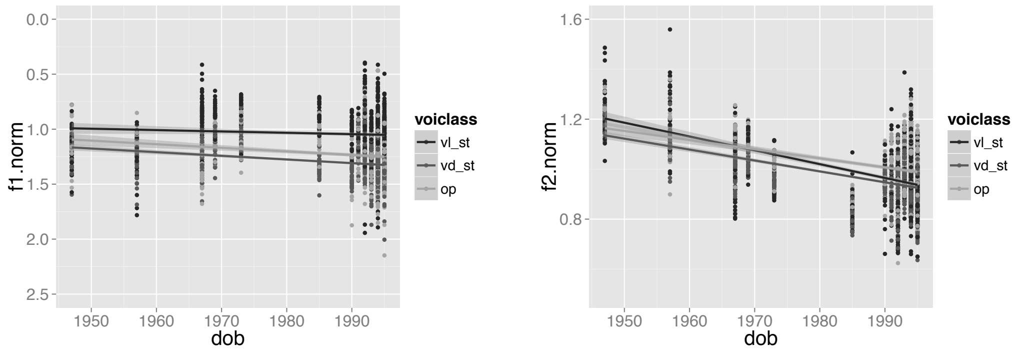
(a) MOUTH nucleus height (**f1.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*), nasals (*medium grey*) and in open syllables (*light grey*)

(b) MOUTH nucleus backness (**f2.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*), nasals (*medium grey*) and in open syllables (*light grey*)

Figure 10.4: The quality of MOUTH at the nucleus measurement before voiceless stops, voiced stops, nasals and in open syllables over date of birth

voiced obstruents. The analysis of the SED data indicates that monophthongisation occurs before voiced stops in southwest Lancashire, but diphthongal realisations are also recorded in this environment. In the analysis of the north Cheshire localities PRICE-type diphthongs are found to occur often before voiced obstruents. However, the main investigation does not find any instances of PRICE-type diphthongs, such as [aɪ], as realisations of the MOUTH tokens. Furthermore, the quality of the offglide of MOUTH has lowered and backed in apparent time, as shown in Figure 10.5. This suggests that offglide weakening may be a later endogenous change of MOUTH phonologically-conditioned variation in LE.

Monophthongisation and raising of MOUTH before nasals is found in the main investigation. The SED analysis in southwest Lancashire demonstrates that MOUTH monophthongisation and raising also often occur before nasals. However, MOUTH is often realised as [aɪ] or [aʊ] before nasals in north Cheshire. The raising process that is found in the contemporary data is affected by speech style, as there is a significant interaction between speech style and the following environment. Specifically, MOUTH is raised ([a̝ː]) before nasals in the word list data and not raised ([aː]) before nasals in the map task data. Furthermore, Figure 10.4 demonstrates that MOUTH before nasals is lowering in apparent time. Therefore, unlike the raising process that occurs before



(a) MOUTH offglide height (**f1.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)

(b) MOUTH offglide backness (**f2.norm**) before voiceless stops (*dark grey*), voiced stops (*grey*) and in open syllables (*light grey*)

Figure 10.5: The quality of the offglide of MOUTH before voiceless stops, voiced stops and in open syllables over date of birth

voiceless stops, raising before nasals is initially an inhibition of lowering. This is slowly changing in apparent time, so that younger speakers are raising less and raising MOUTH before nasals occurs less in casual speech. Therefore, the non-lowering is likely a process that occurred after new-dialect formation. Conversely, monophthongisation before nasals is present throughout the data and occurs frequently in some of the contributing varieties to the dialect mixture in Liverpool. Therefore, monophthongisation is inherited as a part of new-dialect formation.

MOUTH before /l/ is not analysed in the SED as a result of too few tokens or realisations across the localities. However, the main investigation found that monophthongisation and shortening of MOUTH occurs before /l/. Given the evidence from the older speakers in the contemporary data and the most common realisations of MOUTH across the southwest Lancashire localities, it is likely that monophthongisation of MOUTH before /l/ is inherited as part of new-dialect formation.

The results of the main investigation indicate that offglide weakening of MOUTH occurs in word-final open syllables. As demonstrated in Figure 10.5, the offglide of MOUTH in open syllables lowers and retracts in apparent time, as was the case for MOUTH before voiced obstruents. In comparison, the results of the analysis of the SED data demonstrate that diphthongal variants of MOUTH are found in word-final open syllables in southwest Lancashire. The offglide fronting process is often inhibited in word-final open syllables in north Cheshire. Therefore, it is likely that offglide weakening is a development that occurred as an endogenous change after new-dialect formation.

MOUTH before morpheme boundaries is not analysed as a separate environment in the SED analysis, as a result of lack of tokens. However, the results of the main investigation suggest that MOUTH before the past tense morpheme is realised with the same variant as MOUTH before voiced stops. Therefore, the results for MOUTH before voiced stops include those lexical items where the following voiced stop is in the same morpheme as the MOUTH vowel and those lexical items where the following voiced stop is in a different morpheme.

The comparison of the analysis of the SED data with the analysis of the contemporary data suggests the following for the emergence and development of MOUTH phonologically-conditioned variation in LE.

1. Processes that are inherited as part of new-dialect formation:
   (a) Non-lowering before nasals
   (b) monophthongisation before nasals and /l/
   (c) shortening before /l/
2. Processes that are later endogenous changes:
   (a) nucleus raising before voiceless stops
   (b) offglide weakening before voiced stops and in word-final open syllables

All of these results taken together indicate that PRICE and MOUTH phonologically-conditioned variation in LE resembles voice-driven (VD) patterns and not Scottish Vowel Length Rule (SVLR) patterns. This finding echoes previous work on PRICE phonologically-conditioned variation in LE (see §3.3.3). Therefore, the influence from immigrants from Scotland is not apparent in the PRICE vowel pattern. It further suggests that LE is another instance of a VD pattern that has developed independently from VD patterns in other varieties of English. Furthermore, PRICE and MOUTH phonologically-conditioned variation in LE is the first reported case of a VD pattern in the UK that involves both diphthongs and not just PRICE.

The processes that are found to occur in the current analysis of the PRICE and MOUTH vowels in LE are also found in previous work on phonologically-conditioned variation of PRICE and MOUTH in other varieties of English. In the analysis of PRICE in the OLIVE dataset only monophthongisation or offglide weakening is found. This process is also reported in other British English varieties, such as the contemporary dialects in south Durham and Hull (see §3.3.1.2). However, the results of the main investigation on both vowels suggest that nucleus raising and monophthongisation occur. As described in §3.3.1, a similar pattern is found for the PRICE vowel historically in Durham, and in more recent studies of the Central Fenland in Britain. Nucleus raising and monophthongisation of PRICE and MOUTH are also found in VD phonologically-conditioned variation in Ann Arbor in the United States and in Cape Flats in South Africa.

Another finding of the current investigation is that duration does not always show the same patterns of variation across different environments as vowel quality. For example, in the main investigation nucleus raising occurs before voiceless stops, but monophthongisation occurs before /l/. However, both of these environments have short vowel durations. While the statistical tests did not control for speech rate specifically, it is doubtful that speech rate acts as a major confound in the current study. Speech rate can increase the amount of random noise in the data, but it is unlikely that it would introduce systematic biases into the results. In the pilot study, only word list data was analysed and in the OLIVE data only casual speech was analysed. It is unlikely that major speech rate differences would occur within one speech style type. Therefore, for the pilot study and OLIVE investigation it is likely that using only one speech style prevents drastic speech rate differences from occurring. Turning to the main investigation, speech style is included as an interaction term in the mixed effects models. Therefore, the different speech styles are evaluated separately. This would again make speech rate effects unlikely to influence overall results found for duration.

Finally, the processes that affect the realisations of PRICE and MOUTH in LE largely overlap between the two vowels and so in order to avoid extensive repetition in the following discussion, I discuss the target vowels in tandem. However, any differences between the patterns of variation of the PRICE and

MOUTH vowels are also discussed within the text.

10.2 EVALUATION OF PREVIOUS APPROACHES

In this section I discuss how well each of the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation is able to account for the findings of the current thesis on PRICE and MOUTH phonologically-conditioned variation in LE. These approaches are discussed in the same order as they are presented in §4.2, so that 'failure-to-lower' is discussed first and new-dialect formation is discussed last.

There does not appear to be much evidence in support of the 'failure-to-lower' approach in the current investigation. While [ɛɪ] and [ɛʊ] realisations are found before voiceless stops in the analysis of the SED data, there are also many cases of a lowered diphthong in this environment. Furthermore, PRICE nucleus raising and fronting is not found in the OLIVE corpus. The fundamental assumptions of the 'failure-to-lower' approach predict that the realisations that are found in the SED data which correspond to non-lowered reflexes of the PRICE and MOUTH vowels should be found in the speech of the older participants in the OLIVE corpus and the contemporary data, and then, subsequently, in speech of the younger participants in the contemporary data. The nucleus of PRICE or MOUTH before voiceless obstruents should not reach a lowered nucleus stage in the development of the vowels. However, the nucleus of PRICE in the OLIVE investigation does reach a stage with a lowered nucleus and then subsequently raises in apparent time, and the nucleus of MOUTH reaches a lowered nucleus stage in the older speakers in the contemporary data and then raises in apparent time, as demonstrated in §10.1. Furthermore, the quality of the nucleus of PRICE is the same in all environments except before /l/ in the OLIVE corpus and the quality of the nucleus of MOUTH is the same in all environments except before /l/ and nasals in the oldest speakers in the contemporary data. As discussed in §4.2, the fundamental assumptions of the 'failure-to-lower' approach does not predict monophthongisation or offglide weakening processes. As a result, it is difficult to assess whether the 'failure-to-lower' approach is able to explain the monophthongisation or offglide weakening processes that affect the PRICE and MOUTH vowels in LE. Given the findings of the present investigation of PRICE and MOUTH in historical and contemporary datasets, the 'failure-to-lower' approach cannot account for the processes that affect the realisations of PRICE and MOUTH in LE.

'Asymmetric assimilation', the second approach, accounts for some of the findings of the PRICE and MOUTH patterns in the current thesis. The fundamental assumptions of the 'asymmetric assimilation' approach predict that offglide peripheralisation occurs before voiceless consonants as a result of phonetic effects of the following voiceless consonants. The offglide peripheralisation results in nucleus shortening, which is in turn misperceived as nucleus raising. Following generations adapt the realisation of the nucleus of PRICE and MOUTH before voiceless obstruents to reflect this misperception. As a result of this, PRICE and MOUTH nucleus raising occurs.

These predictions are generally borne out by the results of the analysis of PRICE and MOUTH before voiceless obstruents in LE. In the analysis of the OLIVE corpus, the nucleus of PRICE is not raised compared to the other environments, but offglide peripheralisation which results in nucleus shortening does occur. This is demonstrated by the inflection point for PRICE before voiceless stops, which indicates shorter nuclei in the OLIVE corpus. Furthermore, two older male speakers in the contemporary data, who do not raise or front the nucleus of PRICE before voiceless obstruents, have shorter nuclei in this environment. Likewise, the results of the investigation of MOUTH in the contemporary data support this account for the two older speakers who do not raise the nucleus of MOUTH before voiceless stops. The f1 and f2 inflection points of MOUTH before voiceless stops for these speakers demonstrate shortened nuclei despite the fact that their MOUTH realisations are not raised in this environment. PRICE and MOUTH nucleus raising seems to result from these shorter nuclei being reanalysed by subsequent generations as nucleus raising, which occurs progressively in apparent time. Therefore, PRICE and MOUTH nucleus raising before voiceless obstruents can be accounted for by the 'asymmetric assimilation' approach.

The second process that affects the realisations of PRICE and MOUTH in LE is offglide weakening. 'Asymmetric assimilation' predicts that offglide weakening occurs as a result of offglide undershoot in environments where the nucleus has been peripheralised and results in longer nuclei. The results of the current thesis do not find strong evidence to support this. For the PRICE vowel, offglide weakening occurs before voiced obstruents and for some speakers in word-final open syllables in the OLIVE dataset. For the MOUTH vowel, offglide weakening occurs before voiced stops and in word-final open syllables. The f1 and f2 inflection points of PRICE and MOUTH before voiced obstruents and in word-final open syllables do not straightforwardly indicate a lengthened nucleus. These inflection points range from between the 35% and 60% measurements. In cases where the inflection points are at less than the 50% measurement, 'asymmetric assimilation' would not predict offglide weakening to occur. For those inflection points that are greater than 50% of the way through the vowel, offglide weakening is predicted to occur by the 'asymmetric assimilation' approach. Therefore, the results of the current investigation do not directly support the 'asymmetric assimilation' approach with regards to the offglide weakening process that affects the PRICE and MOUTH vowels.

In the contemporary dataset, PRICE in word-final open syllables is realised as [aɪ], which suggests that offglide weakening is lost at some stage. This result appears to support the 'asymmetric assimilation' approach, as inflection points of PRICE in word-final open syllables in the OLIVE corpus have approximately the same nucleus and offglide lengths. As a result neither the nucleus or the offglide are peripheralised.

Finally, 'asymmetric assimilation' predicts that offglide weakening may develop into monophthongisation if the longer nuclei are misperceived as monophthongs. This misperception is reanalysed by subsequent generations, who begin to produce monophthongal realisations over time. Monophthongisation of PRICE and MOUTH occurs initially before nasals and /l/ and then in some cases extends to before all voiced consonants. The monophthongisation of PRICE that occurs before voiced obstruents for male speakers in the OLIVE corpus extends to all speakers by the time that the contemporary data was collected. On the other hand, monophthongisation of MOUTH has only extended to before all voiced consonants for some speakers in the current sample.

While the results of the present investigation are not incompatible with the 'asymmetric assimilation' account, there are better explanations for the emergence of the monophthongisation process using the new-dialect formation approach. Monophthongal variants of PRICE and MOUTH before nasals are recorded in the SED data. Furthermore, monophthongisation is found in the OLIVE corpus for the PRICE vowel and in the oldest speakers in the contemporary dataset for the PRICE and MOUTH vowels. It is again found in the youngest speakers in the sample for both target vowels. Therefore, it is unlikely that PRICE and MOUTH monophthongisation is the result of phonetic effects on the vowel and is not accounted for by the 'asymmetric assimilation' approach.

Finally, it is not clear whether 'asymmetric assimilation' predicts raising of MOUTH before nasals. The 'asymmetric assimilation' approach suggests that raising results from a misperception of nucleus shortening. However, in this case there is no nucleus. The nucleus of PRICE and MOUTH or PRICE and MOUTH monophthongs is generally lowering and retracting in all environments except before voiceless stops in apparent time. However, some of the younger participants in the current sample have lowered MOUTH before nasals. Therefore, it is more likely that MOUTH raising before nasals is actually inhibiting of lowering due to common phonetic co-articulatory effects of following nasals, as reported in other varieties of English, such as varieties in the United States (see, for example, Labov et al. 2005, Baker et al. 2008 and Roeder 2009).

The 'enhancement of pre-fortis clipping' approach in many ways is similar to the 'asymmetric assimilation' approach. One of the main differences is that 'enhancement of pre-fortis clipping' predicts that offglide peripheralisation should occur in all clipped or short duration environments. This is not supported by the findings of the current investigation if we assume that the shortening of PRICE and MOUTH before voiceless obstruents and before /l/ are the same process. However, it is likely that PRICE and MOUTH before voiceless obstruents is the result of the voicing effect, which is a universal process. On the other hand, pre-/l/ shortening is likely a different process which is found consistently across the entire speech sample. Furthermore, the shortening process before voiceless stops affects diphthongs, but it affects monophthongs before /l/. It is unclear how pre-/l/ shortening emerged, but it is shown to be a robust feature of LE, even in the oldest speakers in the current sample. As a result of these findings, the additions that 'enhancement of pre-fortis clipping' built on 'asymmetric assimilation' do not appear to provide a better explanation for the results of the current investigation.

Previous discussions on the origins of different linguistic features in LE provide evidence that new-dialect formation accounts for the emergence of some of these features (see Honeybone 2004, and Watson and Clark forthcoming). With regards to PRICE and MOUTH patterns, the fundamental assumptions of new-dialect formation predict that if there is no clear dominant realisation, then more than one realisation of PRICE and MOUTH survives the initial levelling processes. However, if there is a dominant realisation then only one variant should survive into the newly formed dialect. Therefore, in principle, it is possible that the variety of LE that emerged after new-dialect formation only retained one variant each for the PRICE and MOUTH vowels, which would indicate that all further developments of PRICE and MOUTH phonologically-conditioned variation in LE are not related to the processes involved in new-dialect formation. However, the results of the present investigations suggest that PRICE and MOUTH phonologically-conditioned variation was already present in LE shortly following new-dialect formation.

First looking at the pattern found in the contemporary data, new-dialect formation cannot provide an explanation for PRICE and MOUTH nucleus raising before voiceless obstruents. This has been described as a later endogenous change, as PRICE and MOUTH nucleus raising before voiceless obstruents does not occur in the oldest speakers in the current datasets. Furthermore, the discussion in §10.1 has demonstrated that this process developed over the course of the current speaker sample and is a change occurring in apparent time. Similarly, new-dialect formation does not provide an explanation for MOUTH offglide weakening in word-final open syllables, as it is shown to be changing in apparent time.

That being said, new-dialect formation may be able to explain the emergence of PRICE phonologically-conditioned variation in LE as seen in the OLIVE corpus and MOUTH phonologically-conditioned variation in LE as seen in the oldest speakers of the contemporary data. There are four vowel realisations that occur in the historical PRICE pattern: [a̝ɪ] before voiceless obstruents and for female speakers in word-final open syllables; [a̝ə] before voiced fricatives, for female speakers before voiced stops, and for male speakers in word-final open syllables; [a̝ː] before nasals; and [a̠] before /l/. The MOUTH pattern in LE in the oldest speakers in the contemporary data is: [æ̞̆ʊ̟] before voiceless stops, [æʊ̟] before voiced stops and in word-final open syllables, [ɛː] before nasals, and [a̟] before /l/.

In order to consider whether these realisations may be predicted by new-dialect formation, I will first establish the approximate distribution of the PRICE and MOUTH variants that are likely to have been available in the initial dialect mixture. The population counts from 1851 presented in §2.1 are used in the current discussion. These are the second oldest birthplace figures in the historical census data and are taken at a time close to when new-dialect formation of LE was likely occurring. The 1841 population counts are not used because in that year England and Wales are included in one count and there is no count for Cheshire or the individual counties in England. Therefore, a more detailed picture is gained by using the 1851 population counts.

It is not possible to determine exact percentages of the population that would have produced each of the variants, as most of the populations that are included in the dialect mixture have more than one variant recorded in previous literature. For example, immigrants from Ireland may have had one or more of the seven different realisations of the PRICE vowel described in §3.2.1 and one or more of the four different realisations of the MOUTH vowel described in §3.2.2. It may also be the case that each individual had more than one realisation of PRICE, like the immigrants from Scotland likely would have. As a result, exact percentages cannot be given. However, it is important to establish dominance of different variants, so the current thesis uses a null hypothesis to approximate the prevalence of each of the variants. The likely null hypothesis in this case is that each of the variants from a dialect is just as likely to occur as the other variants in that dialect. For example, in the case of the immigrants from Ireland, §3.2.1 described variants from the south, southwest, west and east of Ireland. In 1851 22.4% of the population of Liverpool were from Ireland and so I divide the population equally between the four areas. I divided the population equally between the four areas because it is not possible to determine exactly how much of the populations came from which part of Ireland, as described in §2.1. This results in 5.6% of the population being from each of these areas. To calculate the percentages of the different variants I need to determine how many variants are reported per area. There are three variants in south Ireland, three in west Ireland, two in the southwest and one in the east. The variant from the east of Ireland accounts for approximately 5.6% of the PRICE variants from the Irish immigrants. On the other hand, the two variants from the southwest account for approximately 2.8% each.

As a result of the SED analysis in §9.1.1, it is possible to have a more nuanced picture of the variants in southwest Lancashire and north Cheshire. Therefore, when discussing south Lancashire and north Cheshire the percentages are calculated based on the proportions found across the localities. For example, there are five PRICE variants that occur most often in southwest Lancashire. However, [ɑɪ] is the most common realisation of PRICE in three of the five southwest Lancashire localities. In 1851 50.3% of the population of Liverpool is from Lancashire or Liverpool. There are five localities in the SED, and reports from Bolton (Shorrocks 1998) and Stockport (Lodge 1966). The 50.3% is divided into six to account for the five localities and other reports, which is 8.4% each. Therefore, the variant [ɑɪ] was used by 25.2% of the population from southwest Lancashire.

According to Trudgill (1986, 2004), it is not the individual dialects that are important, but the prevalence of the different variants. Therefore, when more than one dialect uses a variant, the percentages are added together for that variant. The result of these calculations are given in Table 10.3 for PRICE and Table 10.4 for MOUTH. The numbers do not equal 100% as 2.5% of the population were immigrants from other parts of the world included in the miscellaneous category that are not included in this description. The variants described for dialects from other parts of England are taken from Kortmann et al. (2004). Note that some of the variants in the following tables are taken from contemporary sources, as discussed in §3.2.

According to the fundamental assumptions of new-dialect formation, rudimentary levelling would have likely removed the least frequent or most traditional dialect variants. Therefore, the PRICE variants: [ɔ̈ɪ], [æɪ], [aə], [ʌɪ], [ɒɪ] and [ɐɪ] would likely have been removed in the initial stages of dialect mixing and the MOUTH variants: [æə], [æʉ], [aɪ], [aʏ] and [æː] would likely have been removed in the initial stages of dialect mixing. This suggests that the PRICE

Variant	Overall %	Where the variant occurs
[ɑɪ]	30.5%	southwest Lancashire, north Cheshire, south Ireland, south and east England
[aɪ]	14.9%	southwest Lancashire, south and southwest Ireland, Wales, northwest and south England
[ɑː]	12.35%	southwest Lancashire, Yorkshire, northwest and south England
[aː]	8.4%	southwest Lancashire
[ɔ̈ɪ]	7.45%	south and east Ireland
[æɪ]	6.25%	southwest and west Ireland, and southwest England
[ɛɪ]	5.9%	southwest Lancashire, north Cheshire, west Ireland, and northeast England
[aə]	4.67%	southwest Lancashire and Scotland
[ʌɪ]	3.72%	west Ireland and Scotland
[ɒɪ]	2.3%	west England
[ɐɪ]	1.1%	east England

Table 10.3: Approximate percentage of PRICE variants in the dialect mixture in Liverpool around the time of new-dialect formation

Variant	Overall %	Where the variant occurs
[aː]	36.65%	southwest Lancashire and north England
[aʊ]	17.9%	southwest Lancashire, north Cheshire, south and west Ireland, Scotland, Wales and northwest England
[ʌʊ]	11.8%	Ireland and Scotland
[ɛː]	9.6%	southwest Lancashire
[æʊ]	8.2%	southwest Lancashire, east Ireland, and west and south England
[ɛʊ]	5.6%	southwest Lancashire, east Ireland, northeast and south England
[æː]	1.8%	southwest Lancashire and southeast England
[æə]	1.75%	southwest Lancashire, and east England
[aɪ]	1.7%	north Cheshire
[aʏ]	1.2%	southwest Lancashire
[æʉ]	0.55%	east England

Table 10.4: Approximate percentage of MOUTH variants in the dialect mixture in Liverpool around the time of new-dialect formation

variants: [ɑɪ], [aɪ], [ɑː], [aː] and [ɛɪ][1] and the MOUTH variants: [aʊ], [ʌʊ], [æʊ], [ɛʊ], [aː] and [ɛː] may have survived into stage two. At this point, there would have been a dominant realisation of PRICE ([ɑɪ]) and MOUTH ([aː]), which occur about twice as often as the next most common realisation, based on the assumptions above. According to the predictions of new-dialect formation, these dominant realisations should have been the only surviving variants in LE, but this does not correspond with the findings of the current thesis. New-dialect formation with regards to variant dominance cannot straightforwardly explain the PRICE pattern found in the OLIVE corpus. In other words, the results of the present investigations do not support Trudgill's (1986) deterministic approach. Despite the fact that there are clearly dominant realisations of PRICE and MOUTH, it is evident that several have survived the levelling processes of new-dialect formation and are present in the patterns in the resultant LE. Alternatively, Liverpool did not have a tabula rasa situation like Trudgill (1986, 2004) describes for new-dialect formation, which may result in slight differences in the predictions of the new-dialect formation approach.

There may be explanations for why more than one variant survived even when there was a dominant variant, as described in §4.2.4. Therefore, I describe the predictions that would be made by new-dialect formation using the assumption that other factors were at play to allow more than one variant to survive the levelling processes. It is possible to suggest likely variants that survived the initial stages of new-dialect formation. The variants that are most frequent and are spoken by the largest number of varieties are the most likely to survive. Therefore, the PRICE variants that were most likely to survive were [ɑɪ], [aɪ], [ɑː], [aː] and [ɛɪ] and the MOUTH variants that were most likely to survive were [aː], [aʊ], [ʌʊ], [ɛʊ], [æʊ] and [ɛː]. In the second stage of new-dialect formation these variants may become interdialectal forms and reallocated to phonetically plausible environments or simply reallocated.

The monophthongal realisations of PRICE and MOUTH before nasals and /l/ are likely inherited as part of new-dialect formation. In the analysis of the SED data of southwest Lancashire and north Cheshire, PRICE monophthongal realisations commonly occur before nasals. As shown in Table 10.4, much of the

[1]While this variant has a small approximate percentage, it is reported in numerous varieties that contributed to the dialect mixture.

population in the initial dialect mixture would likely have had a monophthongal MOUTH variant and the results of the analysis of the SED data for MOUTH demonstrated that diphthongal realisations of MOUTH did not occur as often before nasals as in other environments. Therefore, monophthongal variants of PRICE and MOUTH before nasals are likely the result of these processes already occurring in some of the dialects in the dialect mixture. In this case, the monophthongisation process is inherited as part of new-dialect formation.

Let us turn to the quality of the variants of the PRICE and MOUTH vowels in LE shortly after new-dialect formation. Firstly, the monophthongal realisation of PRICE before nasals in the OLIVE corpus does not directly correspond to either of the two monophthongal variants in the dialect mixture. However, it is the same as [aː] in terms of vowel backness and is only slightly raised from it in terms of vowel height. The quality of the MOUTH variant before nasals ([ɛː]) is the same as one of the variants reported in southwest Lancashire. Neither of these particular variants are the most common variants in the dialect mixture. However, both occur in southwest Lancashire and the MOUTH variant [ɛː] is found to occur in contemporary dialects in other areas of southwest Lancashire, such as Bolton (Shorrocks 1998). Therefore, these variants may demonstrate a 'founder effect', as discussed in §4.2.4.

Similarly, the quality of the PRICE monophthongal variant before /l/ closely approximates the [aː] vowel in the dialect mixture with the added processes of pre-/l/ shortening and retraction. This may again suggest a 'founder effect'. On the other hand, the quality of the MOUTH monophthongal variant before /l/ ([a̟]) is quite similar to the most prevalent monophthongal variant. This variant may indicate retention of the most common variant. Therefore, new-dialect formation can account for monophthongisation of PRICE and MOUTH before nasals and /l/.

Likewise, the PRICE diphthongal variant before voiceless obstruents and in open syllables can be explained by new-dialect formation. The analysis of the SED data indicates that diphthongal realisations of PRICE are often found before voiceless obstruents and in open syllables. This may suggest that a diphthongal realisation would be likely to occur in these environments, which is supported by the summary of PRICE and MOUTH patterns in varieties of English (§3.3). The cross-dialectal evidence may suggest that before voiceless obstruents and in open syllables are phonetically plausible environments for diphthongal variants of PRICE and MOUTH to occur. Therefore, a diphthongal variant being reallocated to before voiceless obstruents and in open syllables aligns with the predictions of new-dialect formation. The quality of the offglide of this diphthongal variant is well supported by the diphthongal variants that are available after the initial levelling. A realisation that is similar to the KIT vowel occurs in all three of the diphthongal variants in the dialect mixture and is found in the results of the OLIVE corpus. However, the quality of the nucleus of the PRICE diphthongal variant before voiceless obstruents and in open syllables appears to be an intermediate form between the quality of the nucleus of the two diphthongs in the initial dialect mixture. The backness of the nucleus is the same as the [aɪ] variant, but the height is intermediate between [aɪ] and [ɛɪ]. Trudgill (2004) and Samuels (1972) discuss the possibility of intermediate forms in the inter-dialectal stages and the retention of these variants as a means of compromise between other competing variants.

The MOUTH diphthongal variant [æ̝̆ʊ̟] occurs before voiceless stops and [æʊ̟] occurs before voiced stops and in open syllables. New-dialect formation only partially accounts for these variants. The results of the SED analysis indicate that diphthongal variants occur often before voiceless stops and in word-final open syllables, which may suggest that these phonological environments are plausible environments for diphthongal variants. On the other hand, MOUTH before voiced stops is not particularly inclined to have diphthongal variants. As the most common realisation of MOUTH in the dialect mixture was a monophthong, it is not clear why a diphthongal variant was reallocated to before voiced stops.

Turning to the quality of the nucleus and offglide of the diphthongal realisations of MOUTH. The quality of the nucleus of the diphthong may reflect an intermediate quality between the nucleus of the diphthongal variants that were likely retained after the initial levelling. There are three raised or centralised nucleus diphthongs ([ʌʊ], [ɛʊ] and [æʊ]) and one non-raised nucleus diphthong ([aʊ]). Therefore, the quality of the nucleus of MOUTH in this environment is between [ɛʊ] and [aʊ]. The quality of the offglide of MOUTH diphthongal variants in the dialect mixture was [ʊ], which is not the same as the quality of the offglide of MOUTH before voiceless obstruents in

LE. As a result, it is not possible to explain the quality of the offglide by new-dialect formation. Therefore, the MOUTH variant before voiceless stops after new-dialect formation is partially accounted for by new-dialect formation.

The third PRICE variant, [a̠ə], occurs before voiced obstruents and in open syllables. The results of the SED analysis suggest that PRICE before voiced obstruents is often monophthongal in some of the localities of southwest Lancashire and north Cheshire. However, in other localities PRICE is often diphthongal in this environment. Therefore, it may be the case that an intermediate form between the diphthongal and monophthongal variants was reallocated to this environment. Offglide weakening is a process that creates an intermediate form between monophthongal and diphthongal realisations. This same explanation cannot be given for the weakened offglide variant in open syllables, as diphthongal variants of PRICE are most often recorded in open syllables. In all of the north Cheshire localities and three of the five southwest Lancashire localities the lexical items with PRICE in word-final open syllables exclusively have a diphthongal realisation. Finally, the quality of the nucleus of the diphthong is the same as for both the monophthongal variant before nasals and the nucleus of the diphthongal variant before voiceless obstruents. The quality of the offglide is between the quality of the offglide in the diphthongal variants and the quality of the monophthongal variants.

In summary, the current discussion demonstrates that none of the approaches to the origins of PRICE and MOUTH phonologically-conditioned variation account for all of the results of the current investigations. It is difficult to explain the results of the current thesis using the 'failure-to-lower' approach. On the other hand, the 'asymmetric assimilation' approach or 'enhancement of pre-fortis clipping' are able to account for PRICE and MOUTH nucleus raising before voiceless obstruents. Finally, the new-dialect formation approach is able to account for monophthongisation of PRICE and MOUTH before nasals and /l/.[2] These results suggest that a combined approach using aspects of new-dialect formation and 'asymmetric assimilation' or 'enhancement of pre-fortis clipping' may provide a more comprehensive account of the emergence and development of PRICE and MOUTH phonologically-conditioned variation in LE.

10.3 ORIGINS AND DEVELOPMENT OF PRICE AND MOUTH PATTERNS

The current section proposes a more comprehensive account of the emergence and development of PRICE and MOUTH phonologically-conditioned variation in LE. Given the discussion in the previous sections, the contemporary patterns of variation of the PRICE and MOUTH vowels are not one pattern specifically, but rather a number of distinct phonological processes that occur at different times and for different reasons. These phonological processes all make up the synchronic situation affecting the realisations of PRICE and MOUTH. Some of these processes are inherited as part of new-dialect formation, such as monophthongisation before nasals and /l/ and pre-/l/ shortening, and other processes occur later as endogenous changes, such as nucleus raising before voiceless obstruents. Therefore, the origins and development of these phonological processes, which together make up the PRICE and MOUTH phonologically-conditioned variation in contemporary LE, are discussed in the current section.

As described in §10.2, monophthongisation before nasals and /l/ or sonorants is inherited as part of new-dialect formation for both PRICE and MOUTH. This pre-sonorant monophthongisation is found in all of the datasets. Furthermore, monophthongisation before nasals appears to be a natural process in varieties of English, as it is found in some of the other PRICE patterns. The results of the analysis of the SED data suggest that monophthongal

[2] Note that a recent study on early New Zealand English has some similar findings to the results of the OLIVE corpus investigation, such as offglide weakening before voiced stops and monophthongisation before nasals (Sóskuthy et al. 2015). As previously mentioned, New Zealand English has been used to provide evidence in favour of the new-dialect formation approach. Similar to the findings of the current thesis, the New Zealand study finds that new-dialect formation alone cannot explain the results of that study. However, also note that the later developments of the PRICE vowel in New Zealand English do not resemble the findings of the current study and the patterns in LE.

realisations were common before nasals in southwest Lancashire and north Cheshire. These observations taken together suggest that before sonorants is a phonetically plausible environment for monophthongal variants and so monophthongal variants are allocated to the pre-sonorant environment as a result of new-dialect formation.

Following this, an endogenous development extends the environment where monophthongisation occurs to before all voiced consonants. The PRICE and MOUTH vowels both have weakened offglide realisations before voiced obstruents. Furthermore, some of the oldest speakers already had monophthongal realisations of PRICE before voiced stops. Therefore, the extension of monophthongisation may be the result of a reanalysis of offglide weakening or as a generalisation that encompasses all voiced consonants in order to simplify the patterns. This development begins with the PRICE vowel, which consistently has monophthongal realisations of PRICE before voiced consonants in the speech of the younger participants in the current sample. Furthermore, as some younger speakers in the current sample have monophthongal realisations of MOUTH before all voiced consonants, this endogenous change may be spreading to the MOUTH vowel as well.

The second phonological process that is inherited as part of new-dialect formation is pre-/l/ shortening of both PRICE and MOUTH. Both the older speakers and the younger speakers in the current sample provide evidence that pre-/l/ shortening is a robust process that was present even in the oldest recorded materials of LE.

Similarly, offglide peripheralisation before voiceless obstruents or prefortis clipping is inherited as part of new-dialect formation. However, this phonological processes is not the result of new-dialect formation. Offglide peripheralisation is driven by the phonetic effects of following voiceless obstruents, which results in shorter nuclei and longer offglides. There is evidence of nucleus shortening of PRICE and MOUTH before voiceless obstruents in the OLIVE corpus and in the oldest participants in the contemporary data.

This leads to PRICE and MOUTH nucleus raising before voiceless obstruents, which is an endogenous development. The shortened nuclei that result from offglide peripheralisation are misperceived and reanalysed by subsequent generations as nucleus raising. The development of PRICE and MOUTH nucleus raising before voiceless obstruents is evident in the apparent time comparison of the nucleus height of the target vowels before voiceless obstruents.

Furthermore, there is an endogenous development which results in the loss of PRICE offglide weakening in open syllables, so that PRICE in open syllables is realised as [aɪ]. However, MOUTH has not lost its process of offglide weakening in open syllables. Thomas (2001) discusses that the offglide of MOUTH is particularly susceptible to undershoot, which may protect the process of offglide weakening in the MOUTH vowel.

Finally, a general historical process of lowering and retraction of PRICE and MOUTH occurs in line with many other varieties of English (see Labov 1994, Kerswill et al. 2008, Minkova 2013 and Sóskuthy et al. 2015). This lowering is blocked by the nucleus raising processes before voiceless obstruents for both vowels, and it is initially inhibited by phonetic co-articulatory effects of the following nasal for the MOUTH vowel. However, the results of the contemporary data demonstrate that MOUTH before nasals is lowering in apparent time, so that some of the younger participants do not have a raised realisation of MOUTH before nasals. Furthermore, retraction does not occur for both vowels before /l/ in apparent time, as it has already been retracted as a result of phonetic coarticulatory effects.

Note that the lowering and retraction of the nucleus of PRICE in LE has not created a situation of diphthong shift or diphthong cross-over (Wells 1982). Diphthong shift describes a situation where the nucleus of PRICE is more backed and lowered than the nucleus of MOUTH, which is fronted and sometimes raised. Therefore, PRICE and MOUTH trajectories cross-over, as PRICE moves from a back nucleus to a front offglide and MOUTH moves from a front nucleus to a back offglide. This is not the case in LE, as a parallel process of retraction and lowering also affects the MOUTH vowel. This general lowering and retraction in both PRICE and MOUTH nuclei results in the nucleus of PRICE and MOUTH having a similar quality in the contemporary data, except before voiceless obstruents.

Given that this process has occurred in many varieties of English since the 19th century, it is likely that this change in the quality of the nucleus of PRICE and MOUTH is the result of the general process that occurred across English. The monophthongal variants also followed this pattern, but the reasons behind this are not straightforward. Monophthongal realisations may lower and retract in order to prevent further variation in this already rather complex system of vowel realisations.

This comprehensive account of the origins and development of PRICE and MOUTH phonologically-conditioned variation in LE using historical and contemporary data provides a combined approach to the patterns of variation found in LE using aspects from different theoretical perspectives. The inclusion of historical data provides evidence that was unrecoverable from contemporary data alone. Hence, with detailed acoustic analyses of data and more detailed analysis of both historical and contemporary data, it is possible to gain a better understanding of the processes that are involved in the emergence and development of phonological features in new-dialect formation. Furthermore, approaching the origins and development of these current patterns from multiple perspectives and different approaches, has produced a more cohesive account and a deeper understanding of PRICE and MOUTH phonologically-conditioned variation in LE.

The results of the current investigation indicate that only some of the varieties that were part of the initial dialect mixture likely contributed to the emergence of PRICE and MOUTH phonologically-conditioned variation in LE. The patterns of variation for the PRICE and MOUTH vowels reported in this thesis resemble voice-driven patterns and not Scottish Vowel Length Rule patterns. Therefore, immigrants from Scotland likely did not have a significant influence on the development of these pattern in LE. This echoes some of the previous research on other features in LE, many of which cannot be attributed to a Scottish origin. On the other hand, immigrants from Lancashire, Cheshire and Ireland have greatly influenced the emergence of PRICE and MOUTH patterns in LE. The 'founder effect' is the explanation for the origins of some of the variants that are described in §10.2, which demonstrates the influence from the Lancashire immigrants. Furthermore, the intermediate forms that are proposed in the current discussion are the result of variants that are found in varieties of English in Lancashire, Cheshire and Ireland. Therefore, the findings of the current investigation indicate that immigrants from Lancashire, Cheshire and Ireland were the most influential in the emergence of PRICE and MOUTH patterns in LE.

The immigrants from Lancashire and Ireland are the largest population groups in Liverpool at the time of dialect mixture. This suggests that immigrant groups with larger populations are more likely to affect the development of phonological features in new-dialect formation. That being said, immigrants from Cheshire only make up approximately 3% of the population in the mid-nineteenth century. However, immigrants from Lancashire and Cheshire are on the same dialect continuum as the original Liverpool residents would have been. Potentially, it is not only those varieties that have the largest population, but also those varieties that are 'closest' to the original population that influence the development of phonological features in new-dialect formation.

Finally, new-dialect formation situations that do not have a tabula rasa as their starting point may not follow the exact same processes as new-dialect formation situations that do. There would be many other factors at play in a situation where there is already a local population of speakers before the dialect mixture is created. The results of the present investigation are not entirely compatible with some of the fundamental assumptions of new-dialect formation (Trudgill 1986, 2004). The dominant variants of PRICE and MOUTH in the initial dialect mixture should have been the only variants retained following new-dialect formation, but this is not borne out by the findings of the current thesis. Instead, a number of different variants are retained and reallocated, some of which may be the result of a 'founder effect.' Therefore, the new-dialect formation approach needs to consider at least two types of dialect emergence: tabula rasa situations with no local population; and situations where a local population is already present before the immigration takes place.

10.4 SYNCHRONIC PHONOLOGICAL VARIATION IN LE

The preceding discussion focused on the origins and development of the PRICE and MOUTH patterns of variation in LE. However, the phonological processes attested in the current dataset must be active in the present-day phonology. Therefore, the current section explores some aspects of the synchronic processes in LE and the comparison with similar synchronic processes in other varieties of English with VD phonologically-conditioned variation.

Canadian Raising, as described in previous research (Chapter 3), is a process where a raised nucleus diphthong occurs before voiceless consonants and a non-raised nucleus diphthong occurs elsewhere. In other words, this process is categorical in the sense that there are two discrete variants that are conditioned by the phonological context. On the other hand, some previous research on the patterns discussed in Chapter 3 suggest that monophthongisation occurs as a variable and/or gradient process, such as in Ann Arbor (Dailey-O'Cain 1997) and the Fenlands (Britain 1997). How does the synchronic processes attested for LE compare to these previously reported patterns?

The results of the current investigation appear to suggest that the synchronic process of nucleus raising in LE is a categorical process. While there is phonetic variation in the production of the raised variant before voiceless obstruents, it seems that this raised nucleus variant is distinct from the variants that occur in other contexts. Therefore, the PRICE and MOUTH nucleus raising processes appear to be categorical. This corresponds well with the findings for nucleus raising processes in other varieties of English, such as Canadian English.

On the other hand, monophthongisation and pre-/l/ shortening may not be categorical. Let us first examine the monophthongisation process. The realisations of MOUTH that occur before sonorants and the realisations of PRICE that occur before all voiced consonants do not show similar categorical variants. While a process of monophthongisation was clearly identifiable in the data, the productions demonstrated a more gradient scale of realisations along the diphthongal to monophthongal scale. Furthermore, there was a certain amount of variability in this environment that suggested that more monophthongal productions were desirable in certain contexts, but that these productions were not exclusively found in those contexts. Unlike the results for the nucleus raising process, where speakers either raise the nucleus of the target vowel consistently or do not raise the nucleus vowel, speakers tended to have mostly monophthongal productions with the possibility for some amount of variability in the monophthongisation environments. As the monophthongisation process in LE is gradient, it is similar to the reported monophthongisation processes in other varieties of English, such as in the Fenlands.

The process of pre-/l/ shortening is also likely gradient. It appears that there are monophthongal productions of PRICE and MOUTH which are consistently shorter in duration before /l/ than other voiced consonants. However, this short variant does not appear to be a categorical unit in the same way that the raised nucleus variant seems to be. Unlike the nucleus raising and monophthongisation processes, it is not possible to compare the pre-/l/ shortening in LE to other varieties as I am not aware of any variety where this process has been reported.

Another aspect of the synchronic pattern of Canadian Raising that has been the focus of much previous research is opacity. Specifically, the opaque relationship that occurs when the flapping process co-occurs with the nucleus raising process. Flapping neutralises the voicing contrast between medial alveolar stops. However, nucleus raising is still found to apply in words where the PRICE vowel is followed by an underlyingly voiceless stop. For example, raising occurs in *writer*, but not in *rider*. If a similar opaque relationship could be found for the nucleus raising process in LE, it would help us understand more about how the synchronic pattern is being processed.

The results of the current investigation can not provide an answer to the opacity question for LE. At this junction, there does not appear to be a phonological process in LE that would introduce opacity into nucleus raising. Therefore, this question must either be left for future study or is potentially not even possible to determine based on the lack of a secondary process that would neutralise the voicing contrast in a similar way that flapping does in Canadian English.

The final aspect of synchronic processes that is discussed is productivity or the extent to which these synchronic processes would extend to new lexical items. I will focus on the nucleus raising process in this section as it is the only categorical phonological process found in the current investigation. The prediction is that if a categorical process is also productive then that process will always extend to new lexical items. For example, Canadian Raising has been shown to be a productive process, as speakers produce raised nucleus variants of PRICE in i^{th} *element* and y^{th} *element* (Idsardi 2006: 123).

Note that the current investigation does not have direct evidence to suggest that nucleus raising is a productive process. However, the lack of exceptions found for the nucleus raising process in LE suggest that this is a productive process. Therefore, given a new lexical item where PRICE or MOUTH is followed by a voiceless consonant, speakers of LE would generalise the nucleus raising process to the new lexical item. To illustrate this point take the example from Idsardi (2006) above of i^{th} *element* and y^{th} *element*. When presented with a phrase such as the i^{th} *element*, LE speakers would produce a raised nucleus realisation of PRICE as a result of the following voiceless obstruent. In other words, the speaker generalises the nucleus raising process to this new lexical item. Future research that uses non-words or new acronyms would be able to establish to what extent nucleus raising is a productive process in LE, but this is beyond the scope of the current thesis.

The synchronic processes in LE are similar to processes found other varieties of English with VD phonologically-conditioned variation. In LE the nucleus raising processes for the PRICE and MOUTH vowels are both categorical and likely productive, which is similar to the results found for Canadian Raising. Furthermore, the monophthongisation process is likely variable and gradient to some extent, which is also demonstrated in varieties in the US and in the Fenland.

CHAPTER 11

CONCLUSION

This thesis looked at the origins of phonological features in situations of new-dialect formation through a case study of phonologically-conditioned variation in the PRICE and MOUTH vowels in Liverpool English. The current investigation was motivated by the following facts: 1. although PRICE and MOUTH phonologically-conditioned variation has been reported and widely studied in many varieties of English around the world, little is known about the patterns of variation found in LE; 2. in order to account for the widespread emergence of these patterns, various approaches from a number of different perspectives have been proposed, but the data we have obtained so far does not straightforwardly support any single approach. I argue that we are only able to account for the emergence and development of PRICE and MOUTH phonologically-conditioned variation in LE by combining different aspects of previous approaches. By using quantitative methods on data from different time points and performing a detailed analysis of census data, it is possible to gain a better understanding of how immigration in Liverpool affected the emergence of these vowel patterns in contemporary LE. However, an examination of the different approaches to these patterns and phonetic effects in light of these data is essential to fully understand the emergence and development of PRICE and MOUTH phonologically conditioned variation in LE. Thus, while pre-sonorant monophthongisation and pre-/l/ shortening are inherited as part of new-dialect formation, nucleus raising and fronting before voiceless obstruents is a later endogenous development, arguably due to the phonetic effects of the following voiceless consonants. Specifically, offglide peripheralisation seems to have been reanalysed as nucleus raising and this reanalysis occurred sometime during the twentieth century, long after new-dialect formation.

The detailed analysis of census records in Chapter 2 provides strong evidence that LE was most likely formed as a result of new-dialect formation in the mid-nineteenth century when massive immigration from Lancashire, Cheshire, Ireland, Scotland and Wales occurred. Given this estimate for the formation of LE, it is reasonable to assume that the *Survey of English Dialect* data is a proxy for the varieties that were spoken in southwest Lancashire and north Cheshire around the time of new-dialect formation. Therefore, this dataset provides us with potential PRICE and MOUTH input variants in the original dialect mixture from varieties of English in Lancashire and Cheshire. On the other hand, the *Origins of Liverpool English* archive corpus is a good reflection of what LE would have been shortly after its formation. Therefore, this second dataset provides insights into the PRICE and MOUTH vowel patterns that emerged in LE as a result of new-dialect formation. Finally, the newly collected data allowed me to explore the precise details of the PRICE and MOUTH vowels in contemporary LE.

In this thesis, I have used dynamic formant measurements to analyse PRICE and MOUTH and tested these measurements using quantitative techniques, such as mixed effects models. This proved to be an effective way to compare the realisations of diphthongal vowels and understand aspects of vowel production that were previously neglected in the literature. The current thesis looked at nucleus and offglide point measurements, vowel trajectories, Euclidean distances and inflection points, which has not been done as part of a single analysis in previous literature. By doing so, a fuller understanding of the features that are involved in diphthongal vowel production is gained, which allows me to determine vowel realisations that develop as a result of phonetic effects. This approach to diphthongal vowels allowed me to create a detailed description of PRICE and MOUTH phonologically-conditioned variation in LE, as demonstrated in Chapters 5 – 9. According to the results of the current thesis, the patterns of variation of PRICE and MOUTH in LE are composed of four main phonological processes: monophthongisation, pre-/l/ shortening, offglide peripheralisation and nucleus raising. These processes occur at different points in the emergence and development of these patterns and, consequently, have different origins.

I also compared the PRICE and MOUTH variants that are reported in the varieties of English involved in the original dialect mixture in Liverpool (Chapter 3) with the resultant patterns found in the oldest speakers in the current investigation (Chapter 10). This comparison allowed me to determine which processes emerged as part of new-dialect formation. In addition, I have also compared the oldest speakers to the youngest speakers in the contemporary data in order to determine the processes that developed after new-dialect formation as endogenous changes (Chapter 10). I further examine the processes that have external explanations, such as a general English process of lowering and retraction of PRICE and MOUTH. These comparisons allowed me to conclude that pre-/l/ shortening, monophthongisation and offglide peripheralisation were inherited as part of new-dialect formation, but nucleus raising is a later endogenous development. It is likely that pre-/l/ shortening and monophthongisation resulted from processes involved in new-dialect formation. However, offglide peripheralisation is a process that occurs to some extent in all varieties of English and was the result of phonetic co-articulatory effects, as described by the 'asymmetric assimilation' and 'enhancement of pre-fortis clipping' approaches. The main endogenous development, nucleus raising, likely occurred as a result of the reanalysis of offglide peripheralisation as nucleus raising, which is demonstrated in apparent time across the speech sample (Chapter 10). Therefore, I have shown that different theoretical perspectives to the origins of such patterns must be used in concert in order to account for the emergence and development of PRICE and MOUTH phonologically-conditioned variation in LE.

APPENDIX: A

A.1 DATA ANALYSIS MATERIALS

A.1.1 Pilot study

The following list provides all of the interview questions used as part of the data collection for the pilot study in chapter 5.

Participant Metadata

1. Would you please say your date of birth and where you were born?
2. Could you tell me what part of Liverpool you are from and how long you have lived there?
   (a) Where else have you lived?
3. Where are your parents from?
   (a) Where are your grandparents from?
   (b) How far away is that?

Questions about Liverpool

4. If you had a friend visiting who has never been to Liverpool where would you take them?
5. What do you like most about Liverpool and the Merseyside?

Questions about Scouse

6. Describe a typical Scouser.
7. What do you think about the Scouse accent?
8. Do you think the Scouse accent is easy to recognise?
9. What do other people think about the Scouse accent?
10. Is there anything noticeable about Scouse?

A.1.2 The Survey of English Dialects analysis

Table A.1 provides the PRICE lexical items from the SED materials used in the current investigation (see chapters 8 and 9) and the question number in the SED materials where these PRICE lexical items occur.

	Environment	Lexical Item	Question Number
1	ME /ix/	lights	III.11.5
2	ME /ix/	fight	III.13.6
3	ME /ix/	light	V.2.12
4	ME /ix/	right	VI.7.13
5	ME /ix/	a fortnight	VII.3.2
6	ME /ix/	last night	VII.3.9
7	ME /ix/	night	VII.3.9, VII.3.11
8	ME /ix/	tonight	VII.3.12
9	ME /ix/	lightning	VII.6.22
10	ME /ix/	sight	VIII.2.9
11	ME /ix/	wright	VIII.4.4
12	ME /ix/	frightened	VIII.8.2
13	ME /ix/	might	IX.4.14
14	ME /ei/	dry	III.1.9, VI.13.10, VII.6.19
15	ME /ei/	died	III.7.2
16	ME /ei/	flies	IV.8.5
17	ME /ei/	eyes	VI.3.1
18	ME /ei/	eye	VI.3.3
19	ME /ei/	eyebrows	VI.3.9
20	ME /ei/	thigh	VI.9.3
21	ME /ei/	lie	VIII.3.6
22	ME /ei/	tried	VIII.8.4
23	voiceless stop	pikel	I.7.11
24	voiceless stop	dyke	IV.2.1, IV.2.2
25	voiceless stop	white	V.1.7, VII.6.6
26	voiceless stop	height	VI.1.9
27	voiceless stop	wipe you mouth	VI.5.3

	Environment	Lexical Item	Question Number
28	voiceless stop	skriking	VI.5.15
29	voiceless stop	windpipe	VI.6.5
30	voiceless stop	writing	VIII.6.6
31	voiceless stop	like(adj)	IX.1.7
32	voiceless fricative	knife	I.7.18
33	voiceless fricative	hay-knife	II.9.14
34	voiceless fricative	mice	IV.5.1
35	voiceless fricative	lice	IV.8.1
36	voiceless fricative	icicles	VII.6.11
37	voiceless fricative	ice	VII.6.12
38	voiceless fricative	wife	VIII.1.24
39	voiced stop	near-side horse	I.6.4a
40	voiced stop	hide	III.11.7
41	voiced stop	spider	IV.8.9
42	voiced stop	side the table	V.8.14
43	voiced stop	sideboards	VI.2.6
44	voiced stop	abide	VI.5.9
45	voiced stop	Friday	VII.4.4
46	voiced stop	on Friday week	VII.4.7
47	voiced stop	hide	VIII.7.6
48	voiced stop	side	IX.2.5
49	voiced fricative	scythe	II.9.6
50	voiced fricative	scythe-stone	
51	voiced fricative	hive	IV.8.8
52	voiced fricative	ivy	IV.10.10
53	voiced fricative	shive	V.6.10
54	voiced fricative	five	VII.5.5, VII.5.6
55	voiced fricative	miser	VII.8.9
56	nasal	bind	II.6.2
57	nasal	rind	III.12.6
58	nasal	grindstone	IV.2.7
59	nasal	blind	VI.3.4

	Environment	Lexical Item	Question Number
60	nasal	windpipe	VI.6.5
61	nasal	nine	VII.1.8
62	nasal	any time	VII.3.16
63	nasal	time	VII.5.1
64	nasal	stopping time	VII.5.9
65	nasal	climb	VIII.7.4
66	nasal	find	IX.3.2
67	nasal	mine	IX.8.5
68	nasal	thine	IX.8.5
69	in open syllable	stye	VI.3.10
70	in open syllable	sky	VII.6.1
71	in open syllable	aye	VIII.8.13
72	in open syllable	shy	VIII.9.2

Table A.1: PRICE lexical items analysed from the SED data

Table A.2 provides the MOUTH lexical items from the SED materials used in the current investigation (see chapters 8 and 9) and the question number in the SED materials where these MOUTH lexical items occur.

	Environment	Lexical Item	Question Number
1	voiceless stop	snout	III.9.1
2	voiceless stop	out of it	IV.2.15
3	voiceless stop	without	V.8.10a
4	voiceless stop	put your tongue out	VI.5.4
5	voiceless stop	about	VII.2.8
6	voiceless stop	drought	VII.6.20
7	voiceless fricative	cowslip	II.2.10
8	voiceless fricative	slaughter-house	III.11.4
9	voiceless fricative	mouse	IV.5.1
10	voiceless fricative	shrew-mouse	IV.5.2
11	voiceless fricative	louse	IV.8.1
12	voiceless fricative	house	V.1.1
13	voiceless fricative	mouth	VI.5.1
14	voiceless fricative	mouth corners	VI.5.2
15	voiceless fricative	wipe your mouth	VI.5.3
16	voiceless fricative	south	VII.6.25
17	voiced stop	cow-dung	II.1.6
18	voiced stop	clouds	VII.6.2
19	voiced fricative	cows	III.1.1
20	voiced fricative	houses	V.1.1
21	voiced fricative	eyebrows	VI.3.9
22	voiced fricative	trousers	VI.14.13
23	voiced fricative	she wears the trousers	VI.14.14
24	voiced fricative	thousand	VII.1.16
25	voiced fricative	cow's legs	IX.8.7
26	nasal	cow-man	I.2.3
27	nasal	to the ground	IV.4.1
28	nasal	half-a-crown	VII.7.6

	Environment	Lexical Item	Question Number
29	nasal	pound	VII.7.8
30	nasal	pound	VII.8.2
31	nasal	pound of tea	VII.8.3
32	nasal	a pound	VII.8.4
33	nasal	ounce	VII.8.5
34	nasal	how many	VII.8.11
35	nasal	sit down	VIII.3.3
36	nasal	lie down	VIII.3.6
37	nasal	bounce	VIII.7.3
38	nasal	drowned	IX.9.6
39	nasal	round	IX.1.1
40	nasal	found	IX.3.1
41	in open syllable	plough	I.8.1
42	in open syllable	cow	III.1.1
43	in open syllable	young sow	III.8.5
44	in open syllable	sow	III.8.6
45	in open syllable	meow	III.10.6
46	in open syllable	bough	IV.12. 5

Table A.2: MOUTH lexical items analysed from the SED data

A.2 MIXED EFFECTS MODELS SUMMARY TABLES

The following summary tables show the results of the mixed effects models that are not included in the main text.

A.2.1 Pilot study

These mixed effects model summary tables correspond to the results presented for the pilot study in §5.2.3.

A.2.1.1 Result for PRICE

	Estimate	Std. Error	t value
(Intercept)	1.49	0.05	29.40
poapoa2	-0.02	0.04	-0.43
voiclassvl_fr	0.01	0.04	0.25
voiclassvd_st	0.06	0.06	1.00
voiclassvd_fr	0.03	0.07	0.48
voiclassna	-0.04	0.04	-1.05
catdi	-0.03	0.02	-1.14
catmorph	0.04	0.04	1.11
poapoa2:voiclassvl_fr	0.02	0.05	0.48
poapoa2:voiclassvd_st	-0.01	0.06	-0.21
poapoa2:voiclassvd_fr	0.05	0.05	0.95
poapoa2:voiclassna	-0.03	0.05	-0.66
poapoa2:catdi	0.03	0.03	0.82
poapoa2:catmorph	-0.06	0.05	-1.27

Table A.3: Summary table for PRICE nucleus normalised f1 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	0.82	0.07	11.35
poapoa2	-0.05	0.04	-1.27
voiclassvl_fr	-0.01	0.04	-0.37
voiclassvd_st	0.26	0.08	3.25
voiclassvd_fr	0.13	0.09	1.45
voiclassna	0.27	0.06	4.13
catdi	0.00	0.03	0.09
catmorph	-0.01	0.04	-0.34
poapoa2:voiclassvl_fr	0.05	0.05	0.97
poapoa2:voiclassvd_st	0.03	0.06	0.58
poapoa2:voiclassvd_fr	0.17	0.06	2.93
poapoa2:voiclassna	0.09	0.05	1.95
poapoa2:catdi	0.00	0.04	0.10
poapoa2:catmorph	0.06	0.05	1.21

Table A.4: Summary table for PRICE offglide normalised f1 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.04	0.03	32.61
poapoa2	0.03	0.03	0.84
voiclassvl_fr	0.02	0.03	0.52
voiclassvd_st	-0.07	0.04	-1.75
voiclassvd_fr	-0.02	0.04	-0.47
voiclassna	-0.04	0.03	-1.29
catdi	0.00	0.02	0.15
catmorph	0.06	0.03	2.06
poapoa2:voiclassvl_fr	-0.04	0.04	-1.11
poapoa2:voiclassvd_st	-0.00	0.05	-0.06
poapoa2:voiclassvd_fr	-0.05	0.05	-0.98
poapoa2:voiclassna	-0.04	0.04	-0.98
poapoa2:catdi	0.01	0.03	0.31
poapoa2:catmorph	-0.04	0.04	-1.07

Table A.5: Summary table for PRICE nucleus normalised f2 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.67	0.03	51.64
poapoa2	0.08	0.03	2.68
voiclassvl_fr	0.04	0.03	1.26
voiclassvd_st	-0.15	0.07	-2.18
voiclassvd_fr	-0.14	0.07	-2.01
voiclassna	-0.17	0.06	-2.87
catdi	-0.07	0.02	-3.17
catmorph	-0.04	0.03	-1.24
poapoa2:voiclassvl_fr	-0.10	0.04	-2.53
poapoa2:voiclassvd_st	-0.11	0.05	-2.34
poapoa2:voiclassvd_fr	-0.14	0.04	-3.12
poapoa2:voiclassna	-0.17	0.04	-4.47
poapoa2:catdi	0.03	0.03	1.17
poapoa2:catmorph	-0.00	0.04	-0.06

Table A.6: Summary table for PRICE offglide normalised f2 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	0.94	0.06	14.47
poapoa2	0.05	0.05	0.99
voiclassvl_fr	0.02	0.05	0.43
voiclassvd_st	-0.20	0.10	-1.99
voiclassvd_fr	-0.16	0.09	-1.65
voiclassna	-0.30	0.09	-3.43
catdi	-0.05	0.03	-1.51
catmorph	-0.03	0.05	-0.63
poapoa2:voiclassvl_fr	-0.04	0.07	-0.63
poapoa2:voiclassvd_st	-0.09	0.08	-1.18
poapoa2:voiclassvd_fr	-0.13	0.07	-1.78
poapoa2:voiclassna	-0.14	0.06	-2.30
poapoa2:catdi	0.02	0.05	0.49
poapoa2:catmorph	-0.06	0.06	-0.94

Table A.7: Summary table for PRICE Euclidean distance mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.56	0.08	19.83
voicingvl_obs	-0.05	0.05	-1.04
moastop	-0.07	0.04	-1.88
catdi	-0.07	0.04	-1.83
catmorph	-0.03	0.05	-0.66
voicingvl_obs:moastop	0.05	0.05	1.18
voicingvl_obs:catdi	0.03	0.05	0.65
voicingvl_obs:catmorph	0.04	0.07	0.52
moastop:catdi	0.16	0.05	2.86
moastop:catmorph	0.09	0.06	1.45
voicingvl_obs:moastop:catdi	-0.14	0.07	-1.88
voicingvl_obs:moastop:catmorph	-0.17	0.09	-1.77

Table A.8: Summary table for PRICE nucleus normalised f1 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	1.05	0.07	14.01
voicingvl_obs	-0.21	0.07	-2.93
moastop	-0.03	0.03	-1.04
catdi	-0.10	0.05	-2.23
catmorph	0.11	0.06	1.99
voicingvl_obs:moastop	-0.00	0.04	-0.06
voicingvl_obs:catdi	0.06	0.05	1.10
voicingvl_obs:catmorph	-0.18	0.07	-2.55
moastop:catdi	0.20	0.05	3.73
moastop:catmorph	0.02	0.06	0.39
voicingvl_obs:moastop:catdi	-0.13	0.07	-1.84
voicingvl_obs:moastop:catmorph	0.00	0.09	0.05

Table A.9: Summary table for PRICE offglide normalised f1 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	1.02	0.02	41.49
voicingvl_obs	0.02	0.03	0.55
moastop	-0.02	0.03	-0.59
catdi	-0.02	0.04	-0.53
catmorph	-0.01	0.05	-0.27
voicingvl_obs:moastop	0.02	0.04	0.51
voicingvl_obs:catdi	0.05	0.05	0.95
voicingvl_obs:catmorph	0.10	0.07	1.60
moastop:catdi	0.02	0.05	0.34
moastop:catmorph	0.01	0.06	0.11
voicingvl_obs:moastop:catdi	0.00	0.07	0.04
voicingvl_obs:moastop:catmorph	-0.04	0.08	-0.48

Table A.10: Summary table for PRICE nucleus normalised f2 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	1.48	0.07	20.46
voicingvl_obs	0.21	0.06	3.35
moastop	0.04	0.03	1.35
catdi	0.06	0.03	2.10
catmorph	-0.10	0.04	-2.80
voicingvl_obs:moastop	-0.00	0.03	-0.05
voicingvl_obs:catdi	-0.09	0.04	-2.40
voicingvl_obs:catmorph	0.11	0.05	2.15
moastop:catdi	-0.11	0.04	-2.75
moastop:catmorph	-0.00	0.05	-0.00
voicingvl_obs:moastop:catdi	0.02	0.05	0.46
voicingvl_obs:moastop:catmorph	0.01	0.07	0.19

Table A.11: Summary table for PRICE offglide normalised f2 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	0.71	0.09	8.12
moastop	0.00	0.05	0.11
voicingvl_obs	0.24	0.09	2.71
catdi	0.09	0.06	1.52
catmorph	-0.17	0.07	-2.52
moastop:voicingvl_obs	0.04	0.06	0.60
moastop:catdi	-0.11	0.07	-1.54
moastop:catmorph	0.05	0.09	0.62
voicingvl_obs:catdi	-0.11	0.07	-1.59
voicingvl_obs:catmorph	0.17	0.10	1.75
moastop:voicingvl_obs:catdi	0.01	0.10	0.10
moastop:voicingvl_obs:catmorph	-0.10	0.12	-0.82

Table A.12: Summary table for PRICE Euclidean distance mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	1.38	0.07	18.54
voiclassvd_st	0.14	0.08	1.84
voiclassna	0.05	0.08	0.58
voiclassla	0.17	0.08	2.06
voiclassop	0.01	0.11	0.06
voiclassure	0.10	0.09	1.04
voiclassvo	0.13	0.10	1.40
voiclassre	0.15	0.08	1.91
log(fre)	0.02	0.01	1.65
voiclassvd_st:log(fre)	-0.01	0.01	-1.05
voiclassna:log(fre)	-0.02	0.01	-1.23
voiclassla:log(fre)	-0.01	0.01	-1.07
voiclassop:log(fre)	0.01	0.02	0.35
voiclassure:log(fre)	-0.00	0.02	-0.20
voiclassvo:log(fre)	-0.01	0.02	-0.53
voiclassre:log(fre)	-0.01	0.02	-0.26

Table A.13: Summary table for PRICE nucleus normalised f1 mixed effects model by log frequency and **voiclass**

	Estimate	Std. Error	t value
(Intercept)	0.81	0.05	15.32
voiclassvd_st	0.24	0.07	3.49
voiclassna	0.31	0.07	4.16
voiclassla	0.52	0.08	6.84
voiclassop	0.08	0.10	0.77
voiclassure	0.49	0.08	5.83
voiclassvo	0.25	0.09	2.89
voiclassre	0.45	0.07	5.99
log(fre)	-0.00	0.01	-0.24
voiclassvd_st:log(fre)	0.01	0.01	0.49
voiclassna:log(fre)	0.00	0.01	0.06
voiclassla:log(fre)	0.01	0.01	0.51
voiclassop:log(fre)	0.03	0.01	1.70
voiclassure:log(fre)	0.01	0.02	0.35
voiclassvo:log(fre)	0.03	0.02	1.95
voiclassre:log(fre)	0.01	0.02	0.45

Table A.14: Summary table for PRICE offglide normalised f1 mixed effects model by log frequency and **voiclass**

	Estimate	Std. Error	t value
(Intercept)	1.15	0.05	24.43
voiclassvd_st	-0.16	0.05	-2.98
voiclassna	-0.13	0.06	-2.32
voiclassla	-0.11	0.06	-1.97
voiclassop	-0.13	0.08	-1.74
voiclassure	-0.01	0.07	-0.12
voiclassvo	-0.13	0.07	-1.84
voiclassre	-0.09	0.06	-1.44
log(fre)	-0.01	0.01	-1.97
voiclassvd_st:log(fre)	0.02	0.01	1.70
voiclassna:log(fre)	0.01	0.01	1.25
voiclassla:log(fre)	0.01	0.01	0.62
voiclassop:log(fre)	0.01	0.01	0.99
voiclassure:log(fre)	-0.01	0.01	-0.67
voiclassvo:log(fre)	0.01	0.01	1.11
voiclassre:log(fre)	0.01	0.02	0.57

Table A.15: Summary table for PRICE nucleus normalised f2 mixed effects model by log frequency and **voiclass**

	Estimate	Std. Error	t value
(Intercept)	1.55	0.05	29.58
voiclassvd_st	-0.04	0.06	-0.69
voiclassna	-0.18	0.06	-2.88
voiclassla	-0.27	0.06	-4.10
voiclassop	0.02	0.09	0.26
voiclassure	-0.26	0.07	-3.64
voiclassvo	-0.01	0.07	-0.07
voiclassre	-0.18	0.06	-2.88
log(fre)	0.03	0.01	3.42
voiclassvd_st:log(fre)	-0.03	0.01	-2.93
voiclassna:log(fre)	-0.01	0.01	-1.19
voiclassla:log(fre)	-0.03	0.01	-3.14
voiclassop:log(fre)	-0.03	0.01	-2.33
voiclassure:log(fre)	-0.02	0.01	-1.43
voiclassvo:log(fre)	-0.05	0.01	-3.82
voiclassre:log(fre)	-0.04	0.02	-2.70

Table A.16: Summary table for PRICE offglide normalised f2 mixed effects model by log frequency and **voiclass**

	Estimate	Std. Error	t value
(Intercept)	0.73	0.08	8.99
voiclassvd_st	-0.03	0.10	-0.29
voiclassna	-0.19	0.10	-1.81
voiclassla	-0.37	0.11	-3.55
voiclassop	0.01	0.14	0.08
voiclassure	-0.49	0.12	-4.06
voiclassvo	-0.00	0.12	-0.01
voiclassre	-0.31	0.11	-2.81
log(fre)	0.03	0.01	2.99
voiclassvd_st:log(fre)	-0.04	0.02	-2.32
voiclassna:log(fre)	-0.03	0.02	-1.81
voiclassla:log(fre)	-0.03	0.02	-2.01
voiclassop:log(fre)	-0.04	0.02	-1.72
voiclassure:log(fre)	-0.01	0.02	-0.31
voiclassvo:log(fre)	-0.07	0.02	-3.32
voiclassre:log(fre)	-0.04	0.03	-1.27

Table A.17: Summary table for PRICE Euclidean distance mixed effects model by log frequency and **voiclass**

A.2.1.2 Result for MOUTH

	Estimate	Std. Error	t value
(Intercept)	1.43	0.07	19.20
poapoa2	0.06	0.08	0.70
voiclassvd_fr	0.14	0.05	2.73
catdi	0.01	0.07	0.14
catmorph	-0.05	0.06	-0.82
poapoa2:voiclassvd_fr	-0.08	0.11	-0.72

Table A.18: Summary table for MOUTH nucleus normalised f1 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.07	0.08	14.25
poapoa2	0.09	0.07	1.38
voiclassvd_fr	-0.04	0.04	-1.14
catdi	-0.01	0.05	-0.15
catmorph	-0.04	0.04	-0.95
poapoa2:voiclassvd_fr	-0.05	0.07	-0.63

Table A.19: Summary table for MOUTH offglide normalised f1 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.01	0.03	31.97
poapoa2	0.04	0.03	1.56
voiclassvd_fr	0.03	0.02	1.50
catdi	0.05	0.02	2.08
catmorph	0.02	0.02	0.97
poapoa2:voiclassvd_fr	-0.03	0.04	-0.90

Table A.20: Summary table for MOUTH nucleus normalised f2 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	0.77	0.04	20.96
poapoa2	-0.03	0.04	-0.81
voiclassvd_fr	0.01	0.03	0.36
catdi	0.05	0.03	1.55
catmorph	-0.01	0.03	-0.48
poapoa2:voiclassvd_fr	-0.03	0.05	-0.66

Table A.21: Summary table for MOUTH offglide normalised f2 mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	0.53	0.07	7.24
poapoa2	0.02	0.09	0.16
voiclassvd_fr	0.10	0.06	1.49
catdi	0.01	0.07	0.15
catmorph	-0.01	0.06	-0.23
poapoa2:voiclassvd_fr	-0.04	0.11	-0.33

Table A.22: Summary table for MOUTH Euclidean distance mixed effects model by place of articulation within each **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.58	0.06	25.60
voicingvl_obs	-0.13	0.04	-3.07
moastop	-0.03	0.04	-0.65
catdi	-0.01	0.04	-0.23
catmorph	-0.05	0.04	-1.21
voicingvl_obs:moastop	0.11	0.05	2.00

Table A.23: Summary table for MOUTH nucleus normalised f1 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	1.05	0.09	11.39
voicingvl_obs	0.06	0.07	0.83
moastop	0.02	0.04	0.65
catdi	-0.01	0.04	-0.20
catmorph	-0.08	0.04	-1.75
voicingvl_obs:moastop	-0.12	0.04	-2.77

Table A.24: Summary table for MOUTH offglide normalised f1 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	1.05	0.04	29.82
voicingvl_obs	-0.02	0.04	-0.60
moastop	0.01	0.04	0.30
catdi	0.04	0.03	1.34
catmorph	-0.01	0.02	-0.30
voicingvl_obs:moastop	0.07	0.04	1.47

Table A.25: Summary table for MOUTH nucleus normalised f2 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	0.75	0.03	23.54
voicingvl_obs	-0.00	0.04	-0.11
moastop	-0.00	0.02	-0.11
catdi	0.06	0.03	2.13
catmorph	0.02	0.02	1.33
voicingvl_obs:moastop	-0.01	0.03	-0.49

Table A.26: Summary table for MOUTH offglide normalised f2 mixed effects model by manner of articulation, voicing and **cat** before fricatives and stops

	Estimate	Std. Error	t value
(Intercept)	1.51	0.04	41.32
voiclassvd_st	0.04	0.03	1.22
voiclassna	-0.05	0.04	-1.38
voiclassla	0.07	0.03	2.23
catdi	-0.01	0.03	-0.27
catmorph	-0.01	0.02	-0.37

Table A.27: Summary table for MOUTH nucleus normalised f1 mixed effects model by **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.02	0.09	11.67
voiclassvd_st	0.06	0.07	0.84
voiclassna	0.32	0.05	6.57
voiclassla	0.27	0.05	5.00
catdi	-0.02	0.04	-0.64
catmorph	-0.09	0.03	-2.89

Table A.28: Summary table for MOUTH offglide normalised f1 mixed effects model by **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	1.11	0.04	26.31
voiclassvd_st	-0.05	0.04	-1.19
voiclassna	0.06	0.04	1.56
voiclassla	-0.07	0.04	-1.72
catdi	0.05	0.05	1.12
catmorph	-0.02	0.02	-0.74

Table A.29: Summary table for MOUTH nucleus normalised f2 mixed effects model by **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	0.75	0.04	20.92
voiclassvd_st	0.04	0.05	0.72
voiclassna	0.13	0.03	3.66
voiclassla	-0.01	0.05	-0.27
catdi	0.01	0.03	0.17
catmorph	-0.01	0.02	-0.57

Table A.30: Summary table for MOUTH offglide normalised f2 mixed effects model by **voiclass** and **cat**

	Estimate	Std. Error	t value
(Intercept)	0.68	0.08	8.74
voiclassvd_st	-0.12	0.08	-1.46
voiclassna	-0.27	0.06	-4.46
voiclassla	-0.22	0.06	-3.79
catdi	0.03	0.05	0.61
catmorph	0.04	0.04	0.89

Table A.31: Summary table for MOUTH Euclidean distance mixed effects model by **voiclass** and **cat**

A.2.2 Main investigation

These mixed effects model summary tables correspond to the results presented for the main investigation in Chapter 7.

A.2.2.1 Result for PRICE

	Estimate	Std. Error	t value
(Intercept)	1.58	0.06	27.91
voiclassm_bound	0.01	0.06	0.22
genm	-0.09	0.03	-3.01
agey	0.06	0.04	1.69
loc_catn	0.05	0.06	0.84
loc_cats	0.01	0.06	0.17
loc_catw	-0.08	0.07	-1.20
voiclassm_bound:genm	-0.05	0.03	-1.66
voiclassm_bound:agey	0.05	0.03	1.48
voiclassm_bound:loc_catn	0.04	0.06	0.75
voiclassm_bound:loc_cats	0.01	0.06	0.14
voiclassm_bound:loc_catw	0.01	0.06	0.14

Table A.32: Summary table for PRICE nucleus normalised f1 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	1.24	0.07	17.29
voiclassm_bound	-0.04	0.04	-1.16
genm	-0.04	0.04	-1.06
agey	0.09	0.05	1.93
loc_catn	0.03	0.07	0.37
loc_cats	0.00	0.08	0.00
loc_catw	0.04	0.09	0.42
voiclassm_bound:genm	-0.00	0.02	-0.14
voiclassm_bound:agey	0.06	0.02	2.92
voiclassm_bound:loc_catn	-0.03	0.04	-0.93
voiclassm_bound:loc_cats	-0.04	0.04	-1.09
voiclassm_bound:loc_catw	0.03	0.04	0.62

Table A.33: Summary table for PRICE offglide normalised f1 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	1.12	0.03	33.25
voiclassm_bound	0.01	0.02	0.52
genm	0.04	0.02	1.98
agey	-0.04	0.02	-1.96
loc_catn	-0.09	0.03	-2.65
loc_cats	-0.12	0.04	-3.18
loc_catw	-0.07	0.04	-1.90
voiclassm_bound:genm	0.01	0.01	1.46
voiclassm_bound:agey	0.00	0.01	0.21
voiclassm_bound:loc_catn	-0.00	0.02	-0.24
voiclassm_bound:loc_cats	-0.01	0.02	-0.44
voiclassm_bound:loc_catw	0.02	0.02	1.29

Table A.34: Summary table for PRICE nucleus normalised f2 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	1.39	0.05	26.91
voiclassm_bound	0.05	0.04	1.29
genm	0.04	0.03	1.56
agey	-0.12	0.03	-3.68
loc_catn	-0.01	0.05	-0.27
loc_cats	-0.06	0.06	-1.09
loc_catw	-0.05	0.06	-0.78
voiclassm_bound:genm	0.00	0.02	0.18
voiclassm_bound:agey	-0.05	0.02	-2.73
voiclassm_bound:loc_catn	0.05	0.03	1.46
voiclassm_bound:loc_cats	0.02	0.03	0.62
voiclassm_bound:loc_catw	0.01	0.04	0.31

Table A.35: Summary table for PRICE offglide normalised f2 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	0.52	0.11	4.79
voiclassvd_st	-0.07	0.07	-1.08
genm	-0.08	0.06	-1.41
agey	-0.13	0.07	-1.84
loc_catn	0.16	0.11	1.48
loc_cats	0.10	0.12	0.87
loc_catw	-0.07	0.13	-0.57
voiclassvd_st:genm	0.05	0.03	1.67
voiclassvd_st:agey	0.05	0.03	1.41
voiclassvd_st:loc_catn	-0.08	0.05	-1.44
voiclassvd_st:loc_cats	-0.05	0.06	-0.84
voiclassvd_st:loc_catw	0.04	0.06	0.65

Table A.36: Summary table for PRICE Euclidean distance mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	0.72	0.22	3.34
voiclassvd_st	-0.40	0.24	-1.67
genm	0.14	0.11	1.34
agey	-0.24	0.12	-1.96
loc_catn	0.60	0.20	3.03
loc_cats	0.39	0.21	1.83
loc_catw	0.39	0.23	1.72
voiclassvd_st:genm	-0.24	0.11	-2.26
voiclassvd_st:agey	0.29	0.12	2.39
voiclassvd_st:loc_catn	-0.16	0.20	-0.81
voiclassvd_st:loc_cats	-0.06	0.21	-0.30
voiclassvd_st:loc_catw	-0.05	0.23	-0.21

Table A.37: Summary table for PRICE normalised duration mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	1.44	0.03	42.09
voiclassna	-0.10	0.04	-2.29
voiclassop	-0.36	0.05	-6.82
voiclassvd_st	-0.10	0.04	-2.68
voiclassvl_st	-0.69	0.03	-21.62
convy	0.03	0.03	1.16
genm	0.05	0.05	1.16
voiclassna:convy	0.01	0.03	0.24
voiclassop:convy	-0.06	0.03	-2.02
voiclassvd_st:convy	0.01	0.03	0.24
voiclassvl_st:convy	0.02	0.03	0.92
voiclassna:genm	-0.05	0.07	-0.82
voiclassop:genm	-0.10	0.08	-1.19
voiclassvd_st:genm	-0.07	0.05	-1.35
voiclassvl_st:genm	0.04	0.05	0.77

Table A.38: Summary table for PRICE offglide normalised f1 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	1.21	0.02	52.75
voiclassna	0.01	0.03	0.44
voiclassop	0.29	0.03	8.59
voiclassvd_st	0.07	0.03	2.55
voiclassvl_st	0.49	0.03	17.00
convy	-0.04	0.02	-1.97
genm	-0.06	0.03	-1.94
voiclassna:convy	-0.05	0.02	-2.68
voiclassop:convy	-0.00	0.02	-0.21
voiclassvd_st:convy	-0.05	0.02	-2.59
voiclassvl_st:convy	-0.05	0.02	-2.37
voiclassna:genm	0.14	0.04	3.25
voiclassop:genm	0.04	0.05	0.75
voiclassvd_st:genm	0.07	0.04	1.98
voiclassvl_st:genm	0.01	0.04	0.27

Table A.39: Summary table for PRICE offglide normalised f2 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

A.2.2.2 Result for MOUTH

	Estimate	Std. Error	t value
(Intercept)	1.60	0.07	22.42
voiclassvd_st	0.05	0.04	1.17
genm	-0.07	0.04	-1.72
agey	0.00	0.05	0.07
loc_catn	0.11	0.07	1.45
loc_cats	0.06	0.08	0.73
loc_catw	-0.00	0.09	-0.04
voiclassvd_st:genm	0.01	0.02	0.42
voiclassvd_st:agey	-0.07	0.02	-2.79
voiclassvd_st:loc_catn	-0.03	0.04	-0.85
voiclassvd_st:loc_cats	-0.03	0.04	-0.63
voiclassvd_st:loc_catw	-0.01	0.04	-0.18

Table A.40: Summary table for MOUTH nucleus normalised f1 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	1.10	0.04	29.39
voiclassvd_st	-0.03	0.03	-1.20
genm	0.11	0.02	5.42
agey	-0.12	0.02	-5.12
loc_catn	-0.09	0.04	-2.44
loc_cats	-0.10	0.04	-2.48
loc_catw	-0.02	0.04	-0.48
voiclassvd_st:genm	-0.01	0.01	-1.09
voiclassvd_st:agey	-0.03	0.01	-2.68
voiclassvd_st:loc_catn	0.05	0.02	2.36
voiclassvd_st:loc_cats	0.03	0.02	1.45
voiclassvd_st:loc_catw	0.04	0.02	1.86

Table A.41: Summary table for MOUTH nucleus normalised f2 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	1.22	0.08	15.02
voiclassvd_st	0.03	0.04	0.71
genm	-0.00	0.05	-0.01
agey	0.17	0.05	3.18
loc_catn	-0.11	0.09	-1.31
loc_cats	-0.10	0.09	-1.06
loc_catw	-0.08	0.10	-0.79
voiclassvd_st:genm	0.02	0.02	0.96
voiclassvd_st:agey	-0.06	0.03	-2.09
voiclassvd_st:loc_catn	0.07	0.05	1.59
voiclassvd_st:loc_cats	0.04	0.05	0.80
voiclassvd_st:loc_catw	0.06	0.05	1.25

Table A.42: Summary table for MOUTH offglide normalised f1 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	0.88	0.07	13.51
voiclassvd_st	0.07	0.02	2.87
genm	0.02	0.04	0.64
agey	-0.01	0.04	-0.17
loc_catn	-0.10	0.07	-1.42
loc_cats	-0.06	0.07	-0.77
loc_catw	-0.03	0.08	-0.34
voiclassvd_st:genm	0.00	0.01	0.06
voiclassvd_st:agey	-0.04	0.01	-2.51
voiclassvd_st:loc_catn	0.00	0.02	0.21
voiclassvd_st:loc_cats	-0.02	0.02	-0.76
voiclassvd_st:loc_catw	-0.01	0.03	-0.49

Table A.43: Summary table for MOUTH offglide normalised f2 mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	0.49	0.10	4.71
voiclassvd_st	-0.08	0.06	-1.23
genm	-0.04	0.06	-0.75
agey	-0.18	0.07	-2.67
loc_catn	0.17	0.11	1.52
loc_cats	0.09	0.12	0.74
loc_catw	0.03	0.12	0.25
voiclassvd_st:genm	-0.03	0.03	-0.82
voiclassvd_st:agey	-0.01	0.04	-0.23
voiclassvd_st:loc_catn	-0.03	0.06	-0.53
voiclassvd_st:loc_cats	0.02	0.06	0.26
voiclassvd_st:loc_catw	0.00	0.07	0.07

Table A.44: Summary table for MOUTH Euclidean distance mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	0.57	0.25	2.30
voiclassvd_st	-0.44	0.32	-1.39
genm	0.03	0.11	0.23
agey	0.01	0.13	0.05
loc_catn	0.58	0.21	2.74
loc_cats	0.46	0.23	2.03
loc_catw	0.36	0.24	1.48
voiclassvd_st:genm	-0.09	0.10	-0.88
voiclassvd_st:agey	0.17	0.12	1.48
voiclassvd_st:loc_catn	-0.52	0.20	-2.63
voiclassvd_st:loc_cats	-0.30	0.21	-1.44
voiclassvd_st:loc_catw	-0.31	0.22	-1.40

Table A.45: Summary table for MOUTH normalised duration mixed effects model by following voiced stop without a morpheme boundary (**vd_st**) and with a morpheme boundary (**m_bound**)

	Estimate	Std. Error	t value
(Intercept)	1.42	0.03	40.78
voiclassna	-0.06	0.05	-1.23
voiclassop	-0.27	0.05	-5.93
voiclassvd_st	-0.18	0.03	-5.33
voiclassvl_st	-0.52	0.05	-11.11
convy	-0.07	0.04	-1.89
genm	0.09	0.05	1.92
voiclassna:convy	0.10	0.03	3.12
voiclassop:convy	0.18	0.03	5.24
voiclassvd_st:convy	0.09	0.03	2.75
voiclassvl_st:convy	0.16	0.03	4.69
voiclassna:genm	-0.08	0.06	-1.20
voiclassop:genm	-0.03	0.07	-0.51
voiclassvd_st:genm	-0.03	0.04	-0.71
voiclassvl_st:genm	0.03	0.07	0.47

Table A.46: Summary table for MOUTH offglide normalised f1 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	0.98	0.03	32.88
voiclassna	0.02	0.03	0.49
voiclassop	0.00	0.03	0.13
voiclassvd_st	-0.02	0.03	-0.70
voiclassvl_st	-0.06	0.03	-1.82
convy	-0.03	0.01	-2.86
genm	0.06	0.03	1.92
voiclassna:convy	-0.00	0.01	-0.34
voiclassop:convy	0.01	0.01	0.96
voiclassvd_st:convy	-0.00	0.01	-0.15
voiclassvl_st:convy	0.03	0.01	2.37
voiclassna:genm	-0.00	0.01	-0.37
voiclassop:genm	-0.02	0.01	-1.94
voiclassvd_st:genm	-0.03	0.01	-2.26
voiclassvl_st:genm	0.02	0.02	0.92

Table A.47: Summary table for MOUTH nucleus normalised f2 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	0.79	0.02	34.44
voiclassna	0.05	0.02	2.32
voiclassop	-0.06	0.02	-2.75
voiclassvd_st	0.02	0.02	1.07
voiclassvl_st	-0.07	0.03	-2.21
convy	-0.03	0.02	-1.48
genm	0.04	0.03	1.15
voiclassna:convy	0.01	0.02	0.73
voiclassop:convy	0.05	0.02	2.26
voiclassvd_st:convy	-0.01	0.02	-0.53
voiclassvl_st:convy	0.00	0.02	0.00
voiclassna:genm	-0.02	0.02	-1.08
voiclassop:genm	-0.02	0.03	-0.76
voiclassvd_st:genm	-0.05	0.02	-2.02
voiclassvl_st:genm	-0.01	0.05	-0.23

Table A.48: Summary table for MOUTH offglide normalised f2 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

A.2.3 OLIVE investigation

These mixed effects model summary tables correspond to the results presented for the OLIVE investigation in Chapter 9.

	Estimate	Std. Error	t value
(Intercept)	1.46	0.06	23.28
voiclassvl_fr	-0.04	0.05	-0.82
voiclassvd_st	0.07	0.06	1.23
voiclassvd_fr	0.02	0.06	0.34
voiclassna	-0.07	0.04	-1.61
voiclassla	-0.16	0.08	-1.97
voiclassop	0.08	0.05	1.72
voiclassbimorph	-0.07	0.06	-1.07
genm	-0.12	0.09	-1.26
voiclassvl_fr:genm	-0.01	0.07	-0.23
voiclassvd_st:genm	-0.05	0.06	-0.75
voiclassvd_fr:genm	-0.02	0.06	-0.36
voiclassna:genm	0.09	0.04	2.18
voiclassla:genm	0.14	0.09	1.46
voiclassop:genm	-0.09	0.06	-1.38
voiclassbimorph:genm	0.09	0.07	1.22

Table A.49: Summary table for PRICE nucleus normalised f1 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	1.33	0.10	13.76
voiclassmorph	-0.15	0.09	-1.69
voiclassna	-0.08	0.08	-1.02
voiclassnone	-0.12	0.08	-1.48
voiclassvd_fr	-0.17	0.09	-1.91
voiclassvd_st	-0.21	0.09	-2.42
voiclassvl_fr	-0.25	0.08	-3.05
voiclassvl_st	-0.29	0.07	-3.94
genm	-0.04	0.13	-0.29
voiclassmorph:genm	0.05	0.11	0.45
voiclassna:genm	0.10	0.09	1.05
voiclassnone:genm	0.01	0.10	0.05
voiclassvd_fr:genm	0.10	0.10	0.95
voiclassvd_st:genm	0.10	0.10	0.94
voiclassvl_fr:genm	-0.09	0.10	-0.89
voiclassvl_st:genm	-0.05	0.09	-0.57

Table A.50: Summary table for PRICE offglide normalised f1 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	1.12	0.02	50.74
voiclassvl_fr	0.02	0.03	0.72
voiclassvd_st	-0.00	0.04	-0.07
voiclassvd_fr	0.00	0.04	0.05
voiclassna	0.02	0.03	0.70
voiclassla	-0.12	0.05	-2.44
voiclassop	-0.01	0.03	-0.23
voiclassbimorph	0.01	0.04	0.19
genm	-0.12	0.03	-4.11
voiclassvl_fr:genm	-0.02	0.04	-0.51
voiclassvd_st:genm	-0.01	0.04	-0.18
voiclassvd_fr:genm	-0.07	0.03	-2.01
voiclassna:genm	-0.01	0.03	-0.54
voiclassla:genm	-0.00	0.06	-0.00
voiclassop:genm	-0.02	0.04	-0.64
voiclassbimorph:genm	0.01	0.04	0.31

Table A.51: Summary table for PRICE nucleus normalised f2 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	1.01	0.07	15.02
voiclassmorph	0.39	0.08	4.78
voiclassna	0.26	0.07	3.72
voiclassnone	0.41	0.07	5.66
voiclassvd_fr	0.35	0.08	4.38
voiclassvd_st	0.41	0.08	5.28
voiclassvl_fr	0.52	0.07	7.16
voiclassvl_st	0.50	0.07	7.50
genm	-0.05	0.09	-0.57
voiclassmorph:genm	-0.13	0.10	-1.22
voiclassna:genm	-0.16	0.09	-1.82
voiclassnone:genm	-0.11	0.10	-1.09
voiclassvd_fr:genm	-0.14	0.10	-1.46
voiclassvd_st:genm	-0.13	0.10	-1.35
voiclassvl_fr:genm	0.05	0.10	0.47
voiclassvl_st:genm	-0.01	0.09	-0.09

Table A.52: Summary table for PRICE offglide normalised f2 mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	0.60	0.06	9.55
voiclassvl_fr	-0.06	0.06	-1.02
voiclassvd_st	-0.06	0.07	-0.88
voiclassvd_fr	-0.15	0.08	-2.00
voiclassna	-0.31	0.05	-5.78
voiclassla	-0.52	0.09	-5.64
voiclassop	-0.10	0.06	-1.78
voiclassbimorph	-0.22	0.08	-2.92
genm	0.03	0.09	0.37
voiclassvl_fr:genm	0.08	0.08	1.10
voiclassvd_st:genm	-0.23	0.07	-3.27
voiclassvd_fr:genm	-0.12	0.07	-1.86
voiclassna:genm	-0.09	0.05	-1.93
voiclassla:genm	0.03	0.10	0.27
voiclassop:genm	-0.16	0.07	-2.25
voiclassbimorph:genm	-0.12	0.08	-1.49

Table A.53: Summary table for PRICE Euclidean distance mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

	Estimate	Std. Error	t value
(Intercept)	-0.50	0.14	-3.48
voiclassvl_fr	0.61	0.29	2.08
voiclassvd_st	1.21	0.32	3.83
voiclassvd_fr	1.20	0.38	3.16
voiclassna	0.63	0.26	2.41
voiclassla	0.17	0.41	0.41
voiclassop	0.94	0.26	3.65
voiclassbimorph	1.19	0.35	3.40
genm	0.05	0.13	0.36
voiclassvl_fr:genm	-0.65	0.32	-1.99
voiclassvd_st:genm	0.11	0.27	0.40
voiclassvd_fr:genm	0.32	0.26	1.24
voiclassna:genm	-0.02	0.19	-0.12
voiclassla:genm	0.36	0.42	0.86
voiclassop:genm	-0.24	0.27	-0.88
voiclassbimorph:genm	0.32	0.32	0.99

Table A.54: Summary table for PRICE normalised duration mixed effects model by **voiclass**, speech style (**conv**) and gender (**gen**)

A.3 ARTICLE ACCEPTED FOR PUBLICATION IN THE JOURNAL OF ENGLISH LANGUAGE AND LINGUISTICS

I have attached a pre-print version of my article titled *Variation in Nasal-Obstruent Clusters and its influence on PRICE and MOUTH in Scouse*, which has been accepted for publication in *English Language and Linguistics* and will feature in the November 2015 issue of the journal. This article provides a small subset of results from the pilot study focusing on the realisations of PRICE and MOUTH before nasal-obstruent clusters. It has been referred to in a number of chapters in the current thesis, including chapters 3, 4 and 5.

BIBLIOGRAPHY

Abercrombie, D. (1979). The accents of standard English in Scotland. In Aitken, A. J. and McArthur, T., editors, *Languages of Scotland*, pages 65–84. Edinburgh: Chambers.

Agirre, E., Diab, M., Cer, D., and Gonzalez-Agirre, A. (2012). Semeval-2012 task 6: A pilot on semantic textual similarity. In *Proceedings of the First Joint Conference on Lexical and Computational Semantics-Volume 1: Proceedings of the main conference and the shared task, and Volume 2: Proceedings of the Sixth International Workshop on Semantic Evaluation*, pages 385–393. Association for Computational Linguistics.

Agutter, A. (1988). The not-so-Scottish Vowel Length Rule. In Macleod, N., editor, *Edinburgh Studies in the English Language*, pages 120–132. Edinburgh: John Donald.

Ahrend, E. R. (1934). Ontario speech. *American Speech*, 9(2):136–139.

Aitken, A. J. (1962). Vowel length in modern Scots. Unpublished Paper. Edinburgh: University of Edinburgh.

Aitken, A. J. (1981). The Scottish Vowel Length Rule. In Benskin, M. and Samuels, M. L., editors, *So Many People, Longages, and Tongues*, pages 131–57. Edinburgh: Middle English Dialect Project.

Anderson, A. H., Bader, M., Bard, E. G., Boyle, E., Doherty, G., Garrod, S., Isard, S., Kowtko, J., McAllister, J., Miller, J., et al. (1991). The HCRC map task corpus. *Language and speech*, 34(4):351–366.

Anderson, J. (1993). Morphology, phonology and the Scottish Vowel-Length Rule. *Journal of linguistics*, 29(2):419–430.

Anderson, P. M. (1987). *A structural atlas of the English dialects*. Routledge Kegan and Paul.

Ash, S. (2002). Social class. In Chambers, J. K., Trudgill, P., and Schilling-Estes, N., editors, *The handbook of language variation and change*, pages 402 — 424. John Wiley and Sons.

Baayen, R. H. (2008). *Analyzing linguistic data: A practical introduction to statistics using R*. Cambridge: Cambridge University Press.

Baayen, R. H., Piepenbrock, R., and Gulikers, L. (1995). The celex lexical database (release 2). University of Pennsylvania, Philadelphia, PA: Linguistic Data Consortium.

Baker, A., Mielke, J., and Archangeli, D. (2008). More velar than/g: Consonant coarticulation as a cause of diphthongization. In Chang, C. B. and Haynie, H. J., editors, *Proceedings of the 26th West Coast conference on formal linguistics*, pages 60–68. Somerville, MA: Cascadilla Proceedings Project.

Ball, M. J. and Muller, N. (2014). *Phonetics for communication disorders*. Psychology Press.

Barber, C. L. (1997). *Early Modern English*. Edinburgh University Press.

Barber, C. L. (2000). *The English language: A historical introduction*. Cambridge: Cambridge University Press.

Barber, C. L., Beal, J. C., and Shaw, P. A. (2009). *The English language: A historical introduction*. Cambridge: Cambridge University Press, 2nd edition.

Barr, D. J., Levy, R., Scheepers, C., and Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of memory and language*, 68(3):255–278.

Barras, W., Honeybone, P., and Trousdale, G. (2007). Is word-frequency a factor in phonological demergers? the sociophonology of SQUARE and NURSE in Lancashire English. In *2nd International Conference on the Linguistics of Contemporary English (ICLCE). Available at http:/www. ling. ed. ac. uk/˜ s9527813/docs/bht-toulouse. pdf*, Toulouse.

Bates, D., Maechler, M., and Bolker, B. (2012). lme4: Linear mixed-effects models using s4 classes. r package (version 0.999999-0). [Software Resource].

Baugh, A. C. and Cable, T. (1993). *A history of the English language*. London: Routledge.

BBC (2014). Bread. Taken from http://www.bbc.co.uk/comedy/bread/.

Beal, J. C., Burbano-Elizondo, L., and Llamas, C. (2012). *Urban North-Eastern English: Tyneside to Teesside*. Edinburgh University Press.

Beal, J. C. and Corrigan, K. (2009). The impact of nineteenth-century irish english migrations on contemporary northern englishes: Tyneside and sheffield compared. In Penttila, E. and Paulasto, H., editors, *Language Contacts Meet English Dialects: Studies in Honour of Markku Filppula.*, pages 231–258. Cambridge: Cambridge Scholars Publishing.

Belchem, J. (2000a). *Merseypride: essays in Liverpool exceptionalism*. Liverpool University Press.

Belchem, J. (2000b). *Popular Politics, Riot and Labour*. University of Chicago Press.

Belchem, J. (2006). *Liverpool 800: culture, character & history*. Liverpool University Press.

Belchem, J. (2007). *Irish, Catholic and Scouse: The History of the Liverpool-Irish, 1800-1939*. Liverpool University Press.

Bermúdez-Otero, R. (2003). The acquisition of phonological opacity. In Spenader, J., Erikkson, A., and Dahl, O., editors, *Variation within Optimality Theory: Proceedings of the Stockholm Workshop on 'Variation within Optimality Theory'*, pages 25–36. Stockholm University.

Bermúdez-Otero, R. (2004). Raising and flapping in Canadian English: grammar and acquisition. In *CASTL Colloquium*. University of Tromsø.

Bermúdez-Otero, R. (2007). Diachronic phonology. In de Lacy, P., editor, *The Cambridge handbook of phonology*, pages 497–517. Cambridge: Cambridge University Press.

Bermúdez-Otero, R. (2014a). The diachronic rise and synchronic representation of phonological opacity: a case study. Paper presented at *Rencontres d'Automne de Linguistique formelle: Langage, Langues et Cognition 8*.

Bermúdez-Otero, R. (2014b). The origins of opacity: the case of /aɪ/-raising and /t/-flapping across English dialects. Paper presented at *Annual Meeting on Phonology 2014*.

Bermúdez-Otero, R. (2014c). Philadelphia /aɪ/-raising without rule insertion. Paper presented at *the Symposium on Historical Phonology*.

Berry, L. (2009). An investigation into the realisations of the diphthongs /aɪ/ and /aʊ/ in Liverpool English. Unpublished Undergraduate Dissertation.

Blake, R. and Josey, M. (2003). The /ay/ diphthong in a Martha's Vineyard community: What can we say 40 years after Labov? *Language in Society*, 32(4):451–485.

Boersma, P. and Pater, J. (2007). Constructing constraints from language data: The case of Canadian English diphthongs. Paper presented at *North East Linguistic Society 38*.

Boersma, P. and Weenink, D. (2013). Praat: doing phonetics by computer (version 5.3.51). [Computer program]. Taken from http://www.praat.org/.

Boult, J. (1871). Speculation on the former topography of liverpool and its neighbourhood part iii. *Proceedings of the Liverpool Literary and Philosophical Society*, XXV:11–38.

Boulton, T. (1768). *The sailor's farewell; or, the guinea outfit. A comedy, in three acts. By Thomas Boulton.* Liverpool, in the Year M,DCC,XXVIII. Taken from Eighteenth Century Collections Online: http://find.galegroup.com.

Bowker, L. (1998). Using specialized monolingual native-language corpora as a translation resource: a pilot study. *Meta*, 43(4):631–651.

Brierley, B. (1881). *Ab-o'th'-Yates Dictionary; Or, Walmsley Fowt Skoomester: Put T'gether by Th'Help O'Fause Juddie*. A Heywood and Sons.

Britain, D. (1997). Dialect contact and phonological reallocation: Canadian Raising in the English Fens. *Language in Society*, 26(1):15–46.

Britain, D. (2002). Diffusion, levelling, simplification and reallocation in past tense BE in the English Fens. *Journal of Sociolinguistics*, 6(1):16–43.

Britain, D. (2010). Supralocal regional dialect levelling. *Language and Identities*, pages 193–204.

Britain, D. and Sudbury, A. (2008). What can the Falkland Islands tell us about diphthong shift. *Essex Research Reports in Linguistics*, 57(1):1–32.

Britain, D. and Trudgill, P. (2005). New dialect formation and contact-induced reallocation: three case studies from the English Fens. *International Journal of English Studies*, 5(1):183–210.

British Association for Applied Linguistics (2006). Recommendations on good practice in applied linguistics student projects. Taken from http://www.baal.org.uk/dox/goodpractice_stud.pdf.

British Library (2010). Archival sound recordings. Taken from http://sounds.bl.uk/.

Bucholtz, M. (1999). Why be normal?: Language and identity practices in a community of nerd girls. *Language in society*, 28(02):203–223.

Bybee, J. (2002). Word frequency and context of use in the lexical diffusion of phonetically conditioned sound change. *Language Variation and Change*, 14(3):261–290.

Bybee, J. (2006). *Frequency of use and the organization of language*. Oxford University Press.

Bybee, J. L. and Hopper, P. J. (2001). *Frequency and the emergence of linguistic structure*. John Benjamins Publishing.

Campbell, L. (1998). *Historical linguistics: An introduction*. MIT press.

Cardoso, A. (2011a). The Liverpool PRICE vowel and reallocation: Is Lancashire part of the pattern? Unpublished MSc Paper: University of Edinburgh.

Cardoso, A. (2011b). PRICE realisations and phonological change: Liverpool English. Master's thesis, University of Edinburgh.

Cardoso, A. (2015). Variation in nasal-obstruent clusters and its influence on PRICE and MOUTH in Scouse. *English Language and Linguistics*.

Cardoso, A., Hall-Lew, L., Kementchedjhieva, Y., and Purse, R. (2015). Between California and the Pacific Northwest: The front lax vowels in San Francisco English. In Fridland, V., Kendall, T., Evans, B., and Wassink, A., editors, *Speech in the Western States*, Publication of the American Dialect Society. Duke University Press. Forthcoming.

Cardoso, A. and Honeybone, P. (2015). Dorsal fricative assimilation can be quantity sensitive in Liverpool English. In preparation.

Carr, P. (1992). Strict cyclicity, structure preservation and the Scottish Vowel-Length Rule. *Journal of Linguistics*, 28(1):91–114.

Carter, R. (1975). Some theoretical implications of the Great Vowel Shift. In Goyvaerts, D. L. and Pullum, G. K., editors, *Essays on the Sound Pattern of English*, pages 369–376. John Benjamins Publishing.

Cassidy, F. G. and LePage, R. (1980). *Dictionary of Jamaican English*. Cambridge: Cambridge University Press.

Census of England and Wales (1891). Area, houses and population. Vol. I. administrative and ancient counties. Taken from http://www.histpop.org. BPP 1893-4 CIV [C.6948].

Census of England and Wales (1901). County of Lancaster: Area, houses and population; also population classified by ages, condition as to marriage, occupations, birthplaces, and infirmities. Taken from http://www.histpop.org. BPP 1902 CXIX [Cd.1002].

Census of England and Wales (1911). Vol. ix. birthplaces of persons enumerated in administrative counties, county boroughs, &c., and ages and occupations of foreigners. Taken from http://www.histpop.org. BPP 1913 LXXVIII [Cd.7017].

Census of Great Britain (1801a). Abstract of the answers and returns made pursuant to an Act, passed in the forty-first year of His Majesty King George III. intituled "an act for taking an account of the population of Great Britain, and the increase or diminution thereof". Parish-registers. Taken from http://www.histpop.org. BPP 1801-02 VII (112).

Census of Great Britain (1801b). Abstract of the answers and returns made pursuant to an Act, passed in the forty-first year of His Majesty King George III. intituled "An act for taking an account of the population of Great Britain, and the increase or diminution thereof". enumeration. Part I. England and Wales. Part II. Scotland. Taken from http://www.histpop.org. BPP 1801-02 VI.

Census of Great Britain (1841). Abstract of the answers and returns made pursuant to acts 3 and 4 Vic. c.99 and 4 Vic. c.7. Taken from http://www.histpop.org. BPP 1843 XXII (496).

Census of Great Britain (1851). Tables of the population and houses in the divisions, registration counties, and districts of England and Wales; in the counties, cities, and burghs of Scotland; and in the islands in the British seas. Taken from http://www.histpop.org. BPP 1851 XLIII (1399).

Chambers, J. K. (1973). Canadian Raising. *Canadian Journal of Linguistics - Revue Canadienne de Linguistique*, 18(2):113–135.

Chambers, J. K. (1989). Canadian Raising: Blocking, fronting, etc. *American Speech*, 64(1):75–88.

Chambers, J. K. and Trudgill, P. (1980). *Dialectology. Cambridge textbooks in linguistics*. Cambridge: Cambridge University Press.

Chambers, J. M., Cleveland, W., Kleinder, and Tukey, P. (1983). *Graphical methods for data analysis.* Belmont, CA: Wadsworth.

Chelliah, S. L. and de Reuse, W. J. (2010). *Handbook of descriptive linguistic fieldwork*. Springer.

Chen, M. (1970). Vowel length variation as a function of the voicing of the consonant environment. *Phonetica*, 22(3):129–159.

Cole, J. and Hasegawa-Johnson, M. (2012). Corpus phonology with speech resources. In Cohn, A. C., Fougeron, C., and Huffman, M. K., editors, *Handbook of Laboratory Phonology*. Oxford: Oxford University Press.

Collier, J. (1748). *A View of the Lancashire Dialect; By Way of Dialogue, between Tummus o'Williams, o'f Margit o'Roafs, an Meary o'Dicks, o'Tummy o'Peggy's. Containing the Adventures & Misfortunes of a Lancashire Clown*. Leeds: Lister.

Combrink, J. (1978). Afrikaans: its origin and development. In Lanham, L. and Prinsloo, K. P., editors, *Language and communication studies in South Africa*, pages 69–95. Oxford, Cape Town: Oxford University Press.

Coupland, N. and Bishop, H. (2007). Ideologised values for British accents. *Journal of Sociolinguistics*, 11(1):74–93.

Cowling, G. H. (1915). *The dialect of Hackness (north-east Yorkshire): with original specimens, and a word-list*. Cambridge: Cambridge University Press.

Crowley, T. (2012). *Scouse: A Social and Cultural History*. Liverpool University Press.

Dailey-O'Cain, J. (1997). Canadian Raising in a midwestern US city. *Language Variation and Change*, 9(1):107–120.

Darlington, T. (1887). *The folk-speech of South Cheshire*. English Dialect Society.

Derksen, S. and Keselman, H. (1992). Backward, forward and stepwise automated subset selection algorithms: Frequency of obtaining authentic and noise variables. *British Journal of Mathematical and Statistical Psychology*, 45(2):265–282.

Deterding, D. (1997). The formants of monophthong vowels in Standard Southern British English pronunciation. *Journal of the International Phonetic Association*, 27(1-2):47–55.

Di Paolo, M. and Yaeger-Dror, M. (2011). *Sociophonetics: a student's guide.* Routledge.

Dobson, E. J. (1962). Middle English lengthening in open syllables. *Transactions of the Philological Society*, 61(1):124–148.

Dobson, E. J. (1968). *English Pronunciation 1500-1700.* Oxford University Press.

Drager, K. and Hay, J. (2010). A novice's guide to understanding mixed effects models. Paper presented at *the Workshop on Using Statistical Tools to Explain Linguistic Variation at NWAV 39.*

Dyer, J. (2002). We all speak the same round here: Dialect levelling in a Scottish-English community. *Journal of sociolinguistics*, 6(1):99–116.

Eckert, P. (2000). *Linguistic Variation as Social Practice: The Linguistic Construction of Identity in Belten High. Malden, Massachusetts.* Malden, Ma & Oxford, UK: Blackwell.

Ellis, A. (1874). *Early English Pronunciation*, volume 4. London: Truebner and Co.

Ellis, A. (1889). On early English pronunciation. *London: Truebner and Co.*

Enfield, W. (1773). *An Essay Towards the History of Leverpool.* Warrington.

Fabricius, A. H., Watt, D., and Johnson, D. E. (2009). A comparison of three speaker-intrinsic vowel formant frequency normalization algorithms for sociophonetics. *Language Variation and Change*, 21(3):413–435.

Farrer, W. and Brownbill, J. (1907). The victoria history of the county of Lancashire. Taken from http://www.british-history.ac.uk/source.aspx?pubid=289.

Farrer, W. and Brownbill, J. (1911). The victoria history of the county of Lancashire. Taken from http://www.british-history.ac.uk/source.aspx?pubid=288.

Ferragne, E. and Pellegrino, F. (2010). Formant frequencies of vowels in 13 accents of the British Isles. *Journal of the International Phonetic Association*, 40(1):1–34.

Finn, P. (2004). Cape Flats English: phonology. In Kortmann, B. and Schneider, E. W., editors, *A handbook of varieties of English*, volume 1, pages 964–984. Walter de Gruyter.

Flemming, E. (2003). The relationship between coronal place and vowel backness. *Phonology*, 20(3):335–373.

Fletcher, J. C. (2006). Effects of coda vocing on onset /n/ and /l/ duration in American English. Master's thesis, Rice University.

Fotheringham, A. S., Kelly, M. H., and Charlton, M. (2013). The demographic impacts of the Irish famine: towards a greater geographical understanding. *Transactions of the Institute of British Geographers*, 38(2):221–237.

Foulkes, P. and Docherty, G. (2007). Phonological variation in England. In Britain, D., editor, *Language in the British Isles*, pages 52–74. Cambridge: Cambridge University Press.

Fruehwald, J. (2008). The spread of raising: Opacity, lexicalization, and diffusion. *University of Pennsylvania Working Papers in Linguistics*, 14(2):83–92.

Fruehwald, J. (2013). *The phonological influence on phonetic change*. PhD thesis, University of Pennsylvania.

Gay, T. (1968). Effect of speaking rate on diphthong formant movements. *The Journal of the Acoustical Society of America*, 44(6):1570–1573.

Gelman, A. and Hill, J. (2006). *Data analysis using regression and multilevel/hierarchical models*. Cambridge University Press.

Giles, H. (1970). Evaluative reactions to accents. *Educational review*, 22(3):211–227.

Ginzburg, L. R. and Jensen, C. X. (2004). Rules of thumb for judging ecological theories. *Trends in Ecology & Evolution*, 19(3):121–126.

Gladstone, W. E. (1888). The phonograph's salutation. Taken from https://archive.org/details/EDIS-SRP-0190-12.

Glauser, B. (1988). Aitken's context in Northumberland, Cumberland and Durham: A computer-assisted analysis of material from the Survey of English Dialects (SED). In Thomas, A., editor, *Methods in dialectology: Proceedings of the 6th international conference held at the University College of North Wales*, pages 611–624.

Goldsmith, J. A., Riggle, J., and Alan, C. (2011). *The handbook of phonological theory*, volume 75. John Wiley & Sons.

Gordon, E., Maclagan, M., and Hay, J. (2007). The ONZE corpus. In Beal, J. C., Corrigan, K., and Moisl, H., editors, *Models and methods in the handling of unconventional digital corpora*, volume 2, pages 82–104. Palgrave Macmillan.

Gordon, M. (2004). The West and Midwest: Phonology. In Kortmann, B. and Schneider, E. W., editors, *A Handbook of Varieties of English*, volume 1, pages 338–350. Walter de Gruyter.

Gottfried, M., Miller, J. D., and Meyer, D. J. (1993). Three approaches to the classification of American English diphthongs. *Journal of phonetics*, 21(3):205–229.

Great Britain Historical GIS Project (2004). Great Britain historical GIS. Taken from http://www.visionofbritain.org.uk/census/Cen_Guide.

Gregg, R. J. (1957). Notes on the pronunciation of Canadian English as spoken in Vancouver. *BC Journal of the Canadian Linguistic Association*, 3(1):20–26.

Gregg, R. J. (1973). Diphthongs əi and ai in Scottish, Scotch-Irish and Canadian English. *Canadian Journal of Linguistics*, 18(2):137–145.

Gries, S. T. (2013). *Statistics for linguistics with R: a practical introduction.* Walter de Gruyter.

Gussenhoven, C. (2007). A vowel height split explained: Compensatory listening and speaker control. In Cole, J. and Hualde, J. I., editors, *Laboratory Phonology 9*, pages 145–172. Mouton De Gruyter.

Haddican, B., Foulkes, P., Hughes, V., and Richards, H. (2013). Interaction of social and linguistic constraints on two vowel changes in northern England. *Language Variation and Change*, 25(3):371–403.

Hall, K. C. (2003). The perception of contrast and the Scottish Vowel Length Rule. Unpublished Undergraduate Dissertation, University of North Carolina.

Hall, K. C. (2005). Defining phonological rules over lexical neighbourhoods: Evidence from Canadian Raising. In Alderete, J., Han, C., and Kochetov, A., editors, *Proceedings of the 24th West Coast Conference on Formal Linguistics*, Cascadilla Proceedings Project, pages 191–199, Somerville, MA.

Hall-Lew, L. (2011). The completion of a sound change in California English. *Proceeding of the International Congress of Phonetic Sciences*, 17:807–810.

Hamer, A. (2007). English on the Isle of Man. In Britain, D., editor, *Language in the British Isles*, pages 171–175. Cambridge: Cambridge University Press.

Harrington, J. and Cassidy, S. (1994). Dynamic and target theories of vowel classification: Evidence from monophthongs and diphthongs in Australian English. *Language and Speech*, 37(4):357–373.

Harris, J. (1985). *Phonological variation and change.* Studies in Hiberno-English. Cambridge: Cambridge University Press.

Harris, J. (2012). The foot as a phonotactic domain: 'aw' and 'wa' in English. *UCL Working Papers in Linguistics*, 24.

Hay, J. and Jannedy, S. (2003). *Probabilistic linguistics.* MIT Press.

Hay, J., Jannedy, S., and Mendoza-Denton, N. (1999). Oprah and /ay/: Lexical frequency, referee design, and style. In Ohala, J., Hasegawa, Y., Ohala, M., Granville, D., and Bailey, A. C., editors, *Proceedings of the 14th International Congress of Phonetic Sciences*, pages 1389–1392.

Hayes, B. (2008). *Introductory phonology.* Oxford: Wiley-Blackwell.

Hegyi, G. and Garamszegi, L. Z. (2011). Using information theory as a substitute for stepwise regression in ecology and behavior. *Behavioral Ecology and Sociobiology*, 65(1):69–76.

Her Majesty's Home State Department (2007). Online historical population reports. University of Essex Online. Census of Great Britain or England and Wales 1801-1931.

Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing and Health*, 31(2):180–191.

Heywood, T. (1862). *On the south Lancashire dialect.* Printed for the Chetham society.

Hickey, R. (1996). Lenition in Irish English. In Henry, A., Ball, M., and MacAliske, M., editors, *Papers from the International Conference on Language in Ireland*, volume 13 of *Belfast Working Papers in Language and Linguistics*, pages 173–93. Belfast: University of Ulster.

Hickey, R. (1998). The Dublin vowel shift and the historical perspective. In Fisiak, J. and Krygier, M., editors, *English Historical Linguistics 1996*, pages 79–106. Mouton De Gruyter.

Hickey, R. (1999a). Dublin English: Current changes and their motivations. In Foulkes, P. and Docherty, G., editors, *Urban voices: Accent studies in the British Isles*, pages 265–81. London: Edward Arnold.

Hickey, R. (1999b). Ireland as a linguistic area. In Mallory, J. P., editor, *Language in Ulster*, volume 45 of *Ulster Folklife*, pages 36–53. Holywood, Co. Down: Ulster Folk and Transport Museum.

Hickey, R. (2004a). Mergers, near-mergers and phonological interpretation. In Kay, C. J., Hough, C., and Wotherspoon, I., editors, *New Perspectives on English Historical Linguistics*, pages 125–37. John Benjamins Publishing.

Hickey, R. (2004b). The phonology of Irish English. In Kortmann, B. and Schneider, E. W., editors, *Handbook of varieties of English. Volume 1: Phonology*, pages 68–97. Mouton De Gruyter.

Hickey, R. (2004c). *A sound atlas of Irish English*, volume 1. Walter de Gruyter.

Hickey, R. (2008). Feature loss in 19th century Irish English. In Nevalainen, T., Taavitsainen, I., Pahta, P., and Korhonen, M., editors, *The Dynamics of Linguistic Variation*, pages 229–243. Amsterdam: John Benjamins.

Hillenbrand, J., Ingrisano, D. R., Smith, B. L., and Flege, J. E. (1984). Perception of the voiced–voiceless contrast in syllable-final stops. *The Journal of the Acoustical Society of America*, 76(1):18–26.

Hintze, J. L. and Nelson, R. D. (1998). Violin plots: a box plot-density trace synergism. *The American Statistician*, 52(2):181–184.

Hirata, Y. (2004). Effects of speaking rate on the vowel length distinction in Japanese. *Journal of Phonetics*, 32(4):565–589.

Holmes, J. (1994). New Zealand flappers: an analysis of 't' voicing in a sample of New Zealand English. *English World-Wide*, 15(2):195–224.

Honeybone, P. (2001). Lenition inhibition in Liverpool English. *English Language and Linguistics*, 5(2):213–249.

Honeybone, P. (2004). Influences in Liverpool English koineisation. In *Symposium on the Influence of the Languages of Ireland and Scotland on Linguistic Varieties in Northern England*. University of Aberdeen.

Honeybone, P. (2007). New-dialect formation in nineteenth century Liverpool: a brief history of Scouse. In Grant, A. and Grey, C., editors, *The Mersey sound: Liverpool's language, people, and places*, pages 106–140. Open House Press.

Honeybone, P. and Watson, K. (2004). The (continuing) development of Scouse: language meets history, society and culture. In *Inaugural Conference of the Centre for Liverpool and Merseyside Studies*. Liverpool John Moores University.

Hooper, J. B. (1976). Word frequency in lexical diffusion and the source of morphophonological change. In Christie, W., editor, *Current progress in historical linguistics*, pages 96–105. Amsterdam: North Holland.

House, A. S. and Fairbanks, G. (1953). The influence of consonant environment upon the secondary acoustical characteristics of vowels. *The Journal of the Acoustical Society of America*, 25(1):105–113.

Hume, E. (2001). Corpus-based phonology: Exploring phonological variation in conversation. Paper presented at *Mid-West Conference on Phonology.*

Hussein, L. (1994). *Voicing-dependent vowel duration in standard Arabic and its acquisition by adult American students.* PhD thesis, The Ohio State University.

Idsardi, W. (2006). Canadian raising, opacity, and rephonemicization. *The Canadian Journal of Linguistics/La revue canadienne de linguistique*, 51(2):119–126.

International Phonetic Association (1999). *Handbook of the International Phonetic Association: A guide to the use of the International Phonetic Alphabet.* Cambridge: Cambridge University Press.

Ivanovic, R. (2009). On some phonological processes in English place names. In Čubrović, B. and Paunović, T., editors, *Ta(l)king English Phonetics Across Frontiers*, pages 131 – 142. Cambridge: Cambridge Scholars Publishing.

Jensen, J. T. (2000). Against ambisyllabicity. *Phonology*, 17(2):187–235.

Jespersen, O. (1909). *A modern English grammar on historical principles. P. 1, Sounds and spellings.* Munksgaard/Allen & Unwin.

Johnson, K. (2011). *Acoustic and auditory phonetics.* John Wiley and Sons.

Johnson, K. and Martin, J. (2001). Acoustic vowel reduction in creek: Effects of distinctive length and position in the word. *Phonetica*, 58(1-2):81–102.

Johnston, P. (1985). Linguistic atlases and sociolinguistics. In Kirk, J. M., Sanderson, S., and Widdowson, J. D., editors, *Studies in Linguistic Geography*, pages 81–93. Beckenham: Croom Helm.

Joos, M. (1942). A phonological dilemma in canadian english. *Language*, 18(2):141–144.

Joyce, P. W. and Dolan, T. (1910). *English as we speak it in Ireland*. Longmans, Green and Co.

Juneau, M. (1972). *Contribution à l'histoire de la prononciation française au Québec: études des graphies des documents d'archives*. Presses de l'Université Laval.

Kahn, D. (1976). *Syllable-based generalizations in English phonology*. PhD thesis, Massachusetts Institute of Technology.

Kallen, J. L. (2013). *Irish English: The Republic of Ireland*, volume 2. Walter de Gruyter.

Kallmeyer, W. and Keim, I. (2003). Linguistic variation and the construction of social identity in a German-Turkish setting. *Discourse constructions of youth identities*, 110:29.

Kaye, J. (1990). What ever happened to dialect b? In Mascaró, J. and Nespor, M., editors, *Grammar in Progress: GLOW Essays for Henk van Riemsdijk*, number 36 in Studies in Generative Grammar, pages 259–263. Walter de Gruyter.

Kendall, T. and Thomas, E. R. (2009-2014). Vowels: Vowel manipulation, normalization, and plotting in R. R package (version 1.2-1). [Software Resource].

Kennedy, L. and Clarkson, L. (1999). *Mapping the Great Irish Famine: A survey of the famine decades*. Four Courts Press Ltd.

Kerrigan, J. (1996). Introduction. In Robinson, P., editor, *Liverpool Accents: Seven Poets and a City: an Anthology*, pages 1 – 8. Liverpool University Press.

Kerswill, P. (1996). Children, adolescents, and language change. *Language Variation and Change*, 8(2):177–202.

Kerswill, P. (2003). Dialect levelling and geographical diffusion in British English. In Britain, D. and Cheshire, J., editors, *Social dialectology: in honour of Peter Trudgill*, pages 223–243. Amsterdam: Benjamins.

Kerswill, P., Torgersen, E. N., and Fox, S. (2008). Reversing drift: Innovation and diffusion in the london diphthong system. *Language Variation and Change*, 20(03):451–491.

King, R. D. (1972). A note on opacity and paradigm regularity. *Linguistic Inquiry*, 3(4):535–539.

Kiparsky, P. (1973). *Abstractness, opacity and global rules*. Indiana University Linguistics Club.

Knooihuizen, R. (2009). Shetland Scots as a new dialect: phonetic and phonological considerations. *English Language and Linguistics*, 13(3):483–501.

Knowles, G. (1973). *Scouse: the spoken dialect of Liverpool*. PhD thesis, Leeds University.

Kolb, E., Glauser, B., Elmer, W., and Stamm, R. (1979). *Atlas of English sounds*. Bern: Francke.

Kortmann, B., Schneider, E. W., Burridge, K., Mesthrie, R., and Upton, C. (2004). *A handbook of varieties of English: a multimedia reference tool*. Walter de Gruyter.

Krashen, S. D. and Seliger, H. W. (1976). The role of formal and informal environments in second language learning: A pilot study. *Linguistics*, 14(172):15–22.

Kwong, K. and Stevens, K. N. (1999). On the voiced-voiceless distinction for writer/rider. *Speech Communication Group Working Papers*, 11:11–1.

Labov, W. (1963). The social motivation of a sound change. *Word-Journal of the International Linguistic Association*, 19(3):273–309.

Labov, W. (1966). *The Social Stratification of English in New York City*. Washington DC: Center for Applied Linguistics.

Labov, W. (1972a). The social motivation of a sound change. In Labov, W., editor, *Sociolinguistic patterns*, pages 1–42. University of Pennsylvania Press.

Labov, W. (1972b). *Sociolinguistic patterns.* University of Pennsylvania Press.

Labov, W. (1990). The intersection of sex and social class in the course of linguistic change. *Language Variation and Change*, 2(2):205–254.

Labov, W. (1994). *Principles of linguistic change. Vol. 1: Internal features.* Oxford: Blackwell.

Labov, W. (2001). *Principles of linguistic change Volume 2: Social factors.* Oxford: Blackwell.

Labov, W., Ash, S., and Boberg, C. (2005). *The atlas of North American English: Phonetics, phonology and sound change.* Walter de Gruyter.

Labov, W. and Rosenfelder, I. (2011). The Philadelphia neighborhood corpus. Resource from the University of Philadelphia.

Lackey, N. R., Wingate, A. L., Brink Pamela, J., and Wood Marilynn, J. (1998). The pilot study: One key to research success. In Brink, P. J. and Wood, M. J., editors, *Advanced design in nursing research*, pages 375–386. Sage Publications London.

Ladefoged, P. (1996). *Elements of acoustic phonetics.* University of Chicago Press.

Ladefoged, P. and Johnson, K. (2014). *A course in phonetics.* Cengage learning.

Lahiri, A. and Plank, F. (2010). Phonological phrasing in germanic: the judgement of history, confirmed through experiment. *Transactions of the Philological Society*, 108(3):370–398.

Lancaster, G. A., Dodd, S., and Williamson, P. R. (2004). Design and analysis of pilot studies: recommendations for good practice. *Journal of evaluation in clinical practice*, 10(2):307–312.

Lang, K. and Lang, G. E. (1953). The unique perspective of television and its effect: A pilot study. *American Sociological Review*, 18(1):3–12.

Lass, R. (1976). *English phonology and phonological theory: synchronic and diachronic studies*. Cambridge: Cambridge University Press.

Lass, R. (1981). Undigested history and synchronic 'structure'. In Goyvaerts, D. L., editor, *Phonology in the 1980s*, volume 4, pages 525 – 544. John Benjamins Publishing.

Lass, R. (1987). *The shape of English: structure and history*. London: Dent.

Lass, R. (1990). Early mainland residues in southern Hiberno-English. *Irish University Review*, 20(1):137–148.

Lass, R. (1992). Phonology and morphology. In Blake, N. F., editor, *The Cambridge history of the English language. Vol. 2, 1066-1476*, pages 23–155. Cambridge: Cambridge University Press.

Lass, R. (1997). *Historical linguistics and language change*. Cambridge: Cambridge University Press.

Lass, R. (2000). The phonology and morphology. In Blake, N. F., editor, *The Cambridge history of the English language Vol. III 1476-1776*, pages 23—155. Cambridge: Cambridge University Press.

Lehiste, I. and Peterson, G. E. (1961). Transitions, glides, and diphthongs. *The Journal of the Acoustical Society of America*, 33(3):268–277.

Lindblom, B. (1963). Spectrographic study of vowel reduction. *The Journal of the Acoustical Society of America*, 35(11):1773–1781.

Liverpool City Council (2013). Liverpool economic briefing 2013. Online Report taken from http://liverpool.gov.uk.

Liverpool City Council (2014). Ward profiles. Taken from http://liverpool.gov.uk/council/key-statistics-and-data/ward-profiles/ward-map/. Crown Copyright: 100018351 2014.

Llamas, C. (2000). Middlesbrough English: Convergent and divergent trends in a part of Britain with no identity. *Leeds Working Papers in Linguistics and Phonetics*, 8:123–48.

Llamas, C., Watt, D., and Johnson, D. E. (2009). Linguistic accommodation and the salience of national identity markers in a border town. *Journal of Language and Social psychology*, 28(4):381–407.

Llisterri, J. (1992). Speaking styles in speech research. Paper presented at *Workshop on Integrating Speech and Natural Language.*

Lobanov, B. M. (1971). Classification of Russian vowels spoken by different speakers. *The Journal of the Acoustical Society of America*, 49(2B):606–608.

Lodge, K. (1966). The Stockport dialect. *Le maitre phonétique*, 126:26–30.

Longley, P., Singleton, A., Webber, R., and Lloyd, D. (2014). Great Britain family names profiling website. Taken from http://gbnames.publicprofiler.org/.

Luick, K. (1896). *Untersuchungen zur englischen Lautgeschichte.* KJ Trübner.

Luick, K. (1900). Der ursprung der neuenglischen ai- und au- diphthonge. *Englische Studien*, 27:89–100.

Luick, K., Wild, F., and Koziol, H. (1929 – 1940). *Historische Grammatik der englischen Sprache*, volume 2. Stuttgart: Bernhard Tauchnitz.

Macaulay, R. K. and Trevelyan, G. (1973). Language, education and employment in Glasgow. *Final report to the Social Science Research Council.*

MacMahon, M. K. (1998). Phonology. In Romaine, S., editor, *The Cambridge history of the English language*, volume 4, pages 373–535. Cambridge: Cambridge University Press.

MacRaild, D. M. (1999). *Irish migrants in modern Britain, 1750-1922.* Macmillan Basingstoke.

Maddieson, I. (1984). *Patterns of sounds.* Cambridge: Cambridge University Press.

Magnus, P. M. (1960). *Gladstone: a biography.* E.P. Dutton and Co. Inc.

Maguire, W. (2013). The dialect of the Holy Island of Lindisfarne. Paper presented at *UK Language Variation and Change conference.*

Maguire, W. (2015). The north above the North: Scotland and Northern English. In Hickey, R., editor, *Researching Northern English*. Amsterdam: John Benjamins.

Maguire, W., Honeybone, P., and Cardoso, A. (2015). Voicing effects in the PRICE vowel in traditional dialects. In preparation.

Maguire, W. N. (2007). *What is a merger, and can it be reversed?: the origin, status and reversal of the 'NURSE-NORTH merger' in Tyneside English*. PhD thesis, Newcastle University.

Malecot, A. (1960). Nasal syllabics in American English. *Journal of speech and hearing research*, 3:268–274.

Martinet, A. (1952). Function, structure, and sound change. *Word-Journal of the International Linguistic Association*, 8(1):1–32.

Mather, J. Y. and Speitel, H. (1977). *The Linguistic Atlas of Scotland*, volume 2. London: Croom Helm.

McClure, J. D. (1977). Vowel duration in a Scottish accent. *Journal of the International Phonetics Association*, 7(1):10–16.

McInnis, M. (2000). The population of Canada in the nineteenth century. In Haines, M. R. and Stecke, R. H., editors, *A population history of North America*, pages 371–432. Cambridge: Cambridge University Press.

McLennan, D., Barnes, H., Noble, M., Davies, J., Garratt, E., and Dibben, C. (2011). The English indices of deprivation 2010. *London: Department for Communities and Local Government*.

McMahon, A. M. (1991). Lexical phonology and sound change: the case of the Scottish Vowel Length Rule. *Journal of Linguistics*, 27(1):29–53.

McMahon, A. M. (2000). *Lexical phonology and the history of English*. Cambridge: Cambridge University Press.

McNeill, J. (2009). Acceptable accents: Do regional accents 'fit' within the discourses of higher education. Paper presented at *Widening Patricipation Research Centre Knowledge Exchange Seminar*.

Mendoza-Denton, N. (2008). *Homegirls: Language and cultural practice among Latina youth gangs*. John Wiley and Sons.

Milroy, J. (1996). Variation in /ai/ in Northern British English, with comments on Canadian Raising. *University of Pennsylvania Working Papers in Linguistics*, 3(1):213–221.

Milroy, J., Milroy, L., Hartley, S., and Walshaw, D. (1994). Glottal stops and tyneside glottalization: Competing patterns of variation and change in british english. *Language Variation and Change*, 6(03):327–357.

Milroy, L. and Gordon, M. (2003). *Sociolinguistics: Method and interpretation*. John Wiley and Sons.

Milroy, L. and Gordon, M. (2008). *Sociolinguistics: Method and interpretation*, volume 13. John Wiley & Sons.

Minkova, D. (2013). *A historical phonology of English*. Oxford University Press.

Moag, R. F. and Narayan, R. (1977). *Fiji Hindi: Phījī Hindīj: a basic course and reference grammar*. Australian National University Press in collaboration with Extension Services, University of the South Pacific, Suva, Fiji (Canberra).

Montgomery, C. (2007). Perceptions of Liverpool English. In Grant, A. and Grey, C., editors, *The Mersey Sound: Liverpools Language, People and Places*, pages 164–185. Open House Press.

Moreton, E. (2004). Realization of the English postvocalic [-voice] contrast in f1 and f2. *Journal of Phonetics*, 32(1):1–33.

Moreton, E. and Thomas, E. R. (2007). Origins of Canadian Raising in voiceless-coda effects: a case study in phonologization. In Cole, J. and Hualde, J. I., editors, *Laboratory Phonology 9*, pages 37–64. Mouton De Gruyter.

Mufwene, S. S. (1996). The founder principle in creole genesis. *Diachronica*, 13(1):83–134.

Mundry, R. and Nunn, C. L. (2009). Stepwise model fitting and statistical inference: turning noise into signal pollution. *The American Naturalist*, 173(1):119–123.

Munro, A. and Sim, D. (2001). *The Merseyside Scots: a study of an expatriate community*. Liver Press.

Nakatani, C., Hirschberg, J., and Grosz, B. (1995). Discourse structure in spoken language: Studies on speech corpora. Paper presented at *AAAI Spring Symposium on Empirical Methods in Discourse Interpretation and Generation*.

Neal, F. (1988). *Sectarian Violence: The Liverpool Experience, 1819-1914: an Aspect of Anglo-Irish History*. Manchester University Press.

Newbrook, M. (1999). West Wirral: norms, self reports and usage. *Urban voices: Accent studies in the British Isles*, pages 90–106.

Nunberg, G. (1980). A falsely reported merger in eighteenth century English: A study in diachronic variation. In Labov, W., editor, *Locating language in time and space*, pages 221 – 250. Academic Press: New York.

Office for National Statistics (2001). 200 years of the census. Taken from http://www.ons.gov.uk/ons/guide-method/census/1991-and-earlier-censuses/census-bicentenary/history-of-the-census/index.html.

Office for National Statistics (2011a). 2011 census variable and classification information: Part 4. Taken from http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/information-by-variable/index.html.

Office for National Statistics (2011b). Census 2011. Taken from www.ons.gov.uk.

Office for National Statistics (2014). Standard occupation classification 2010. Taken from http://www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/soc2010/soc2010-volume-1-structure-and-descriptions-of-unit-groups/index.html.

Office of the Chief Executive (2012). Liverpool ward profiles summary: Autumn 2012. Online report taken from http://liverpool.gov.uk, Liverpool City Council.

Ogura, M. (1987). *Historical English Phonology: A lexical perspective*. Tokyo: Kenkyusha.

Ogura, M. (1990). *Dynamic dialectology: A study of language in time and space*. Tokyo: Kenkyusha.

Ogura, M., Wang, W., and Cavalli-Sforza, L. (1998). The development of ME /ī/ in England: A study in dynamic dialectology. In Fisiak, J. and Oizumi, A., editors, *English historical linguistics and philology in Japan*, pages 237 – 286. Walter de Gruyter.

Onyut, L. P., Neuner, F., Schauer, E., Ertl, V., Odenwald, M., Schauer, M., and Elbert, T. (2005). Narrative exposure therapy as a treatment for child war survivors with posttraumatic stress disorder: Two case reports and a pilot study in an African refugee settlement. *BMC psychiatry*, 5(7). Taken from http//10.1186/1471-244X-5-7.

Orton, H. (1933). *The phonology of a south Durham dialect: descriptive, historical, and comparative*. K. Paul, Trench, Trubner & Co. Ltd.

Orton, H. (1962). *Survey of English Dialects: Introduction*. Leeds: Edward Arnold.

Orton, H. and Barry, M. V. (1969). *Survey of English Dialects: Volume 2: The West Midland Counties*. Leeds: Edward Arnold.

Orton, H. and Dieth, E. (1962-1971). *Survey of English Dialects*. University of Leeds.

Orton, H. and Halliday, W. J. (1962). *Survey of English Dialects: Volume 1: Six Northern Counties and the Isle of Man*. Leeds: Edward Arnold.

Orton, H., Sanderson, S., and Widdowson, J. (1978). *The Linguistic Atlas of England*. London: Croom Helm.

Owen, A. and Watson, K. (2009). The production and perception of NURSE and SQUARE in Wigan. Paper presented at *UK Language Variation and Change conference*.

Oxford English Dictionary (2008). Oxford english dictionary online. Taken from http://www.oed.com.

Paton, H. (2013). Influence of Liverpool Welsh on lenition in Liverpool English. Master's thesis, Bangor University.

Peeters, W. J. and Barry, W. J. (1989). Diphthong dynamics: production and perception in Southern British English. In *First European Conference on Speech Communication and Technology*, pages 1055–1058.

Penhallurick, R. (2004). Welsh English: phonology. In Kortmann, B. and Schneider, E. W., editors, *A Handbook of Varieties of English*, volume 1, pages 98–112. Walter de Gruyter.

Penny, R. J. (2000). *Variation and change in Spanish*. Cambridge: Cambridge University Press.

Perrien, J. and Ricard, L. (1995). The meaning of a marketing relationship: a pilot study. *Industrial Marketing Management*, 24(1):37–43.

Petyt, K. M. (1980). *The study of dialect: An introduction to dialectology*. Andre Deutsch.

Phillips, B. S. (1984). Word frequency and the actuation of sound change. *Language*, 60(2):320–342.

Picard, M. (1977). Canadian Raising - case against reordering. *Canadian Journal of Linguistics - Revue Canadienne de Linguistique*, 22(2):144–155.

Picton, J. (1888). Does Mr. Gladstone speak with a provincial accent. *Notes and Queries*, 7(6):210–211.

Picton, J. A. (1875). *Memorials of Liverpool, Historical and Topographical*, volume 2. Longmans, Green & Company.

Pierrehumbert, J. B. (2001). Lenition and contrast. In Bybee, J. and Hopper, P., editors, *Frequency and the emergence of linguistic structure*, pages 137–158. John Benjamins Publishing.

Pitermann, M. (2000). Effect of speaking rate and contrastive stress on formant dynamics and vowel perception. *The Journal of the Acoustical Society of America*, 107(6):3425–3437.

Podesva, R. J. and Sharma, D. (2014). *Research methods in linguistics*. Cambridge: Cambridge University Press.

Port, R. F. and Dalby, J. (1982). Consonant/vowel ratio as a cue for voicing in English. *Perception and Psychophysics*, 32(2):141–152.

Power, M. J. (1992). The growth of Liverpool. In *Popular Politics, Riot and Labour: Essays in Liverpool History 1790-1940*, pages 21–37. Belchem, John.

Preston, D. R. (1999). A language attitude approach to the perception of regional variety. *Handbook of Perceptual Dialectology*, 1:359–373.

Primer, S. (1890). The pronunciation of Fredericksburg, Va. *Publications of the Modern Language Association of America*, 5(2):185–199.

R Core Team (2013). R: A language and environment for statistical computing. [Software Resource]. ISBN 3-900051-07-0.

Rácz, P. (2013). *Salience in sociolinguistics: A quantitative approach*. Walter de Gruyter.

Rice, K. (2006). Ethical issues in linguistic fieldwork: An overview. *Journal of Academic Ethics*, 4(1-4):123–155.

Richards, S. A., Whittingham, M. J., and Stephens, P. A. (2011). Model selection and model averaging in behavioural ecology: the utility of the it-aic framework. *Behavioral Ecology and Sociobiology*, 65(1):77–89.

Richins, M. L. (1983). Negative word-of-mouth by dissatisfied consumers: a pilot study. *The Journal of Marketing*, 47(1):68–78.

Rivard, A. (1914). *Études sur les parlers de France au Canada*. JP Garneau.

Roberts, J. (2007). Vermont lowering? Raising some questions about /ai/ and /au/ south of the Canadian border. *Language Variation and Change*, 19(2):181–197.

Roca, I. and Johnson, W. (1999). *A Course in Phonology*. Oxford: Blackwell.

Roeder, R. (2009). The effects of phonetic environment on english /æ/ among speakers of Mexican heritage in Michigan. *Toronto Working Papers in Linguistics*, 31.

Roscoe, W. (1777). *Mount Pleasant: a descriptive poem. To which is added, an Ode. [By William Roscoe.]*. Printed by W. Eyres, for J. Johnson, and S. Crane: Warrington.

Ross, F., Stead, R., and Holderness, T. (1877). *A Glossary of Words Used in Holderness in the East-Riding of Yorkshire: By Frederick Ross,... Richard Stead,... and Thomas Holderness*. English Dialect Society.

RStudio (2012). Rstudio: Integrated development environment for R (version 0.98.501). [Software Resource]. Boston, MA.

Rutter, B. (2011). Acoustic analysis of a sound change in progress: The consonant cluster/str/in English. *Journal of the International Phonetic Association*, 41(1):27–40.

Samuels, M. L. (1972). *Linguistic evolution: with special reference to English*. Cambridge: Cambridge University Press.

Sangster, C. M. (2001). Lenition of alveolar stops in Liverpool English. *Journal of Sociolinguistics*, 5(3):401–412.

Schafer, A. J., Speer, S. R., Warren, P., and White, S. D. (2005). Prosodic influences on the production and comprehension of syntactic ambiguity in a game-based conversation task. In Tanenhaus, M. and J., T., editors, *Approaches to studying world situated language use: Psycholinguistic, linguistic and computational perspectives on bridging the product and action tradition*, pages 209–225. MIT Press Cambridge.

Schilling-Estes, N. (1998). Investigating self-conscious speech: The performance register in Ocracoke English. *Language in Society*, 27(1):53–83.

Schilling-Estes, N. and Wolfram, W. (1997). Symbolic identity and language change: A comparative analysis of post-insular /ay/ and /aw/. *University of Pennsylvania Working Papers in Linguistics*, 4(1):83–109.

Schreier, D. and Trudgill, P. (2006). The segmental phonology of nineteenth-century Tristan da Cunha English: convergence and local innovation. *English Language and Linguistics*, 10(1):119–141.

Scobbie, J. M., Gordeeva, O. B., and Matthews, B. (2006). Acquisition of Scottish English phonology: an overview. *QMU Speech Science Research Centre Working Papers*.

Scobbie, J. M., Hewlett, N., and Turk, A. E. (1999a). Standard English in Edinburgh and Glasgow: the Scottish Vowel Length Rule revealed. In Foulkes, P. and Docherty, G., editors, *Urban Voices: Accent studies in the British Isles*, pages 230–245. London: Edward Arnold.

Scobbie, J. M. and Stuart-Smith, J. (2008). Quasi-phonemic contrast and the fuzzy inventory: Examples from Scottish English. In Avery, P., Dresher, E., and Rice, K., editors, *Contrast: Perception and Acquisition: Selected Papers from the Second International Conference on Contrast in Phonology*, pages 87–113. Berlin: Mouton de Gruyter.

Scobbie, J. M., Turk, A., and Hewlett, N. (1999b). Morphemes, phonetics and lexical items: The case of the Scottish Vowel Length Rule. In *Proceedings of the XIVth International Congress of Phonetic Sciences.*, volume 2, pages 1617–1620. International Congress of Phonetic Sciences.

Scott, D. (1907). *Liverpool.* London: Adam and Charles Black.

Self, D. J., Schrader, D., Baldwin, D., and Wolinsky, F. (1993). The moral development of medical students: a pilot study of the possible influence of medical education. *Medical education*, 27(1):26–34.

Selkirk, E. O. (1972). *The phrase phonology of English and French.* PhD thesis, Massachusetts Institute of Technology.

Selkirk, E. O. (1995). The prosodic structure of function words. *University of Massachusetts Occasional Papers in Linguistics*, 18:439–470.

Selkirk, E. O. (1996). The prosodic structure of function words. In Morgan, J. and Demuth, K., editors, *Signal to syntax: Bootstrapping from speech to grammar in early acquisition*, pages 187–214. Mahwah, NJ: Erlbaum.

Seltman, H. J. (2012). Experimental design and analysis. Taken from http://www.stat.cmu.edu/ hseltman/309/Book/Book.pdf.

Shattuck-Hufnagel, S. and Veilleux, N. (2000). The special phonological characteristics of monosyllabic function words in American English. In *Proceedings of the 6th International Conference on Spoken Language Processing*, volume 1, pages 540–543.

Shewmake, E. F. (1925). Laws of pronunciation in eastern Virginia. *Modern Language Notes*, 40(8):489–492.

Shorrocks, G. (1998). *Dialect of the Bolton Area: Part I–Introduction Phonology.* Frankfurt am Main: Peter Lang.

Shryock, H. S., Siegel, J. S., and Larmon, E. A. (1980). *The methods and materials of demography*, volume 2. Department of Commerce, Bureau of the Census, fourth edition.

Sim, D. (2011). The Scottish community and Scottish organisations on Merseyside: Development and decline of a diaspora. *Journal of Scottish Historical Studies*, 31(1):99–118.

Skandera, P. and Burleigh, P. (2005). *A manual of english phonetics and phonology.* Tübingen: Gunter.

Smith, J. and Durham, M. (2012). Bidialectalism or dialect death? explaining generational change in the Shetland Islands, Scotland. *American Speech*, 87(1):57–88.

Smith, J. J. (2007). *Sound change and the history of English.* Oxford University Press.

Sosa, A. V. (2008). *Lexical effects in typical phonological acquisition.* ProQuest.

Sóskuthy, M. (2013). *Phonetic biases and systemic effects in the actuation of sound change*. PhD thesis, The University of Edinburgh.

Sóskuthy, M., Hay, J., Maclagan, M., Drager, K., and Foulkes, P. (2015). Early new zealand english: The closing diphthongs. In Hickey, R., editor, *Listening to the Past*. Cambridge: Cambridge University Press. forthcoming.

Stockwell, R. (1961). The middle english “long close” and “long open” mid vowels. *Texas Studies in Literature and Language*, 2(4):529–538.

Stockwell, R. (2002). How much shifting actually occurred in the historical English vowel shift? In Minkova, D. and Stockwell, R., editors, *Studies in the history of the English Language: A millennial perspective*, volume 39, pages 267–282. Walter de Gruyter.

Stockwell, R. and Minkova, D. (1988). The English Vowel Shift: problems of coherence and explanation. In Kastovsky, D. and Bauer, G., editors, *Luick Revisited*, pages 355–94. Tübingen: Gunter Narr Verlag.

Stoddart, J., Upton, C., and Widdowson, J. D. (1999). Sheffield dialect in the 1990s: revisiting the concept of NORMs. In Foulkes, P. and Docherty, G., editors, *Urban Voices: Accent studies in the British Isles*, pages 72–89. London: Edward Arnold.

Stuart-Smith, J. and Timmins, C. (2006). ‘Tell her to shut her moof’: the role of the lexicon in TH-fronting in Glaswegian. In Caie, G. D., Hough, C., and Wotherspoon, I., editors, *The Power of Words: Essays in Lexicography, Lexicology and Semantics. In Honour of Christian J. Kay (Costerus NS 163)*, pages 171 – 184. Editions Rodopi B.V.

Sudbury, A. (2001). Falkland Islands English: A southern hemisphere variety? *English World-Wide*, 22(1):55–80.

Syers, R. (1830). History of Everton.

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., Robson, R., Thabane, M., Giangregorio, L., and Goldsmith, C. H. (2010). A tutorial on pilot studies: the what, why and how. *BMC medical research methodology*, 10(1). Taken from http://www.biomedcentral.com/1471-2288/10/1.

Thomas, C. K. (1961). The phonology of New England English. *Communications Monographs*, 28(4):223–232.

Thomas, E. R. (1991). The origin of Canadian Raising in Ontario. *Canadian Journal of Linguistics - Revue Canadienne de Linguistique*, 36(2):147–170.

Thomas, E. R. (2000). Spectral differences in /ai/ offsets conditioned by voicing of the following consonant. *Journal of Phonetics*, 28(1):1–25.

Thomas, E. R. (2001). *An acoustic analysis of vowel variation in New World English*. Publication of the American Dialect Society. Duke University Press.

Thomas, E. R. (2010). *Sociophonetics: an introduction*. Palgrave Macmillan.

Townsend, J. M. (1989). Mate selection criteria: A pilot study. *Ethology and Sociobiology*, 10(4):241–253.

Trammell, R. L. (1993). English ambisyllabic consonants and half-closed syllables in language teaching. *Language learning*, 43(2):195–238.

Trudgill, P. (1972). Sex, covert prestige and linguistic change in the urban british english of norwich. *Language in society*, 1(2):179–195.

Trudgill, P. (1983). *On dialect: Social and geographical perspectives*. Oxford: Blackwell.

Trudgill, P. (1985). New-dialect formation and the analysis of colonial dialects: the case of Canadian Raising. In Warkentyne, H., editor, *Papers from the 5th International Conference on Methods in Dialectology*, pages 35–45. Victoria: University of Victoria.

Trudgill, P. (1986). *Dialects in contact*. Oxford: Blackwell.

Trudgill, P. (1990a). Dialect geography. In Polome, E. C., editor, *Research Guide on Language Change*, pages 257–271. Berlin: Mouton de Gruyter.

Trudgill, P. (1990b). *The dialects of England*. London: Blackwell.

Trudgill, P. (1999). Norwich: endogenous and exogenous linguistic change. In Foulkes, P. and Docherty, G., editors, *Urban Voices: Accent studies in the British Isles*, pages 124–140. London: Edward Arnold.

Trudgill, P. (2004). *New-Dialect Formation: The Inevitability of Colonial Englishes*. Edinburgh University Press.

Tsukada, K. (2008). An acoustic comparison of English monophthongs and diphthongs produced by Australian and Thai speakers. *English world-wide*, 29(2):194–211.

UK Statistics Authority (2014). Office for national statistics. Taken from http://www.ons.gov.uk/.

Van der Gaaf, W. (1917). *Study of Historical Phonology: inaugural lesson*. Groningen, J.B. Wolters.

Van Son, R. J. and Pols, L. C. (1992). Formant movements of Dutch vowels in a text, read at normal and fast rate. *The Journal of the Acoustical Society of America*, 92(1):121–127.

van Teijlingen, E. and Hundley, V. (2002). The importance of pilot studies. *Nursing Standard*, 16(40):33–36.

Vance, T. J. (1987). Canadian Raising in some dialects of the northern United States. *American Speech*, 62(3):195–210.

Wakelin, M. F. (1972). *English dialects: An introduction*. London: Athlone Press.

Wales, K. (2006). *Northern English: A social and cultural history*. Cambridge: Cambridge University Press.

Wang, H. and Van Heuven, V. J. (2006). Acoustical analysis of English vowels produced by Chinese, Dutch and American speakers. *Linguistics in the Netherlands*, 23(1):237–248.

Watson, K. (2006a). Lenition and segmental interaction: evidence from Liverpool English (and Spanish). *Glossa, I*, 1.

Watson, K. (2006b). Phonological resistance and innovation in the north-west of England. *English Today*, 86:55.

Watson, K. (2007a). Is Scouse getting Scouser? exploring phonological change in contemporary Liverpool English. In Grant, A. and Grey, C., editors, *The Mersey Sound: Liverpool's Language, People and Places*, pages 215–41. Open House Press.

Watson, K. (2007b). *The phonetics and phonology of plosive lenition in Liverpool English*. PhD thesis, University of Lancaster.

Watson, K. and Clark, L. (2011). Capturing listeners' real-time reactions to local and supralocal linguistic features. Paper presented at *Variation and Language Processing Conference*.

Watson, K. and Clark, L. (2015). OLIVE: The Origins of Liverpool English. In Hickey, R., editor, *Listening to the Past*. Cambridge: Cambridge University Press. Forthcoming.

Watt, D. (2002). I dont speak with a Geordie accent, I speak, like, the Northern accent: Contact-induced levelling in the Tyneside vowel system. *Journal of Sociolinguistics*, 6(1):44–63.

Watt, D. and Fabricius, A. (2002). Evaluation of a technique for improving the mapping of multiple speakers vowel spaces in the f1∼f2 plane. In Nelson, D., editor, *Leeds Working Papers in Linguistics and Phonetics 9*, pages 159–173. University of Leeds.

Watt, D. and Ingham, C. (2000). Durational evidence of the Scottish Vowel Length Rule in Berwick English. *Leeds Working Papers in Linguistics and Phonetics*, 8:205–228.

Watt, D., Llamas, C., and Johnson, D. E. (2010). Levels of linguistic accommodation across a national border. *Journal of English Linguistics*, 38(3):270–289.

Watt, D. and Milroy, L. (1999). Patterns of variation and change in three Newcastle vowels: is this dialect levelling. In Foulkes, P. and Docherty, G., editors, *Urban Voices: Accent studies in the British Isles*, pages 25–46. London: Edward Arnold.

Wells, J. C. (1982). *Accents of English*, volume 1. Cambridge: Cambridge University Press.

Wells, J. C. (1990). Syllabification and allophony. In Ramsaran, S., editor, *Studies in the Pronunciation of English, a Commemorative Volume in Honour of AC Gimson*, pages 76–86. London: Routledge.

West, H. F. (2009). 'I'm not Geordie! I'm not actually anything!' Convergent and divergent trends: Dialect levelling and the struggle for identity in a South Durham New-Town. Master's thesis, University of Edinburgh.

Whittingham, M. J., Stephens, P. A., Bradbury, R. B., and Freckleton, R. P. (2006). Why do we still use stepwise modelling in ecology and behaviour? *Journal of animal ecology*, 75(5):1182–1189.

Wickham, H. (2009). ggplot2: An implementation of the grammar of graphics. R package (version 0.8. 3). [Software Resource]. ISBN 978-0-387-98140-6.

Williams, A. and Kerswill, P. (1999). Dialect levelling: continuity vs. change in Milton Keynes, Reading and Hull. In Foulkes, P. and Docherty, G., editors, *Urban Voices: Accent Studies in the British Isles*, pages 141–162. London: Edward Arnold.

Williams, D. and Escudero, P. (2014). A cross-dialectal acoustic comparison of vowels in Northern and Southern British English. *The Journal of the Acoustical Society of America*, 136(5):2751–2761.

Williams, D. P. (2013). *Cross-language acoustic and perceptual similarity of vowels: The role of listeners' native accents*. PhD thesis, University of Sheffield.

Wilson, M. (1988). MRC psycholinguistic database: Machine-usable dictionary (version 2.00). *Behavior Research Methods, Instruments, & Computers*, 20(1):6–10.

Wolfe, P. M. (1972). *Linguistic change and the Great Vowel Shift in English*. University of California Press.

Wolfram, W. A. (1969). A sociolinguistic description of Detroit negro speech. *Language*, 46(3):764–773.

Wood, J. (2011). Short-a in northern New England. *Journal of English Linguistics*, 39(2):135–165.

Wright, R. and Nichols, D. (2009). How to measure vowel formants using praat. Taken from http://courses.washington.edu/l453/Formants.pdf. Information for course on Lab Phonetics.

Wyld, H. C. (1936). *A history of modern colloquial English*. Oxford: Blackwell, 3rd edition.

Yusuf, Y. Q. and Pillai, S. (2013). An acoustic description of diphthongs in two varieties of Acehnese. *Pertanika Journal of Social Sciences and Humanities*, 21:153 – 168.

Zue, V. W. and Laferriere, M. (1979). Acoustic study of medial /t, d/ in American English. *The Journal of the Acoustical Society of America*, 66(4):1039–1050.