2010-07-02

The Effect of First Language Dialect Vowel Mergers on Second Language Perception and Production

Christine Elaine Gardner
Brigham Young University - Provo

Follow this and additional works at: https://scholarsarchive.byu.edu/etd
Part of the Other Languages, Societies, and Cultures Commons

BYU ScholarsArchive Citation
https://scholarsarchive.byu.edu/etd/2158

This Thesis is brought to you for free and open access by BYU ScholarsArchive. It has been accepted for inclusion in All Theses and Dissertations by an authorized administrator of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.
The Effect of First Language Dialect Vowel Mergers on
Second Language Perception and Production

Christine E. Gardner

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Arts

Laura Catharine Smith, Chair
Wendy Baker
Dirk A. Elzinga

Center for Language Studies
Brigham Young University
August 2010

Copyright © 2010 Christine Elaine Gardner
All Rights Reserved
Previous second language (L2) acquisition research has assumed that L2 learners from a common first language (L1) have the same problems in an L2, ignoring the potential impact of a speaker’s L1 dialect on L2 acquisition. This study examines the effects of L1 dialect on the acquisition of L2 German vowels. In particular, this thesis investigates two questions: 1) Do speakers from L1 dialects with vowel mergers perceive or produce vowel contrasts in the L1 and/or L2 differently than speakers from dialect areas without the same mergers? and 2) Are subjects’ patterns of L1 perception or production paralleled in the L2? This thesis focuses on the vowel contrasts “pin”-“pen,” “fail”-“fell,” and “pool”-“pull”-“pole,” which are merged (i.e., neutralized) in some environments in the Mississippi dialect, such that words like “him” and “hem” are heard or produced as the same word. Two groups of subjects participated: students from The University of Mississippi (the merging group) and students from Brigham Young University (BYU) (the non-merging group). Subjects completed a perceptual task and a production task. The perception task was a forced-choice identification task in which subjects heard English and German words and indicated which word they heard. In the production task, subjects read aloud German and English sentences. Results indicate that BYU subjects were significantly better than UMiss subjects at perceiving many vowel contrasts in English and German. Additionally, some perceptual patterns seemed to transfer to the L2, e.g., /m/ and /en/, were identified with similar accuracy in English and in German. In production, the groups differed significantly from each other in their production of many vowel contrasts, while acoustic analysis found no production mergers for either group in English or German. In two case studies, perception results and production results (as found by native speaker judgments), showed that vowel contrasts merged in English were also problematic in L2 German, though the problematic vowel was not necessarily the same. In sum, the UMiss speakers with mergers in their L1 dialect appeared to face different challenges than the BYU speakers when perceiving and producing German vowel contrasts. Results have implications for the L2 classroom and L2 research, suggesting that instructors may need different teaching strategies for speakers from merging dialects.

Keywords: Perception, Production, Vowel Mergers, Mississippi Dialect, English, German, Second Language Acquisition
ACKNOWLEDGEMENTS

I would like to thank many people for helping me complete this thesis and my degree. First, I thank Dr. Laura Catharine Smith for her efforts in stretching me to write a better thesis, and for the many hours spent reviewing and editing my writing. I am grateful to Dr. Wendy Baker for performing all statistical procedures and for her help with my thesis. Thanks also to Dr. Dirk Elzinga for inspiring me in class and for his insights for my thesis. I also appreciate Christine Ricks, Jared Loehrman, Justin Low, Lore Schultheiss, and Dr. Hans-Willhelm Kelling for their help as native speakers and the BYU students who were subjects in this study.

Many thanks to Dr. Christopher Sapp of The University of Mississippi, who wonderfully arranged everything for my trip to Mississippi, and to the students there who hosted me and participated in my study. I am especially grateful to Grace Jacobs, who recorded the Mississippi informants. I also thank the honor society Phi Kappa Phi for the Love of Learning Scholarship, which funded my travel to Mississippi to collect data.

I thank my husband, Michael, for the hours spent helping with graphs and data organization, even in the midst of writing his own thesis. Thanks also to my mother, Alison Craig, for editing help and babysitting my son, Jeffrey, who is a wonderful and patient baby. To my friends and family, thank you for saving my academic soul.

Findings from this thesis were presented at the 2009 Germanic Linguistics Annual Conference, which I was able to attend because of travel funding from the College of Humanities and the Center for Language Studies, for which I am very grateful.
TABLE OF CONTENTS

Table of Contents .............................................................................................................................................. iv
List of Tables ...................................................................................................................................................... vii
List of Figures .................................................................................................................................................... viii
List of Abbreviations ........................................................................................................................................ x
Chapter 1: Introduction ...................................................................................................................................... 1
  1.0 Introduction ................................................................................................................................................ 1
  1.1 Research Questions .................................................................................................................................... 3
  1.2 Delimitations .............................................................................................................................................. 4
  1.3 Thesis Overview ......................................................................................................................................... 5
Chapter 2: Review of the Literature ................................................................................................................... 6
  2.0 Introduction ................................................................................................................................................ 6
  2.1 Theories Regarding L1 Influence on SLA ............................................................................................... 6
  2.2 Additional Factors in SLA .......................................................................................................................... 11
  2.3 L1 Dialect and Transfer to the L2 ............................................................................................................. 13
  2.4 Vowel Mergers .......................................................................................................................................... 17
    2.4.1 Definition of Vowel Mergers ............................................................................................................... 17
    2.4.2 The Relationship between Perception and Production .................................................................. 20
    2.4.3 Vowel Mergers and Transfer of L1 Dialect to the L2 ..................................................................... 22
    2.4.4 Vowel Mergers in Mississippi English ............................................................................................ 23
  2.5 American English Speakers Learning L2 German .................................................................................... 26
  2.6 Conclusion .................................................................................................................................................. 27
Chapter 3: Methodology .................................................................................................................................... 28
  3.0 Introduction ................................................................................................................................................ 28
  3.1 Subjects ...................................................................................................................................................... 29
  3.2 Procedures .................................................................................................................................................. 32
    3.2.1 Perception .............................................................................................................................................. 33
      3.2.1.1 Stimuli .......................................................................................................................................... 33
      3.2.1.2 Procedures .................................................................................................................................. 35
      3.2.1.3 Analysis of perceptual data ....................................................................................................... 36
    3.2.2 Production ............................................................................................................................................ 37
      3.2.2.1 Stimuli .......................................................................................................................................... 37
      3.2.2.2 Procedures .................................................................................................................................. 37
3.2.2.3 Acoustic analysis of production data ................................................................. 38
3.2.2.4 Acoustic data analysis of production data .......................................................... 38
3.3 Conclusion .................................................................................................................. 39
Chapter 4: Results .......................................................................................................... 40
4.0 Introduction ................................................................................................................ 40
4.1 Perception Task ........................................................................................................ 40
  4.1.1 “Pin”-“Pen” Vowel Set ......................................................................................... 41
    4.1.1.1 Tokens from English Informants .................................................................. 41
    4.1.1.2 Tokens from Mississippi Informants ............................................................ 42
    4.1.1.3 Tokens from German Informants ................................................................. 42
  4.1.2 “Fail”-“Fell” Vowel Set ......................................................................................... 43
    4.1.2.1 Tokens from English Informants .................................................................. 43
    4.1.2.2 Tokens from Mississippi Informants ............................................................ 44
    4.1.2.3 Tokens from German Informants ................................................................. 45
  4.1.3 “Pool”-“Pull”-“Pole” Vowel Set .......................................................................... 46
    4.1.3.1 Tokens from English Informants .................................................................. 46
    4.1.3.2 Tokens from Mississippi Informants ............................................................ 47
    4.1.3.3 Tokens from German Informants ................................................................. 48
  4.1.4 Conclusions for Perceptual Task .......................................................................... 49
4.2 Production Task ........................................................................................................ 49
  4.2.1 “Pin”-“Pen” Vowel Set ......................................................................................... 51
    4.2.1.1 Subjects’ English Productions .................................................................. 51
    4.2.1.2 Subjects’ German Productions .................................................................. 53
  4.2.2 “Fail”-“Fell” Vowel Set ......................................................................................... 56
    4.2.2.1 Subjects’ English Productions .................................................................. 56
    4.2.2.2 Subjects’ German Productions .................................................................. 59
  4.2.3 “Pool”-“Pull”-“Pole” Vowel Set .......................................................................... 61
    4.2.3.1 Subjects’ English Productions .................................................................. 61
    4.2.3.2 Subjects’ German Productions .................................................................. 63
  4.2.4 Conclusions for Production Task .......................................................................... 66
4.3 Conclusion ................................................................................................................ 66
Chapter 5: Discussion of Results ..................................................................................... 69
5.0 Introduction ................................................................................................................ 69
5.1 Perception .................................................................................................................. 70
LIST OF TABLES

Table 1. Demographic Information of Subjects ................................................................. 31
Table 2. Comparison of Subjects’ English and German Productions............................... 67
Table 3. Summary of Mergers found in UMiss and BYU Groups' Subjects' Perception and Production.................................................................................................................. 67
Table 4. Comparison of UMiss and BYU vowel identifications........................................ 71
Table 5. Summary of Patterns in L1 and L2 Perception .................................................. 73
Table 6. Review of Production Results for “pin”-“pen,” “fail”-“fell,” and “pool”-“pull”-“pole” ........................................................................................................................................... 76
Table 7. Patterns in Height and Frontedness Productions of “pin”-“pen” ......................... 78
Table 8. Patterns in Height and Frontedness Productions of “fail”-“fell” ......................... 79
Table 9. Patterns in Height and Frontedness Productions of “pool”-“pull”-“pole” .......... 80
Table 10. Comparison of Perception and Production Results from Subject 1 ................. 93
Table 11. Comparison of Perception and Production Results from Subject 12 ............... 95
Table 12. Demographic Information of UMiss Subjects .................................................... 115
Table 13. Demographic Information of BYU Subjects ..................................................... 116
LIST OF FIGURES

Figure 1. Markedness continuum of voicing contrasts (adapted from Eckman, 1977). ..........7
Figure 2. Mississippi English vowel chart (adapted from Fridland, 1998)..................25
Figure 3. Standard North American English vowel chart (Hall, 2003: 108).................25
Figure 4. Standard German vowel chart (Hall, 2003: 107)...................................26
Figure 5. Correct identifications of English and Mississippi /ɪn/ and /ɛn/ tokens..........41
Figure 6. Correct identifications for English and German /ɪn/ and /ɛn/ tokens.............43
Figure 7. Correct identifications for English and Mississippi /e/ and /ɛ/ tokens............44
Figure 8. Correct identifications of English and German /e:/ and /ɛ/ tokens.................45
Figure 9. Correct identifications of English and Mississippi /u/, /ʊ/, and /o/ tokens........46
Figure 10. Correct identifications of English and German /u:/, /ʊ/, and /o:/ tokens.........48
Figure 11. Subjects’ average productions of English /ɪn/ and /ɛn/...........................51
Figure 12. UMiss subjects’ average productions of English /ɪn/ and /ɛn/.....................52
Figure 13. BYU subjects’ average productions of English /ɪn/ and /ɛn/.......................52
Figure 14. Subjects’ average productions of German /ɪn/ and /ɛn/..............................54
Figure 15. UMiss subjects' average productions of German /ɪn/ and /ɛn/......................55
Figure 16. BYU subjects’ average productions of German /ɪn/ and /ɛn/......................55
Figure 17. Subjects’ average productions of English /e/ and /ɛ/.................................57
Figure 18. UMiss subjects' average productions of /e/ and /ɛ/.................................58
Figure 19. BYU subjects’ average productions of /e/ and /ɛ/ ...........................................58
Figure 20. Subjects’ average productions of German /ɛː/ and /ɛ/ ............................................59
Figure 21. UMiss subjects’ average productions of German /ɛː/ and /ɛ/ .................................60
Figure 22. BYU subjects’ average productions of German /ɛː/ and /ɛ/ .................................60
Figure 23. Subjects’ average productions of English /u/, /ʊ/, and /o/ .................................61
Figure 24. UMiss subjects’ average productions of English /u/, /ʊ/, and /o/ .........................62
Figure 25. BYU subjects’ average productions of English /u/, /ʊ/, and /o/ .........................62
Figure 26. Subjects’ average productions of German /uː/, /ʊ/, and /oː/ ...........................64
Figure 27. UMiss subjects’ average productions of German /uː/, /ʊ/, and /oː/ .................65
Figure 28. BYU subjects’ average productions of German /uː/, /ʊ/, and /oː/ .................65
Figure 29. Correct identifications of vowels by Subject 1. .....................................................84
Figure 30. Percent of productions rated as not merged for Subject 1 .................................86
Figure 31. Correct identifications of vowels by Subject 12 ..................................................88
Figure 32. Percent of productions rated as not merged for Subject 12 .........................90
Figure 33. UMiss subjects’ English vowel productions ....................................................131
Figure 34. BYU subjects’ English vowel productions .......................................................132
Figure 35. UMiss subjects’ German vowel productions ..................................................133
Figure 36. BYU subjects’ German vowel productions .....................................................134
LIST OF ABBREVIATIONS

AAVE = African American Vernacular English
AE = American English
ANOVA = Analysis of variance
Avg. = Average
BYU = Brigham Young University
C = Consonant
CAH = Contrastive Analysis Hypothesis
EF = European French
F = Female
L1 = First Language
L2 = Second Language
M = Male
MDH = Markedness Differential Hypothesis
NG = Native German
OPM = Ontogeny-Phylogeny Model
PAM = Perceptual Assimilation Model
QF = Quebec French
SLA = Second Language Acquisition
SLM = Speech Learning Model
HSD = Honestly Significant Difference
UMiss = University of Mississippi
USA = United States of America
V = Vowel
[ₕₜ] = allophone

/ₕₜ/ = phoneme

<ₜₜ> = orthographic form

: = lengthening of a vowel

[r] = apical trill “r”

[R] = uvular trill “r”
CHAPTER 1: INTRODUCTION

1.0 Introduction

Learners of foreign and second languages typically struggle to attain accent-free speech, in part because of influences from their first language (L1), among many other factors such as age (Flege, 1995), experience (Trofimovich & Baker, 2006), and developmental errors, i.e., errors similar to those made by children when learning their L1 (Major, 2001). Because of the influence of the L1, many researchers have proposed theories to explain the impact of the L1 on second language (L2) phonological systems (e.g., Lado, 1957; Eckman, 1977; Flege, 1995; Best, 1995; Major, 2001). Few studies, however, have addressed the impact of L1 dialect on second language acquisition (SLA), possibly because researchers may assume that L2 learners from a common L1 region such as the United States have the same patterns in SLA, even if the speakers come from various dialect areas. However, the small number of studies that have addressed L1 dialectal influence on SLA have shown that L1 dialect does indeed influence L2 perception and production (Grosse & Hameyer, 1979; Broselow, 1983; Teasdale, 1997; Seubsunk, 1999; O’Brien & Smith, in press). One such area of potential dialect influence can be found in the impact of vowel mergers (i.e., the neutralization of vowel contrasts) in a speaker's L1 dialect on the pronunciation of corresponding L2 contrasts, a point which has received little attention outside of research by Grosse and Hameyer (1979); Smith, Gardner, Whitlock, and Fitzner (2007); Smith and Gardner (2007); and Gardner, Smith, and Baker (2009).

The present study investigates this potential L1 dialect influence by researching how speakers with vowel mergers in their L1 dialect perceive and produce these same vowels in L2 German, and if these speakers perceive or produce German differently than English speakers from dialect areas without the same mergers. Speakers with vowel mergers in their L1 dialect
may perceive vowels differently than speakers from other dialects because mergers neutralize phonological contrasts, meaning that two or more separate vowel or consonant sounds become merged into one single sound in certain environments. This neutralization can occur in production or perception or both (Labov, Karen, & Miller, 1991; Labov, Ash, & Boberg, 2006; Bowie, 2003; Di Paolo, 1992). In a production merger, normally distinct sounds are produced as the same sound (Di Paolo, 1992), such as a speaker producing both “pole” and “pull” indistinctly as “pull.” Similarly, perception mergers cause two separate phonemes in a language to be perceived as the same sound (Labov, 1994), e.g., when a listener cannot perceive the difference between “pin” and “pen” and identifies both as “pin.” With mergers the two sounds can become indistinguishable, leading to possible communication difficulties among speakers from different L1 dialects (Labov, 1994; Di Paolo, 1992).

Vowel mergers occur in many American English dialects, and are becoming more common in many dialect areas, including the Mississippi English dialect. The University of Southern Mississippi, for example, published a guide on school nutrition programs which states, “Although there is useful information on the manufacturer Web sites, the Web sites are also intended to market the products for sell [italics added]” (National Food Service). Another merger error occurs on a social-networking website where a user from the Jackson, Mississippi area exclaims, “My last two bosses were fool [italics added] of themselves” (Woozyboozy). In these examples from Mississippi English, the dialect under investigation in this thesis, the authors have confused the correct words, most likely because the vowels in “sale” and “sell” and in “full” and “fool” are merged in their dialect. Such vowel neutralizations in the L1 may lead to potential difficulties in an L2, a possibility this thesis examines.
1.1 Research Questions

Because of this gap in SLA research regarding how L1 dialect vowel mergers can affect L2 acquisition, this thesis investigates how speakers of the Mississippi dialect perceive and produce the vowels in the “pin”-“pen,” “fail”-“fell,” and “pool”-“pull”-“pole” contrasts, which are often merged in the Mississippi dialect, in both English and L2 German. English and German were chosen as the L1 and L2 for this study in part because they both belong to the Germanic language family and therefore share many sound contrasts in addition to the many similarities in their structure and vocabulary.

Subjects who participated in this study were college-aged students recruited from the University of Mississippi (UMiss), who served as the experimental group, and from Brigham Young University (BYU) from areas without the vowel mergers in question, who served as the control group. Subjects were native speakers of English who spoke German as an L2 and were in third semester or higher German courses.

Both a perceptual (forced-choice identification task) and a production (reading-based) task were completed by the subjects in order to answer the questions:

1. a. Do speakers from non-merging dialects differ from speakers of merging dialects, e.g., Mississippi, in their perception of vowels in “merger sets” in L1 English and L2 German?
   b. Are the same patterns found in both the L1 and L2 for subjects’ perception of vowel contrasts in a given environment?

2. a. Do speakers from merging dialects, e.g., Mississippi, and speakers from non-merging dialects differ in terms of production of vowel contrasts in merging environments in the L1 and L2?
b. Are patterns in learners’ productions of L1 vowel contrasts in merging environments also found in their L2 for the same vowel contrasts in the same environments?

1.2 Delimitations

This thesis, as with any work of research, was designed with specific delimitations to constrain the scope of the study. First, only one dialect with vowel mergers was investigated as the experimental dialect in this thesis: the Mississippi English dialect. The inclusion of only one experimental dialect was necessary because of the length of the perceptual task and potential subject fatigue. Additionally, this study examines only native speakers of North American English and not speakers of other varieties of English, such as British English, because these varieties do not have the same underlying phonetic and phonological systems.

Other factors such as age, gender, in-country experience and age of L2 exposure were not examined as specific factors in determining a subject’s pronunciation and perception. While these factors may contribute to L2 proficiency, specific examinations of these influences were outside the scope of the thesis. However, because age contributes to the way a dialect is spoken (Thomas, 2004; Labov et al., 2006), the study did control for age by inviting only college-age subjects to participate.

Finally, this thesis examines only the merger contrasts found in the vowel contrasts “pin”-“pen,” “fail”-“fell,” and “pool”-“pull”-“pole,” although other mergers do exist in Mississippi English and other dialects of North American English.¹ Any additional vowel sets would have increased the length of the perceptual task, possibly leading to fatigue or subject attrition.

¹ Data for the “mile”-“mall” merger contrast was collected, but were ultimately not analyzed because the neutralization of this contrast could be the result of monophthongization or glide deletion (Labov et al., 2006), neither of which play a role in the other vowel mergers investigated in this thesis.
1.3 Thesis Overview

Following this brief overview of the thesis, I turn to a review of the literature in Chapter 2, where I examine concepts such as an overview of SLA theories of perception and production from the perspective of direct and indirect transfer, a summary of the role of dialect in SLA, a description of vowel mergers, and a comparison of Mississippi English, North American English, and Standard German vowel systems. Chapter 3 presents the methodology for the thesis research, including detailed descriptions of the subjects’ backgrounds, a discussion of the perception and production tasks used to elicit data, and information on data analysis. Next, Chapter 4 presents the results of the statistical analysis of the data and reports on statistical significance of the data analysis. Finally, Chapter 5 concludes the thesis with a discussion of the results in order to answer the research questions, the implications of the research, limitations, and suggestions for further research.

Turning now to Chapter 2, the literature review will situate this study in the current context of SLA research and will describe factors important to this research, including language transfer and the Mississippi dialect.
CHAPTER 2: REVIEW OF THE LITERATURE

2.0 Introduction

This chapter provides the context and background for this thesis, which examines how speakers from dialect areas with vowel mergers, e.g., speakers of Mississippi English, perceive and produce English and German vowels in comparison to speakers from areas without vowel mergers. In addition, this thesis investigates whether being a speaker from a merging dialect area affects the perception and production of equivalent vowel contrasts in an L2. To this end, this chapter outlines relevant literature describing the impact of the L1 on learning L2 sounds, the role of L1 dialect in acquiring L2 sounds, vowel mergers in American English dialects, and the vowel systems of Mississippi English, Standard American English, and Standard German. Because this study examines the effects of L1 dialect on L2 perception and production, this chapter will begin with a focus on the impact of the L1 on learning L2 sounds.

2.1 Theories Regarding L1 Influence on SLA

To explain the complex problems L2 language learners encounter when learning to perceive and produce sounds of an L2, SLA researchers have proposed a number of theories explaining the influence that an L1 has on learning an L2. Early theories such as those proposed by Lado (1957), Eckman (1977), and Major (1986, 2001) focused mainly on comparing the phonemic inventories of the L1 and L2, whereas more recent theories have incorporated more phonetically-oriented comparisons of the L1 and L2 (Best, 1995; Flege 1995).

Lado’s (1957) Contrastive Analysis Hypothesis (hereafter CAH) was one of the first widely-influential hypotheses describing the manner in which people learned to pronounce sounds in a foreign language. Lado hypothesized that L2 sounds that were similar to sounds in
the L1 phonemic inventory would be easiest to learn, e.g., English speakers learning Arabic /h/, while sounds in the L2 that were new or different from sounds in the L1 would be the most difficult to learn, e.g., English speakers learning the Arabic uvular plosive /q/ sound (Lado, 1957). In this way, the CAH hypothesizes that L2 sounds that are different from those in the L1 will contribute to a speaker’s accent the most.

The CAH, however, proved to be unable to correctly predict or even account for many of the problems encountered when learning an L2. In order to address the problems with the CAH, Eckman (1977) proposed the Markedness Differential Hypothesis (MDH), proposing that the degree of difficulty as well as direction of difficulty of acquiring a language feature could be determined by examining markedness. Here, markedness was defined in terms of language universals, where a specific phenomenon $P$, e.g., voicing contrasts in plosives in medial position, occurs only with another phenomenon $Q$, e.g., voicing contrasts in plosives in initial position. While $P$ only occurs in combination with $Q$, $Q$ can occur independently of $P$ (Eckman, 1977).

For example, as illustrated in Figure 1 below, there is a continuum of markedness for the occurrence of voicing contrasts in plosives, where the more positions in a word where the contrast occurs, the more marked a language is considered to be. As shown in Figure 1, Korean has no voicing contrasts in any position, making it the least marked. At the other end of the continuum, English has a voicing contrast in all positions, making it the most marked for this feature.

*Figure 1. Markedness continuum of voicing contrasts (adapted from Eckman, 1977).*

<table>
<thead>
<tr>
<th>Least Marked</th>
<th>Korean</th>
<th>Corsican</th>
<th>German</th>
<th>English</th>
<th>Most Marked</th>
</tr>
</thead>
<tbody>
<tr>
<td>No voicing contrast</td>
<td>No contrasts</td>
<td>Contrast in initial position</td>
<td>Contrast in initial and medial position</td>
<td>Contrast in all positions (initial, medial, and final)</td>
<td>Voicing contrast in all positions</td>
</tr>
</tbody>
</table>
The MDH accounts for direction of difficulty by stating that areas in an L2 that are more marked than in the L1 will be more difficult to learn, whereas elements of an L2 that are less marked than in the L1 will be easier to learn. Therefore, according to the example in Figure 1, Korean speakers would have the hardest time learning the voicing contrasts in English when compared to Corsican or German speakers, because Korean speakers would have to learn to produce a contrast in all positions, whereas Corsican speakers would have to learn to produce a contrast in two additional positions, namely medial and final position, and German speakers learning English would only have to learn to produce a voicing contrast in one additional position, i.e., final position. Thus, the degree of difficulty varies between languages according to whether the features in their L1 are more or less marked than the L2 they are learning. Thus, the MDH uses markedness to enhance explanations regarding the degree of difficulty and direction of difficulty in the CAH. Consequently, Eckman claims that the MDH is better able to explain the difficulties encountered by an L2 learner than the CAH alone.

Another theory on phonological acquisition in SLA is Major’s (2001) Ontogeny and Phylogeny Model (OPM), an expansion of Major’s (1986) Ontogeny Model. This theory hypothesizes that the main explanation for L2 pronunciation errors is the interaction between transfer errors and developmental errors, rather than similarity or markedness alone. Transfer errors are problems in the L2 resulting from similarities or differences between the L1 and L2. Developmental errors, on the other hand, are those errors that cannot be explained by L1 interference and are often the same as children’s errors when learning their L1. According to the OPM, transfer errors decrease over time, while developmental errors increase before decreasing over time. For example, the OPM accounts for the difficulties English speakers encounter when learning to produce the Spanish trill /r/. In the early learning stages, learners are affected more by
L1 transfer errors, whereby they almost exclusively produce English /ɹ/. These transfer errors decrease gradually, while developmental errors increase, such that learners produce [r], [ɾ], and the uvular trilled [R] (Major, 2001). Major asserts that it is the combination between markedness and whether phonemic items are similar or different that will determine how developmental and transfer processes will affect learning an L2 segment.

While the above theories and others like them account for the difficulty of L2 segments based on phonemic similarity and/or differences based on markedness, other more recent theories have changed emphasis by incorporating more phonetically oriented comparisons of the L1 and L2. These recent theories, such as the Perceptual Assimilation Model (PAM) (Best, 1995) and the Speech Learning Model (SLM) (Flege, 1995) assume the heavy influence of cross-language perception on L2 perception and production. Contrary to what the theories above assert, theories such as PAM and SLM claim that sounds that are similar between languages will be the hardest to produce accurately.

Best’s (1995) PAM asserts that L2 segments are “perceived according to their similarities to, and discrepancies from, the native segmental constellations that are in closest proximity to them in native phonological space” (p. 193). Thus, each L2 phoneme in a non-native contrast can be perceived, generally speaking, in one of three ways, 1) as exemplars of an existing L1 sound category (a similar sound) (e.g., an English speaker categorizing German /u:/ as English /u/), 2) as uncategorizable (a new segment) (e.g., German /x/, when categorized by an English speaker), or 3) as a non-speech sound (an English speaker categorizing a Zulu click, for example). The perception of the two phonemes determines the discriminability of the segments, i.e., the ability of the learner to distinguish between two sounds. For example, if two segments are perceived as exemplars of the same category, such as an English speaker assimilating both German /y:/ and
/u:/ to English /u/, the two sounds will be difficult to discriminate. If, however, one of two segments is perceived as being similar to a speech sound (e.g., the Zulu velar voiceless aspirated stop and the English /k/), and one is perceived as being a non-speech sound (e.g., a Zulu non-nasalized click consonant), the two should be very easy to discriminate. Thus, through descriptions of different modes of assimilation for non-native contrasts, Best accounts for patterns of perceptual assimilation and ease of perception.

A model often considered in conjunction with PAM is Flege’s (1995) Speech Learning Model (SLM), which links perception with production, assuming that many L2 pronunciation errors have their basis in perception. Originally, one of the main tenets of the SLM was based on the categorization of L2 sounds as either “new” (not found in the L1) or “similar” (having the same phonetic representation as the L1 sound).² The SLM proposed that segments that are “similar” to those in the L1 would be the hardest to pronounce correctly, because the learner would not be able to create a new category for them, a process known as equivalence classification (Flege, 1995). For example, when English speakers categorize German /u:/ as the same sound as English /u/, they will more likely produce /u:/ with an accent because they will not adjust their pronunciation to produce the vowel farther back in the mouth or to include more lip rounding. However, over time, learners are more likely to create a new category for so-called “new” sounds. For example, according to the SLM, native German speakers learning English may eventually with experience acquire the “new” sound /æ/, which does not occur phonemically in their L1. This was confirmed by Bohn and Flege (1992), where native-speaking Germans learning English as an L2 were tested on their abilities to produce the “similar” English

² Flege has since distanced himself from the terms “new” and “similar” because these terms are not specific enough to accurately account for degree of similarity (cf., for example, McAllister, Flege & Piske, 2002; Flege, Schirru, & MacKay, 2003; Flege & MacKay, 2004). Although Flege has distanced himself from these terms, they were widely used in SLA literature for a time.
vowels /i, ɪ, ɛ/ and the “new” English vowel /æ/. As expected, according to the SLM, the experienced learners were able to form a new category for /æ/. Subjects produced /ɛ/ differently than was expected, which, Bohn and Flege hypothesize, may be a result of subjects perceiving /ɛ/ and /æ/ as exemplars of one “new” vowel, and thereby creating a new category for it. Finally, neither the experienced nor the inexperienced learners were able to form new categories for /i, ɪ/ because they were assimilated into the equivalent L1 category. Thus, equivalence classification rarely occurs for “new” vowels that occur in the L2 but not in the L1 because a category can be formed for “new” vowels. However, category formation is blocked by equivalence classification for similar vowels because the “similar” L2 vowel is mapped onto the L1 category (Flege, 1995).

2.2 Additional Factors in SLA

While the SLM long drew on the notion of “similar” and “new” sounds between the L1 and L2, researchers have found it difficult to classify whether vowels are similar, new or different. In Strange, Bohn, Trent, and Nishi (2004), where native English speakers judged German vowels according to their cross-language similarities to English vowels, acoustic similarity (i.e., comparisons of the measurements of the vowel formants) was found to be different than perceived similarity (i.e., the similarity as judged by listeners). This result suggests that neither spectral similarity nor comparisons of vowel inventories capture all the factors necessary to account for perception of cross-language vowel similarity. This problem was noted, for example, for the German front rounded vowels, i.e. /y:/, /ø:/, /œ/, and /œ/. Spectrally, these
vowels are acoustically intermediate between English front vowels and back vowels. However, English-speaking judges classified these sounds as English back rounded vowels.

As the results in Strange et al. (2004) illustrate, native speaker judgments do not necessarily correspond to findings based on acoustic analysis. Additional findings from Strange et al. (2004) suggest that vowels can also be judged by non-native speakers differently based on mode of presentation. Strange et al. tested acoustic and perceptual similarity of German vowels read aloud in citation form and in sentence context. They found that duration differences were smaller in sentence readings, and acoustic analysis revealed that the vowels were produced closer together in sentences than in word form. In cross-language vowel categorizations of German vowels, vowels in sentences were often judged slightly differently than vowels produced in citation context. For example, German /e:/ in sentence form was judged most often to be similar to English /ɪ/, while German /e:/ in citation form was judged most often to be English /i:/.

Strange et al. attributed these differences to prosodic context. These results of native speaker ratings in Strange et al. indicate that the relationship between vowels in different languages cannot simply be determined only by a comparison of the two languages’ phonologies.

In subsequent research on consonantal context, Strange, Bohn, Nishi and Trent (2005) found that listeners may develop a context-independent strategy for identifying non-native vowels in consonant-vowel-consonant (CVC) context. However, other studies have found that pre- and post-vocalic consonantal context can indeed lead to different identifications (cf. Broselow, 1983; Trofimovich, Baker, & Mack, 2001; Jacewicz, 1999; Schultheiss, 2008). Jacewicz likewise found that prevocalic consonantal context, i.e., CV, has an impact on vowel identifications. In her study, only the initial consonant(s) varied, namely /bl/, /d/, /g/1, /pfl/, /f/, /ʃ/ and /t/, and all vowels were followed by “–cken.” This consonantal context affected the
identifications of rounded German vowels /ʏ/, /ʊ/ by native English speakers, while the perceptions of the unrounded vowels /ɪ/, /ɛ/ were left unaffected by the preceding consonant.

Essentially, pre-vocalic consonants can play a role in vowel perception. In comparison, Schultheiss found that subjects’ cross-language perception of rounded and unrounded German vowels, i.e. /a/, /ɛ/, /ɛː/, /ɪ/, /ɔ/, /ʊ/, /ʏ/, /yː/, was affected by post-vocalic phonetic context, especially before the alveolar sounds /r/ and /n/, when mapped to English vowels. It is not surprising that postvocalic /r/ and /n/ had an impact on L2 vowel perception in this study because, historically, both /r/ and /n/ have played a role in sound change in Germanic languages. In fact, postvocalic /r/ and /n/ still play a role in sound change today, creating “merging environments” that can trigger vowel mergers, neutralizing the contrasts between words.

2.3 L1 Dialect and Transfer to the L2

While the above theories, models, and hypotheses attempt to explain how the L1 affects L2 perception and production, they do not explicitly address dialectal variation within the L1 and the potential impact this variation could have on SLA. This gap in research has only rarely been explored as researchers have begun to recognize the need for a more in-depth analysis of the L1 and L2 relationship. Nevertheless, a handful of educators have proposed that the L1 dialect is an important factor in instruction (e.g., James, 1977; Melchers, 1985; Gast, 1990; Hall, 2003) and

Among the many historical changes triggered by these sounds, one example of the role of “n” can be found in West Germanic, where the vowel “u” was lowered to “o” when the following syllable contained a non-high vowel, in particular “a,” “e,” or “o.” For example, Indo-Germanic +iugom ‘yoke’ became + iok(an) in West Germanic, joh in Old High German, and juk in Gothic. However, before “n” + C, this change did not occur, as demonstrated by the example of Germanic +tungon ‘tongue,’ which became Old High German zunga, and tungo in Gothic (Schweikle, 1986). The historical workings of “r” are illustrated in Old English “breaking,” where the vowels “i,” “e,” and “a” before “r”+ C were diphthongized and became the vowels “io,” “eo,” and “ea,” respectively. For example, Old Saxon erða ‘earth’ stands in contrast to eorde in Old English and Old Saxon warð ‘became’ contrasts with Old English wearþ (Robinson, 1992).
call for an awareness of students’ L1 dialect and an understanding of the advantages and
disadvantages specific to students’ L1 dialect in learning an L2. These claims of L1 dialectal
influence in SLA have been substantiated by a small but growing number of studies focusing on
the role of L1 dialect in SLA, including Grosse and Hameyer (1979), Broselow (1983), Teasdale
(1997), Seubsunk (1999), and more recently O’Brien and Smith (in press).

In a study regarding L1 Thai dialects and L2 English pronunciation, Seubsunk (1999)
found that L2 learners of English transferred phonotactic patterns in their L1 dialect to their L2
English. In this study, Seubsunk compared subjects from two different Thai dialects on word-
initial pronunciation of stop-liquid clusters in English. Speakers from the dialect that lacked stop-
liquid clusters in the L1 dialect likewise deleted the liquid in the analogous L2 English clusters,
e.g., producing English “blessing” as “bessing.” Conversely, speakers from dialects that had
stop-liquid clusters in the L1 had no difficulty with these clusters in English. Broselow (1980)
similarly found that speakers of two Arabic dialects used epenthesis differently in producing
obstruent-liquid clusters in L2 English. Speakers of Egyptian Arabic dealt with these
impermissible forms by inserting /i/ between the obstruent and liquid, producing English “floor”
as “filoor,” while Iraqi Arabic speakers inserted /i/ before the cluster, producing “ifloor.” These
insertions in L2 English production were parallel to the pronunciation of syllable-initial clusters
in the L1 Arabic dialects. Thus, this transfer of cluster phonotactics may be attributed to different
phonological rules present in the L1 dialects.

Similarly, Grosse and Hameyer (1979) found that specific features of African American
Vernacular English (AAVE),4 such as deletion of postvocalic /r/ and /l/, merging of pre-nasal /h/
and /e/, monophthongization of /aj/ and /aw/, merging of /ij/ and /ej/, and deletion of final /d/ and

---

4 AAVE is referred to as “the black southern English dialect” in Grosse and Hameyer (1979).
/t/ in final clusters were paralleled in L2 German perception and production. Students from Norfolk State College in Virginia (the target population, composed of AAVE speakers), Old Dominion University also located in Virginia (a varied population, composed of AAVE speakers and speakers of other North-American English dialects), and the University of Massachusetts (the control population, composed of speakers from non-AAVE dialects), were tested on the perception and production of L2 German words by reading aloud and transcribing German words presented to themaurally. Results showed that the AAVE speakers had the most problems in pronouncing and perceiving these sounds in German—problems that paralleled features in their L1 dialect. Interestingly, the group from Norfolk State College displayed higher degrees of error for all traits, including the “pin”-“pen” vowel merger, which showed the greatest L1 dialect influence in comparison with the other L1 dialect traits.

While the dialect groups in Seubsunk (1999), Broselow (1980), and Grosse and Hameyer (1979) showed almost identical traits in both their native languages and in their L2s, Teasdale (1997) found a less direct manner by which the L1 dialect influences the L2 in the differential substitution of English /θ/ by Quebec French (QF) speakers and European French (EF) speakers. The QF and EF speakers were shown to differ in their L1 pronunciation of [s] and manner of pronunciation ultimately correlated with the particular phone substituted for English /θ/.

Teasdale found that in their L1, QF speakers produced an alveolar [s] and substituted alveolar [t] for English /θ/, while EF speakers used a dental [ ] in their L1 dialect, and substituted dental [ ] in L2 English. These results show that the articulations of individual sounds by speakers of a given dialect can affect L2 production.

O’Brien and Smith (in press) also investigated the effects of fine-tuned phonetic differences in the L1 on L2 pronunciation of /u:/ and /y:/.
regions of North American English, namely the Inland North, North Central, and Western Canada, were recorded reading English and L2 German words aloud. Results revealed that, while subjects did not directly transfer their L1 /u/ to German, subjects’ German /u:/ and /y:/ productions varied according to their L1 dialect. Of note is the Inland North dialect group, whose English /u/ was produced farthest back in the mouth and was therefore the most like a German /u:/; However, when producing German, these subjects actually produced the German /u:/ with the most fronting, thereby making it the least German-like of the three groups. Moreover, all subjects were able to produce the contrast between German /u:/ and /y:/ distinctly, although they differed in how they marked the contrast. Subjects from the Inland North and North Central dialect regions differentiated /y:/ and /u:/ according to frontedness, while those from Western Canada distinguished the vowels based on lip rounding. O’Brien and Smith conclude that dialect is the best predictor for how segments will be produced in an L2, even though the L2 German productions did not parallel the L1 English productions.

In summary, although most SLA research does not address the effect of the L1 dialect on the acquisition of L2 segments, the studies described above demonstrate that the influence of L1 dialect on L2 perception and production cannot be overlooked. In particular, speakers from different dialect areas within an L1 will likely have different pronunciations in an L2. While recent theories in SLA have moved away from the notion of direct transfer, findings reported in Seubsunk (1999), Broselow (1980), and Grosse and Hameyer (1979) demonstrate that phonotactic patterns and vowel mergers, among other things, can be directly transferred, whereas more phonetically based analyses and vowel production, as identified by Teasdale (1997) and O’Brien and Smith (in press), demonstrate that transfer of L1 dialect features at the phonetic level is not necessarily based on direct transfer (L.C. Smith, personal communication; cf. also
Smith, 2009). In conclusion, the effects of the L1 dialect on SLA merit attention and further research, and suggest that categorization of the L1 dialect transfer as direct or indirect depends on the specific aspect of perception or production under investigation. The current study aims to further contribute to this line of research by investigating how speakers of the Mississippi English dialect differ from speakers of other dialects in their L2 German perception and production, and whether any differences can be attributed to direct or indirect transfer of features found in the speakers’ L1 dialects.

2.4 Vowel Mergers

Lists of differences between many dialects, e.g., in North American English, often include the presence or absence of vowel mergers (cf. Labov, Ash, & Boberg, 2006; Kortmann & Schneider, 2004). Although little previous research has addressed the influence of L1 vowel mergers on L2 phonetic acquisition outside that done by Grosse and Hameyer (1979) and Dr. Laura Catharine Smith and students (e.g., Smith et al., 2007; Smith & Gardner, 2007; Gardner et al., 2009) such research is providing useful insights for SLA and the L2 and foreign language classroom.

2.4.1 Definition of Vowel Mergers

Merging is a phenomenon that affects the perception and/or production of a speaker's vowels (Labov et al., 1991; Labov et al., 2006; Bowie, 2003; Di Paolo, 1992). In a perception merger, two sounds that exist as separate phonemes in the language are perceived as one sound, often resulting in misidentifications of words out of context (Labov, 1994). Thus, speakers from a dialect area with merged vowels lack the ability to contrast the two sounds (Labov, 1994). For
instance, when hearing “pin” and “pen,” a listener with a merger would hear both words as “pen” or both as “pin.” In a production merger, the phonemically separate vowels are produced as the same vowel sound, e.g., a speaker with a production merger might pronounce “pen” and “pin” as “pin” (Di Paolo, 1992). Because vowel mergers neutralize the distinction between words, the merging of two or more segments in a dialect may hamper the ability of speakers in that dialect area to communicate (Labov, 1994), especially with others from outside their dialect area.

However, speakers with merged vowels do not necessarily merge the contrast in all environments. Many vowel mergers are conditioned mergers, where the contrast between sounds is only neutralized in certain phonetic environments. A majority of conditioned vowel mergers occur before a liquid, most frequently /l/, or a nasal (e.g., /m/ or /n/) (Labov et al., 2006), although they may also occur before /ʃ/ (Wolfram & Schilling-Estes, 1998). While vowels can be merged in these specific environments, Di Paolo (1992) and Labov (1994) explain that mergers do not necessarily appear in all environments where they have the potential to occur. Merging may be more limited than was once thought and is part of a variable process (Bowie, 2003) and may more often occur on a word-by-word basis (cf. Gardner et al., 2009; Bauer & Parker, 2008). Merging is also affected by speech register and style of speech. In more controlled styles of speech, such as careful reading or more formal registers, vowels are merged less often (Labov et al., 1991). Specifically, vowels are more often merged when unstressed rather than stressed (Labov, 1972; Smith et al., 2007). Of course, most English vowels are reduced when in unstressed position in rapid speech and are usually reduced to /ə/ (Roca & Johnson, 1999). In contrast, vowel mergers occur when one vowel moves into the phonetic space of another vowel and the distinction between the two vowels is lost. Vowel mergers usually result in a vowel that is similar to one of the vowels in the original contrast (Wolfram & Schilling-Estes, 1998), rather
than reducing to /ə/. In normal speech, a person with vowel mergers would most likely produce the vowels as merged even in stressed position when speaking at a normal rate (Di Paolo, 1992).

Although merged vowels are often considered to be perceived and produced exactly the same, Labov et al., (1991) have found evidence of partial vowel mergers, called “near-mergers” in many English dialects. They define near-mergers as occurring when two words are judged to be “the same” but are actually produced slightly differently (indicating a merger in perception and a near-merger in production) (Labov, Yaeger, & Steiner, 1972). Labov et al. (1991) explains that, for tokens taken from subjects’ recordings, “in roughly half of the utterances that include one of these [nearly-merged] words, listeners would not be able to guess which word was which from the sound alone; in the other half of the cases, they would be able to do so” (p. 44). Thus, while small differences between two nearly-merged vowels may exist, the vowels are situated very close together within the phonetic space and are often perceived as the same vowel. These near-mergers may also be similar to allophonic variations where differences in production are made but do not differentiate meaning (and therefore are often unnoticed). Along these lines, Faber and Di Paolo (1995) found that some Utah English speakers actually do make small distinctions between their nearly-merged vowels such as breathy or creaky voice. While these distinctions may be imperceptible (or non-contrastive) to those from other dialect areas, they are adequate to keep nearly merged-vowels distinct from one another. However, Labov et al. (1991) found that speakers from Philadelphia with near-mergers were no better at categorizing clearly distinct tokens than speakers with completely merged vowels.

In certain areas of the United States, vowel mergers are especially well documented, including Utah, the South, and Pennsylvania (cf. Labov et al., 2006; Kortmann & Schneider, 2004; Wolfram & Schilling-Estes, 1998; Bowie, 2003; Faber & Di Paolo, 1995; Di Paolo, 1992;
Thomas, 2004; Tillery & Bailey, 2004), although it is incorrect to assume that vowel mergers only affect a small number of English speakers in discrete regions. In the United States alone, the contrast between vowel pairs is lost in many regions, although not all of these lost distinctions are the result of conditioned mergers described above, but can also be mergers such as the merger of the vowels in “cot” (/a/) and “caught” (/ɔ/). Other common mergers in American English dialects include mergers of /i/ and /ɪ/ (e.g., “feel”–“fill”); /e/ and /ɛ/ before /l/ (e.g., “fail”–“fell”); /u/ and /ʊ/ (e.g., “pool”–“pull”); /ɛ/, /æ/, and /ʌ/ before /r/ (e.g., Mary, merry, marry, Murray); and /l/ and /ɛ/ before nasals (e.g., “pin”–“pen”) (Wolfram & Schilling-Estes, 1998). While this list is not comprehensive, it demonstrates the variety of mergers found in American English dialects and outlines the phonetic environments that will be considered in this thesis.

2.4.2 The Relationship between Perception and Production

One important aspect of the communicative abilities of speakers with vowel mergers is whether they can distinguish commonly merged vowel contrasts perceptually and/or produce a difference between the vowels when speaking. In fact, perception is often seen as the key to learning to both perceive and produce vowels correctly. For example, after the early-bilingual subjects in Flege, MacKay, and Meador (1999) were found to produce vowels with intelligibility levels similar to native English speakers, the researchers predicted that these subjects would also perceive the vowels accurately based on the SLM’s claim that without native levels of perception, learners cannot achieve native levels of production (cf. Flege, 1995). Ultimately, the subjects did perceive the vowels at a similar level to native English speakers, supporting the idea
that perception is a key component of production. In another experiment on perception and production, Bradlow, Pisoni, Akahane-Yamada, and Tohkura (1997) found that perceptual training significantly improved Japanese speakers’ productions of L2 English /r/ and /l/, thereby highlighting the link between perception and production. Both of these studies were based on the assumption that perception is central to accurate production.

Nevertheless, others have argued that accurate perception is not a necessary precondition for production (e.g., Smith, 2001). Sheldon and Strange (1982) found that native speakers of Japanese who produced English /r/ and /l/ accurately still made errors in their perception of the contrast. Interestingly, some of their Japanese participants reported that they were explicitly instructed in articulatory parameters when learning English, but they were not instructed in auditory cues. Similarly, Smith (2001) argues that kinesthetic feedback may be one process by which production can proceed independently of perception. Together, these articles help demonstrate that perception abilities do not necessarily dictate production abilities and that the relationship between perception and production is more complex than commonly thought.

The relationship between perception and production is also of interest to researchers of vowel mergers because of the differences speakers exhibit between the perception and production of commonly merged vowel contrasts. In their 2005 article, Conrey, Potts, and Niedzielski reported that subjects in their study with production mergers had more perception mergers than those subjects without a production merger in their dialect. Similarly, Labov et al., (1991), in a study of speakers of a dialect in Philadelphia, found that most subjects differentiated between the vowels /e/ and /ʌ/ in production, yet inconsistently identified them as the same segment in perception. Results from the study further indicate that perception and production are not necessarily equal, a finding that four possible categories in segment perception and
production do occur: “people who could hear and produce a contrast, people who could neither hear nor produce, people who could hear but not produce, and even people who could produce but not hear” (p. 46), meaning that production mergers do not necessarily dictate the presence of mergers in perception, and vice versa. The results of Labov et al. combined with the results of Conrey et al. (2005), demonstrate that, some people who produce mergers may be able to distinguish between the two segments perceptually, while some people with production mergers will also have mergers in perception, thereby additionally hampering their ability to communicate. Labov et al. states that findings describing vowel mergers in every combination of perception and production refutes the long-held belief that “we are all listeners as we talk and speakers as we listen” (p. 36), an idea that implied the “symmetry of production and perception” (p. 36). In sum, findings from these studies suggest that, in the case of vowel mergers, perception does not necessarily dictate production or vice versa, and that researchers and instructors should not assume that because a speaker can produce a contrast correctly, the speaker can perceive a difference between members of the contrast.

2.4.3 Vowel Mergers and Transfer of L1 Dialect to the L2

Vowel mergers may affect more than just the communicative capacity between L1 speakers. If transferred from the L1 to the L2, mergers in L1 dialects may actually cause communication problems in the L2 as well. According to PAM, equivalent vowel contrasts in an L2 should be mapped to the same categories in the L1 (Best, 1995). However, when a contrast is neutralized in the L1 because of vowel mergers, the two L2 vowels would be mapped to one sound instead of two, under certain phonetic environments. Therefore, it is important to investigate how these dialectal differences impact learning the equivalent L2 vowel contrasts in
the same merging environments. To date, few studies have addressed this issue of merger transfer from the L1 to the L2. In Smith et al., (2007), which investigated the effects of L1 Utah vowel mergers on L2 German perception and production, mergers from the L1 did transfer to the L2. In particular, mergers in subjects’ perception of the “pool”-“pull”-“pole” contrast were found in both English and German. Additionally, in a case study, parallels between the individual’s L1 and L2 productions were found. However, not all mergers transferred from the L1 to the L2, either directly or indirectly from a perceptual or acoustic perspective. In Smith and Gardner (2007), subsequent analysis based on native speaker judgments demonstrated that individual subjects with an L1 merger transferred the merger to the L2: the subject with two mergers in English had the same two mergers in German and the subject with only one merger in English had the same merger in L2 German. Therefore, these studies provide evidence that vowel mergers do indeed transfer from the L1 to the L2, although not necessarily in all speakers and in all words.

2.4.4 Vowel Mergers in Mississippi English

In order to determine if vowel mergers do actually transfer from the L1 to the L2, this thesis specifically investigates the L2 German pronunciation of speakers of the Mississippi English dialect, a dialect with the vowel mergers in question, in comparison with American English speakers who do not have the same mergers. The Mississippi dialect is characterized by a number of vowel mergers, especially among younger speakers (Labov et al., 2006; Thomas, 2004; Tillery & Bailey, 2004). These include the merger of /i/ and /e/ before nasals as in “pin” and “pen” with the resulting vowel usually closer to /i/ in quality for most speakers, although some speakers produce it closer to /e/. This feature of Mississippi English is actually contracting,
i.e., becoming less common, although it is still prominent (Thomas, 2004). The Mississippi dialect also includes the expanding merger of /u/ as in “fool” and /ʊ/ as in “full,” which most often results in a vowel between the two original vowels. Finally, the dialect also contains the less frequent but expanding merger of /e/ to /ɛ/ before /l/ as in “fail” and “fell,” where /e/ typically merges to /ɛ/ (Thomas, 2004; Tillery & Bailey, 2004). Because two of the three mergers are currently expanding and becoming more common among younger speakers, one cannot expect to find these mergers produced by all speakers in Mississippi at this time (Labov et al., 2006; Thomas, 2004; Tillery & Bailey, 2004).

Another change currently occurring in the Southern dialect region, including the Mississippi dialect, is the Southern vowel shift (Labov et al., 2006; Tillery and Bailey, 2004; Thomas, 2004; Fridland, 1998). While this vowel shift in the Mississippi dialect is reported to have caused a reversal of /e/ and /ɛ/ in the acoustic space of Mississippi English speakers (Labov et al., 2006; Fridland, 1998), this is not the case for most of the subjects from Mississippi in this study.

---

5 The vowel /o/ is included as part of the /u/-/ʊ/ contrast in this thesis because /o/ is merged with /u/-/ʊ/ in other dialects, such as Utah English (Smith et al., 2007) and Central Ohio (Wolfram & Ward, 2006). Including /o/ in the /u/-/ʊ/ vowel contrast could potentially facilitate future comparison of the results of the current study to results found for research on speakers of other dialects.

6 The Southern vowel shift is a chain shift involving the movement of the front vowels, which affects some of the vowel contrasts that are merged in the Mississippi dialect. In the vowel shift, among other changes, /e/ and /ɪ/ are shifting downward and becoming more centralized. The shift also involves the movement of the short front vowels in the opposite direction, meaning that /u/ and /ʊ/ shift toward the outer edge of the vowel space and rise until they may become higher than /i/ and /ɛ/. In the Mississippi dialect region /ɛ/ has been found to be higher and more fronted than /ɛ/, although the changes involving /u/ and /ɪ/ have not yet taken place (Labov et al., 2006).
thesis. Because this shift does not seem to affect the subjects in this study, the Mississippi vowel chart in Figure 2 does not depict /e/ and /ɛ/ as reversed.

Figure 2. Mississippi English vowel chart (adapted from Fridland, 1998).

Figure 3. Standard North American English vowel chart (Hall, 2003: 108).

Note how in Mississippi English many of the vowels such as /u/, /ʊ/, and /æ/ are produced more toward the center of the mouth than in standard American English. In addition, the spatial relationship between many of the Mississippi English front vowels is different from Standard English because of the changes currently taking place in the Mississippi dialect as a result of the Southern vowel shift.

---

7 The lack of reversal for /e/ and /ɛ/ by the subjects in this study is shown in Figures 15 and 16 in Chapter 4.
8 Although many of the vowels in Mississippi English are merged by many speakers, they are only merged in certain environments, including pre-nasal, pre-/r/, and pre-/l/ environments, and otherwise remain separate sounds. The basic phonemes are depicted in the vowel chart.
2.5 American English Speakers Learning L2 German

As stated above, this thesis focuses on the perception and production of German and English words by speakers of Mississippi English as well as by speakers of other American English dialects without the vowel mergers investigated in this thesis. German and English share many of the same vowel contrasts, including those tested here: /ɪ/-/ɛ/, /ɛ/-/ɛ/, and /u/-/ʊ/-/o/. An analysis of the acoustic similarity of German and English vowels performed by Strange et al. (2005) “showed that NG [Native German] vowels range from excellent cross-language matches to their AE [American English] counterparts to vowels which span two spectrally distinct AE vowel categories” (p. 1761). Thus, some German vowels have almost identical placement with English vowels (e.g., /ɪ/ and /ɛ/), while some German vowel areas may overlap more than one English vowel area (e.g., German /a/ overlaps parts of English /a/ and /ʌ/, as found by Strange et al., 2005). Even German vowels that are very similar acoustically to English vowels are produced more at the edges of the vowel space and with more articulatory tension than their English counterparts (Hall, 2003), as shown in Figure 4.

Figure 4. Standard German vowel chart (Hall, 2003: 107).
German and English vowels also differ in that tense vowels such as /e:/, /o:/, and /u:/ in German are underlyingly long, as indicated by the colon (:). German vowels are also produced higher in the mouth than American English vowels and are not diphthongized (Hall, 2003). While German and English share many of the same vowel contrasts, some of these contrasts are neutralized in certain environments in the Mississippi dialect, but are generally not neutralized in standard German.

2.6 Conclusion

As already noted, this thesis seeks to help fill the gap in the current understanding of how a speaker’s L1 dialect can influence their L2 perception and production by focusing on how speakers of Mississippi English with vowel mergers perceive and produce L2 German. Having provided a background and context for addressing this issue by summarizing L1 transfer in SLA, the effects of L1 dialect on learning to perceive and produce contrasts in an L2, vowel mergers, the Mississippi dialect, and the similarities between German and English vowel systems, I now turn to a detailed description of the research methodology in Chapter 3.
3.0 Introduction

As noted in Chapter 2, the role of L1 dialect in SLA has received little attention in previous studies. However, research by Grosse and Hameyer (1979), Teasdale (1997), Seubsunk (1999), O’Brien and Smith (in press), and others on the subject has demonstrated that the L1 dialect can indeed influence L2 perception and production. This thesis thus seeks to further investigate the role that a person’s L1 dialect plays in learning to produce and perceive sounds in an L2, focusing in particular on the role of L1 vowel mergers on acquiring the equivalent contrasts in the L2. Specifically, I set out to answer the following research questions (repeated from section 1.2, above):

1. a. Do speakers from non-merging dialects differ from speakers of merging dialects, e.g., Mississippi, in their perception of vowels in “merger sets” in L1 English and L2 German?
   b. Are the same patterns found in both the L1 and L2 for subjects’ perception of vowel contrasts in a given environment?

2. a. Do speakers from merging dialects, e.g., Mississippi, and speakers from non-merging dialects differ in terms of production of vowel contrasts in merging environments in the L1 and L2?
   b. Are patterns in learners’ productions of L1 vowel contrasts in merging environments also found in their L2 for the same vowel contrasts in the same environments?

As described above, this thesis compares the English and German of speakers of the Mississippi dialect of American English, which is characterized by a number of vowel mergers, to speakers of non-merging dialects, here students from Brigham Young University (BYU) who

---

9 Within both sets of research questions, (a) deals with the differences between the two dialect groups, while (b) addresses the impact of subjects’ L1 dialect on their L2 perception or production.
were not from merging dialects like Utah. Under investigation in this thesis are the vowel contrasts "pin"-"pen" (/ɪn/-/ɛn/), “fail”-“fell” (/ɛ/-/ɛ/), and “pool”-“pull”-“pole” (/ʊ/-/ʊl/-/ʊl/), which occur in both English and German. These contrasts undergo merging in some phonetic environments in the Mississippi English dialect, but not in German or the dialects of the control group.

3.1 Subjects

In order to answer the research questions above, subjects with and without vowel mergers in their L1 dialect were recruited. Subjects who participated in this study were currently enrolled or recently graduated students from the University of Mississippi (UMiss) or BYU at the time of testing and were assigned to groups based on the university they attended. All subjects were native speakers of English who were learning German as an L2.11 UMiss students were assigned to the experimental group if they spoke the dialect under investigation, while BYU students were assigned to the control group if they spoke a dialect without the vowel mergers in question. In total, 61 students participated: 35 from UMiss and 26 from BYU. However, data from a number of subjects were not analyzed for a number of reasons. First, in order to have their responses calculated in this study, subjects were required to finish both the perception and production tasks, thereby eliminating 4 BYU subjects and 7 UMiss subjects. One additional BYU subject and two UMiss subjects were eliminated because their recordings from the production task were corrupted. Next, subjects’ responses to a biographical questionnaire determined whether subjects

10 The vowels from the “pin”-“pen” pair are designated by /ɪn/ and /ɛn/ in order to differentiate the vowel /ɛ/ in the “fail”-“fell” contrast from the /ɛ/ in the “pin”-“pen” contrast, which occur before nasals in tokens used in this thesis.

11 German students at UMiss were invited to participate through announcements made by their professors in class. Students at BYU were recruited by email through various German courses and the German Foreign Language Residence.
met the language requirements, outlined below, for inclusion in this study. For example, subjects were required to have learned German as an L2, and consequently, one BYU and two UMiss subjects were eliminated because they were German-English bilinguals and had therefore learned both German and English as their native language. UMiss subjects needed to be native speakers of the Mississippi English dialect, and therefore native Mississippians, to participate in this study. Subjects were determined to be “from” an area if they had lived there for a majority of time between the ages of 6 and 14. This eliminated 8 UMiss subjects. Similarly, BYU subjects were required to be speakers of American English from dialect areas outside of Mississippi and the so-called “Mormon corridor,” an area including Utah, southern Idaho, and northern Arizona, well known for the vowel mergers in this study (Chatterton, 2008). This requirement excluded an additional 11 BYU subjects. Finally, subjects needed to be able to read German aloud at an intermediate to advanced level, as determined by the researcher and her advisor during analysis, which eliminated an additional 3 UMiss subjects. A subject’s German reading abilities were considered below the intermediate level when the subject pronounced common words incorrectly, e.g., pronouncing gutes ‘good’ as [guts] instead of [gutas], or if the subject did not know how to pronounce words containing <ie> [iː] or <ei> [æi], including pronunciation of words such as viel ‘many’ as [fil] instead of [fiːl] and reisen ‘travel’ as [rez] instead of [raɪs]. If subjects could not pronounce these very frequent words properly, their

---

12 In order to determine eligibility and gather other biographical information, subjects completed an online questionnaire while participating in the study. The questionnaire collected non-identifying information such as the area subjects were from, how much foreign language experience they had, and other foreign languages spoken. The complete biographical questionnaire is located in Appendix B.
13 A full list of where subjects were from is located in Appendix A.
14 Labov (1972) describes the ages of 4-13 as a formative period that cements speech to the dialectal pattern of the area. Similarly, Di Paolo (1992) defines a person as being “from” an area if s/he moved there before the age of 9 and lived there for 5 or more years between the ages of 4 and 13.
pronunciation was deemed too poor to determine if errors were caused by mergers or by reading mistakes and these subjects were excluded from analysis.

Following the elimination of subjects who did not meet the criteria for inclusion, data from just 13 UMiss subjects and 9 BYU subjects were analyzed. Table 1 outlines subjects’ demographic information including age, age of first exposure to German, and the number of years of German study. Of the 13 UMiss subjects whose data were analyzed, 8 were male and 5 were female. The average age for this group was 20.07 (range 19-26 years), while the average age at which they began learning German was 16.46 (range 14-19 years). UMiss subjects had studied German for an average of 3.53 years (range 1-11). Seven UMiss subjects were in their 3rd to 4th semester of German (courses 102 and 202), five were in 300-level courses (5th or 6th semester German), and one had graduated one year earlier with a master degree in German.

Table 1. *Demographic Information of Subjects*

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Subjects</th>
<th>Age (Years)</th>
<th>Age of 1st Exposure (Years)</th>
<th>Number of Years of German Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMiss</td>
<td>13 (8 M, 5 F)</td>
<td>Avg: 20.7</td>
<td>Avg: 16.46</td>
<td>Avg: 3.53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Range: 19-26)</td>
<td>(Range: 14-19)</td>
<td>(Range: 1-11)</td>
</tr>
<tr>
<td>BYU</td>
<td>9 (4 M, 5 F)</td>
<td>Avg: 22.1</td>
<td>Avg: 15.7</td>
<td>Avg: 5.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Range: 20-25)</td>
<td>(Range: 11-19)</td>
<td>(Range: 1-10)</td>
</tr>
</tbody>
</table>

In comparison, the BYU group (composed of subjects from dialects without the mergers in question) was composed of 4 males and 5 females, as shown in Table 1. The BYU group’s average age was 22.1 years old (range 20-25 years). On average, they began learning German at 15.7 years (range 11-19), and had been learning German for an average of 5.4 years (range 1-10

---

15 This particular 102 class is described as an intermediate level German course focusing on culture and grammar. For the one subject in this class whose data was used in this thesis, this was his 4th semester of German.
years) at the time of the study. Of the BYU group, seven were in 300-level courses (5th or 6th semester German), and two were in 400-level courses (7th semester) at the time of testing.

It became evident during analysis that mainly 200-level (3rd and 4th semester) students participated at UMiss, while 300-level (5th semester and higher) students at BYU participated. Though the differences in subjects’ German course levels may seem incompatible for comparison, case studies from similar research presented in Smith and Gardner (2007) demonstrated that even advanced L2 speakers displayed transfer of L1 mergers to their L2 German. These findings suggest that problems in L2 pronunciation, such as transfer of vowel mergers, are not restricted to less advanced learners but can indeed occur among more advanced speakers of L2 German as well.

3.2 Procedures

Subjects completed the study in two sessions, each consisting of either a perception task or a production task. The perceptual task was a forced-choice identification task while the production task was a reading-based task. Only the production task required a meeting with the researcher. For the UMiss subjects, the production task was completed first and, within two weeks of completing the production task, subjects were emailed a link to the online perceptual task. Most subjects completed the perceptual task within two weeks of receiving the link, although some took as long as one month. BYU subjects were emailed the link to the perceptual task at the same time that they were invited to participate in the study. They completed either the

---

16 The advanced learners in the three case studies in Smith and Gardner (2007) had the same number and type of mergers in the L1 as in the L2 even after 4-11 years of German study and 8-29 months in-country experience. For example, one subject merged /e/ and /ɛ/ in the L1 and L2, e.g., she merged “tail” and “tell” in English and “fehl” ‘miss’ and “Fell” ‘animal pelt’ in German. Another subject also merged /e/ and /ɛ/ as well as /ɪn/ and /ɛn/ in the L1 and L2, while one subject had no mergers in the L1 or the L2.
perception or the production task first, with both sections completed within three weeks.
Together, the two tasks lasted approximately 60 to 90 minutes.

3.2.1 Perception

3.2.1.1 Stimuli

The words used in the perception task formed minimal pairs contrasting the following vowels in both English and German: /ɪn/-/ɛn/ (e.g., “pin”-“pen”), /ɛ/-/ɛl/ (e.g., “fail”-“fell”), and /u/-/ʊ/-/o/ (e.g., “pool”-“pull”-“pole”). These contrasts are well known to be merged in English by speakers from various American English dialects, including Mississippi English, particularly before liquids (most often /l/) and nasals (most often /n/) (Wolfram & Schilling-Estes, 1998; Labov et al., 2006). Five sets of minimal pairs with vowels in the phonetic environments known to trigger merging were used as target words for each vowel set in each language. In order to create five minimal pairs for each vowel contrast, some nonce words and low-frequency words were included as target words, especially in German. Nine additional

---

17 Words forming minimal pairs with the vowels /ai/ and /a/ were also tested for both perception and production. However, these vowels were excluded from analysis because they represent a possible monophthongization or glide deletion (Labov et al., 2006). Therefore, this contrast was too different from the other vowel mergers under investigation to be included in this thesis.

18 In isolation, two of the /ʊ/ words used in this study, “gull” and “cul,” included in vowel sets for the “pool”-“pull”-“pole” contrast are often pronounced with /ʌ/. However, in this study “cul” is presented in sentences in the form of “cul-de-sac,” which can be pronounced with /ʌ/, while the word “gull” takes the form of “seagull” in this study and was pronounced with /ʊ/ by some speakers, as verified by the researcher. Additionally, research presented in Labov et al. (2006) suggests that, before /l/ codas, mergers between /ʌ/ and /ʊ/ are evidenced in Southern dialect areas. Similarly, Tillery and Bailey (2004) note that /ʌ/ is often merged by Southerners with the vowel that results from the /ʊ/-/ʊ/ merger, usually /ʊ/.

19 While the inclusion of low-frequency words and nonce words was necessary in order to create minimal pairs, such words may be problematic in testing for mergers. It may be plausible that when reading unfamiliar words in testing situations, subjects may monitor their pronunciation, i.e., produce words in what they believe to be the “correct” way, rather than speaking as they normally do. In perception, research by Luce & Pisoni (1998) and Morrisette (2000) has found that subjects often choose real and more frequent words over low-frequency or nonce words in identification tasks.
possible target words with alternate spellings or sentence positions were included in the reading lists. In order to disguise the purpose of the study and provide additional data, twelve distractor words were included in which the vowels occurred before plosives. Words were embedded in sentences in unstressed positions, e.g., “The little boy fell the whole way down the stairs” (where “fell” is the target word). A full list of the English and German sentences containing the target and distractor words is provided in Appendix C. These sentences were used to create a randomly ordered English sentence list and a randomly ordered German list, containing 58 English and 60 German phrases. Sentence order was randomized in order to disguise the purpose of the study and to avoid sequences of sentences with the same vowel or vowel contrast.

The English sentences were recorded twice by four informants: one male and one female speaker of Canadian English (a dialect without the vowel mergers in question) and one male and one female who spoke Mississippi English (a dialect with the vowel mergers in question).

While each vowel set contained at least five sets of minimal pairs within the merging environments, the English “pool”-“pull”-“pole” contrast contained two sentences for the word “cool” (one with “cool” in medial position, which was used in the study, and one in final position, which was not used). Additionally, the English “fail”-“fell” contrast had two sentences for “tail,” from which the “tattle-tale” sentence was used, and an additional sentence for “tail.” In German, the “pool”-“pull”-“pole” contrast had seven sets of minimal pairs (one of which was alternate spellings of the same sounds as another set), and the German “fail”-“fell” contrast contained a sixth test pair “fehlen”-“miss”-“füllen”-“to fell (a tree),” which was later excluded based on “füllen” actually containing the vowel /ɛ:/ and both words containing two syllables. Finally, in the German “fail”-“fell” contrast, “fäl” was originally included as an alternate for “fehl” but was later excluded from analysis because it may be pronounced with /ɛ:/.

The emphasis is used here for clarification purposes only. The actual sentences given to informants and subjects to read did not emphasize which word was the target word.

The Canadian English speaking male was from Cardston, Alberta, Canada, an area with American English influence, and had lived in the USA for 4 years. The Canadian English speaking female was from Toronto, Ontario, Canada and had lived in the USA for 11 years. Neither speaker had the mergers in question. The Mississippi English speakers were from Charleston, Mississippi and had lived in the area their entire lives, as had their parents. All speakers were between 18 and 37 years of age at the time of recording.
Speech from the Mississippi English dialect was included in order to test the Mississippi subjects on their perception and production of contrasts in their own dialect. Recordings for the German tokens were recorded by one male and one female college-age native German informant who spoke High German and had been living in the USA for at least 2 years.\textsuperscript{26}

Before recording, informants were instructed to speak at a normal rate and to speak as if they were having a conversation with a good friend from home in order to minimize over-emphasized or enunciated speech. The Canadian English and German native speaker informants were recorded in a quiet area in the BYU German department or in their homes using an iPod with a Belkin TuneTalk Stereo recorder attached. Mississippi English informants were recorded using Praat in a quiet classroom at a high school in Charleston, Mississippi. Recordings were made at a sampling rate of 44.1 kHz with 16-bit amplitude resolution and were saved in .wav format. Tokens from informants’ second repetitions were extracted from the carrier phrases using Praat and were saved individually. If tokens from the second repetitions were unusable because of poor recording quality, mispronunciation, skipped words, or other such problems, then tokens from the first repetition were used. All token recordings from the native speaker informants were converted to mono sound files.

3.2.1.2 Procedures

The tokens described above were used to create the forced identification task using the internet-based survey delivery program Qualtrics, which presented tokens one at a time in a randomized order. English tokens were presented first, followed by the German tokens in a

\textsuperscript{26} The native German male was from Osnabrück, Germany and had lived in the USA for 5 years and had taken two month-long return trips to Germany during that time. The female was from Bonn, Germany and had lived in the USA for 2 years at the time of recording. She returns to Germany once per year for approximately 3 weeks. Both spoke standard High German.
second block. Tokens were presented to subjects via headphones. As subjects heard each token, (e.g., “fail”), all words for that particular contrast (e.g., “fail” and “fell”) appeared on the computer screen. For the “pool”-“pul”-“pole” triad, all three possible words were displayed on the screen. For instance, if the subject heard “fool”, s/he was presented with the three options of “fool,” “full,” and “foal.” Subjects then clicked the word they thought they had heard from these choices on their screen. In order to familiarize subjects with the testing procedure, subjects were first presented with five practice questions before beginning the actual identification task. In the identification task, each token containing a target vowel was presented aurally via headphones once by each informant for a total of 198 presented tokens, which includes 132 English tokens (33 tokens x 4 informants) and 66 German tokens (33 tokens x 2 informants). Identifications of the ten tokens containing “mile”-“mall” (/ai/-/a/) vowels were included in the test and in the total count of the number of presented tokens although they were later excluded from analysis. This identification task lasted approximately fifty minutes.

3.2.1.3 Analysis of perceptual data

Data from the perceptual task were analyzed by calculating each subject’s mean correct response for each vowel identification. Average correct responses for vowels in each vowel set were compared for each subject. These comparisons determined if variance in subjects’ scores was due to better perception of one vowel over another, differences between the two groups (UMiss and BYU), or an interaction between the two. This was done using a series of repeated measures ANOVAs with group (BYU or UMiss) as between group and vowel pair (as shown

---

27 See Appendix D for screenshots of the perception task.
28 Responses to the practice questions were recorded but were not analyzed.
below) as within group variables with a $p$-value of .05.\textsuperscript{29} The dependent variable for the ANOVAs was the accuracy of the identification of the vowels by subjects. The independent variables were 1) group, (i.e., UMiss subjects vs. the BYU group) and 2) vowel (namely the seven vowels of the study: /ɪn/, /ɛn/, /e/, /ɛ/, /u/, /ʊ/, /o/). ANOVAs were performed separately on the English and German data.

3.2.2 Production

3.2.2.1 Stimuli

The same two lists of randomized sentences, one English and one German, were used to elicit the target words used to examine production of the vowel contrasts in question. (Cf. section 3.2.1.1, above, for a description of sentences and tokens.)

3.2.2.2 Procedures

Subjects were recorded reading the sentence lists twice in a recording studio or computer lab using the Belkin TuneTalk Stereo for iPod. An additional back-up recording on a laptop computer was made using Goldwave at UMiss and Audacity at BYU. Two recordings were made for each subject: an English recording and a German recording. The production task lasted approximately twenty minutes. Recordings were made at a sampling rate of 44.1 kHz with 16-bit amplitude resolution and were saved as stereo files in .wav format.

\textsuperscript{29} A $p$-value of .05 indicates that the researcher is 95\% confident that the results were not obtained by chance (Hatch and Lazaraton, 1991).
3.2.2.3 Acoustic analysis of production data

Using the recordings from the iPods, the data from the production task were submitted to acoustic analysis. If the iPod recordings were low quality, too noisy, or skipped, the back-up recordings from the laptops were analyzed instead. Using Praat, the vowels in the target words from each subject were analyzed acoustically at one point in the middle of the steady state of the vowel. In order to determine the production of the vowel within the acoustic space, the fundamental frequency (F0) and first three formants (F1, F2, and F3) were measured. The measurements for F0, F1, and F2 were then normalized to the Bark scale to control for differences between subjects such as gender and vocal tract length. In accordance with the Bark scale corrected height and frontedness values, B0 (Bark scale F0) represents pitch, B1 minus B0 corresponds to vowel height, and B2 minus B1 corresponds to vowel frontedness. (Ultimately, the F3 measurements were not analyzed because they are not used in the calculations used for the Bark measurements in this analysis.)

3.2.2.4 Acoustic data analysis of production data

As outlined above, production task data were analyzed according to individuals’ averages of their Bark measurements of vowel height (B1 minus B0) and frontedness (B2 minus B1). Each vowel’s mean height and mean frontedness were then compared to the mean height and frontedness of the subject’s other vowel(s) in the vowel set. These comparisons were performed using a series of repeated measures ANOVAs with group (BYU and UMiss) as between group and vowel pair (outlined below) as within group variables, where \( p = .05 \). The individuals’ averages of vowel height and frontedness were used as the dependent variables. The independent
variables were again, 1) group, (i.e., UMiss subjects vs. the BYU group) and 2) vowel (namely
the 7 vowels of the study: /ɪn/, /ɛn/, /ɛl/, /ɛl/, /u/, /ʊ/, /o/).

3.3 Conclusion

In summary, subjects completed both perception and production tasks to determine if
they had vowel mergers in English and/or in German. Correct identification scores for the
perception task were tallied in order to compare the UMiss and BYU groups, while subjects’
productions were analyzed acoustically. Results from both tasks were submitted to inferential
and descriptive statistical analysis. Having outlined the methodology of the study, I now turn to
Chapter 4 for a presentation of the results of the statistical analysis of the data collected. As a
caveat for the presented results in Chapter 4, two case studies are included in Chapter 5.
CHAPTER 4: RESULTS

4.0 Introduction

The results of the statistical analysis for this research are presented below, beginning with the perception results and followed by the production results. Results are grouped according to vowel contrast, namely “pin”-“pen,” “fail”-“fell,” and “pool”-“pull”-“pole.” For perception, results for each vowel contrast are presented in terms of the native language of the informants who recorded the perceptual tokens and are arranged in the following order: English tokens, Mississippi tokens, and German tokens. Next, the results of the statistical analysis of the production task are presented according to vowel contrast and language produced (English or German). The production results are further divided into sections on vowel height and frontedness, according to their Bark scale adjustments.

4.1 Perception Task

As described in Chapter 3, subjects’ perceptions were tested using a forced choice identification task. Each subject’s percent correct identification scores were compared using a series of repeated measures ANOVAs with subject group as the between group variable and vowel set as within group variables with a p-value set at p<.05. The dependent variable was the number of times a subject correctly identified the vowel in question.

---

30 Throughout this thesis, the “informants” are those who recorded the tokens used in order to create the perception tasks. The informants are divided into three groups: English, Mississippi, and German, depending on their native language or native dialect. “Subjects” are those who completed the perception and production tasks, i.e., those who were tested, and were divided into the two groups: UMiss and BYU.

31 As noted in Chapter 3, vowel height corresponds roughly to tongue height.

32 As described in Chapter 3, the UMiss group is the experimental group in this thesis because of the vowel mergers common in the Mississippi dialect. The BYU group is composed of students from BYU who were not from Utah or Mississippi in order to ensure that they are less likely to have the vowel mergers in question.
4.1.1 “Pin”-“Pen” Vowel Set

4.1.1.1 Tokens from English Informants

Subjects’ identification accuracy scores of the English “pin”-“pen” (/ɪn/-/ɛn/) tokens were averaged and are shown below in Figure 5. The UMiss subjects’ mean correct identifications are indicated by the shaded bars and the BYU subjects’ mean correct identifications are indicated by the white bars. The mean score for identifications for /ɪn/ and /ɛn/ for the UMiss subjects was 76% and 80%, respectively. For the BYU subjects, the mean identification scores were 66% for /ɪn/ and 83% for /ɛn/.

![Figure 5. Correct identifications of English and Mississippi /ɪn/ and /ɛn/ tokens.](chart.png)

The data graphed in Figure 5 above were submitted to a repeated measures ANOVA. Results show, for the tokens produced by the native English speakers, no effect of group ($F=.312, p<.597$), no effect of vowel ($F=14.025, p<.107$), and no group x vowel interaction ($F=1.061, p<.308$). These results indicate that the subjects performed similarly and there was no significant difference for the identification of either vowel.
4.1.1.2 Tokens from Mississippi Informants

The mean correct scores for the identifications of /m/ and /ɛn/ tokens produced by the Mississippi informants are also shown in Figure 5 above. The UMiss subjects’ mean correct scores on the identifications differed by vowel with 68% correct for /m/ and 34% for /ɛn/. The BYU subjects likewise identified the two vowels with very different accuracy rates, with 81% correct for /m/ but just 21% for /ɛn/. The repeated measures ANOVA found a group x vowel interaction ($F=9.794$, $p<.003$) and an effect of vowel ($F=119.978$, $p<.0001$) but no effect of group ($F=.001$, $p<.979$). This means that both groups were better at identifying one vowel than the other vowel and that one group was better at identifying one vowel in particular than the other vowels. Further Tukey HSD tests revealed that both groups were significantly better at identifying /m/ (words like “pin”) than /ɛn/ (words like “pen”) and that the BYU subjects were significantly better at identifying /m/ than /ɛn/. The result that both groups were better at identifying /m/ may stem from the mergers in the Mississippi informants’ speech. As confirmed by the researcher, the informants often produced both /m/ and /ɛn/ as /m/, the phone that was best identified.

4.1.1.3 Tokens from German Informants

Turning now to the identification accuracy of the subjects for the same phonemes, but this time in German, results show that UMiss subjects identified /m/ correctly 68% of the time and /ɛn/ 76% of the time. BYU subjects performed better on both identifications with scores of
99% for /ɪn/ and 89% for /ɛn/. These mean percent correct scores for the /ɪn/-/ɛn/ German token identifications are shown in Figure 6, below.33

![Figure 6](image)

*Figure 6. Correct identifications for English and German /ɪn/ and /ɛn/ tokens.*

Results of the repeated measures ANOVA indicated that there was an effect for group ($F=16.638, p<.0001$), but no effect for vowel ($F=.043, p<.836$), nor a group x vowel interaction ($F=2.772, p<.102$). Thus, the BYU subjects were significantly better than the UMiss subjects at identifying both /ɪn/ and /ɛn/ tokens when native German speakers produced the tokens.

4.1.2 “Fail”-“Fell” Vowel Set

4.1.2.1 Tokens from English Informants

For the next set of vowels, namely the “fail”-“fell” (/ɛ/-/ɛl/) vowel pair, both groups identified the English tokens with 80% accuracy or better, as depicted in Figure 7. The UMiss subjects’ mean percent correct identifications scores were 98% for /ɛ/ and 93% for /ɛl/. The BYU

---

33 The correct identifications of the English (non-Mississippi) tokens are repeated in each German perception graph in order to facilitate comparison between the subjects’ performance in both languages. The identifications of the Mississippi tokens are not used in this comparison because they may not accurately reflect perception ability—likely a result of the vowel mergers in the informants’ speech.
subjects’ means for the identifications were 80% for /e/ and 96% for /ɛ/. It should be noted that the UMiss subjects were better at identifying /e/ than the BYU subjects.

Figure 7. Correct identifications for English and Mississippi /e/ and /ɛ/ tokens.

Statistical analysis for the perception of English /e/ and /ɛ/ found an effect for group (F=15.571, p<.0001), vowel (F=7.439, p<.009), and group x vowel interaction (F=31.684, p<.0001), revealing that /e/ was better identified overall and that the UMiss subjects were better at identifying the vowels in this vowel set. Further Tukey HSD post hoc analyses of the group x vowel interaction revealed that the UMiss subjects were significantly better at identifying English /e/ (words like “fail”) than /ɛ/, while the BYU subjects were significantly more accurate at identifying English /ɛ/ (words like “fell”) than /e/. The results for this English vowel pair are surprising because, not only were the UMiss subjects better overall, but each group was significantly better at identifying the opposite vowel.

4.1.2.2 Tokens from Mississippi Informants

As for the Mississippi informants’ tokens, both groups were more accurate at identifying /e/ (83%) than /ɛ/ (20%), as shown in Figure 7, above. Similarly, the BYU subjects’ mean scores
were 86% for /e/ and 12% for /ɛ/. Results from the repeated measures ANOVA revealed an effect of vowel ($F=196.731, p<.0001$), but no effect of group ($F=.365, p<.549$), nor a group x vowel effect ($F=1.324, p<.255$). Thus, both the UMiss and BYU group were more accurate in their perception of /e/ than /ɛ/. The significantly lower level of correct identifications for the Mississippi vowel /ɛ/ likely results from the merger of /ɛ/ to [e] by the Mississippi informants, as verified by the researcher.

4.1.2.3 Tokens from German Informants

For the identification of vowels produced by the German informants, Figure 8 shows that the BYU subjects were more accurate than the UMiss subjects at identifying both /e:/ and /ɛ/ vowels. The UMiss subjects’ mean scores were 64% for /e:/ and 77% for /ɛ/, as compared to the BYU subjects, with scores of 85% for /e:/ and 88% for /ɛ/.

![Graph showing correct identifications of English and German /e:/ and /ɛ/ tokens.](image)  
*Figure 8. Correct identifications of English and German /e:/ and /ɛ/ tokens.*

Statistical analysis found the difference between the groups, noted above, to be significant ($F=6.507, p<.014$). However, no effect of vowel ($F=1.539, p<.220$) nor a group x
vowel interaction \((F=0.591, p<0.446)\) was found. The results revealed that the BYU subjects performed significantly better than the UMiss subjects on both vowel identifications, and each group identified German /ɛ:/ and /e/ with similar accuracy.

4.1.3 “Pool”-“Pull”-“Pole” Vowel Set

4.1.3.1 Tokens from English Informants

In this section, the results of the identifications of the “pool”-“pull”-“pole” vowel contrasts are presented. The mean percent correct scores for the three-way vowel identifications are shown in Figure 9, below. As shown by the shaded bars, the UMiss subjects identified all three of the vowels similarly, identifying both /u/ and /ʊ/ correctly 73% of the time and /o/ 70%. The BYU subjects’ mean scores, indicated by white bars are 86% for /u/, 77% for /o/, and 70% for /ʊ/.

![Figure 9. Correct identifications of English and Mississippi /u/, /ʊ/, and /o/ tokens.](image)

Statistical analysis revealed that the identifications for the vowels produced by the English informants found no effect of group \((F=2.778, p<.1)\), vowel \((F=2.195, p<.188)\), nor a group x vowel interaction \((F=2.056, p<.135)\). Statistically, the two groups performed similarly to each other for all identifications in this vowel set and all of the vowels were identified with a
similar level of accuracy regardless of vowel. These results indicate that neither group merged these vowels in perception and that the BYU subjects, i.e., the group composed of subjects from non-merging dialects for these vowel contrasts, did not perform better on these identifications than the UMiss subjects when they heard the English tokens.

4.1.3.2 Tokens from Mississippi Informants

As for the identifications of the Mississippi “pool”-“pull”-“pole” tokens, UMiss subjects’ mean scores, also depicted in Figure 9, were the lowest for /u/ with only 40% of the tokens identified correctly. The other vowels were perceived with higher accuracy at 76% for /ʊ/, and 80% for /o/. Similarly, the BYU subjects’ mean scores were also low for /u/ with 43%. BYU identifications for /ʊ/ were 72% accurate and were 64% for /o/. Statistical analysis using a repeated measures ANOVA revealed that subjects identified tokens from the Mississippi informants with a significant effect of vowel ($F=39.177, p<.0001$), but no significant effect of group ($F=2.718, p<.103$), nor a vowel x group interaction ($F=2.771, p<.069$). This means that both groups’ identification scores were statistically alike for each vowel identification and that both groups performed significantly differently on one vowel than on the other vowels. Tukey HSD tests indicated that both groups were significantly worse at identifying /u/ (“pool”) than /ʊ/ (“pull”) and /o/ (“pole”), which is illustrated in Figure 9. Again, because both groups performed similarly on the Mississippi identifications and did well on the English identifications, it is more likely that this problem is a result of the vowel merger in the informants’ speech between /u/ and /ʊ/, confirmed by the researcher, rather than a merger in the perception of the subjects.
4.1.3.3 Tokens from German Informants

In the identifications of the German /uː/-/ʊ/-/oː/ tokens, the BYU subjects performed better than the UMiss subjects overall, with mean accuracy scores of 96% for /uː/, 75% for /ʊ/, and 54% for /oː/. In comparison, the accuracy scores of the subjects in the UMiss group were lower for all vowels at 89% for /uː/, 51% for /ʊ/, and 47% for /oː/. Both groups identified /oː/ with the least accuracy, as shown in Figure 10, below.

![Figure 10. Correct identifications of English and German /uː/, /ʊ/, and /oː/ tokens.](image)

Statistical analysis of the German token identifications using a repeated measures ANOVA shows that some of the differences described above are significant with an effect of group ($F=5.48$, $p<.022$) and vowel ($F=21.86$, $p<.001$), but no vowel x group interaction ($F=1.234$, $p<.297$). These results mean that the BYU subjects were significantly better than the UMiss subjects at identifying the vowels overall. Subsequent Tukey HSD tests on the data showed that both groups were significantly better at identifying /uː/ ("puhl") than /oː/ ("pohl") and /ʊ/ ("pull"). The fact that both groups were worse at identifying both /uː/ and /oː/ than /uː/ may indicate a merger between the two of these vowels for both groups or may demonstrate that these vowels are mismatched in the acoustic space between English and German. The subjects’ poor performance identifying /oː/ in the current study stands in contrast to the results in York
(2008), where /o:/ was more accurately identified than both /u:/ and /ʊ/ in German by native English speakers.  

4.1.4 Conclusions for Perceptual Task

In summary, both groups were able to perceive most of the vowel sets as distinct in English and German, although the groups were not equally accurate in their vowel identifications. The exception relates to the results of both groups on the identifications of the German /u:/-/ʊ/-/o:/ contrast, where /ʊ/ and /o:/ were not identified as well as /u:/.

The result that both groups were able to perceive most vowels as distinct is similar to the results in Smith et al. (2007), where speakers from both Utah and non-merging dialect areas performed similarly on all vowel identifications. The vowels produced by the Mississippi informants often received the lowest correct identification scores, because the tokens in the informants’ speech were often merged, rather than because the vowels are merged in the subjects’ perception, as seen by subjects’ identifications of the English tokens. Also of note is that, while both groups were able to perceive most of the vowels with similar rates, the groups often performed statistically differently from one another, as in the English “fail”-“fell” contrast and all German contrasts. These differences will be discussed further in Chapter 5.

4.2 Production Task

In order to analyze the production of the vowels produced by the UMiss and BYU subjects, the normalized formant measurements from the acoustic analysis of the vowels were submitted to a series of repeated measures ANOVAs with group (BYU and UMiss) as the

---

34 See Chapter 5 for further discussion of the results of the current study in comparison to York (2008).
between variable and vowel set (as shown below) as within group variables. The dependent
variables were height and frontedness based on Bark scale adjustments, with the \( p \)-value set at
\( p < .05 \). The description of the results of the analysis for each vowel set is divided into
comparisons of first, vowel height and second, vowel frontedness.

Figures 11-24 in this section plot the average productions of each of the individual
subjects in the vowel space for each of the English and German vowel sets examined in this
study. Within each vowel set, the BYU and UMiss vowels are first depicted together to illustrate
the location of the vowels relative to the full vowel space.\(^{35}\) Next, the UMiss vowels, indicated
by red squares, are presented in a closer view in order to show the distance between the vowel
productions of each individual. The UMiss chart is followed by the BYU vowels, indicated by
blue circles, with the vowel space size kept consistent across the graphs of the two groups.
Vowels are distinguished within the vowel sets by shaded (i.e., filled in) or blank shapes (i.e.,
outline only). In each of the graphs with a close up view of the vowels, vowels produced by one
individual are connected by a line and each data point is labeled with the subject’s number.
Vowel contrasts that are produced particularly close together, i.e., \(.5 \) Barks or less\(^{36}\) for both
height and frontedness,\(^{37}\) are marked by a dotted line, indicating that these vowels could
potentially be merged by that individual.

\(^{35}\) Appendix F contains figures of each group’s German and English vowel productions to illustrate the relationship of the vowels to each other in the vowel space.

\(^{36}\) Research on German vowels (Traunmüller, 1981; Bohn and Flege, 1992) and on English vowels (Hoemeke & Diehl, 1994; Fahey, Diehl, & Traunmüller, 1996; Diehl, 2000) has found that the height difference between members of a vowel contrast is often at least \(1 \) Bark. Graphs in Bohn and Flege (1992) demonstrate that both German and English vowels are often separated by \(.5 \) to \(2 \) Barks for frontedness.

\(^{37}\) Both height and frontedness were taken into account when identifying possibly merged vowels because together they provide a more complete interpretation of the actual vowel that was produced.
4.2.1 “Pin”-“Pen” Vowel Set

4.2.1.1 Subjects’ English Productions

As shown in Figure 11, which depicts the productions of both groups of words from the “pin”-“pen” contrast, the BYU subjects produced their /ɪn/ vowels more distinctly from their /ɛn/ vowels than the UMiss group, i.e., with less overlap in the acoustic space.

![Figure 11](image)

*Figure 11. Subjects’ average productions of English /ɪn/ and /ɛn/.*

In Figures 12 and 13, below, the BYU subjects’ productions of each vowel are more compact than the productions of the UMiss subjects and do not overlap. This suggests that the UMiss group is less homogenous in their productions of these vowels, possibly evidencing the changes that are currently occurring in the Mississippi dialect such as the expansion and contraction of mergers and the Southern vowel shift. While none of the subjects in the BYU group are tending towards merging, four of the UMiss subjects, i.e., Subjects 3, 5, 9, and 13, seem to have potential mergers of the vowels in this contrast, as indicated by the dotted blue
lines connecting vowel productions of individual speakers that are less than .5 Barks apart.

Statistical analysis of the results of the acoustic measurements on the height of the subjects’ English productions shows an effect of vowel ($F=66.374, p<.0001$) and a group x vowel interaction ($F=8.101, p<.01$), but no effect of group ($F=2.0, p<.173$). These results reveal that there were no mergers according to the acoustic analysis for height for either group. In addition, BYU subjects produced /ɛn/ (blank blue circles) significantly lower in the acoustic space than the other vowels.

**Figure 12.** UMiss subjects’ average productions of English /ɪn/ and /ɛn/.

**Figure 13.** BYU subjects’ average productions of English /ɪn/ and /ɛn/.
While the above figures illustrate the differences between individuals, statistical analysis results describe the group. Therefore, while some individuals may have been close to producing mergers, analysis of the frontedness of these vowels found a significant effect of vowel \((F=1.597, p<.0001)\) and a significant group x vowel interaction \((F=24.711, p<.0001)\), but no group effect \((F=3.003, p<.099)\), meaning that both groups produced the vowels /ɪn/ and /ɛn/ distinctly in terms of frontedness. However, Tukey HSD tests also found that the UMiss subjects produced /ɛn/ with significantly more frontedness than /ɪn/. Because both groups produced one of the vowels significantly more fronted than the other vowel, no vowel mergers were found for the group according to frontedness. The results for height and frontedness show that, while some individuals may have merged /ɪn/ and /ɛn/, these vowels were not merged for either group as a whole, according to this method of analysis.

4.2.1.2 Subjects’ German Productions

Subjects’ German /ɪn/ and /ɛn/ productions are mapped in Figure 14, where the less homogenous productions of UMiss /ɛn/ (shaded squares) occupy a slightly greater vowel space than BYU /ɛn/ (shaded circles), meaning that the productions varied more within the UMiss group than within the BYU group.
Figure 14. Subjects’ average productions of German /ɪn/ and /ɛn/.

A closer view of the data points in Figures 15 and 16 again depicts more variation in the UMiss vowel productions than the BYU subjects’ productions, although there is some variation within the BYU group, e.g., the productions of Subjects 22 and 19 differ from the group’s vowels in the fact that their /ɛn/ is produced farther forward in the mouth than their /ɪn/. Of particular interest is that four UMiss subjects (1, 4, 9, and 10) have potential mergers of /ɪn/ and /ɛn/, but none of the BYU subjects show merged vowel productions.
The results of a repeated measure ANOVA of the height of the German productions show an effect of vowel ($F=37.884$, $p<.0001$) and an effect of group ($F=7.112$, $p<.015$), but no group x vowel interaction ($F=3.29$, $p<.085$). These statistical results indicate that both groups produced German /m/ and /ɛn/ distinctly according to height and that the groups were different from each other in how they produced the vowels.

Results for frontedness found a significant effect of vowel ($F=72.91$, $p<.0001$), group ($F=6.338$, $p<.02$), and group x vowel interaction ($F=4.836$, $p<.04$). According to these results,
overall the vowels were produced distinctly and the groups differed from each other in their production of the vowels in terms of frontedness. According to additional post hoc Tukey HSD tests, the BYU group produced German /ɛn/ significantly farther back in the acoustic space than /in/. Thus, both groups produced these German vowels as not merged in terms of both height and frontedness, although the groups made these distinctions between the two vowels to a different degree from one another. This also indicates that the groups did differ according to dialect, but that neither group had a vowel merger in their productions of these vowels in German according to these methods of analysis.

4.2.2 “Fail”-“Fell” Vowel Set

4.2.2.1 Subjects’ English Productions

The average of each subject’s English vowel production in the vowel space for both the UMiss and BYU subjects for the /e/ and /ɛ/ vowel contrasts is plotted in Figure 17 below. Note that the UMiss /e/ vowels (blank red squares) overlap with the UMiss /ɛ/ vowels (shaded red squares), suggesting that these two vowels may not be completely distinct for some UMiss speakers. In contrast, the BYU “fail”-“fell” vowels (blue circles) are separate in the acoustic space, i.e., they do not overlap, suggesting that the vowels are not merged for the BYU subjects.
Figure 17. Subjects’ average productions of English /e/ and /ɛ/.

In the closer views of the vowel productions in Figures 18 and 19, it becomes clear that the productions of the BYU group for the “fail”–“fell” vowels are more similar to each other than the productions of the UMiss group. This dissimilarity can be seen within the UMiss group, where three subjects (4, 6, and 7) seem to have merged their productions (as indicated by dotted blue lines), while many of the other UMiss subjects have greater distance between their vowels. In contrast, no subjects in the BYU group appear to have merged their vowels for this vowel contrast.
The results of the repeated measures ANOVA for vowel height for the “fail”–“fell” contrast found an effect of vowel ($F=38.874$, $p<.0001$) and a significant group x vowel interaction ($F=6.772$, $p<.017$), but no effect of group ($F=.319$, $p<.578$). Similarly, the results for frontedness parallel those for height, showing an effect for vowel ($F=78.982$, $p<.0001$) and a group x vowel interaction ($F=5.49$, $p<.03$), but again, no effect for group ($F=.383$, $p<.543$).

These results revealed that both the BYU subjects and the UMiss subjects as a whole were able to produce both height and frontedness for /e/ and /ɛ/ distinctly in English, indicating no mergers. In addition, the BYU subjects produced the vowels more distinctly than the UMiss subjects by producing /e/ higher and more fronted in the acoustic space than the UMiss subjects and also
producing /ɛ/ significantly lower and farther back than the UMiss subjects, as shown clearly in Figures 18 and 19.

4.2.2.2 Subjects’ German Productions

For the German vowels, graphed in Figure 20, the groups produced the height and frontedness of /ɛ/ in a similar position to each other: the acoustic spaces of the /ɛ/ productions (the shaded shapes) are very similar, although the UMiss productions of /e:/ are more spread out in the acoustic space than the other vowels.

![Figure 20. Subjects’ average productions of German /e:/ and /ɛ/.

Productions of this vowel set, shown in Figures 21 and 22, seem to possibly be merged by six UMiss subjects (1, 3, 4, 10, 11, and 12) but by only one BYU subject (16).
According to a repeated measures ANOVA, the results for the height of the German /e:/ and /ɛ/ productions show an effect of vowel ($F=16.88, p<.001$), but no effect of group ($F=1.094, p<.309$), nor a group by vowel interaction ($F=2.557, p<.126$). This means that, while individual subjects may have merged these vowels, overall both groups produced the vowel heights distinctly, and did so in a similar way, without differences between the groups. The results for frontedness are the same as for height: there is a statistically significant effect of vowel ($F=43.396, p<.0001$), but again with no effect of group ($F=.242, p<.629$), nor a group by vowel interaction ($F=2.148, p<.159$). Again, both groups behaved similarly in producing the frontedness of the two vowels distinctly. Thus, based on the statistically significant different productions of both groups for height and frontedness, no vowel mergers were found for either group.
4.2.3 “Pool”-“Pull”-“Pole” Vowel Set

4.2.3.1 Subjects’ English Productions

In addition to the vowel pairs described above, vowels were also analyzed in the “pool”-“pull”-“pole” triad. Individuals’ productions of these vowels are shown in Figure 23, below. Notably, these vowels show the most within-group differences, meaning that the productions of these vowels showed the most variation of the three sets of vowel mergers investigated here.

Figure 23. Subjects’ average productions of English /u/, /ʊ/, and /o/.

As shown in Figures 24 and 25, eight UMiss subjects (3, 4, 5, 7, 9, 11, 12, and 13) may have merged /u/ and /ʊ/, while five BYU subjects (16, 19, 20, 21, and 22) may have merged these vowels. In addition, two UMiss subjects (2 and 12) and four BYU subjects (15, 16, 17, and 18) seem to have merged /ʊ/ and /o/.

38 Lines connecting vowels are included between /u/ and /ʊ/ and between /ʊ/ and /o/. Lines are not included between /u/ and /o/ because these vowels are not normally merged because /ʊ/ is intermediate between /u/ and /o/.
Figure 24. UMiss subjects’ average productions of English /u/, /ʊ/, and /o/.

Figure 25. BYU subjects’ average productions of English /u/, /ʊ/, and /o/.

As these figures illustrate, a few individuals from each group appear to have merged some of their vowel contrasts with regards to placement within the vowel space. However, the
statistical analysis found that both groups produced all three vowel heights distinctly and to a similar degree. The results using a repeated measures ANOVA of the height of both the UMiss and BYU subjects’ English productions of the /u/-/ʊ/-/o/ merger triad (in Figures 13 and 14, above) show an effect of vowel ($F=97.67, p<.0001$), but no effect of group ($F=1.679, p<.21$), nor a group x vowel interaction ($F=.159, p<.854$). The results for frontedness are the same as for height: they demonstrate an effect of vowel ($F=16.364, p<.0001$), but no effect of group ($F=1.366, p<.256$), nor a group x vowel interaction ($F=.014, p<.986$). Again, both groups produced the frontedness of all three vowels distinctly and the frontedness productions were similar between the two groups. According to these results, neither group had vowel mergers in height or frontedness for these English vowels.

4.2.3.2 Subjects’ German Productions

Shown below in Figure 26, the vowel productions of both groups for the “pool”-“pull”-“pole” triad vary greatly among both the UMiss and BYU subjects. Note that, the UMiss and BYU productions of /u:/ and /ʊ/ appear to overlap in the acoustic space, while /o:/ remains more separate from the other vowels. The productions of /o:/, in particular, also show a lot of fronting by subjects in both groups.
Figure 26. Subjects’ average productions of German /u:/, /ʊ/, and /o:/.

As shown in Figures 27 and 28, two UMiss subjects (6 and 12) and two BYU subjects (16 and 20) appear to merge their productions of /u:/ and /ʊ/. In contrast, no UMiss subjects or BYU subjects appear to have merged /ʊ/ and /o:/ in German.
For the “pool”-“pull”-“pole” contrast, the results of the repeated measures ANOVA for height found an effect of vowel ($F=35.874$, $p<.0001$), but no effect of group ($F=.033$, $p<.857$), nor a group x vowel interaction ($F=1.838$, $p<.186$). Similar to the English productions, both groups were able to produce all three German vowels with distinct height, and the difference in
vowel height between the UMiss vowels was similar to the difference in height between the BYU vowels. Finally, for the frontedness of the German /u:/, /ʊ/, and /o:/ there was an effect of vowel (F=83.011, p<.0001) and group (F=5.835, p<.025), but no group x vowel interaction (F=1.871, p<.181). According to these findings, both groups produced the vowels’ frontedness distinctly. The effect of group indicates that BYU subjects’ productions had greater differences in frontedness between the vowels than the UMiss subjects’ productions, according to post hoc Tukey HSD tests.

4.2.4 Conclusions for Production Task

In summary, although individuals in each group may have mergers in their productions of some vowels, the UMiss and BYU groups as a whole produced all vowels distinctly in terms of both height and frontedness according to the statistical analysis. However, the BYU subjects did have a significantly greater degree of distinction in frontedness between English /ɪn/-/ɛn/, /ɛ/-/ɛ/, and German /ɪn/-/ɛn/ and /u:/-/ʊ/-/o:/ and a significantly greater difference in height between English /ɛ/-/ɛ/ and /ɪn/-/ɛn/ than the UMiss subjects, meaning that the UMiss subjects’ vowels were closer together than the BYU subjects’ vowels for these contrasts.

4.3 Conclusion

In conclusion, the two groups perceived some of the vowel sets in a similar way and both groups were often much better at identifying one vowel in a vowel set over the others. Additionally, some problems in identifying vowels produced by the Mississippi informants are likely the result of the mergers in the informants’ speech. In production, UMiss subjects had
more potential mergers than the BYU subjects, especially for the “pin”-“pen” and “fail”-“fell” contrasts in both English and German. Although only UMiss Subjects 9 and 4 had the same potential mergers in English and in German, the general trend of the mergers in both languages for the UMiss group implies that transfer of vowel merger from the L1 to the L2 can occur.

Possible mergers in the English “pool”-“pull”-“pole” contrast were found among both BYU and UMiss subjects, although fewer mergers were found for this contrast in German.

Table 2. Comparison of Subjects’ English and German Productions

<table>
<thead>
<tr>
<th>Possibly merged</th>
<th>UMiss</th>
<th>BYU</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ɪn/-/ɛn/</td>
<td>English: 3, 5, 9, 13</td>
<td>German: 1, 4, 9, 10</td>
</tr>
<tr>
<td>/e/-/ɛ/</td>
<td>English: 4, 6, 7</td>
<td>German: 1, 3, 4, 10, 11, 12</td>
</tr>
<tr>
<td>/u/-/ʊ/</td>
<td>English: 3, 4, 5, 7, 9, 11, 12, 13</td>
<td>German: 6, 12, 16, 19, 20, 21, 22</td>
</tr>
<tr>
<td>/ʊ/-/o/</td>
<td>English: 2, 12</td>
<td>German: None, 15, 16, 17, 18</td>
</tr>
</tbody>
</table>

In production, results indicate that, in terms of the group, subjects were able to produce all vowel contrasts distinctly when comparing height against height or frontedness against frontedness, as summarized in Table 3.

Table 3. Summary of Mergers found in UMiss and BYU Groups’ Subjects’ Perception and Production

| Did the group statistics find vowel mergers in the subjects’ productions? |
|-----------------|-------|------|------|------|------|------|
|                 | “pin”-“pen” | “fail”-“fell” | “pool”-“pull”-“pole” |
|                 | English | German | English | German | English | German |
| UMiss Perception | No     | No     | No     | No     | No     | No     |
| UMiss Production | No     | No     | No     | No     | No     | No     |
| BYU Perception   | No     | No     | No     | No     | No     | No     |
| BYU Production   | No     | No     | No     | No     | No     | No     |
Although there were no mergers found for either group as a whole, Figures 11-24 above, illustrate that some individuals within the group may have vowel mergers in their production. In addition, there were at times significant differences between the UMiss subjects and the BYU subjects for how distinctly some of the vowels were produced.

A discussion of how these results provide answers to the research questions will follow in Chapter 5.
CHAPTER 5: DISCUSSION OF RESULTS

5.0 Introduction

In this chapter, I discuss the results from the current study, as described in Chapter 4, in relationship to the research questions at the core of this study. The research questions, repeated from above, are as follows:

1. a. Do speakers from non-merging dialects differ from speakers of merging dialects, e.g., Mississippi, in their perception of vowels in “merger sets” in L1 English and L2 German?
   b. Are the same patterns found in both the L1 and L2 for subjects’ perception of vowel contrasts in a given environment?

2. a. Do speakers from merging dialects, e.g., Mississippi, and speakers from non-merging dialects differ in terms of production of vowel contrasts in merging environments in the L1 and L2?
   b. Are patterns in learners’ productions of L1 vowel contrasts in merging environments also found in their L2 for the same vowel contrasts in the same environments?

As previously described, subjects in this study performed a perceptual forced choice identification task and a production (reading) task in order to investigate the role that a learner’s L1 dialect (i.e., vowel mergers in Mississippi English) plays in learning to perceive and produce sounds in L2 German. This chapter begins with a discussion of the perception results to answer the research questions 1(a) and 1(b) and is followed by a discussion of how the production task results address the research questions 2(a) and 2(b). Subsequently, two case studies are presented which shed more light on the transfer of mergers from the L1 to the L2. These case studies are followed by the conclusions of the study, including the overall implications of the results in this thesis. Finally, limitations and suggestions for future research are given.
5.1 Perception

5.1.1 Research Question 1(a): Do speakers from non-merging dialects differ from speakers of merging dialects, e.g., Mississippi, in their perception of vowels in “merger sets” in L1 English and L2 German?

Although neither group had vowel mergers in English or German perception, the effects of group and group x vowel interaction results obtained in this study show that the UMiss subjects (the subjects from the dialect area with vowel mergers) did perceive English “fail”-“fell,” Mississippi “pin”-“pen,” and all German vowels differently than the BYU subjects (the control group), as shown in Table 4.

While the groups did not differ significantly in their English “pin”-“pen” vowel identifications, they did differ in their Mississippi “pin”-“pen” identifications, as shown by the group x vowel interaction, which indicates that the BYU subjects identified /ɪn/ significantly better than the UMiss subjects. The BYU subjects were also significantly better at identifying German /ɪn/ and /ɛn/ than the UMiss subjects.

The statistical results for “fail”-“fell,” also summarized in Table 4, revealed that the UMiss and BYU speakers differed significantly in their perception of English /e/ and /ɛ/.

Surprisingly, the UMiss subjects identified the English tokens significantly better than the BYU subjects overall. However, the BYU subjects were significantly better than the UMiss group in perceiving vowels in the German “fail”-“fell” contrast (/ɛ:/-/ɛ/). The groups did not differ from one another in their identifications of the Mississippi tokens.

39 It is likely that both groups were significantly better at identifying Mississippi /ɪ/ because the productions of the Mississippi informants were merged, so that both /ɪ/ and /ɛ/ were often produced as /ɪ/.
Table 4. Comparison of UMiss and BYU vowel identifications

<table>
<thead>
<tr>
<th></th>
<th>English Tokens</th>
<th>Mississippi Tokens</th>
<th>German Tokens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Review of statistical results</td>
<td>A group x vowel interaction ( (p&lt;.003) ) but no effect of group ( (p&lt;.979) )</td>
<td>An effect of group ( (p&lt;.0001) ) but no group x vowel interaction ( (p&lt;.102) )</td>
</tr>
<tr>
<td>Description</td>
<td>No significant difference between groups (UMiss /ɪn/ (76%), /ɛn/ (80%); BYU /ɪn/ (66%), /ɛn/ (83%))</td>
<td>BYU subjects significantly better at identifying /ɪn/ (81%) than UMiss subjects (68%)</td>
<td>BYU subjects significantly better at identifying both /ɪn/ (99%) and /ɛn/ (89%) than UMiss subjects (68% and 76%)</td>
</tr>
<tr>
<td>Did the groups differ?</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Review of statistical results</td>
<td>Found effect of group ( (p&lt;.0001) ) and a group x vowel interaction ( (p&lt;.0001) )</td>
<td>Found no effect of group ( (p&lt;.549) ) and no group x vowel interaction ( (p&lt;.255) )</td>
<td>Found effect of group ( (p&lt;.014) ) but no group x vowel interaction ( (p&lt;.446) )</td>
</tr>
<tr>
<td>Description</td>
<td>UMiss subjects significantly better overall on identifications of /e/-/ɛ/; UMiss significantly better at identifying /ɛ/ (98%) than BYU subjects (80%); BYU subjects significantly better at identifying /e/ (96%) than UMiss subjects (93%)</td>
<td>No significant difference between groups (BYU /e/ 86%, /ɛ/ 12%; UMiss 83%, 20%)</td>
<td>BYU subjects significantly better overall on identifications of /e:/ (85%) and /ɛ/ (88%) than the UMiss subjects (64% for /e:/ and 77% for /ɛ/)</td>
</tr>
<tr>
<td>Did the groups differ?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Review of statistical results</td>
<td>No effect of group ( (p&lt;.1) ) nor a vowel x group interaction ( (p&lt;.135) )</td>
<td>No effect of group ( (p&lt;.103) ) nor a vowel x group interaction ( (p&lt;.069) )</td>
<td>Effect of group ( (p&lt;.022) ) but no vowel x group interaction ( (p&lt;.297) )</td>
</tr>
<tr>
<td>Description</td>
<td>No significant difference between groups (BYU /u/ 86%, /ʊ/ 70%, /o/ 77%; UMiss /u/ 73%, /ʊ/ 73%, /o/ 70%)</td>
<td>No significant difference between groups (BYU /u/ 43%, /ʊ/ 72%, /o/ 64%; UMiss /u/ 40%, /ʊ/ 76%, /o/ 80%)</td>
<td>BYU subjects were significantly better overall at identifying /u:/-/ʊ/-/o:/ than UMiss subjects (BYU /u:/ 96%, /ʊ/ 75%, /o:/ 54%; UMiss /u:/ 89%, /ʊ/ 51%, /o:/ 47%)</td>
</tr>
<tr>
<td>Did the groups differ?</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
As for the “pool”-“pull”-“pole” contrast, results indicated that the groups differed only in their identification accuracy for the German vowels: the BYU subjects were significantly better overall at identifying /u:/, /ʊ/, and /o:/ than the UMiss subjects, as shown in Table 4. In comparison, the groups did not differ in their perception of these vowels in English or Mississippi English.

In sum, research question 1(a) can be answered in the affirmative for the cases of Mississippi “pin”-“pen,” German “pin”-“pen,” English “fail”-“fell,” German “fail”-“fell,” and German “pool”-“pull”-“pole,” because the UMiss and BYU subjects differed significantly from each other in their perception of these vowels. Most often the BYU subjects were significantly better at identifying the vowels, with the exception of the English “fail”-“fell” pair, where the UMiss group was better overall. Notably, the BYU subjects were significantly better at identifying the German vowels in every vowel set, possibly a result of their higher proficiency levels, but also suggesting that L1 dialect may indeed play a role in L2 perception. Consequently, these results suggest that speakers from non-merging dialects and merging dialects can differ from each other in how they perceive some vowels.

5.1.2. Research Question 1(b): Are the same patterns found in both the L1 and L2 for subjects’ perception of vowel contrasts in a given environment?

The statistical results of the perception task, specifically significant effects of vowel or group x vowel interactions, revealed patterns in the L1 and L2 for BYU and UMiss subjects.\(^\text{40}\)

\(^{40}\) Identifications of Mississippi tokens are not included in the discussion of research question 1(b) because problems in identifying Mississippi tokens were presumably a result of mergers in the speech of the informants rather than problems in the perception of subjects, as already argued in section 4.1.3.2.
Interesting trends were also found that were not supported by the statistics. The results for all three vowel contrasts are summarized in Table 5.

Table 5. Summary of Patterns in L1 and L2 Perception

<table>
<thead>
<tr>
<th></th>
<th>&quot;pin&quot;-&quot;pen&quot;</th>
<th>&quot;fail&quot;-&quot;fell&quot;</th>
<th>&quot;pool&quot;-&quot;pull&quot;-&quot;pole&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMiss Subjects</td>
<td>&quot;Yes&quot;, UMiss subjects were equally accurate(^{41}) in identifications of /ɪn-/ɛn/ in both English and German</td>
<td>&quot;No&quot;, UMiss subjects were significantly better at identifying /e/ in English but showed no differences in their German vowel identifications</td>
<td>&quot;Yes&quot;, UMiss subjects were best at identifying /ə/, although the difference was only significant in German</td>
</tr>
<tr>
<td>BYU Subjects</td>
<td>&quot;Yes&quot;, BYU subjects were equally accurate in identifications of /ɪn-/ɛn/ in both English and German</td>
<td>&quot;Yes&quot;, BYU subjects were better at identifying /ɛ/ than /e/, although the difference was only significant in English</td>
<td>&quot;Yes&quot;, BYU subjects were best at identifying /u/, although the difference was only significant in German</td>
</tr>
</tbody>
</table>

In the case of the "pin"-"pen" vowels, subjects identified the English vowels with statistically similar accuracy and were able to do the same in German, meaning that no perceptual mergers were found in either language. However, it is interesting to note that BYU subjects were better, although not significantly, at identifying some German vowels than the same English vowels, /ɪn/ in particular.

For identifications of the "fail"-"fell" vowels, both the UMiss and BYU subjects had an advantage in English that did not appear in German on one vowel, as shown in Table 5. However, the BYU subjects were better at identifying /ɛ/ than /e/ in both English and German, although this pattern is not statistically significant.

\(^{41}\) The term "equally accurate" as used here means that there was no statistical difference found between the subjects' perceptions of the vowels in the vowel contrast. It does not indicate how accurate the perceptions were, just that they were similar to each other within the informant language.
Next, the “pool”-“pull”-“pole” tokens were identified with significantly similar accuracy in English only, as shown in Table 5, while in contrast, UMiss and BYU subjects were significantly better at identifying German /u:/ than /ʊ/ or /o:/. The result that both groups had difficulty identifying German /o:/ in comparison to /u:/ and /ʊ/ is surprising, based on findings in York (2008) where /o:/ was the second most correctly identified German vowel after /ə/. A close examination of the tokens used in York indicates that only one out of four token sets contained the vowel /o:/ before a merger triggering environment, namely /l/. Especially of note is that the tokens used in York’s perception test were two syllable words such as “pohle,” while words in the present study were single syllable words such as “pohl.” This difference in syllable structure affects the merging environment: in order for a merger to occur before /l/, /l/ must be in the same syllable, i.e., in the coda of the same syllable. In disyllabic words, the /l/ is actually part of the second syllable, meaning that no merging environment exists (Wolfram & Schilling-Estes, 1998). Therefore, the differences in results of the perception of /o:/ in York and this study could be attributed to subjects encountering the vowel in this study in a merging environment, whereas York’s subjects did not.

To review, many patterns were found in both the L1 and L2 for both groups, as summarized in Table 5, although only the patterns in German and English /m/-/en/ were significant.

We can now answer research question 1(b) in the affirmative. Transfer of patterns from the L1 to the L2 may occur but it is not a given: learners may transfer some patterns from the L1 to the L2, but not others.
5.2 Production

5.2.1 Research Question 2(a): Do speakers from merging dialects, e.g., Mississippi, and speakers from non-merging dialects differ in terms of production of vowel contrasts in merging environments in the L1 and L2?

The group and group x vowel interaction results for English and German “pin”-“pen,” highlighted in Table 6, indicate that the BYU subjects produced a greater difference in both height and frontedness between the two vowels than the UMiss subjects.\textsuperscript{42}

Next, results for the “fail”-“fell” tokens, also summarized in Table 6, reveal that the BYU subjects’ English height and frontedness productions were more distinct than those of the UMiss subjects. However, no such difference was found between groups for the German productions. Therefore the groups differed in their productions of this vowel contrast only in English, but not in German for either parameter.

Finally, for the “pool”-“pull”-“pole” contrast, no significant differences between the groups were found for height in either English or German production. However, the BYU subjects produced German /u:/, /ʊ/, and /o:/ with significantly less frontedness overall than the UMiss subjects.

\textsuperscript{42} Cf. Figures 11-24 in Chapter 4 for plots of the average height and frontedness productions of the subjects.
Table 6. Review of Production Results for “pin”-“pen,” “fail”-“fell,” and “pool”-“pull”-“pole”

<table>
<thead>
<tr>
<th></th>
<th>Did the groups differ in their productions of the vowels in English and German?</th>
<th>Height</th>
<th>Frontedness</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>pin</td>
<td>Yes, group x vowel interaction (p&lt;.01) indicates BYU subjects did produce /en/ significantly lower than the other vowels</td>
<td>Yes, group x vowel interaction (p&lt;.0001) indicates BYU subjects produced /en/ significantly less fronted than the other vowels and UMiss subjects produced /in/ significantly less fronted than the other vowels</td>
<td>Yes, in English, UMiss subjects produced the vowels in a different manner from the BYU subjects.</td>
<td></td>
</tr>
<tr>
<td>fail</td>
<td>Yes, effect of group (p&lt;.015) reveals BYU subjects produced the heights of /in/-/en/ significantly differently than the UMiss subjects.</td>
<td>Yes, effect of group (p&lt;.02) reveals BYU subjects produced the frontedness of /in/-/en/ significantly differently from the UMiss subjects; group x vowel interaction (p&lt;.04) indicates BYU subjects produced /en/ significantly less fronted than the other vowels</td>
<td>Yes, in German, UMiss subjects produced the vowels in a different manner from the BYU subjects.</td>
<td></td>
</tr>
<tr>
<td>pool</td>
<td>No, no significant difference between groups</td>
<td>No, no significant difference between groups</td>
<td>No, in German, UMiss and BYU subjects produced the vowels in a similar manner.</td>
<td></td>
</tr>
<tr>
<td>pull</td>
<td>No, no significant difference between groups</td>
<td>No, no significant difference between groups</td>
<td>No, in German, UMiss and BYU subjects produced the vowels in a similar manner.</td>
<td></td>
</tr>
<tr>
<td>pole</td>
<td>No, no significant difference between groups</td>
<td>Yes, effect of group (p&lt;.025) reveals BYU subjects produced /u:/-/o:/ with significantly less frontedness overall than the UMiss subjects</td>
<td>Yes, only for frontedness: UMiss subjects produced German frontedness in a different manner from the BYU subjects.</td>
<td></td>
</tr>
</tbody>
</table>
Because differences were found between the groups’ productions for English and German height and frontedness for /ɪn/-/ɛn/, English frontedness for /ɛ/-/e/, and German frontedness for /u:/-/ʊ/-/o:/, we can conclude that groups can differ in their productions for some of the parameters: UMiss subjects did produce some of the vowels differently than the BYU subjects, although differences between the groups is not a given.

5.2.2 Research Question 2(b): Are patterns in learners’ productions of L1 vowel contrasts in merging environments also found in their L2 for the same vowel contrasts in the same environments?

According to the statistical results for “pin”-“pen,” including any effects of vowel or group x vowel interactions, as reviewed in Table 7, patterns in height were consistent across English and German for both groups in that BYU and UMiss subjects produced the vowels distinctly in both English and German with /ɪn/ produced higher than /ɛn/.

For the same vowel pair, “pin”-“pen,” this time in terms of frontedness, many patterns in English were also found in German for both groups, as shown in Table 7. UMiss and BYU subjects did not merge these vowels in English or German; however group x vowel effects revealed that /ɪn/ was produced with less frontedness in English only, while /ɛn/ was produced with less frontedness in German only.
<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>German</th>
<th>Are the patterns the same in English and German?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>Vowels not merged(^{43}) for height ((p&lt;.0001)); /і/ produced higher than /ен/; Group x vowel interaction ((p&lt;.01)) indicates BYU produced /ен/ significantly lower than UMiss</td>
<td>Vowels not merged for height ((p&lt;.0001)); /і/ produced higher than /ен/ (No group x vowel interaction ((p&lt;.085)))</td>
<td>Yes, UMiss subjects did not merge /і/-/ен/, /і/ produced higher than /ен/ in English and German</td>
</tr>
<tr>
<td>Frontedness</td>
<td>Vowels not merged for frontedness ((p&lt;.0001)); /і/ produced with less frontedness than /ен/; Group x vowel interaction ((p&lt;.0001)) reveals that UMiss /і/ produced with significantly less frontedness than /ен/</td>
<td>Vowels not merged for frontedness ((p&lt;.0001)); /ен/ produced with less frontedness than /і/</td>
<td>Yes, vowels were not merged in English or German; No, group x vowel shows UMiss /і/ produced with significantly less frontedness in English only.</td>
</tr>
</tbody>
</table>

\(^{43}\) The vowels are considered not merged if the statistical results revealed that the vowels were significantly different from one another in terms of height or frontedness.
Results for the vowels in the “fail”-“fell” contrast, shown in Table 8, illustrate that patterns of production can transfer to the L2. Subjects produced the height and frontedness of the vowels distinctly in English and German and /e/ was produced higher than /ɛ/ in both languages.

However, not all patterns were transferred, as in the case of BYU producing /ɛ/ lower in English only.

Table 8. Patterns in Height and Frontedness Productions of “fail”-“fell”

<table>
<thead>
<tr>
<th></th>
<th>Height</th>
<th>English</th>
<th>German</th>
<th>Are the patterns the same in English and German?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What is the pattern of production for UMiss subjects?</td>
<td>Vowels not merged for height (p&lt;.0001); /e/ produced higher than /ɛ/</td>
<td>Vowels not merged (p&lt;.001); /e/ produced higher than /ɛ/</td>
<td>Yes, vowels not merged in English or German and /e/ produced higher than /ɛ/ in both languages</td>
</tr>
<tr>
<td></td>
<td>What is the pattern of production for BYU subjects?</td>
<td>Vowels not merged for height (p&lt;.0001); /e/ produced higher than /ɛ/; Group x vowel interaction (p&lt;.017) reveals that BYU /e/ produced significantly lower than /ɛ/</td>
<td>Vowels not merged (p&lt;.001); /e/ produced higher than /ɛ/</td>
<td>Yes, vowels not merged in English or German and /e/ produced higher than /ɛ/ in both languages; No, group x vowel shows BYU produced /e/ significantly lower than /ɛ/ in English only</td>
</tr>
<tr>
<td></td>
<td>What is the pattern of production for UMiss subjects?</td>
<td>Vowels not merged for frontedness (p&lt;.0001); /e/ produced more fronted than /ɛ/</td>
<td>Vowels not merged (p&lt;.0001); /e/ produced more fronted than /ɛ/</td>
<td>Yes, vowels not merged in English or German, /e/ produced more fronted than /ɛ/ in both languages</td>
</tr>
<tr>
<td></td>
<td>What is the pattern of production for BYU subjects?</td>
<td>Vowels not merged (p&lt;.0001); /e/ produced more fronted than /ɛ/; Group x vowel interaction (p&lt;.03) reveals that BYU /e/ produced with less frontedness than /ɛ/</td>
<td>Vowels not merged (p&lt;.0001); /e/ produced more fronted than /ɛ/</td>
<td>Yes, vowels not merged in English or German, /e/ produced more fronted than /ɛ/ in both languages; No, group x vowel shows BYU produced /e/ with significantly less frontedness than /ɛ/ in English only</td>
</tr>
</tbody>
</table>
The frontedness patterns for the “fail”-“fell” contrast, also shown in Table 8, are similar to the height patterns for the “fail”-“fell” contrast in that subjects produced the frontedness of the vowels distinctly in English and German and /ɛ/ was produced more fronted than /e/ in both languages, displaying transfer from English to German. Again, however, BYU subjects produced /ɛ/ with less frontedness in English only, indicating that transfer did not occur in this case.

As with the other vowel sets, the results for the “pool”-“pull”-“pole” contrast, reviewed in Table 9 also show that both groups produced the vowels as distinct according to height and frontedness in English and in German, indicating that patterns in production may transfer from the L1 to the L2.

Table 9. Patterns in Height and Frontedness Productions of “pool”-“pull”-“pole”

<table>
<thead>
<tr>
<th>Height</th>
<th>English</th>
<th>German</th>
<th>Are the patterns the same in English and German?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What is the pattern of production for UMiss subjects?</td>
<td>Vowels not merged for height (p&lt;.0001)</td>
<td>Vowels not merged for height (p&lt;.0001)</td>
</tr>
<tr>
<td></td>
<td>What is the pattern of production for BYU subjects?</td>
<td>Vowels not merged for height (p&lt;.0001)</td>
<td>Vowels not merged for height (p&lt;.0001)</td>
</tr>
<tr>
<td>Frontedness</td>
<td>What is the pattern of production for UMiss subjects?</td>
<td>Vowels not merged for frontedness (p&lt;.0001)</td>
<td>Vowels not merged for frontedness (p&lt;.0001)</td>
</tr>
<tr>
<td></td>
<td>What is the pattern of production for BYU subjects?</td>
<td>Vowels not merged for frontedness (p&lt;.0001)</td>
<td>Vowels not merged for frontedness (p&lt;.0001)</td>
</tr>
</tbody>
</table>

In conclusion, since the lack of vowel mergers for height and frontedness in the L1 was also seen in L2 German, this research question can be answered in the affirmative for many patterns in the L1 and L2. Transfer also occurred from the L1 to the L2 for the manner by which all vowel pairs were produced distinctly, such as /ɪ/ being produced higher than /ɛ/, /ɛ/ being produced higher than /ɛ/, and /ɛ/ being produced more fronted than /ɛ/ in both languages. These
patterns suggest that transfer of ability can occur between the L1 and L2, but it may not appear in the L1 in exactly the same way as the L2, as in the case of frontedness for the “pin”-“pen” pair, where /ɪn/ was produced with less frontedness in English by both groups and /ɛn/ was produced with less frontedness in German. However, because both groups produced all vowels as distinct, it is unclear whether actual mergers would transfer to the L2 if any existed in the L1. Because of the lack of vowel mergers found in the UMiss subjects’ L1 dialect when determined by acoustical analysis, two case studies from the UMiss subjects are presented below which help to answer this research question more fully.

5.3 Case Studies

As noted above, the method of analyzing vowel mergers using acoustic measurements in this thesis did not find any mergers in the vowel productions. One potential explanation is that this type of acoustic analysis cannot account for the complex interactions between vowel height, frontedness, and other potential differences between vowels (cf. Faber & Di Paolo, 1995). By analyzing only height or frontedness, this type of acoustic analysis cannot compare vowels in a completely meaningful and holistic way. Additionally, analysis of groups tends to confound mergers produced by individuals because mergers by some of the subjects may be cancelled out by a lack of mergers in the majority of speakers. Furthermore, no set p-value has been determined as to what constitutes a vowel merger. Native speaker judgments can yield different results from standard acoustic analysis (Strange et al., 2004) and native speaker judges are able to draw on a more holistic interpretation of the vowel, instead of only looking at vowel height or frontedness. For these reasons, native judgments were used to interpret the production data in the two case studies presented below. The results obtained from the native speaker judgments will
help to answer the question of whether a speaker with vowel mergers in their L1 will also have vowel mergers in their L2.

Data from these subjects’ perception task are also included in order to determine whether speakers with mergers in perception in their L1 also have mergers in their L2 perception. In addition, these data are included in order to compare how mergers in perception relate to mergers in production.

5.3.1 Case Studies Methodology

The two subjects whose data are presented below were also members of the general UMiss group and their data were included in the group analysis. These two subjects demonstrated production mergers that were not apparent in the group analysis, although they are not the only subjects who showed evidence of vowel mergers. These subjects are not meant to be representative of the group; instead they represent a story that occurs within the group and show how vowel mergers in the L1 affect L2 perception and production.

In addition to presenting the subjects’ individual perception results, I present additional analyses of their production using native speaker judgments. In order to assess whether these subjects produced mergers, their tokens were saved individually in .wav format and were presented one at a time to two native German judges (one male, one female) and to two native English speakers, both female.44 Judges circled the word that they heard on a response sheet,45 and had the option of circling more than one word, indicating that the presented vowel sounded

44 The German male was from Bremen, Germany and had lived in the USA for 52 years, with return trips to Germany every summer. The female was from Hanover, Germany and had lived in the USA for 20 years. Although the female has not returned to Germany, she has taught German and worked as a professional translator/interpreter. Both speak standard High German. The English-speaking females were 24 and 37 years old at the time of the judgments. One was from Toronto, Ontario, Canada and had lived in the USA for 11 years, with the exception of 8 months spent in Munich and Berlin, Germany. The other was from Utah County, Utah and had lived in the USA her entire life, with the exception of 1 year when she lived near Stuttgart, Germany.
45 The response sheet for the native speaker judgments is available in appendix E.
like it was produced between the vowels in the circled words. If judges circled X, this indicated
that the vowel did not sound like any of the vowels in the vowel set. \(^{46}\) Discussion between the
judges was allowed, although judges did not have to agree on the identifications they personally
gave. All judgments were tallied but were not submitted to statistical analysis. \(^{47}\) Results were
determined by calculating the total scores for all judges combined. \(^{48}\)

5.3.2 Subject 1

Subject 1 was an eighteen-year-old male who had lived in Mississippi and Louisiana, \(^{49}\)
but spent most of his life in Mississippi. He had never been to Germany and was enrolled in
German 202 (fourth-semester German) at the time of testing.

5.3.2.1 Perception Results for Subject 1

The perception results for Subject 1 are presented below in Figure 29, where the black
bars represent the subject’s mean percent correct responses on the English vowels and the white
bars represent the correct responses on the German vowels. Subject 1 identified English /ɪn/
correctly 60% and /ɛn/ (70%), with German identification scores of 70% for /ɪn/ and 50% for
/ɛn/. Interestingly, /ɛn/ was better identified in English and was worse identified in German,

\(^{46}\) Because the judges identified individual words, results describe whether the tokens words were produced in a
different manner than would be expected. However, because the judges did not always compare tokens within a
contrast, e.g., “tale” and “tell,” it is unknown whether these vowels were produced in the same way. Results in the
current study may have differed if the judges had been asked to compare the tokens and judge them as the same or
different.

\(^{47}\) For the native speaker judgments, merged and nearly merged words were both considered “merged” for the
purposes of this study.

\(^{48}\) Subjects read 5-6 words containing the target vowel in both English and German. Four judges identified each
word for a total of 20-24 judgments of each vowel for each subject in both English and German.

\(^{49}\) Speakers in the Louisiana area where Subject 1 lived have the same vowel mergers and are experiencing the
vowel shift in a similar way to speakers from the Mississippi dialect area investigated in this thesis (Labov, et al.,
2006).
which may indicate that, while these vowels may be tending towards a merger, the merger occurs in a different direction in each language for this subject.

In contrast, Subject 1 identified the English /e/ and /ɛ/ with 100% accuracy in English, suggesting no mergers in English perception for the “fail”-“fell” vowel contrast, but Subject 1 identified these vowels with less accuracy in German: /e/ (79%) and /ɛ/ (71%).

![Figure 29. Correct identifications of vowels by Subject 1.](image)

Finally, in identifications of the “pool”-“pull”-“pole” contrast, Subject 1 showed evidence of vowel mergers in both English and German. The resulting merger, however, differed between the two languages, i.e., English /ʊ/ was merged to /u/ while German /o:/ and /ʊ/ were merged to /u:/, suggesting that transfer between the L1 and L2 is not necessarily direct. Note that the pattern of identification is similar for all of the back vowels, with English tokens better identified than German tokens in all three cases. Subject 1 identified English tokens of /u/ as /u/ (90%) and /ʊ/ (10%). English tokens of /ʊ/ were identified as /u/ (50%), and /o/ (40%), but as /o/ only 10% of the time, while English /o/ was identified as /o/ (60%), /o:/ (30%), or /u/ (10%). Because English /u/ was almost perfectly identified but problems in identifying /o/ and /o/ appear, this subject may merge English /o/ and /o/.
In German, Subject 1 identified /u:/ tokens as /u:/ (75%), /ʊ/ (17%), or /o:/ (8%). He also
identified /ʊ/ tokens as /ʊ/ (50%), /u:/ (33%), or /o:/ (17%), while identifying German /o:/ as /u:/
(58%), /o:/ (25%), or /ʊ/ (17%). These results indicate that both /o:/ and /ʊ/ were often merged to
/u:/.

Because this subject merged vowels from the “pool”-“pull”-“pole” contrast in both English and
German, this suggests that transfer between the L1 and L2 can occur, although the exact
nature of the merger may not be the same. In addition, the resulting merger differed in the L1 and
L2, indicating that transfer is not necessarily direct.

In summary, these results suggest that ability to distinguish members of a vowel contrast
can transfer from the L1 to the L2, as in the case of “fail”-“fell,” and also that the inability to
distinguish vowels in vowel contrasts can transfer, as in the case of the “pin”-“pen” vowels and
the “pool”-“pull”-“pole” vowels.

5.3.2.2 Production Results for Subject 1

We can now examine Subject 1’s productions in terms of the results of the native speaker
judgments, as presented in Figure 30 which depicts the number of times a token was identified as
“not merged.” For the “pin”-“pen” contrast, Subject 1 produced /ɛn/ as merged with /ɪn/
according to the native speaker judges. The /ɛn/ tokens were produced without mergers only 5%
in English and German, while judges identified English /ɪn/ tokens as not merged 75% and 100%
in German, indicating that /ɛn/ is merged to /ɪn/ in production in both languages. Of note is that
the mergers found here in production are more extreme than the mergers found for Subject 1 in perception.\footnote{A more in-depth comparison of the perception and production results from each case study follows the general conclusions of the case studies.}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure30.png}
\caption{Percent of productions rated as not merged for Subject 1.}
\end{figure}

In comparison, the /e/-/ɛ/ pair shows less merging overall. In English, /e/ was produced as unmerged 79\% and /ɛ/ 60\%. In German, /e/ was unmerged 46\% and /ɛ/ 69\%. Because the vowels were not rated well in both English and German and because the opposite vowel was better rated in each language, this subject may have the start of an expanding merger of these vowels, meaning that this speaker is not consistent in his production of unmerged tokens (cf. Tillery & Bailey, 2004).\footnote{The distribution of scores for the /e/-/ɛ/ vowel pair may also indicate that the vowels were not merged completely to /e/ or to /ɛ/, but were merged to a vowel in between the two original vowels.}

Results for the ―pool‖―pull‖―pole‖ tokens show that the judges rated this subject’s English productions as unmerged 70\% for /u/, 85\% for /o/, and 20\% for /ʊ/. German productions were rated as unmerged 87\% for /uː/, 79\% for /oː/, and only 5\% for /ʊ/. Because of the low ratings for /ʊ/, the judges responses were further investigated: judges most often rated English /u/ as “between /oː/ and /uː/” (40\%), as “between /u/ and /uː/” (25\%), or as /uː/ (10\%). In German, /u/
was most often rated as “between /u:/ and /ʊ/” (42%) and as /u:/ (37%). Overall, it is clear that /ʊ/ is merged with another vowel, although it seems to be merged more often with /o/ in English and /u:/ in German.

According to the native judgments of Subject 1, patterns in L1 production were seen in the L2, namely merged vowel productions in the English vowel sets /ɪn/-/ɛn/ and /u/-/ʊ/-/o/ were also merged in German, suggesting transfer of merger, but not necessarily transfer of the direction of the merger, as in the case of /ʊ/.

5.3.3 Subject 12

Subject 12, a nineteen-year-old male, had spent his life in Mississippi and had not been to Germany at the time of testing. He was enrolled in German 202 (fourth semester German).

5.3.3.1 Perception Results for Subject 12

Subject 12 perceived the vowels in the “pin”-“pen” contrast well, with mean percent correct scores of 90% for English /ɪn/ and 70% for /ɛn/. In German /ɪn/ was identified correctly 100% of the time and /ɛn/ 80% of the time. These results may indicate some confusion of /ɛn/ as /ɪn/.

For “fail”-“fell,” English /e/ was identified with 100% accuracy and /ɛ/ was also identified well at 90%. Subject 12 identified German /ɛ/ correctly 79% of the time and /ɛ/ only
57% of the time, indicating problems in German for both vowels, though /e/ seems especially problematic.

![Figure 31. Correct identifications of vowels by Subject 12.](image)

For the “pool”-“pull”-“pole” contrast, Subject 12 showed evidence of vowel mergers in both English and German, although the resulting merger differed between the two languages.

Subject 12’s responses suggest that he may have a perceptual merger in English between /ʊ/ and /o/ that usually results in /o/, while in German /o:/ seems to be merged with /u/, /u:/, or a vowel between /o/ and /u:/.

Note that Subject 12’s responses for /o/ and /ʊ/ are reversed in English and German, suggesting that mergers in the L1 are not necessarily transferred directly to the L2. As shown in Figure 31, Subject 12’s perceptual accuracy varied widely on these vowels: English /u/ was identified correctly 80% of the time, while /ʊ/ was identified correctly only 20% of the time, and /o/ was identified correctly 70% of the time. In German, /u:/ and /ʊ/ were identified correctly 67% of the time, while /o:/ was identified correctly only 25% of the time. In order to further investigate Subject 12’s difficulties in identifying English /ʊ/ and German /o:/', Subject 12’s responses for these vowels are presented below. When presented with English /ʊ/, Subject 12 chose /o/ 70% of the time and when presented with English /o/, he chose /ʊ/ 30% of the time. In
German, Subject 12 identified /u/ as /u:/ 33% of the time, while /o:/ was identified as /u/ 42% of the time and /u:/ 33% of the time. These results suggest an indirect transfer from the L1 to the L2 where Subject 12 merged /u/ with /o/ in English, and merged /o:/ with /u/ and/or with /u:/ in German.

In summary, Subject 12’s results show that patterns in English can transfer both directly and indirectly to the L2. In the “pin”-“pen” contrast, vowels were identified in a similar pattern in English and German, although the German vowels were better identified. In the “fail”-“fell” contrast the same vowel, namely /e/, was more accurately identified in both languages even though identifications of both vowels were worse in German. Mergers were found in German and English in the “pool”-“pull”-“pole” triad: in English /ʊ/ and /o/ seem to be merged to /o/ and in German /o:/ seems to be merged to /u/ and/or /u:/, indicating another case of indirect transfer.

5.3.3.2 Production Results for Subject 12

Scores from the native speaker judgments for Subject 12 are presented in Figure 32. Beginning with the “pin”-“pen” vowels, the judges rated English /ɪn/ tokens as unmerged 85% of the time, and /ɛn/ 0% of the time. In German /ɪn/ was rated unmerged in 100% of cases and /ɛn/ 5% of the time, indicating that Subject 12 merged almost all of his productions of /ɛn/ with /ɪn/ in both English and German, suggesting direct transfer of this merger, just as with Subject 1.

For “fail”-“fell,” English productions of /e/ were rated as unmerged 71% of the time and /ɛ/ was rated as unmerged 85% of the time. In German, /e:/ was unmerged only 29% of the time.
and /ɛ/ 62% of the time. While the subject does not appear to have merged the English vowels, he seems to have merged German /ɛ/ with /ɛ/ more often than not.

**Figure 32.** Percent of productions rated as not merged for Subject 12.

Finally, for the “pool”-“pull”-“pole” triad, English tokens of /u/ were only rated as unmerged in 10% of cases. (Tokens of /u/ were rated as /o/ (30%), /ʊ/ (20%), “between /u/ and /ʊ/” (20%), “between /o/ and /u/” (15%), and “between /o/ and /ʊ/” (5%).) The vowel /u/ was rated 50% unmerged (and was also rated as /o/ (20%), “between /o/ and /ʊ/” (20%), “between /o/ and /ʊ/” (5%), and as /u/ (5%)).

In German, /u:/ was identified as unmerged 50% of the time. Tokens of /u:/ were also rated as “between /u:/ and ‘X’” (another vowel, i.e., /y:/) 21% of the time, meaning that /u:/ was often produced incorrectly. Other ratings for /u:/ include “X” (another vowel) (13%), “between /u:/ and /ʊ/” 8%, /o:/ (4%), and “between /o:/ and /u:/” (4%). In German /u/ was only rated as unmerged 10% of the time. (German /ʊ/ was also rated as /u:/ (25%), “between /u:/ and ‘X’” (25%), “between /u:/ and ‘X’” (10%), “between /o:/ and /ʊ/” (10%), “between /u:/ and /ʊ/” (10%), and “X” (another vowel) (10%).) It is clear when listening to this subject’s recordings that he had difficulties in correctly pronouncing words such as “puhl” (/u:/). Often these tokens
were pronounced as /pjʊl/. However, when produced without the /j/, his productions often seemed to be merged with either /u/ or /oː/.

Note that the tokens of /u/ were judged as unmerged in only 10% of instances in English, but in 50% of instances in German, indicating a stronger merger in English than in German. Conversely, /ʊ/ was judged as not merged 50% of the time in English and 10% in German, indicating a stronger merger in German than in English. Together, these results indicate that the vowels /ʊ/ and /u/ were merged in both German and English, but the direction of the merger differed, namely English /u/ was most often merged to /o/, while German /u/ was most often merged to /uː/. The final vowel in the triad, /o/, was judged as /o/ in English at 75% and 93% in German, indicating fewer problems with this vowel than with /u/ or /oː/.

For Subject 12, mergers in the L1 influence the same vowel sets in the same environments in the L2. Evidence comes from the “pin”-“pen” pair, where /ɛn/ was merged in English and in German. In the case of /ɛ/-/e/, /e/ was judged as merged more often than /ɛ/ in English and German, which may indicate the transfer of a merger for these vowels. Finally, for /u/-/ʊ/-/o/, Subject 12 had difficulties with English and German /u/ and /o/, indicating a merger in both languages, although the actual merger differed between the two languages.

5.3.4 Conclusions Drawn from Case Studies

5.3.4.1 General Conclusions

In conclusion, both of the case studies presented here demonstrate that problems in perceiving and producing members of a vowel set distinctly in L1 English can transfer to L2
German in the same environments. In perception, relationships between vowel mergers in the L1 and L2 were found for Subject 1 in the case of the “pin”-“pen” vowels and the “pool”-“pull”-“pole” vowels. For Subject 12, parallel mergers between the L1 and L2 were found in the “pin”-“pen” and “fail”-“fell” contrasts. For both subjects, mergers were found in the “pool”-“pull”-“pole” triad in English and German, although for both subjects the direction of the merger was different between the two languages.

In production, both Subject 1 and Subject 12 merged /ɛn/ to /ɪn/ in English and German and both subjects had difficulties perceiving and producing the “pool”-“pull”-“pole” vowels in both languages, although the direction of the merger differed in English and German. In fact, the exact mergers in this triad differed for the two subjects even though they were from the same dialect area. The results of the case studies in the current thesis are similar to results in Smith and Gardner (2007), which also found that mergers in individual case studies were not apparent when dealing with all subjects as part of the group to which they belong.

5.3.4.2 Comparison of Perception and Production Results

Although much SLA research assumes that perceptual mastery must be achieved before accurate production can take place, this may not be the case (Smith, 2001). Similar to the results in Labov et al. (1991), different combinations of perception and production abilities were found in the two case studies. A comparison of the perception and production results are displayed in Tables 10 and 11, which shows the vowels that were better perceived and produced in each contrast, any mergers found in perception and/or production, and whether any problems, i.e., mergers or one vowel receiving a higher score than the other, are in the same direction in
perception and production. Perception scores from the identification task and production scores from the native speaker judgments are also included in the table.

Table 10. **Comparison of Perception and Production Results from Subject 1**

<table>
<thead>
<tr>
<th></th>
<th>“pin”-“pen”</th>
<th>“fail”-“fell”</th>
<th>“pool”-“pull”-“pole”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>English</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production better for /ɪn/; perception much better for /ɛn/</td>
<td>Perception much better for /e/, better for /ɛ/</td>
<td>Perception better for /u/ and much better for /ʊ/; production better for /o/</td>
<td></td>
</tr>
<tr>
<td>Direction of problems: Different</td>
<td>Direction of problems: Different</td>
<td>Direction of problems: Different</td>
<td></td>
</tr>
<tr>
<td>Merger in production only (/ɪn/ perc. 60% vs. 75% prod. /ɛn/ perc. 70% vs. 5% prod.)</td>
<td>No clear mergers in production or perception (/e/ perc. 100% vs. 79% prod.; /ɛ/ perc. 100% vs. 60% prod.)</td>
<td>No clear mergers in perception, merger in production of /u/ with /o/ (/u/ perc. 90% vs. 70% prod.; /ʊ/ perc. 60% vs. 20% prod.; /o/ perc. 60% vs. 85% prod.)</td>
<td></td>
</tr>
<tr>
<td><strong>Subject 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production better for /ɪn/ and /ɛn/</td>
<td>Perception better for /e:/; perception and production similar for /ɛ/</td>
<td>Perception better for /ʊ/; production better for /o:/ and better for /u:/</td>
<td></td>
</tr>
<tr>
<td>Direction of problems: Same</td>
<td>Direction of problems: Different</td>
<td>Direction of problems: Different</td>
<td></td>
</tr>
<tr>
<td>Clear merger in production; poor perception for /ɛn/ (/ɪn/ perc. 70% vs. 100% prod.; /ɛn/ perc. 50% vs. 5% prod.)</td>
<td>No mergers in perception or production of /e/ (/e:/ perc. 79% vs. 46% prod.; /ɛ/ perc. 71% vs. 69% prod.)⁵²</td>
<td>No clear mergers in perception; production merger of /u/ with /ʊ/ (/u:/ perc. 75% vs. 87% prod.; /ʊ/ perc. 50% vs. 5% prod.; /o:/ perc. 42% vs. 79% prod.)</td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>/ɛn/ strongly merged in English and German production</td>
<td>German perception of /ɛ/ and /e:/ worse than English; German production of /ɛ:/ worse than English</td>
<td>/o:/ production better than perception in German and English; /u/ merged in English and German production</td>
</tr>
</tbody>
</table>

Let us start the discussion by comparing perception and production. Percentages in red in the tables indicate which modality was superior for each vowel, perception or production. For the English vowels, Subject 1’s perception was superior to his production in all cases except for /ɪn/.

⁵² Differences of 5% or less between perception and production are considered to be similar.
and /o/ (i.e., two out of seven vowels). However, for his German vowels, Subject 1’s perception was only better than his production in three of seven instances, namely for /ɛn/, /e:/, and /ʊ/. In one case, perception and production were similar, i.e., /ɛ/ as in “fell.” But for the three remaining vowels, /m/, /u:/ and /o:, production was actually better than perception. Note that “pole” (/o/) was also better produced in English. Thus we see that while perception is typically better in Subject 1’s L1, this is not the case in his L2, German. However, the reader should keep in mind that even if one modality is better than the other, it does not mean that that modality is accurate in the first place. For instance, Subject 1’s perception of /ʊ/ was just 50%. However, when compared with a rate of just 5% for accurate production, it is indeed superior to production.

We can next investigate the role of mergers in perception versus production. As noted earlier, no clear mergers were found in perception; however, the two vowels that were merged in English, i.e., /ɛn/ and /ʊ/, were also merged in German. This accounts for the superior perception to production in these cases. Finally, we address the question of whether the problem vowels in perception the same as for production. With the exception of the “pin-pen” contrast in German, the vowel that was superior in perception was not the same vowel that was superior in production. However, there are still some similarities. In both English and German /u(ː)/ was the best perceived vowel in the 3-way contrast, while /ʊ/ was the worst produced.

Let us now turn to a review of the patterns found in Subject 12’s results found in Table 11 below.
Beginning again with a comparison between perception and production of English vowels, we see that Subject 12 perceived the vowels better than he produced them in just three cases, namely /ɛn/, /ɛ/, and /u/. Indeed perception and production are similar for Subject 12 in three instances, namely for /ɪn/, /ɛ/, and /o/, where for the most part, both perception and production rates are quite high. This leaves /ʊ/ for which rates of accurate production exceeded

<table>
<thead>
<tr>
<th>Subject 12</th>
<th>English</th>
<th>German</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perception much better for /ɛn/; perception and production similar for /ɪn/</td>
<td>Perception much better for /ɛ/; perception and production similar for /ɛ/</td>
<td>/ɛ/ perception better in English and German; /o/ production better, despite greater differences between perception and production for English /u/, and German /o/</td>
</tr>
<tr>
<td></td>
<td>Direction of problems: Same</td>
<td>Direction of problems: Different</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Merger in production only for /ɛn/</td>
<td>No mergers in perception or production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(/ɪn/ perc. 90% vs. 85% prod.; /ɛn/ perc. 70% vs. 0% prod.)</td>
<td>(/ɛ/ perc. 100% vs. 71% prod.; /ɛ/ perc. 90% vs. 85% prod.)</td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>/ɛn/ strongly merged in English and German production; German and English results similar</td>
<td>Both sounds worse in German perception; production of /ɛ/ worse in English and German</td>
<td></td>
</tr>
</tbody>
</table>

**Table 11. Comparison of Perception and Production Results from Subject 12**
perception, although both were problematic. A similar pattern emerges in German where Subject 12 perceived just four vowels better than he produced them, i.e., /ɛn/, /e:/, /u:/, and /ʊ/. With the exception of /ʊ/, these are the same vowels that were better perceived in English. Lastly, German /ɪn/ and /ɛ/ were similarly perceived and produced, with just /o:/ being produced more accurately, i.e., without indications of mergers, than perceived. We again see that contrary to claims in the literature, perception is not systematically superior to production in every case.

Turning now to a discussion of mergers, we see clear mergers in a few instances in English and German. Subject 12 merges /ɛn/ in both English and German showing a direct transfer of the merger from the L1 to the L2. However, the situation with the 3-way contrast is more complex. Whereas /ʊ/ is merged in perception in English, it is merged in production in German. Moreover, /u/ is merged in production in English with no concomitant German merger. Likewise, /o:/ is problematic in Subject 12’s German perception, but without the same extent of problems in English. Although the merger itself was not transferred, the fact that the subject had difficulties with this particular contrast in the L1 was reflected in the L2, albeit with differences in how these problems manifested themselves.

This leads well into our discussion of whether problems in perception and production are the same. The sounds that are better perceived are typically not the sounds that are better produced. For instance, English /e/ was better perceived than /ɛ/ (100%-90% respectively), however, a comparison of production showed that /ɛ/ was produced more accurately than /e/ (85%-71% respectively). Likewise, the sounds that were better perceived or produced in English were not always the same in German.
Based on these two case studies we can draw some general conclusions. First, perception is not always better than production as we found for both subjects. In some case, vowels were produced more accurately than they were perceived, or they were perceived and produced at similar rates. Moreover, the vowels that were better in perception were not always the same vowels that were best produced, again showing differences in perception and production. Lastly, even if the specific merger within a given contrast did not transfer from the L1 to the L2, difficult contrasts in the L1, e.g., the 3-way contrast between /u/-/ʊ/-/o/, were also different in the L2.

5.4 Overall Conclusions

Based on the discussion of the results, we can conclude for question 1(a) that the two groups (UMiss and BYU) did differ in their abilities to perceive the contrast between vowel sets, demonstrating that dialect does indeed impact how an L1 and L2 are perceived. Subjects with vowel mergers in their L1 dialect often performed worse on the identifications, indicating the possibility that neutralized contrasts in the L1 do affect the assimilation of L2 vowels by learners of an L2. However, although the BYU group did better on many of the identifications than the UMiss group, this does not mean that all individuals within the BYU group are better at identifying vowels than all individuals within the UMiss group. As demonstrated by the case studies, the results of individuals are often masked by the results of the group.

Next, for question 1(b), regarding transfer of dialect from the L1 to the L2, only one statistically significant pattern in BYU and UMiss learner’s L1 perception did transfer to the L2, namely that /m/ and /en/ were identified equally well, while other non-significant patterns were also parallel in the L2, namely that both groups were best at identifying /u/ of the “pool”-“pull”-
“pole” contrast, and BYU subjects were better at identifying /ɛ/ (“fail”-“fell”) in English and German.

Similar to the group results, the case studies showed few mergers in perception. In fact, the only mergers in perception were for Subject 12, who had perceptual mergers in the “pool”-“pull”-“pole” vowel contrast in English, i.e., /ʊ/ merged with /o/, and also in German, i.e., /ʊ/ merged with /u:/ This is the only instance of a perceptual merger and is found in both the L1 and L2, which indicates that L1 patterns in a learner’s perception can transfer to the L2, although it is not a given, and that when transfer does occur, it is not necessarily direct.

For research question 2(a), which compared the production of contrasting pairs by the BYU and UMiss groups, the two groups did differ significantly in their production of some vowels in merging environments, i.e., German height and frontedness of /in/-/en/, English frontedness of /e/-/ɛ/, and German frontedness for /u:/-/ʊ/-/o:/, demonstrating that dialect does play a role in how some segments or contrasts are pronounced in the L1 and L2. Results for question 2(b), regarding the similarities in producing vowel contrasts in German and English, according to the acoustic analysis, demonstrated that the ability to distinguish between vowels in the L1 was also apparent in the L2, indicating no mergers for either group in English or German. In addition, many patterns of production were present in both the L1 and the L2, including transfer of nonmergers in the “pool”-“pull”-“pole” triad, the transfer of the manner in which a vowel pair was produced distinctly, namely that the subjects produced /e/ of the “fail”-“fell” contrast higher and more fronted than /ɛ/ in both English and German and produced /in/ of the
“pin”-“pen” contrast higher than /en/. These patterns suggest that transfer of ability occurs between the L1 and L2.

However, the case study data reveal an interesting picture: in production, both Subject 1 and Subject 12 merged “pin”-“pen” and “pool”-“pull”-“pole” in the L1 and L2, while Subject 12 also merged “fail”-“fell” in German. For both subjects, the merger in the “pool”-“pull”-“pole” contrast was not the same in English and German: Subject 1 merged /u/ with /o/ in English but merged /u/ with /u:/ in German, while Subject 12 merged /u/ with /o/ in English but /o/ with /o:/ in German. Thus the results from the native speaker judgments of the case studies provide slightly different insights into how vowel mergers affect L2 pronunciation of the same contrasts, namely that vowel mergers in the subjects’ L1 productions were also reflected in the L2, even if the vowels were merged in a different direction in German than English. This difference may exist because of the phonetic differences between German and English vowels that result in slightly different pronunciation. These results suggest symmetry in many cases between pronunciation in the L1 and the L2.

5.5 Implications

5.5.1 The Individual and the Group

Although the statistical analysis of the groups found no mergers, evidence from the production figures in Chapter 4 and from the case studies shows that individuals within the group did have vowel mergers. It is possible that the subjects in the UMiss group did not show consistent vowel mergers because vowel mergers are still expanding and contracting in this area (Tillery & Bailey, 2004) to different degrees for different speakers. This means that not everyone
from the same dialect area will have the same problems in learning an L2, which has implications for classroom instruction. Instructors should be aware that vowel mergers may affect some students’ perception and/or production, but not necessarily to the same degree.

5.5.2 Transfer from the L1 to the L2

Findings, especially those from the case studies, indicate that transfer from the L1 to the L2 can be either direct or indirect. In some cases, subjects had difficulties in producing the same vowels in English and German, such as the vowel /ɛn/ in the “pin”-“pen” contrast. This is an example of direct transfer. Indirect transfer was evidenced in the case study subjects’ productions of vowels in the “pool”-“pull”-“pole” triad, where a problem existed in both English and German, but the vowels were merged in different directions in each language, e.g., Subject 1 merged /ʊ/ with /o/ in English and /u/ in German, while Subject 12 merged /u/ to /o/ in English and /u:/ to /u:/ in German. This indirect transfer may be a result of the phonetic differences between the vowels in the two languages, with the result that the subjects’ perception and production of these L2 vowels is different than in the L1. Instructors and learners should understand that problems in L2 pronunciation that result from the L1 may not necessarily be identical to the problems in the L1.

5.5.3 Existing Mergers in Mississippi English

Of interest is whether the subjects in the current study displayed the mergers described in the literature for the Mississippi English dialect. As stated in Chapter 2, Mississippi speakers merge /ɪn/ and /ɛn/ with the resulting vowel usually closer to /ɪn/ (Thomas, 2004). While the
group analysis found no mergers, approximately four individuals within the group appear to have merged /en/ to /m/, as seen in the production graphs in Chapter 4. In both of the case studies in production /en/ was almost completely merged to /m/.

In the literature for the “fail”-“fell” contrast, /e/ is reported as being merged to /ɛ/ (Thomas, 2004; Tillery & Bailey, 2004). While, again, no mergers were found for the group, three individuals seem to have merged /e/ and /ɛ/, with the productions falling between the two vowels, as depicted in the production figures in Chapter 4. Both subjects in the case studies seemed to confuse /e/ and /ɛ/ in production, although the direction of the merger was unclear.

Finally, the vowels of the “pool”-“pull”-“pole” contrast are described as containing a merger between /u/ as in “fool” and /ʊ/ as in “full,” often resulting in an intermediate vowel between the two original vowels ([ ]) (Thomas, 2004; Tillery & Bailey, 2004). As previously reported, no production mergers were found for either group. However, eight subjects seem to have merged English /u/ and /ʊ/, while two seemed to merge English /u/ and /o/, according to the production figures in Chapter 4. A closer examination of two of these subjects in the case studies found that Subject 1 merged /u/ with /o/ and Subject 12 merged /u/ with /o/ in English.

These results show that some speakers of the Mississippi dialect do have the mergers described in the literature, although the end result of the mergers sometimes differed from what was described. As expected, subjects who merged English /m/ and /en/ merged the vowels to /m/. However, mergers of /e/ and /ɛ/ were only apparent in the case studies and the direction of the merger varied, although these variations can be explained by the current expansion of this
merger. The finding that mergers of /u/ and /ʊ/ seemed to include /o/ differs from the
descriptions in Thomas (2004) and Tillery and Bailey (2004) above, where /o/ was not included
in the merger.

5.5.4 Perceptions of One’s Own Dialect

Evidence was also found that the UMiss subjects could not perceive the tokens produced
by the Mississippi informants any better than the BYU subjects. In every vowel set, UMiss and
BYU subjects performed in a similar manner on the identifications of the tokens from the
Mississippi informants. (The only exception being that the BYU subjects were actually better at
identifying Mississippi /ɪn/ than the UMiss subjects.) Because of these similarities, it seems that
the UMiss subjects had no special key to perceptually distinguish words with vowel mergers in
Mississippi English.53

5.5.5 Vowel Identification Training

Because the UMiss subjects often performed worse on the vowel identifications than the
subjects from dialect areas without mergers, i.e., the BYU subjects, this study has implications
for instruction, including the importance of vowel identification training for subjects from areas
where vowel mergers are prevalent. Practice in recognizing vowels in non-merging and merging
environments may help students to perceive and produce the vowels distinctly in both the L1 and
L2. Instructors should also ensure that learners hear unmerged exemplars of L2 words and that

53 The results that the UMiss subjects were not better than the BYU group at perceiving contrasts in their own
dialect does not completely rule out the possibility that speakers of the Mississippi dialect do not make any sort of
contrast for merged words. Recall that Faber and DiPaolo (1995) in investigations of Utah vowel mergers found that
Utahns made distinctions between “merged” words using creaky voice.
the students receive enough unmerged and authentic input that they will be able to learn the contrast if possible.

5.5.6 Current Methods in Vowel Merger Research

Additionally, this study demonstrates that current methods of analysis for finding vowel mergers are not without limitations, as they may not be sensitive enough to accurately detect mergers. These findings are analogous to those in Strange, Bohn, Trent, and Nishi (2004), where acoustic similarity of L2 German vowels was found to be different from the perceived similarity of the vowels. Results from the current study in combination with Strange et al., (2004) suggest that spectral similarity of vowels does not contain all of the factors necessary to account for how vowels are actually perceived. In addition, as stated above, productions of individuals should be analyzed instead of the data of many individuals together as a group, because examining subjects as a group may not portray whether mergers transfer from the L1 to the L2 as accurately as individuals’ L1 and L2 productions.

5.6 Limitations

This study was marked by a number of limitations. First, the groups themselves were less homogenous than originally planned, with a wide range of German abilities in each group. In addition, not all of the subjects in the UMiss group had mergers, so that the results of the subjects with mergers were masked by the results of the subjects without vowel mergers. Despite study design and recruitment, differences within each group were also accompanied by differences between the groups, e.g., the BYU subjects had, on average, 1.87 more years of German study than the UMiss subjects, which may have given the BYU subjects an advantage in perceiving or
producing German vowel sounds. However, results from this thesis should not be discounted based on this discrepancy in years of German study, as research by Smith and Gardner (2007) has found that even more advanced speakers often produce more mergers in their L2.

Further differences between the groups stem from possible differences in instructional focus between the two universities, as well as the type of input received during instruction by the students at each university. If the UMiss subjects received mostly merged input in their German classes, their pronunciation and perception would understandably be affected.

In addition, since mergers between /ʌ/ and /ʊ/ before /l/ codas are evidenced in the Mississippi dialect (Labov et al., 2006; Tillery & Bailey, 2004), UMiss subjects may produce /o/ as /ʌ/, making /ʊ/ seem more distinct from /u/ and /o/.

Methods of testing for vowel mergers also proved to be problematic. Subjects needed to be able to read aloud well in German and understand sound-spelling correspondences, including rules governing long (tense) and short (lax) vowels. Without these skills, a reading production task will not be effective in eliciting data.54

Further problems in testing include that many low-frequency and nonce words were used in order to create the minimal pairs in this study, especially in German. An informal review of the results showed that subjects often produced more mergers in high-frequency words than in low-frequency words, meaning that the results may not reflect whether subjects actually had mergers. Research on low-frequency and nonce words in identification tasks has shown that such words can be problematic because subjects often choose real and more frequent words over low-

54 Other methods of merger elicitation, such as picture descriptions, would require that the subjects be able to produce the required words spontaneously, something that would be difficult with the low-frequency words required to make minimal pairs.
frequency or nonce-words (Luce & Pisoni, 1998; Morrisette, 2000). Thus, the inclusion of low frequency words and nonce words may have affected the results of this study.

Also, the UMiss subjects completed the production task first and then completed the perception task at least 2 weeks later. Most subjects in the BYU group, however, completed the perception task first and then the production task within one week, although some took longer. These differences in order of testing and length of time between the tests may have affected the results. Subjects who completed the perception task first may have been more conscious of their pronunciation of vowel contrasts in the production task.

Finally, multiple people performed the acoustic analysis of the production data, potentially introducing error in the formant measurement values. Ideally, only one person would have done the measurements to ensure consistency. In order to reduce this error somewhat, the completed measurements were compared and any apparent anomalies were measured again.

5.7 Future Directions

Based on the findings and limitations of the current research, I propose the following directions for future research:

1. The progress of the UMiss students should be tracked in order to test whether the number of vowel mergers in their L2 perception and production changes as a result of more experience with the German language.

2. In order to discern whether vowels in a merging contrast are actually produced in the same way as each other, additional “same-different” native judgments could be performed on the data, i.e., paired tokens from one vowel contrast would be judged to be
either “the same” as each other or “different” from each other. Results could also be
compared to the “identification” native judgments used in the current study.

3. In addition to researching the merging of the vowels listed above, other mergers common
in Mississippi English could be examined. This includes analyzing the data that has
already been collected regarding the monophthongization of /ai/ to /a/.

4. This study should be replicated with groups of a more similar L2 proficiency level in
order to better support the results of L1 dialect transfer.

5. Additional dialects should be investigated in connection with L2 perception and
production of vowel mergers and other dialectal features.

6. Research on the merging of /ʌ/, /u/, and /ʊ/ in Mississippi English should be undertaken
in order to determine which vowels are merged more often. This investigation could
include documenting the pronunciation of words like “seagull” and “cul-de-sac.”

7. Methods to determine vowel mergers should be explored, including focusing on the
individual instead of the group. Future research should compare the perception and
production of individuals.

8. The methods used to test for vowel mergers should be reevaluated. Future testing could
include using only high-frequency words and only real words, disguising the production
task as a “grammar test,” e.g., eliciting the word *kennt* ‘to know’ (3rd person singular) by
asking a subject to conjugate the verb *kennen* “to know” (infinitive) in a sentence. In
addition, future research could investigate what constitutes a merger in terms of statistical
analysis.\(^55\)

\(^{55}\) I am grateful to Dr. Richard Page for suggesting a grammar test as an alternative testing option during the
question and answer period at the Germanic Linguistics Annual Conference, 2009.
5.8 Conclusion

The results of this thesis provide many valuable insights into how vowel mergers in the L1 dialect of Mississippi English can affect the same contrasts in L2 German. The results demonstrate that learners from Mississippi differ from speakers of other dialects with regards to L2 perception and production of the vowel contrasts in merging environments. Because of these differences in L2 perception and production, L2 learners from different dialect areas or even from a common dialect area cannot necessarily be treated as a homogenous group in L2 studies or in the classroom. Additionally, results from the general study as well as the case studies demonstrate that learners who merge contrasts in their L1 dialect may also merge the same contrasts in an L2 in the same environments, resulting in disadvantages in L2 vowel perception and production. Because vowel mergers neutralize contrasts in specific environments, learners face a unique challenge in perceiving and producing equivalent contrasts in an L2.

The findings of this thesis, in addition to the suggestions for future research, justify more research in the area of how L1 dialect can affect L2 pronunciation, in particular the effects of L1 vowel mergers. Future research could help determine better methods for identifying vowel mergers using statistics and could help instructors in different dialect areas tailor their lessons to the specific needs of their students.
REFERENCES


APPENDIX A

Demographic Information of Subjects

Table 12. Demographic Information of UMiss Subjects

<table>
<thead>
<tr>
<th>UMiss Subject #</th>
<th>Gender</th>
<th>Main State(s) of residence between ages 6 and 14</th>
<th>Age of 1st Exposure to German</th>
<th>Years of German Study</th>
<th>German course at time of testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>Louisiana, Mississippi</td>
<td>14</td>
<td>4</td>
<td>German 202: Intermediate German II</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>Mississippi</td>
<td>15</td>
<td>4</td>
<td>German 304: Grammar and Composition II</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>Mississippi</td>
<td>18</td>
<td>2</td>
<td>German 304: Grammar and Composition II</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>Mississippi</td>
<td>14</td>
<td>6</td>
<td>German 311: Business German</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>Mississippi</td>
<td>15</td>
<td>5</td>
<td>German 304: Grammar and Composition II</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>Mississippi</td>
<td>18</td>
<td>1</td>
<td>German 102: Intermediate German (For this subject, his fourth semester of German)</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>Mississippi</td>
<td>19</td>
<td>3</td>
<td>German 202: Intermediate German II</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>Texas, Mississippi</td>
<td>18</td>
<td>1</td>
<td>German 202: Intermediate German II</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>Mississippi, Florida</td>
<td>14</td>
<td>6</td>
<td>German 202: Intermediate German II</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>Tennessee, Mississippi</td>
<td>16</td>
<td>1</td>
<td>German 202: Intermediate German II</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>Mississippi</td>
<td>19</td>
<td>2</td>
<td>German 304: Grammar and Composition II</td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>Mississippi</td>
<td>19</td>
<td>1</td>
<td>German 202: Intermediate German II</td>
</tr>
<tr>
<td>13</td>
<td>M</td>
<td>Mississippi</td>
<td>15</td>
<td>11</td>
<td>None. (Had graduated the previous semester with a masters degree in German)</td>
</tr>
<tr>
<td>BYU Subject #</td>
<td>Gender</td>
<td>Main State(s) of residence between ages 6 and 14</td>
<td>Age of 1st Exposure to German</td>
<td>Years of German Study</td>
<td>German course at time of testing</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
<td>-----------------------------------------------</td>
<td>------------------------------</td>
<td>----------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>Texas, California</td>
<td>15</td>
<td>6</td>
<td>German 415: Pro-Seminar</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>Ohio</td>
<td>18</td>
<td>2.5</td>
<td>German 330: Cultural History of Germany</td>
</tr>
<tr>
<td>16</td>
<td>M</td>
<td>Colorado</td>
<td>19</td>
<td>5</td>
<td>German 330: Cultural History of Germany</td>
</tr>
<tr>
<td>17</td>
<td>F</td>
<td>Illinois</td>
<td>18</td>
<td>4</td>
<td>German 320: Advanced Grammar and Composition I</td>
</tr>
<tr>
<td>18</td>
<td>M</td>
<td>Idaho</td>
<td>16</td>
<td>4.5</td>
<td>321: Advanced Grammar and Composition II; German 415: Pro-Seminar</td>
</tr>
<tr>
<td>19</td>
<td>M</td>
<td>Idaho</td>
<td>19</td>
<td>2.5</td>
<td>German 330: Cultural History of Germany</td>
</tr>
<tr>
<td>20</td>
<td>F</td>
<td>Massachusetts, Connecticut, Pennsylvania</td>
<td>11</td>
<td>10</td>
<td>German 320: Advanced Grammar and Composition I</td>
</tr>
<tr>
<td>21</td>
<td>M</td>
<td>Wisconsin</td>
<td>12</td>
<td>9</td>
<td>German 460: Structure of Modern German</td>
</tr>
<tr>
<td>22</td>
<td>F</td>
<td>Texas</td>
<td>14</td>
<td>5</td>
<td>German 310: Phonetics and Phonology; German 311: Conversation; German 330: Cultural History of Germany</td>
</tr>
</tbody>
</table>
APPENDIX B

Biographical Questionnaire

This questionnaire concerns your language experiences over the course of your lifetime. Feel free to elaborate at the end of the survey if you think it would be helpful to the study. All responses are confidential. Thank you again for your participation.

1. Please fill in the information below. (Your name will only be used to associate your answers here with your productions and will be removed from the data once you are assigned a subject number.)

First Name
Last Name
Age
Telephone Number
Email

2. Gender:
   - Male
   - Female

3. Are you a native speaker of English?
   - Yes
   - No

4. Where were you born?
   (Please list city, state, and country.)

5. At what age were you first exposed to the German language on a daily basis?

6. At what age did you begin to speak German with ease?

7. How long have you been speaking German? (in years)

---

56 This questionnaire was presented in electronic form on the internet using the test creation and delivery software Qualtrics. Questions were grouped and were not all presented on one page.
8. **Where** have you lived (six months' stay minimum)? **Indicate the city, state, country and the language you spoke there for each new location.**

This question is important to help us situate your native language dialect and any other dialects you would have been exposed to growing up.

9. How many years have you studied German in total?

10. On a scale of 1 (not at all motivated) to 10 (highly motivated), rate your motivation to learn German.

11. Before this semester or term, what was the highest German course you had taken? (Please list course number and name.)

12. Which German class are you currently taking? (Please list course number, name, and give a brief description.)

13. Have you spent more than 3 months in a German speaking country? If so, why? Where? And how long?
14. Please rate your German abilities.

<table>
<thead>
<tr>
<th>How would you rate your overall ability in German?</th>
<th>beginning</th>
<th>intermediate</th>
<th>advanced</th>
<th>near-native</th>
<th>Native</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you rate your ability to speak German?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How would you rate your ability to read German?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How would you rate your ability to understand spoken German?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How would you rate your German writing ability?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. How often do you read German?

<table>
<thead>
<tr>
<th>Please indicate how often you read these types of German texts.</th>
<th>never</th>
<th>sometimes</th>
<th>often</th>
<th>very often</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magazines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Websites</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Letters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newspapers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16. Tell us about your experience with other foreign languages.

   a. At what age(s) did you start learning each of your other foreign languages? ('Start learning' = first exposure of 6 months or more, or first study of one semester or more.)

   b. On a scale of 1 (least nativelike) to 10 (most nativelike), please rate your oral proficiency in each of your languages, including your native language AND German.
17. In the boxes below, indicate in percentages your use of German and other languages *at home* during the past 6 months. The numbers should equal 100%.

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>German</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0</td>
</tr>
</tbody>
</table>

Total: 0

18. In the boxes below, indicate in percentages your use of German and other languages *at school* during the past 6 months. The numbers should equal 100%.

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>German</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0</td>
</tr>
</tbody>
</table>

Total: 0

19. In the boxes below, indicate in percentages your use of German and other languages *with friends* during the past 6 months. The numbers should equal 100%.

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>German</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0</td>
</tr>
</tbody>
</table>

Total: 0
20. In the boxes below, indicate in percentages your use of German and other languages *elsewhere* during the past 6 months. The numbers should equal 100%.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>0</td>
</tr>
<tr>
<td>German</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

21. In the boxes below, indicate in percentages your use of German and other languages *overall* during the past 6 months. The numbers should equal 100%.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>0</td>
</tr>
<tr>
<td>German</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
</tr>
</tbody>
</table>

22. Do you identify more closely with the German culture or the American culture?

- [ ] German culture
- [ ] American culture

23. Do you feel that you have a special talent for learning languages? Please elaborate.
24. What aspects of your mental makeup helped you learn German? (Please mark all that apply.)

- Memory for grammatical features
- Memory for vocabulary
- An ability to imitate language sounds
- An ability to analyze language structures
- An "ear" for language sounds
- Desire to learn German

25. Did you learn German by "ear" or by "eye"? That is, did you rely more on reading or on listening? Please rate how much reading and listening helped you learn German by giving them a percentage totaling 100%.

- Reading %
- Listening %

Total

26. I would appreciate any comments or other information you feel would be useful about your dialect influences, language abilities, etc.
APPENDIX C
Production Test Sentences

English Sentences

Please state your name at the beginning of the recording. Read this list twice into the microphone. Speak naturally, as if you were talking to a roommate or friend.

1. The town fool was always a happy fellow.
2. The cool and damp basement was really frightening!
3. The dead spider caused quite a stir in the house.
4. Do you like this head of lettuce, or that one?
5. Did you see Peter’s new Dell computer?
6. I gave Mr. Bool from Toronto a huge tip.
7. Can you hang the diploma on the wall next to the painting?
8. I like the Italian tile from Florence in the kitchen.
9. The dog made quite a din when he chased the cat.
10. My mother tells me I shouldn’t tattle tale anymore.
11. It’s a green pool, not a blue one.
12. He was pretty full after eating dinner.
13. He took some money from his little brothers Ben and Peter to buy some Gummi Bears.
14. He has a big smile on his face in this picture.
15. The good ol’ pen and ink still does the trick.
16. I was completely shocked when he bade me to go
17. Will you go to sleep if I tell you a story?
18. It’s a taffy pull extravaganza!
19. The paper is in the yellow file cabinet in the corner.
20. Karen’s been sitting a while in the corner thinking about what she’s done.
21. I thought I would fail the test.
22. The California seagull is Utah’s state bird.
23. Have you seen the new foal on the farm?
24. We often hid behind the barn when we played hide-and-go-seek.
25. How small a tree do you want to plant in the garden?
26. The flower girl walked down the long aisle throwing rose petals.
27. Grab the dust bin from the closet, will you?
28. The bed in that corner, not this one was mine when I was young.
29. No! Mary was NOT able to sell the last box of Girl Scout cookies today.
30. The furnace used wood, coal, and oil, but now it runs on natural gas.
31. Where is the nearest store selling clothes for big and tall men in this town?
32. The plans for the fire pit are going well.
33. You can pick up your ID pin and badge at the front desk.
34. Please put the rocks back in the pail on the table.
35. That’s cool!
36. There was a cute dog for sale at the pet store today.
37. The Smithers live at the end of the cul-de-sac in Newtown.
38. Do you know if Frank is all better from the flu?
39. My sisters Jen and Mary go swimming every day.
40. I had lunch with Missy Dade in the garden, not Chrissy Dade.
41. The little boy fell the whole way down the stairs.
42. All he wanted to do was score a goal in the championship game.
43. The West Edmonton shopping mall is considered by some to be the biggest in the world.
44. In school we learned about the Dust bowl of the Great Depression.
45. The lion’s den at the zoo is quite a thing to see.
46. The town is about one mile away from the highway exit.
47. I think that the fall leaves are pretty when they change to bright red.
48. They put the pretty Jersey cow in with the bull from the fair.
49. My cousin Dale Murphy played a little baseball in his time.
50. When our pet cat Fluffy was sick, my mom took her to the vet.
51. Dr. Roberts likes gin and tonic after a long day.
52. No, the dog has a big tail, not a little one.
53. Each night he would tell another long tale about fighting pirates on the sea.
54. The children dressed up as scary ghouls and goblins for Halloween.
55. It’s the older not the younger Mr. Pell that teaches physics.
56. Josh always wins when he plays Phase Ten with his friends.
57. He climbed up the pole in the middle of the courtyard.
58. Did you see that rendition of Cat on a Hot Tin Roof?

German Sentences

Please state your name at the beginning of the recording. Read this list twice into the microphone. Speak naturally, as if you were talking to a roommate or friend.

1. Ein Sinn für Humor hilft uns, ein gutes Leben zu führen.
2. Im besten Fall erhält er fünf Stimmen.
3. Professor Gull kommt aus Berlin und unterrichtet Physik.
4. Kannst du Hans Ditte ein Paket für mich geben?
5. Der nette Senn aus Bayern produziert die beste Butter!
6. An der Jacke fehlen zwei Knöpfe.
7. Ich bett’ meine kranke Mutter auf das Sofa.
8. Was machst du denn da mit so viel Geld?
10. Der Rotkohl schmeckte gar nicht gut.
12. Ich renn’ durch die ganze Stadt, wenn das Wetter gut ist.
15. Ich bitt’ dich um Verständnis!
16. Er hat mir immer gesagt: Hör mal zu!
18. Jeden Samstag kehl’ ich die Fische, die Fischer Fritz mir bringt.
20. Am Kinn bedeckte der Bart die Narbe.

125
23. Ich schenke Herrn Kull eine neue Krawatte zum Geburtstag.
24. Mit Mehl und Zucker hat Frau Schmidt eine Torte gebacken.
27. Das war total cool von der Band, mir eine CD zu geben.
29. Sie hat den Ball mit dem Stock geschlagen.
30. Danach campen wir auf der Insel Pohl in der Nordsee.
31. Herr Wagner schenkt Frau Hull die neue CD.
32. Darf ich den Apfel mit Karamell essen?
33. Wissen Sie, dass ein Gal eine physikalische Einheit der Beschleunigung ist?
34. Einen Hund bekam Fräulein Rinn von der Gemeinde.
35. Die Sonne strahlte hell und breit am Mittag.
36. Alles was er wollte war ein Goal in dem Spiel für die Meisterschaft.
37. Onkel Hubert kennt die ganze Familie aus Texas.
38. Von Fritz will die Familie Dinn nichts hören.
41. Ihre Jacke aus Seide und Mull kann sie nicht finden.
42. Kranke, dette, leise oder gute: Das zweite ist kein deutsches Wort.
43. Leider fäll’ ich den schönen Kirschbaum.
44. Der Weg war steil in der Nähe von den Felsen.
46. Wir haben das Fell zum Markte getragen.
47. Mit einem kleinen Beil kann er den Baum fällen.
48. Ich kenn’ das beste Restaurant in Berlin.
49. Was hast du Frau Kell und ihrer Tochter gesagt?
50. Diese Rhapsodie von Heinz Mohl kann sie sehr gut spielen.
51. Diese Musik ist schön, herrlich, geil, super!
52. Den grünen BMW dort drüben stehl’ ich mir.
53. Können Sie Herrn Mell davon erzählen?
54. Ich gab dem Kind ein bisschen Schokolade.
55. Katrin Huhl telefoniert mit meiner Schwester in Aachen.
56. Wir gaben Doktor Stohl und seinen 8 Kindern eine Karte.
57. Das alte Pferd pull’ ich zum Zaun.
58. Die junge Familie hat einen ganzen Stall voll Kinder.
59. Klaus hat einen Hehl daraus gemacht.
60. Meine Katzen Puhl und Fritz sind die besten Freunde.
APPENDIX D

Perceptual Test Screen Shots

<table>
<thead>
<tr>
<th>Which word did you hear?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>sell</td>
<td>sale</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Which word did you hear?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>bool</td>
<td>bull</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

128
APPENDIX E

Native Judgment Sheets

Subject #_______ (English)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bade</td>
<td>Bed</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Bade</td>
<td>Bed</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Bin</td>
<td>Ben</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Bin</td>
<td>Ben</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Bool</td>
<td>Bowl</td>
<td>Bull</td>
</tr>
<tr>
<td>6</td>
<td>Bool</td>
<td>Bowl</td>
<td>Bull</td>
</tr>
<tr>
<td>7</td>
<td>Bool</td>
<td>Bowl</td>
<td>Bull</td>
</tr>
<tr>
<td>8</td>
<td>Cool</td>
<td>Coal</td>
<td>Cul</td>
</tr>
<tr>
<td>9</td>
<td>Cool</td>
<td>Coal</td>
<td>Cul</td>
</tr>
<tr>
<td>10</td>
<td>Cool</td>
<td>Coal</td>
<td>Cul</td>
</tr>
<tr>
<td>11</td>
<td>Dead</td>
<td>Dade</td>
<td>X</td>
</tr>
<tr>
<td>12</td>
<td>Dale</td>
<td>Dell</td>
<td>X</td>
</tr>
<tr>
<td>13</td>
<td>Dead</td>
<td>Dade</td>
<td>X</td>
</tr>
<tr>
<td>14</td>
<td>Dale</td>
<td>Dell</td>
<td>X</td>
</tr>
<tr>
<td>15</td>
<td>Din</td>
<td>Den</td>
<td>X</td>
</tr>
<tr>
<td>16</td>
<td>Din</td>
<td>Den</td>
<td>X</td>
</tr>
<tr>
<td>17</td>
<td>Fail</td>
<td>Fell</td>
<td>X</td>
</tr>
<tr>
<td>18</td>
<td>Fail</td>
<td>Fell</td>
<td>X</td>
</tr>
<tr>
<td>19</td>
<td>Fool</td>
<td>Foal</td>
<td>Full</td>
</tr>
<tr>
<td>20</td>
<td>Fool</td>
<td>Foal</td>
<td>Full</td>
</tr>
<tr>
<td>21</td>
<td>Fool</td>
<td>Foal</td>
<td>Full</td>
</tr>
<tr>
<td>22</td>
<td>Ghoul</td>
<td>Goal</td>
<td>Gull</td>
</tr>
<tr>
<td>23</td>
<td>Gin</td>
<td>Jen</td>
<td>X</td>
</tr>
<tr>
<td>24</td>
<td>Ghoul</td>
<td>Goal</td>
<td>Gull</td>
</tr>
<tr>
<td>25</td>
<td>Ghoul</td>
<td>Goal</td>
<td>Gull</td>
</tr>
<tr>
<td>26</td>
<td>Hid</td>
<td>Head</td>
<td>X</td>
</tr>
<tr>
<td>27</td>
<td>Hid</td>
<td>Head</td>
<td>X</td>
</tr>
<tr>
<td>28</td>
<td>Gin</td>
<td>Jen</td>
<td>X</td>
</tr>
<tr>
<td>29</td>
<td>Pell</td>
<td>Pail</td>
<td>X</td>
</tr>
<tr>
<td>30</td>
<td>Pell</td>
<td>Pail</td>
<td>X</td>
</tr>
<tr>
<td>31</td>
<td>Pin</td>
<td>Pen</td>
<td>X</td>
</tr>
<tr>
<td>32</td>
<td>Pit</td>
<td>Pet</td>
<td>X</td>
</tr>
<tr>
<td>33</td>
<td>Pin</td>
<td>Pen</td>
<td>X</td>
</tr>
<tr>
<td>34</td>
<td>Pit</td>
<td>Pet</td>
<td>X</td>
</tr>
<tr>
<td>35</td>
<td>Pool</td>
<td>Pole</td>
<td>Pull</td>
</tr>
<tr>
<td>36</td>
<td>Pool</td>
<td>Pole</td>
<td>Pull</td>
</tr>
<tr>
<td>37</td>
<td>Pool</td>
<td>Pole</td>
<td>Pull</td>
</tr>
<tr>
<td>38</td>
<td>Sell</td>
<td>Sale</td>
<td>X</td>
</tr>
<tr>
<td>39</td>
<td>Sell</td>
<td>Sale</td>
<td>X</td>
</tr>
<tr>
<td>40</td>
<td>Tell</td>
<td>Tail</td>
<td>X</td>
</tr>
<tr>
<td>41</td>
<td>Tell</td>
<td>Tale</td>
<td>X</td>
</tr>
<tr>
<td>42</td>
<td>Tell</td>
<td>Tale</td>
<td>X</td>
</tr>
<tr>
<td>43</td>
<td>Ten</td>
<td>Tin</td>
<td>X</td>
</tr>
<tr>
<td>44</td>
<td>Ten</td>
<td>Tin</td>
<td>X</td>
</tr>
</tbody>
</table>
Subject # ______ German

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bett</td>
<td>Bitt</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Bett</td>
<td>Bitt</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Cool</td>
<td>Kull</td>
<td>Kohl</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Den</td>
<td>Denn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Den</td>
<td>Denn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>Ditte</td>
<td>Dette</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Dinn</td>
<td>Denn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Ditte</td>
<td>Dette</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>Faell</td>
<td>Fell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Fehl</td>
<td>Fell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>11</td>
<td>Fehl</td>
<td>Fell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>12</td>
<td>Goal</td>
<td>Gull</td>
<td>Guhl</td>
<td>X</td>
</tr>
<tr>
<td>13</td>
<td>Goal</td>
<td>Gull</td>
<td>Guhl</td>
<td>X</td>
</tr>
<tr>
<td>14</td>
<td>Goal</td>
<td>Gull</td>
<td>Guhl</td>
<td>X</td>
</tr>
<tr>
<td>15</td>
<td>Hehl</td>
<td>Hell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>16</td>
<td>Hehl</td>
<td>Hell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>17</td>
<td>Hull</td>
<td>Huhl</td>
<td>hohl</td>
<td>X</td>
</tr>
<tr>
<td>18</td>
<td>Hull</td>
<td>Huhl</td>
<td>hohl</td>
<td>X</td>
</tr>
<tr>
<td>19</td>
<td>Hull</td>
<td>Huhl</td>
<td>hohl</td>
<td>X</td>
</tr>
<tr>
<td>20</td>
<td>Kehl</td>
<td>Kell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>21</td>
<td>Kehl</td>
<td>Kell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>22</td>
<td>Kinn</td>
<td>Kenn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>23</td>
<td>Kind</td>
<td>Kennt</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>24</td>
<td>Kind</td>
<td>Kennt</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>25</td>
<td>Kinn</td>
<td>Kenn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>26</td>
<td>Cool</td>
<td>Kull</td>
<td>Kohl</td>
<td>X</td>
</tr>
<tr>
<td>27</td>
<td>Cool</td>
<td>Kull</td>
<td>Kohl</td>
<td>X</td>
</tr>
<tr>
<td>28</td>
<td>Mehl</td>
<td>Mell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>29</td>
<td>Mehl</td>
<td>Mell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>30</td>
<td>Mohl</td>
<td>Muhl</td>
<td>Mull</td>
<td>X</td>
</tr>
<tr>
<td>31</td>
<td>Mohl</td>
<td>Muhl</td>
<td>Mull</td>
<td>X</td>
</tr>
<tr>
<td>32</td>
<td>Mohl</td>
<td>Muhl</td>
<td>Mull</td>
<td>X</td>
</tr>
<tr>
<td>33</td>
<td>Pohl</td>
<td>Puhl</td>
<td>Pull</td>
<td>X</td>
</tr>
<tr>
<td>34</td>
<td>Pol</td>
<td>Puhl</td>
<td>Pull</td>
<td>X</td>
</tr>
<tr>
<td>35</td>
<td>Pol</td>
<td>Puhl</td>
<td>Pull</td>
<td>X</td>
</tr>
<tr>
<td>36</td>
<td>Pohl</td>
<td>Puhl</td>
<td>Pull</td>
<td>X</td>
</tr>
<tr>
<td>37</td>
<td>Rinn</td>
<td>Renn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>38</td>
<td>Rinn</td>
<td>Renn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>39</td>
<td>Sehn</td>
<td>Senn</td>
<td>Sinn</td>
<td>X</td>
</tr>
<tr>
<td>40</td>
<td>Sehn</td>
<td>Senn</td>
<td>Sinn</td>
<td>X</td>
</tr>
<tr>
<td>41</td>
<td>Sinn</td>
<td>Senn</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>42</td>
<td>Stehl</td>
<td>Stell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>43</td>
<td>Stehl</td>
<td>Stell</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>44</td>
<td>Stohl</td>
<td>Stuhl</td>
<td>Stull</td>
<td>X</td>
</tr>
<tr>
<td>45</td>
<td>Stohl</td>
<td>Stuhl</td>
<td>Stull</td>
<td>X</td>
</tr>
<tr>
<td>46</td>
<td>Stohl</td>
<td>Stuhl</td>
<td>Stull</td>
<td>X</td>
</tr>
</tbody>
</table>
These figures depict the acoustic space of the UMiss and BYU subjects. Each data point represents the mean Bark scale values for one vowel for one subject.\footnote{Note that the vowel /e/ has two realizations: in pronunciations before a nasal (/en/ in the figures), symbolized by black triangles, and when produced before a liquid (/e/), symbolized by white triangles.}
Figure 34. BYU subjects’ English vowel productions.
Figure 35. UMiss subjects’ German vowel productions.
Figure 36. BYU subjects’ German vowel productions.