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# /ae/ and /e/ in El Paso English

Lance Levi Williams

University of Texas at El Paso, llwilliams@miners.utep.edu

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**/æ/ AND /ɛ/ IN EL PASO ENGLISH**

**LANCE LEVI WILLIAMS, B.S.**

**Department of Languages and Linguistics**

APPROVED:

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Jon Amastae, Ph.D., Chair

---

Nicholas J. Sobin, Ph.D.

---

Nigel Ward, Ph.D.

---

Patricia D. Witherspoon, Ph.D.  
Dean of the Graduate School

## **DEDICATION**

To my parents,

My older brothers,

My little sister,

&

The late, great Rocky R Rockbourne

**/æ/ AND /ɛ/ IN EL PASO ENGLISH**

**by**

**LANCE LEVI WILLIAMS, B.S.**

**THESIS**

**Presented to the Faculty of the Graduate School of**

**The University of Texas at El Paso**

**in Partial Fulfillment**

**of the Requirements**

**for the Degree of**

**MASTER OF ARTS**

**Department of Languages and Linguistics**

**THE UNIVERSITY OF TEXAS AT EL PASO**

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## TABLE OF CONTENTS

DEDICATION .....	ii
ACKNOWLEDGEMENTS .....	iv
LIST OF TABLES .....	ix
LIST OF FIGURES .....	x
CHAPTER 1 – BACKGROUND	
1.0 Introduction .....	1
1.1 Previous Findings on /æ/ and /ɛ/ in the El Paso Region .....	1
1.2 Patterning of /æ/ and /ɛ/ in Chicano English .....	3
1.3 Acquisition of /æ/ and /ɛ/ by Speakers of Spanish and Chicano English .....	4
1.4 Differential Production of /æ/ and /ɛ/ between Chicano and Anglo Speakers .....	6
1.5.0 Allophonic Processes Involving /æ/ and /ɛ/ in Chicano English .....	7
1.5.1 Prelateral Neutralization in English Dialects .....	7
1.5.2 Prelateral Neutralization as an Artifact of Acquisition .....	8
1.6.1 Chicano English as a Minority Dialect .....	10
1.6.2 Chicano English as a Majority Dialect .....	11
1.7 The Current Investigation .....	12
CHAPTER 2 – EXPERIMENTAL DESIGN	
2.0 Introduction .....	15
2.1.0 Subjects .....	15
2.1.1 Difficulties in Recruiting Balanced Bilinguals .....	16
2.1.2 Difficulties in Recruiting Anglo Subjects .....	16
2.1.3 Roster of Subjects .....	17
2.2.0 Methodology & Apparatus .....	19
2.2.1 Questionnaire .....	19

2.2.2 Picture Recognition Task .....	19
2.2.3 Using Praat .....	20
2.2.4 Listening Task .....	21
2.2.5 Listening Task Apparatus .....	22
CHAPTER 3 – RESULTS OF PERCEPTION TEST	
3.0 Analysis of Perception .....	24
3.1 “Unanalyzed” Tokens .....	26
3.2.0 General Results of Perception Test .....	27
3.2.1 Reference Tokens .....	30
3.3.0 Perception with Respect to Phonological Environment .....	30
3.3.1 Perception before Voiceless Obstruents .....	31
3.3.2 Perception before Voiced Obstruents .....	39
3.3.3 Perception before /n/ .....	41
3.3.4 Perception before /l/ .....	43
3.4 Group Performance vs. Individual Performance .....	48
CHAPTER 4 – RESULTS OF PRODUCTION TASK	
4.0 Production Analysis .....	50
4.1 Comparison to Delattre’s Canonical Formant Values .....	50
4.2 Comparison to <i>The Atlas of North American English</i> Data .....	53
4.3 Prenasal Production of /æ/ and /ɛ/ .....	58
4.4 Prelateral Production of /æ/, /ɛ/, and /e/ .....	60
4.5 Other Possible Conditioning Environments .....	62
4.6 General Overlap of /æ/ and /ɛ/ .....	64
4.7 Connection between Production and Perception of /æ/ and /ɛ/ .....	66



## CHAPTER 5 – DISCUSSION

5.1.0 Limitations of Experimental Design .....	70
5.1.1 Non-Standard Production of Voice Actor .....	70
5.1.2 No Controlling for Speech Styles .....	71
5.1.3 Improving the Picture Naming Task .....	72
5.1.4 Better Control for Phonological Environments .....	73
5.2 Conclusion .....	73
REFERENCES .....	79
APPENDIX A — CONSENT FORM .....	81
APPENDIX B — SUBJECT QUESTIONNAIRE .....	86
APPENDIX C — LISTENING TASK ANSWER CHOICES .....	87
CURRICULUM VITA .....	89

## LIST OF TABLES

Table 2.1. Roster of subjects .....	18
Table 3.1. Perception scores for tokens of /æ/ and /ɛ/ by following environment and group .....	31
Table 4.1. Production of /æ/ by subject, mean formant values (Hz) by following environment .....	51
Table 4.2. Production of /ɛ/ by subject, mean formant values (Hz) by following environment .....	52
Table 4.3. Production of /æ/ by group, mean formant values (Hz) by following environment .....	57
Table 4.4. Production of /ɛ/ by group, mean formant values (Hz) by following environment .....	57
Table 4.5. Comparison of formant values by group to literature values for pre-obstruent /æ/ and /ɛ/ .....	57
Table 4.6. Description of distribution of prenasal /æ/ and /ɛ/ by subject .....	60
Table 4.7. Description of distribution of prelateral /æ/, /ɛ/, and /e/ by subject .....	62
Table 4.8. Degree of overlap for pre-obstruent /æ/ and /ɛ/ for subjects showing overlap .....	64

## LIST OF FIGURES

Figure 3.1. Accuracy and agreement scores for all tokens of /æ/ by group .....	28
Figure 3.2. Accuracy and agreement scores for all tokens of /ɛ/ by group .....	28
Figure 3.3. Perception scores for /æ/ and /ɛ/ before voiceless obstruents by heritage group .....	32
Figure 3.4. Perception scores for /æ/ and /ɛ/ before voiced obstruents by heritage group .....	32
Figure 3.5. Perception scores for /æ/ and /ɛ/ before nasals by heritage group .....	33
Figure 3.6. Perception scores for /æ/ and /ɛ/ before lateral liquids by heritage group .....	33
Figure 3.7. Perception of tokens of /æ/ and /ɛ/ before /t/ with length values given .....	34
Figure 3.8. Perception of tokens of /æ/ and /ɛ/ before /p/ with length values given .....	36
Figure 3.9. Perception of tokens of /æ/ and /ɛ/ before /k/ with length values given .....	36
Figure 3.10. Perception of tokens of /æ/ and /ɛ/ before /s/ with length values given .....	38
Figure 3.11. Perception of tokens of /æ/ and /ɛ/ before /ʃ/ with length values given .....	38
Figure 3.12. Perception of tokens of /æ/ and /ɛ/ before voiced obstruents .....	39
Figure 3.13. Perception of tokens of /æ/ and /ɛ/ before /n/ .....	42
Figure 3.14. Perception of tokens of /æ/ and /ɛ/ before /l/ .....	44
Figure 3.15. Change in F2 over length of vowel for tokens FALLOW and FALLOW1 .....	47
Figure 4.1. Comparison of production of /æ/ and /ɛ/ before voiceless obstruents by group .....	54
Figure 4.2. Comparison of production of /æ/ and /ɛ/ before voiced obstruents by group .....	54
Figure 4.3. Comparison of production of /æ/ and /ɛ/ before nasals by group .....	55
Figure 4.4. Comparison of production of /æ/ and /ɛ/ before prelateral liquids by group .....	55
Figure 4.5. Production plot for P015, showing overlap of prenasal and prelateral /æ/ and /ɛ/ ...	63
Figure 4.6. Production plot for P006, showing overlap of pre-obstruent /æ/ and /ɛ/ .....	67
Figure 4.7. Production plot for P007, showing overlap of pre-obstruent /æ/ and /ɛ/ .....	68

## **CHAPTER 1 – BACKGROUND**

### **1.0 Introduction**

The English language is usually considered to have at least 10 vowel phonemes and somewhere in the neighborhood of 15 to 20 vocal allophones, but Spanish is often thought to have only five of each: /a/, /e/, /i/, /o/, and /u/. For Spanish speakers learning English as a second language, this difference can make acquisition a difficult process as some English vowels can become approximated by if not conflated with Spanish vowels, resulting in recognizably Hispanic accents. The vowels /æ/ and /ɛ/ in particular are known to be problematic for many Hispanics. This is not to say that Hispanic varieties of English spoken by bilingual communities are just a form of L2 English, but that one must consider the historical and sociolinguistic substrate which can influence the speech of those with a Hispanic background—similar conclusions are drawn by Konopka & Pierrehumbert (2008). Therefore, as we consider the production and perception of /æ/ and /ɛ/ in El Paso English, it is important to make an account for the pressing linguistic and social factors in the region.

### **1.1 Previous Findings on /æ/ and /ɛ/ in the El Paso Region**

Telsur data published in *The Atlas of North American English* (ANAE) by Labov, Ash, & Boberg (2005) gave estimates of height and backness for /æ/ and /ɛ/ in the El Paso region. /æ/ was found to be relatively low and front, and /ɛ/ was found to be relatively high and front, in comparison to data from other regions of the United States and Canada. However, these data may prove to be unrepresentative of El Paso as a whole, due to a number of factors. First, the Telsur study could not control for ethnicity, nor could it employ more precise interview methods,

and it is unclear (and probably unlikely) that the respondents in the Telsur survey actually represented El Paso, which is estimated to be 80.0% Hispanic (or Latino) by the U.S. Census Bureau (2008). Second, “minority” dialects such as Chicano English were, by the authors’ admission, outside of the scope of the Telsur study; again, since El Paso is about 80% Hispanic, the possibility that a form of Chicano English is more than just a “minority” dialect for this region must be considered, and no study of the greater El Paso speech community can be complete without considering how this form of Chicano English may influence speakers of “majority” dialects in the region. Therefore, it behooves us to examine previous findings concerning Chicano English.

A perhaps more striking conclusion drawn from the Telsur data, if this data at least somewhat reflects the reality of the situation at hand, is that El Paso does not quite fit into what the authors consider the West and the South dialect regions of the United States (as defined by ongoing vowel changes which are fairly well-documented in the United States at large); El Paso is in both cases just outside these regions, though it is included in the Southeastern super-region, which the authors argue ties it to the rest of Texas, the Southeastern United States, and other states peripheral to this area, but it should be noted that this classification is made on the basis of a single linguistic feature (namely, the fronting of /ow/). This classification also ignores the complicated history of El Paso’s non-Hispanic demographic, as Anglos displaced from regions of the United States not necessarily adjacent to El Paso have come to El Paso due to historical forces as well as due to military transfer to Ft. Bliss, a large military base.

A possibility which must be considered is that El Paso is a transitional or diffuse speech community. How much of this is owed to El Paso being “not quite” part of the West and “not

quite” part of the South—about as much linguistically as geographically, with El Paso resting in the Chihuahuan Desert, hundreds of miles from any American city with a comparable population—as well as how much is owed to El Paso’s ubiquitous Hispanic influence, is not yet readily apparent, though it certainly merits consideration.

## **1.2 Patterning of /æ/ and /ɛ/ in Chicano English**

/æ/ patterns with front vowels in some English dialects and with low vowels in others; in Chicano English, according to previous literature, it may pattern with low vowel /ɑ/ due to /æ/-backing (Fought, 2003), but this is within the context of the California English speech community, where it also appears to participate in California English /æ/-raising, suggesting that patterning of /æ/ is a product of California English for Chicanos in California and not necessarily intrinsic to Chicano English.

Since El Paso is not necessarily a part of the California English speech community, and since varieties of Chicano English may arise at least somewhat independently from region to region, it is not immediately certain how or whether observations made in El Paso will match those already made in California. Santa Ana & Bayley (2005) suggest that front vowel overlap, in particular /ɛ/ and /ɪ/, may be a general feature of Chicano English; this is reflected in the larger clouds for these and other lax vowels (rather than tense vowels) employed by Chicano English speakers. If /æ/ among El Paso Chicano English speakers patterns with front vowels rather than low vowels (as it does for California Chicanos), but these large vowel clouds are maintained, this sort of overlap of /æ/ and /ɛ/ may result among El Paso speakers.

According to Penfield & Ornstein-Galicia (1985), the distribution of /æ/ and /ɛ/ in Chicano English differs from their distribution in standard American English varieties according in part to word class, such that some underlying /æ/ sounds for Anglo English speakers are realized as [ɛ] (or [e]) and some underlying /ɛ/ sounds are pronounced as [æ] by Chicanos. There is also a tendency to tense /ɛ/ to [e], especially before nasals. It will be of interest to see how speakers from the El Paso region compare to these findings.

### **1.3 Acquisition of /æ/ and /ɛ/ by Speakers of Spanish and Chicano English**

It is well-understood, if not common knowledge in the region, that /æ/ and /ɛ/ are initially merged, at least at a phonetic level, by a number of Spanish-speaking English language learners. This results in, for example, the pronunciation of *man* and *men* both as (or closer to) *men*. Eventual acquisition of the contrast between /æ/ and /ɛ/ does occur; however, there are at least two imaginable ways in which the nature of the contrast could differ from native speakers of American English dialects. The first would be the acquisition of the contrast between /æ/ and /ɛ/ “fossilizing” for these learners, reaching a point where it is perhaps not quite as distinct or as “complete” as it is for native English speakers, which could perpetuate some degree of overlap between the allophonic range of the two phonemes that native English speakers would not necessarily display. The second possibility would be the contrast between /æ/ and /ɛ/ being exaggerated via hypercorrection. It should be noted that these two possibilities are not mutually exclusive in the sense that there might be overlap between the phonemes in more casual speech, with hypercorrection highlighting the contrast between them in more formal speech, which also suggests an overriding system of perception (or social evaluation, perhaps) mediating production in both cases. Also, in both situations, whether by production inconsistent with that of a standard

English variety or the need for variation in production (and perception) so that the contrast can be acquired, or both, the production of /æ/ and /ɛ/ could vary necessarily over a wide region in the vowel space, which may account (at least in part) for the large vowel clouds mentioned above. In either of these two scenarios, we might also expect some interference from Spanish /e/, which could be conflated with English /ɛ/; another scenario is that hypercorrection could force English /ɛ/ away from Spanish /e/ to maximize contrast between those two vowels, possibly at the expense of contrast between English /æ/ and /ɛ/.

For native Chicano English speakers acquiring English in an environment including many ELLs (i.e. friends and relatives), the possibility that a dialogue with the production of ELLs (as well as their Chicano English peers) will work to shape the organization of the vowels involved cannot be discounted. That is, features of ELL speech which are essentially L2-acquisitional phenomena might be passed on to L1 learners of Chicano English. As these native Chicano English speakers learn alternate speech styles or other varieties of American English, these features which originated as acquisitional issues can now come to bear sociolinguistic (and therefore social) significance as markers of speech style, in this case the variety of English being spoken, more specifically the socially diagnostic linguistic variables which could roughly define the stereotype of the “accent” which is Chicano English. It is beyond the scope of the current study to answer the question of whether /æ/ and /ɛ/ are such markers definitively, but any observed variation in the production of the targeted variables by social factors may serve as a bridge to a more in-depth investigation. It should also be noted that a large degree of variation within the community could lead to the formation of different strategies of perception and production between speakers, with some processing the variety of phonetic cues—including vowel formant values, length, and pitch—and the interaction among them with variable priority.



To offer some idea of what acquisition of /æ/ and /ɛ/ might be like for a monolingual English speaker, Otomo & Gammon (1992) studying unrounded vowel acquisition among presumably non-Chicano children in Washington observed that /æ/ was much more likely to be mispronounced as [a] than as [ɛ], while /ɛ/ was pronounced incorrectly as [æ] more often than any other incorrect pronunciation. Overall, /æ/ was produced more consistently as [æ] than /ɛ/ was as [ɛ] among these children. As the tendency among Hispanics would appear to be /æ/ realized as [ɛ], this would suggest the possibility of two notably different monolingual paths of acquisition of /æ/ and /ɛ/. (The study mentioned here, however, should not be taken as a definitive comparison, as their results are subject to dialectal variation as well.)

#### **1.4 Differential Production of /æ/ and /ɛ/ between Chicano and Anglo Speakers**

These considerations may hint at a substrate of social and linguistic factors which work in concert to establish general overlap in the phonetic ranges of /æ/ and /ɛ/ in Chicano or Chicano-influenced speakers that may not be observed in speakers who are presumably or by default not within this sphere of influence. This substrate of interacting variables could also lead to a general restructuring manifest in observable differences in the allophonic behavior of /æ/ and /ɛ/ between the groups in question. Therefore, we might expect to see some degree of neutralization between /æ/ and /ɛ/ among our subjects within this Chicano sphere, and though this is unlikely to be a merger in the narrowest sense, where /æ/ and /ɛ/ occupy precisely the same region of the vowel space across all environments and are best modeled as a single phoneme, we feel safe expecting at least some linguistic behaviors to be socially mediated and that even in historically unmarked environments there will be less of a distinction made by our most heavily Chicano-influenced subjects, at least on the basis of the most basic acoustic variables (F1 and F2,

essentially), than by our Anglo subjects. (To this end, the term “neutralization” as it is used from here on should be interpreted by default in the broadest phonetic sense, and seen generally as hinting at a possible sound change or merger in progress, though this does not preclude the possibility of a “complete” phonemic merger between the phonemes in question for certain conditioning phonemic environments.)

### **1.5.0 Allophonic Processes Involving /æ/ and /ɛ/ in Chicano English**

As stated above, aside from considering just the possibility of significant overlap in the general phonetic range of /æ/ and /ɛ/ among subjects in the current study, it is worth noting that the phonemic environment may condition the production and perception of /æ/ and /ɛ/ by the speakers of interest. Findings presented by Penfield & Ornstein-Galicia (1985) mentioned above suggest that nasals are affecting the production of /ɛ/ at least, where it becomes tensed to [e]. In combination with a change in the general patterning of /æ/ and /ɛ/, this leaves open the possibility of similar variation in the production of /æ/ before nasals. In addition, a prelateral merger of /æ/ and /ɛ/, or at least some degree of overlap in the range of prelateral /æ/ and /ɛ/, is suspected based on casual observations, and this possibility is discussed in further detail below.

#### **1.5.1 Prelateral Neutralization in English Dialects**

Several cases of neutralization among vowels before phonemic /l/ have been documented among varieties of American English, including /ʊ/ and /uw/ (as in *full* and *fool*), /ɪ/ and /iy/ (as in *fill* and *feel*), and /ɛ/ and /e/ (as in *fell* and *fail*); according to Telsur data (Labov, Ash, & Boberg, 2005), only the first of these may be occurring in the El Paso region, though not strongly. However, a prelateral merger of /æ/ and /ɛ/ in American English varieties has not been

studied to great depth, and certainly not at all in the El Paso region; however, Penfield & Ornstein-Galicia (1985) report the possibility that the pronunciation of /ε/ before /l/ as [æ] is an identifying characteristic of the Chicano accent of California, particularly in Los Angeles (or /æley/, perhaps). The tendency of /e/ to [ε] (as well as /i/ to [I] and /uw/ to [u]) before /l/ in Chicano English is, interestingly enough, reported by Penfield & Ornstein-Galicia (1985), presenting another possible conflict with Telsur data. There are several studies investigating this merger, directly and indirectly, in Australia and New Zealand, but there is no apparent connection between these speech communities and the El Paso region. Perhaps the most notable of these studies, Cox & Palethorpe (2003) and Thomas & Hay (2005), found that for those who participated in this merger, the tendency was for both vowels to be phonetically realized more like [æ] than [ε] (suggesting that /ε/ is dropped to [æ], instead of /æ/ being raised to [ε]) in prelateral environments. The Australian and American vowel systems have some underlying differences, however—notably /ε/ sounding more like [e] in Australian English to the extent that an alternate phonetic alphabet has even been proposed for Australian English (Cox & Palethorpe, 2007)—and care should be taken in attempting to make any direct comparisons should El Paso speakers show the same tendency of lowering the higher vowel, as it could be happening for appreciably different underlying reasons, some possibilities of which are discussed below.

### **1.5.2 Prelateral Neutralization as an Artifact of Acquisition**

Another question that arises is the possibility that prelateral neutralization (or any other neutralization) between the phonemes in question may be an artifact of language acquisition, namely the acquisition of English, even at relatively young ages, after the native acquisition of Spanish is complete, or at least well on its way (i.e. the acquisition of a second language

probably no earlier than late in the critical period after the first language is well-established and in a position to interfere with all future acquisition). If /æ/ and /ɛ/ must be “unmerged” by Spanish-speaking ELLs, it is possible that this “unmerger” stops (or at least statistically declines) at environments that appear to favor neutralization even for fully native English speakers—with distinction between /æ/ and /ɛ/ in each of these environments arranged along an acquisition continuum similar to Amastae’s (1981) analysis of English consonant acquisition by Spanish speakers. A merger of /æ/ and /ɛ/ before /l/ could be favored in at least two ways according to environment, as an extension of other prelateral mergers and/or as an extension of the merger of /æ/ and /ɛ/ before /r/ (whatever the underlying reasons for their occurrence). The acquisition of English velarized “dark L” by Spanish speakers may further confound the likelihood of making a separation between /æ/ and /ɛ/ by the velarization of /l/ drawing more of the learner’s attention than the distinction between the preceding vowels, and/or by the velarization itself causing the distinction between /æ/ and /ɛ/ to become more subtle (possibly via “l-coloring” of the vowels which could result in reduced vowel space between /æ/ and /ɛ/) and therefore give it an opportunity to go undetected in this environment. Also, a lack of salient minimal pairs involving prelateral /æ/ and /ɛ/ may work to reduce the priority of such a distinction in the face of acquiring more crucial (and common) distinctions. This combination of factors, along with constant interaction with bilinguals, may eventually lead to monolingual English speakers acquiring the same merger second-handedly.

For many in the El Paso region, the reality is that Spanish is acquired first at home (with nearly 75% of El Pasoans speaking Spanish at home), and any acquisition of English during this stage of life is done within this context. Such children may not encounter their first “monolingual” English speech community until entering grade school; this environment is

“monolingual” in the sense that at least the use of English is strongly encouraged in grade school by the fact that it is the primary or even the only language of instruction, along with its mastery being the target of language arts courses. (Public education has long been a vehicle of acculturation in the United States, and shifting to the English language appears to be no exception to this pattern.) The term “monolingual” is being used cautiously here because more likely than not the children in these schools are speaking a good deal of Spanish to each other (and in some cases even to their teachers, who often respond in Spanish).

### **1.6.1 Chicano English as a Minority Dialect**

Santa Ana (1991) observed that /æ/ and /ɛ/ were merged for an English language learner (ELL) in a Chicano English-speaking environment. However, native Chicano English speakers in this same community did not demonstrate such a merger. A number of studies show, in fact, that native Chicano English speakers tend to make the same distinctions (including /æ/ and /ɛ/) and non-distinctions (such as the “cot/caught” merger) as are made by native speakers of the American English varieties around them, which also suggests that there are multiple varieties of Chicano English; it is possible that Chicano English arises independently from one speech community to the next. This gives us at least two things to consider. First, it would be fallacious to reason that the behavior of /æ/ and /ɛ/ (or any other linguistic variables, for that matter) in Chicano English is merely due to the “imperfect” acquisition (possibly attributed to interference) of a more standard form of English if Chicano English has features of more standard varieties of American English which are never attributed *per se* to such “imperfect” acquisition, but more commonly to the larger non-ethnic speech community of which they are a member; that is, the behavior of /æ/ and /ɛ/ would be determined by a well-defined Chicano English grammar

acquired by speakers of that variety. Second, it appears that majority pressures play a significant role in shaping minority dialects. In addition to sharing stable features of American English dialects, Chicano English speakers also participate in the ongoing linguistic changes of their surrounding speech community; for example, Fought (2003) observes California English-style u-fronting taking hold among Californian speakers of Chicano English. If for no other reason, Chicano English must be looked at as a veritable English variety and not just a stage of acquisition of some other variety of English since there are monolingual speakers of Chicano English who have not necessarily acquired or begun to acquire a more standard English variety, as well as speakers who may speak Chicano English and Anglo English both with competence and may switch between the two as a matter of “speech style.” (The misconception that Chicano English is an illegitimate form of L1 English may be comparable to similar views on African American Vernacular English. Similarly, speakers are known to master both AAVE and a more standard variety of English particular to their region.)

### **1.6.2 Chicano English as a Majority Dialect**

However, in El Paso, Chicanos are hardly a “minority” anymore (as El Paso city is 80.0% Hispanic, with nearly 75% of El Pasoans speaking Spanish in their homes according to current U.S. Census data); it appears unreasonable to assume that a significant number of Chicano English speakers in a community could necessarily fail to influence the other English varieties in contact with it within that community if standard American English speakers can influence Chicano English speakers when these roles are reversed. Godinez & Maddieson (1985) showed that the production of /æ/ and /ɛ/ by monolingual and bilingual speakers of California Chicano English was nearly identical between groups, and clearly differentiated from that of monolingual

General Californian English speakers; however, it should also be noted that Godinez and Maddieson drew their Chicano English groups from East Los Angeles, an overwhelmingly Hispanic community, but their General Californian English groups from Sherman Oaks, a suburb of Los Angeles in the San Fernando Valley with an overwhelmingly white, non-Hispanic population, where they would most likely fall outside the influence of East Los Angeles Chicanos. In a community such as El Paso where both Chicano English monolinguals and Chicano bilinguals comprise such a large percent of the population, the difference in demographics may correlate to a difference (whether it proves to be increased or decreased) in the distance between the production of Chicano English speakers and speakers of a more standard American English variety. That is, production and perception of /æ/ and /ɛ/ citywide may be influenced by Chicano English (and/or the underlying Spanish substratum which is thought to be responsible for many features of Chicano English) above all else.

### **1.7 The Current Investigation**

As it stands, several broad questions have been raised, with the three that are perhaps the most important as follows: Can the El Paso region's reversed dynamic of a Chicano majority and an Anglo minority be manifest in sociolinguistic differences from communities with the standard dynamic of a Chicano minority among an Anglo majority? How might El Paso's geographical placement on the periphery of previously established dialect regions be sociolinguistically visible? Could acquisition-like linguistic variation find its way from language learners to speakers of "minority" dialects, and then on to speakers of "majority" dialects, and how? And, as with any linguistic inquiry, there is the overarching question as to whether the answers to

these questions can provide some universal insights, particularly to language change and variation.

By examining the target variables, /æ/ and /ɛ/, through an exploratory interview which will test both the production and perception thereof for El Paso English speakers classified by their social and linguistic backgrounds, and then comparing this data to all relevant past findings, we may be able to establish tentative connections between the linguistic data collected and the social and linguistic variables which are thought to be the mediating factors. There are many hypotheses implied by our discussion of the target variables, but we will begin the examination by looking at the behavior of the target variables in a number of different environments, so that at the very least we have a linguistic description from which we can draw further hypotheses.

To this end, participants' linguistic and ethnic backgrounds would be established as part of the interview process via questionnaire. A picture naming task would collect tokens of the vowels in question in various phonological environments and a perception test based on pre-recorded tokens would establish the hard linguistic data necessary. Specifically, this data could display evidence of any possible overlap in individuals' production and/or perception of /æ/ and /ɛ/, as well as establish which phonological environments may favor such overlap. Once examined in light of their linguistic and ethnic backgrounds, it could also answer whether such a display of any overlap, or lack thereof, correlates to these variables. Certainly, variable production and perception within the group of Hispanic subjects would lend credence to the notion that El Paso Hispanics are a diffuse speech community, while observing comparable results between L1 and L2 English speakers could support the hypothesis that acquisition-like features have spread from ELLs to Hispanic monolinguals. By comparison, it will also be of interest to see if El Paso Anglos and those of mixed heritage also display any signs of diffusion



and/or artifacts of acquisition, to the effect of at least partially illuminating the dynamic between the “majority” and “minority” dialects of the region. Last but not least, any fundamental properties of production and perception across all subjects might highlight any possible unity within the El Paso speech community.

## **CHAPTER 2 – EXPERIMENTAL DESIGN**

### **2.0 Introduction**

In order to answer the questions raised in the previous section—whether variation in production and perception will correlate to linguistic and ethnic background in such a way as to show any evidence of socially and/or acquisitionally mediated linguistic differences and similarities—an interview process in which both subjects’ perception and production of the target variables could be tested was designed. The recruiting and design processes are described below.

#### **2.1.0 Subjects**

Subjects were sought out on the basis of their being born and raised in the El Paso region. Due to the limited scope of the study, only males between the ages of 18 and 35, with preference given to those in their twenties, were asked to participate to limit the number of potential complicating factors<sup>1</sup>, and to focus on the ones hypothesized to be of the most relevance: ethnic and linguistic background. This was not a true random sample, but a convenience sample taken for a set of data which could be analyzed with more focus on basic qualitative than quantitative concerns. The particular ethnic backgrounds or identities targeted were Hispanic, Anglo, or some combination thereof, and from the linguistic perspective, English monolinguals and English-Spanish bilinguals from various spots along the bilingualism spectrum. Recruitment began with personal contacts of the interviewer. From there a network of contacts was formed. 26 participants were interviewed, but one was excluded after he revealed he had not lived in El Paso until after his graduation from high school. Out of the 25 remaining, only one was younger

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<sup>1</sup> Among these complicating factors would be vowel formant normalization, which though not performed for this study, was largely reduced in pertinence by the non-inclusion of female subjects.

than 20, and four were 30 or older. Recruitment required Institutional Review Board approval, which was received, and each participant was presented with a consent form (Appendix A).

### **2.1.1 Difficulties in Recruiting Balanced Bilinguals**

It proved difficult to recruit perfectly balanced bilinguals, as even many subjects whose first language was Spanish that were apparently fluent in both English and Spanish still admitted to being much more comfortable in English, if not having come to rely on it in all domains (i.e. home, school, work, and out on the town); all subjects unhesitatingly claimed to be fluent in English. Another common case was that of language attrition. Several subjects admitted to speaking Spanish (sometimes to the exclusion of English) until they entered the public schools, after which their Spanish fell into disuse. Subjects were not asked for their opinions on bilingualism *per se*, but the preference for English did not appear—at least subjectively—to have as much to do with the stigmatization of Spanish as much as it did with the educational and economic opportunities English apparently afforded them. This observation would be consistent with the hypothesis that the stigma on speaking Spanish in El Paso is not necessarily as strong as it used to be, though it is possible that the stigma has only gone covert; unfortunately, nothing in the current experimental apparatus suggested which of these two scenarios is the more likely.

### **2.1.2 Difficulties in Recruiting Anglo Subjects**

The most striking aspect of the sample of participants was the apparent rarity of subjects in the target age group who had two Anglo parents, but there is a plausible explanation for this; El Paso, whose Hispanic population is approaching 80% of its citizenry according to the latest census data, and its surrounding area, collectively called the Upper Rio Grande, have been experiencing a sharp increase of overall Hispanic population with an overall decrease of non-

Hispanic population. It is also by no means the only region of the state of Texas (or of the nation) undergoing such change. Aside from an increasing number of Hispanics in the Upper Rio Grande region on both the relative and absolute scales, analyses of data from the 2000 U.S. Census revealed that the Hispanic population of Texas has a significantly lower average age than the state's non-Hispanic population. This is manifest in a population pyramid, where the Hispanic population of Texas is skewed towards younger age groups (including the one targeted by this study) (Hispanic Research Center, 2002). This pyramid effect has been attributed to multiple factors, not the least of which is immigration, as well as the comparatively high fertility and morbidity rates of Texas Hispanics; this pyramid became much more pronounced between the 1990 and 2000 censuses, and there is reason to suspect it is becoming even more pronounced yet. Also, between 1990 and 2000, the average age of the non-Hispanic population increased from 32.9 to 38.1 years of age, while the Hispanic population's average age went up by a much smaller proportion, from 24.6 to 25.5. All this data is consistent with the suggestion that the unmistakable Anglo is becoming rare in the region, which may explain the difficulty of finding unambiguously Anglo subjects in the age group targeted, particularly those born and raised in or around El Paso.

### **2.1.3 Roster of Subjects**

A roster of subjects is shown in Table 2.1. As we can see, only 3 participants (12%) have completely Anglo parentage, 5 (20%) have mixed heritage, and the remaining 17 (68%) claim only Hispanic heritage. In terms of personal identity, which is something of a choice for those in the mixed heritage group, 2 self-identified as Hispanic, 2 as Anglo, and 1 as both equally; this yields 19 participants (76%) as Hispanic, 5 (20%) as Anglo, and 1 as having no particular preference of identity. Assuming there is any consistency with census data and that non-white

minorities were not targeted, this distribution is not surprising. There was a ranking “Fluent” for speakers who were fluent in Spanish but not native; however, no speakers attested to being fluent in Spanish without being native speakers as well. A number of subjects admitted to language attrition in their Spanish, claiming to have spoken the language but essentially abandoning it when they reached a certain age (usually around the time they entered grade school).

Table 2.1. Roster of subjects.

<b>Participant</b>	<b>Heritage</b>	<b>Identity</b>	<b>Age</b>	<b>Reported Spanish Ability</b>
P001	Hispanic	Hispanic	20	Poor
P002	Hispanic	Hispanic	25	Poor
P003	Hispanic	Hispanic	28	Not Good
P004	Hispanic	Hispanic	28	Good
P006	Hispanic	Hispanic	22	None
P007	Hispanic	Hispanic	26	Native
P008	Hispanic	Hispanic	29	Good
P009	Hispanic	Hispanic	24	Native
P010	Hispanic	Hispanic	25	Not Good
P011	Hispanic	Hispanic	27	Good
P012	Hispanic	Hispanic	34	Not Good
P013	Hispanic	Hispanic	30	Good
P014	Hispanic	Hispanic	24	Good
P015	Hispanic	Hispanic	29	Not Good
P016	Hispanic	Hispanic	25	Native
P017	Both	Anglo	19	Poor
P018	Hispanic	Hispanic	20	Native
P019	Both	Hispanic	22	Native
P020	Both	Hispanic	34	Very Good
P021	Both	Anglo	31	Poor
P022	Both	Both	28	Very Good
P023	Hispanic	Hispanic	25	Good
P024	Anglo	Anglo	20	Good
P025	Anglo	Anglo	28	Not Good
P026	Anglo	Anglo	20	Not Good

Note: Subject P005 was excluded as explained above.

## **2.2.0 Methodology & Apparatus**

Each interview had three parts, presented in this order: a brief questionnaire to establish the subject's linguistic and ethnic background, a picture recognition task to elicit tokens of /æ/ and /ɛ/ for analysis, and a listening task to test the subjects' perception relative to a common stimulus. Between the three tasks, there would be enough data to begin to draw correlations and other comparisons between the social and linguistic factors involved.

### **2.2.1 Questionnaire**

In the questionnaire stage, subjects were asked their age, their ethnicity in terms of their parentage and their personal identity, their first language, their self-assessment of their ability in any languages other than their first language (most importantly English and Spanish, of course), their use of English and Spanish, their relative exposure to English and Spanish, and their relative comfort level between English and Spanish. The combination of questions regarding language background and usage were used to place each speaker along the English-Spanish bilingualism spectrum. Since all subjects were necessarily fluent in English, the scale for this began at those who admitted to no Spanish ability to speak of to those who were native and fluent in Spanish (see Table 2.1). A rating of "poor" was one level above no Spanish ability. The interviewer, based on participant responses, appropriately filled out the questionnaire form (Appendix B) during this stage of the interview.

### **2.2.2 Picture Recognition Task**

The purpose of the picture recognition task was to collect data regarding the subjects' production of the target vowel sounds. In a PowerPoint presentation, subjects were presented with a slide show of photos of objects whose most common names contained at least one token

of the targeted vowels so that when the subjects responded they would produce these vowel sounds. To record their responses, subjects' answers were recorded using a stereo array microphone placed on the flat surface (usually a desk or table) nearest to them; this microphone was used in preference to other available equipment due to its compatibility with the laptop computer being used for the recordings and good combination of sensitivity and sound quality. Audacity (Audacity Team, 2006), a freeware sound editing application, was used to capture the recording in stereo format at 44100 kHz (file extension .AUP). From the Audacity project files, shorter .WAV files were extracted of words containing the targeted sounds. Only vowels in a high stress position were targeted, as the purpose of the current study was to focus on the general behavior of the target sounds, not the vowel reduction system of the English language.

### **2.2.3 Using Praat**

The collected .WAV files were imported into Praat phonetic analysis software to extract their pitch, length, and most importantly vowel formants. These values as recorded by Praat (Boernsma & Weenink, 2009) were then transferred to spreadsheet files for further analysis. To ensure that the data was reliably encoded, a principled approach was taken to this extraction process. The default settings of Praat were sufficient to extract such data for most files, but on a few occasional tokens, settings had to be slightly adjusted to get Praat to take its measurements along the dark bands indicating vowel formants that were clearly visible on the spectrogram, as well as detect pitch values only within a reasonable range due to high-frequency noise obscuring the clarity of some tracks. Also, in extracting vowel sounds from Praat, great care was taken to target the part of the vowel not clearly affected by the preceding phonological environment as indicated by discontinuities in the spectrogram, waveform, detected formant values, or some combination thereof. Since the effect of the following consonant was necessarily part of our

analysis, the vowels were clipped only as close as possible to these sounds on the other end so as to preserve effects such as glides caused by the following consonant, using methods similar to those for the onset of the vowel.

Any estimates of vowel lengths that were collected were precise to the nearest 1-800<sup>th</sup> of a second, or 0.00125 s. Praat reports formant values to many decimal places, more than enough to produce a numerical percent error well below a fraction of a percent, assuming it reports these values accurately. However, the actual accuracy (or error) of these values would depend more on the actual length of the vowel measured while accounting for the element of human error as the appropriate region is selected manually in the Praat window by the user, this process being a bit of a “judgment call.” The amount of care taken in extracting each token was done to minimize error, as measurements were checked and rechecked, and there is no apparent reason to believe that this choice of software has confounded the results in any way.

#### **2.2.4 Listening Task**

In the listening task, which was used to collect data on subjects’ perception of /æ/ and /ɛ/ which could then be compared to their production data from the previous stage of the interview in light of the sociolinguistic context established by responses in the first stage of the interview, subjects listened to isolated words containing tokens of the targeted vowel sounds and were asked to circle their responses on a sheet which presented them with two main choices. In general, these choices were formed from a minimal pair such as *shall/shell* or *pat/pet*, with the “intended” word being either one of these; however, there were a few exceptions to this, which will be discussed with further detail in the results. Concerns of participant fatigue lead to no inclusion of distractor stimuli. (The answer sheet used by each participant is in Appendix C.)



The tokens presented were not randomized, but arbitrarily ordered by ascending pitch, if for no other reason than simplicity. There was also no apparent connection between pitch and intended stimuli, and the difference in pitch from one token to the next was less than 1 Hz on average, giving little reason to suspect this would confound results.

Participants were instructed to go with their “first instinct,” as well as told they were allowed to circle both words if they were not sure which of the two they were hearing; also, they were provided with a blank to the side of each minimal pair to write down any words they heard that were not offered as a choice. There was only about one second of silence interspersed between each word to give the participants time to circle their choices, but not (hopefully) too much time to overthink their responses. In the case of random occasional disruptions, the interviewer reserved the ability to pause the playback or skip back to previous words.

### **2.2.5 Listening Task Apparatus**

The sounds played back during the listening task were recorded with the valuable assistance of a third party, an older Anglo male from the Midwest United States whom none of the participants were likely to be personally acquainted with. A speaker of a non-local and not immediately recognizable variety of English was employed to preclude or at least mitigate the possibility of listeners recognizing an accent familiar to them and adjusting their responses accordingly, consciously or subconsciously. Our “voice actor” was presented with lists of words which were candidates—i.e., members of minimal pairs distinguishable by the contrast between /æ/ and /ɛ/—to be presented in the listening of task and paragraphs containing these words. He was recorded in similar fashion to our subjects using the same equipment and software.

From a pool of over 100 relevant tokens recorded from our voice actor, a good deal of variation for both vowels in marked and unmarked phonological environments was apparent; on the basis of F1 and F2 values alone it was quickly apparent the task would certainly challenge the perception of our participants due to some overlap in production. To choose the best tokens for the task, however, only tokens of exceptional clarity were selected. To this end, tokens with extremely short or long vowel lengths and extremely high or low pitches were discarded to avoid unnecessary confounds with these variables, especially reduced or overly emphatic vowel tokens which were not of interest for this study; only tokens that were within one standard deviation of the mean for both vowel length and pitch were considered for candidacy in the playback test, bringing the final number of tokens to 64: 31 tokens of /æ/ and 30 tokens of /ε/ in various environments, along with 3 (prelateral) tokens of /e/. The relevant formant and length values crucial to the following analysis were extracted using Praat software as it was used to analyze production by our participants.

Because of the possibility that variation in the production of the voice actor could complicate matters, a few reference tokens were established for the basis of following analyses. There were tokens where the intended stimulus and its interpretation by all listeners were in total agreement. These tokens could serve as a sort of baseline for our discussion of variation. These tokens are discussed more below as they become relevant to the results of the experiment.

## CHAPTER 3 – RESULTS OF PERCEPTION TEST

### 3.0 Analysis of Perception

To analyze the perception of our participants, four groups of tokens were formed from 59 of the 64 tokens where a de facto dichotomy between /æ/ and /ɛ/ existed: 22 tokens before voiceless obstruents, 13 tokens before voiced obstruents, 11 tokens before nasals, and 13 tokens before prelateral liquids. (Two tokens before /r/ and three tokens of prelateral /e/ were not “analyzed” *per se* as discussed below.) On a related note, one cannot discuss perception of a common stimulus without mentioning that stimulus itself, so much of this discussion will also be centered on the production of our voice actor where it may—and, arguably, necessarily does—affect the results of the perception task. As suspected, no apparent connection between order of presentation and correct responses was observed, as both high and low scoring tokens were distributed throughout with respect to order of presentation, so this discussion will assume this to be negligible.

To reach general conclusions about our group and subgroups as a whole, it was thought best to measure their “success” at the perception task along two lines: 1) accuracy, or their perception of intended stimulus, which would give us a common standard by which to measure all groups and individuals; and 2) agreement, or the plurality of the most common judgment within our group and subgroups, usually equal to accuracy, but especially useful when our subjects were mostly (or, theoretically, universally) “inaccurate”, accounting for differences between them and the voice actor while preserving any similarities among themselves. In sociolinguistic terms, a high agreement score for a group of judgments indicates a more unified speech community. By design, this number cannot be below 50 for dichotomous judgments.

When discussing a single token, the accuracy and agreement score are the same when the accuracy score is over 50%, but for accuracies below 50%, the agreement is actually equal to 100% minus the accuracy; that is, a set of judgments for one token can be 0% accurate, but with 100% agreement, and this would suggest a unified speech community who simply does not share some perhaps foreign linguistic property displayed in the test. (These scores will be rounded to the nearest percentage point and separated by a forward slash in most places for simplicity, such that 55%/75% will indicate 55% accuracy and 75% agreement on a group of judgments.)

It should be noted that the small number of tokens analyzed does not lend itself well to a very robust statistic analysis *per se*, so a more qualitative approach was taken to examining these results in the hopes of coming up with hypotheses less open-ended than the broad questions raised earlier that could be investigated with greater depth in a future targeted study.

Also, if a participant admitted to overlap on a token, this was coded as identifying the token one-half time as /æ/ and one-half time as /ε/, such that there was only one “total” judgment recorded for that participant on such a token; this also had the statistical effect of making such responses just as accurate as they are not accurate. Despite the option to admit to their own confusion by circling two choices or circling one and writing one in the blank, most participants, 17 in total, did not take this option; this may be the product of the structure of the test with some bias towards mutual exclusivity. Of the 8 that did opt to admit their confusion, the use was uneven, as it was used—in order from most often to least often—14, 12, 5, 4, 3, 2, 1, and 1 times; curiously, but perhaps trivially, the two subjects that used it the most turned out to be students of speech pathology.

### 3.1 “Unanalyzed” Tokens

The two tokens before /r/ were determined to be insufficient for any rigorous analysis, though what little was collected was not necessarily inconsistent with the working assumption that /æ/, /ɛ/, and /e/ before /r/ are already merged in perception and production for members of the El Paso speech community. Production before /r/ was not of interest to this study as there was no suspicion that the vowels in question were merged before /r/. In the production test, some subjects produced a few incidental tokens of /æ/, /ɛ/, and /e/ before /r/, and all were perceptually judged to be very clearly /ɛ/; a quick glance at extracted formant values confirmed this casual observation, and it was thought better to direct efforts towards the more difficult questions of the study.

Three tokens of /e/ before /l/ could not be analyzed *per se* as the two main choices of *Sal* and *sell* which were offered for two of them (tokens SAIL and SAIL1) and the choices of *gel* and *Jill* offered for the token JAIL1 (the only token where the “dichotomy” was not between /æ/ and /ɛ/) appear to have biased the responses of our participants, as only one of these tokens, SAIL, had any rate of successful perception (34%). In reviewing these tokens, it became apparent that only SAIL had a salient though very brief glide to the front before gliding back towards /l/, apparently noticed by at least 9 of the participants due to their answering correctly; 15 participants reported hearing *sell* for this token. These groups overlap slightly as one participant claimed to hear both *sell* and *sail*, admitting his own confusion. Two participants circled *Sal* in this case; it is possible they heard *sail*, homophonous with *sale*, and thought that either word had been misspelled by one letter, but there is no way to tell for sure at this point. As for token SAIL1 without a salient glide to the front before gliding to the back, 18 participants reported hearing *sell*, 4 heard *sill*, 2 heard *seal*, and 1 circled *Sal* (who also circled *Sal* for token SAIL).

JAIL1 was overwhelmingly reported as *Jill* by all 25 participants (and also as *gel* by one of these 25); in all fairness, it should be noted that a review of the recording revealed that this token sounded more like *Jill* than *jail*, and has formant values which place it well above the lax vowel /ɛ/, a region of the vowel space normally reserved for /I/. SAIL and SAIL1 occupy a similar part of the vowel space but start farther back; whatever the case, it is apparent that both the stimulus and the choices offered have likely confounded the results for these tokens. (*Sal* may also have suffered from a frequency effect, as it is less common than the alternative *sell*.) There is a remote possibility that this hints at overlap in the perception of *sell* and *sail*, but it is hard to tease this apart from these other complications with any reliable certainty.

### 3.2.0 General Results of Perception Test

Subjects' overall accuracy and agreement scores for all tokens of /æ/ and /ɛ/ was 79%/85%. In general, subjects perceived tokens of /ɛ/ with a much higher accuracy and more agreement than tokens of /æ/, with scores of 91%/91% to 67%/80%. All participants except for one, for whom the scores were equal, had a higher accuracy score on tokens of /ɛ/ than tokens of /æ/. These results immediately suggest that /æ/ is the more perceptually problematic of the two vowels for the 25-person group. Tokens of /e/, and *Mary/marry/merry* were excluded from this analysis, as explained above, for 59 judgments per subject, except for 2 subjects with 58 responses.

Accuracy and agreement appear to correlate with ethnicity (see Figures 3.1 and 3.2). The Hispanic heritage group of 17 showed a score of 65%/80% on tokens of /æ/, and 91%/91% on tokens of /ɛ/, for an overall score of 78%/85%, from a total number of judgments of 1001 (which should have been 1003 with 17 participants making 59 judgments each, but strangely, a couple

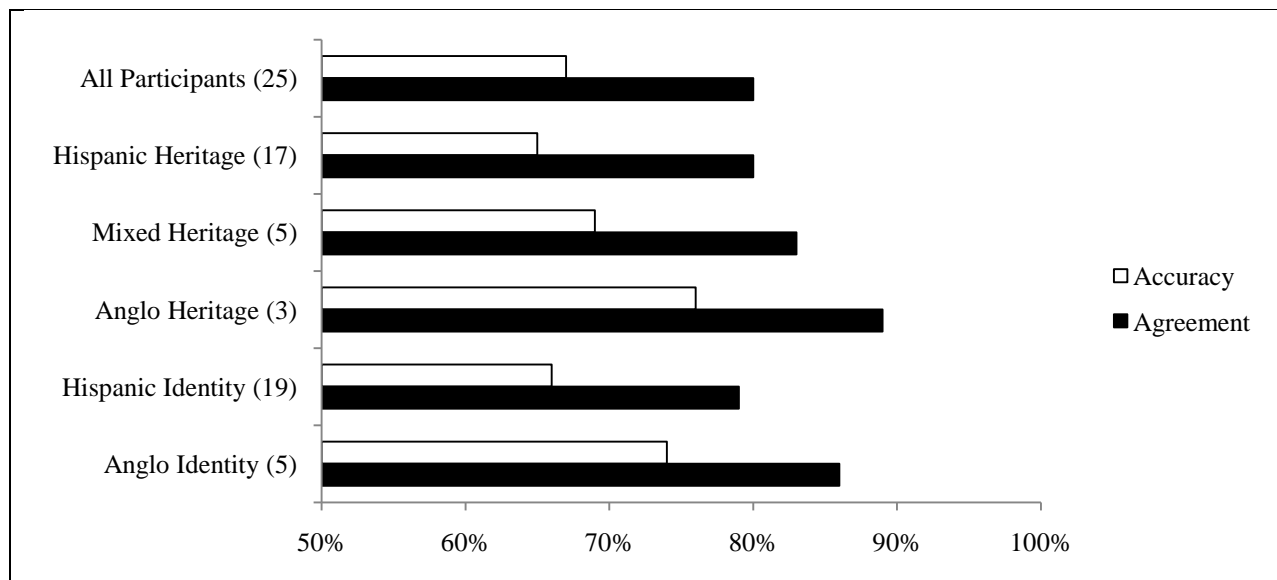


Figure 3.1. Accuracy and agreement scores for all tokens of /æ/ by group.

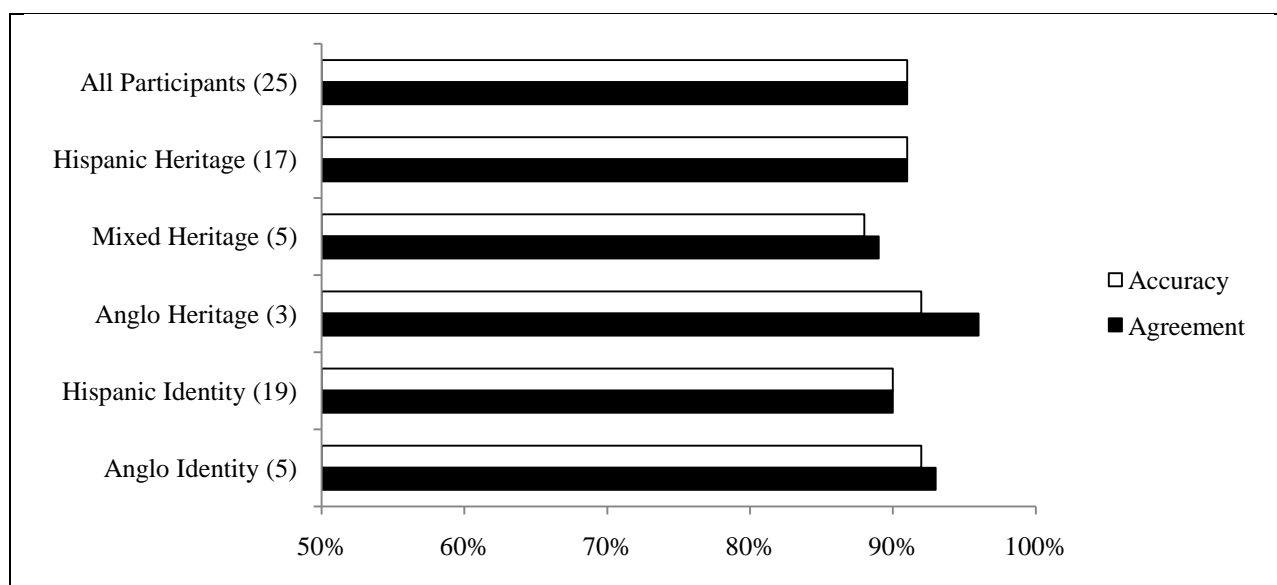


Figure 3.2. Accuracy and agreement scores for all tokens of /ε/ by group.

of participants left two different items unanswered). The mixed heritage group of 5 had, respectively, accuracy and agreement scores of 79%/86% overall, 69%/83% for tokens of /æ/, and 88%/89% for tokens of /ε/, from 295 total judgments. The Anglo heritage group of 3 displayed scores of 84%/93% overall, 76%/89% for tokens of /æ/, and 92%/96% for tokens of /ε/, from 177 total judgments.

Redistributed by identity, with 2 members of the mixed heritage group joining the Hispanic heritage group to form a Hispanic identity group, and 2 other members of the mixed heritage group joining the Anglo heritage group to form an Anglo identity group, high scores again appeared to correlate with the Anglo group. The 19 participants in the Hispanic identity group had an overall score of 78%/85% (no different from the Hispanic heritage group), with scores of 66%/79% for tokens of /æ/ and 90%/90% for tokens of /ε/, from 1119 judgments. The Anglo identity group of 5 had an overall score of 82%/89%, with scores of 74%/86% for tokens of /æ/ and 92%/93% for tokens of /ε/, based on 295 judgments. (The one participant who identified equally well with his Hispanic and Anglo heritage was excluded from this analysis.) Even though this is a small group of people, it involves a large number of judgments.

Noticeable from these results is the greater disparity in scores for tokens of /æ/ than /ε/, as well as a general stair step pattern from the group by definition the most Hispanic to the least Hispanic; this suggests that Anglo heritage and/or identity may be the main social variable correlating to and ability to perceive the vowel /æ/ that is both “intrinsically” (as indicated by accuracy) and “extrinsically” (as indicated by agreement) sound.

An attempt to explain the disparity in terms of reported bilingual ability is inconclusive. Separating the Hispanic heritage group into those who reported to have “very good” or better Spanish ability from those who were below this mark resulted in an overall score of 81%/86% for the first group, with 67%/76% for tokens of /æ/ and 96%/96% for tokens of /ε/, and an overall score of 77%/85% for the second group, with 64%/81% for tokens of /æ/ and 90%/90% for tokens of /ε/. The first group closed the gap on Anglo groups with respect to accuracy concerning tokens of /æ/ but sacrificed agreement, and the second lost some accuracy while gaining some agreement, with neither group completely closing the gap on the Anglo groups.



Excluding Hispanic heritage or identity speakers not native in English was no more conclusive, as the Anglo group maintained the higher score. There is a possibility that the choice of voice actor could also be responsible for these disparities. As we continue with the results, we will examine whether there are certain phonological environments which are at least partly responsible for the differences we see in scores between groups.

### **3.2.1 Reference Tokens**

There were some tokens where there existed 100% accuracy and agreement for our subjects. These were taken as our “absolutes” when trying to draw conclusions about our subjects’ perceptual organization of the vowels examined in specific phonological environments; that is, when a token was not perceived at or near 100% accuracy and agreement, we would question what would make that token difficult to perceive as opposed to the ones that were unmistakable, working with the assumption that there was something paradigmatic to our group of speakers about the 100%/100% tokens for their particular environments. On all the relevant figures in this section, these “pure” tokens are portrayed in white, with any other tokens in black.

### **3.3.0 Perception with Respect to Phonological Environment**

The sound following each token of /æ/ and /ε/ was considered to get an idea of which environments favored more accurate perception, as well as agreement in judgment, of the two vowels in general. A general summary of the data with respect to perception of each vowel in particular environments as well as ethnic heritage and identity can be seen in Table 3.1 on the next page. When analyzed with respect to heritage, the Anglo heritage group has the highest accuracy in 5 out of 8 total environments, and the highest agreement score in 7 out of 8. There were two situations in particular where the performance of Anglos was noticeably better: tokens

Table 3.1. Perception scores for tokens of /æ/ and /ɛ/ by following environment and group.

Group (Size)	Vowel	Following Environment			
		Voiceless Obstruent	Voiced Obstruent	Nasal	Lateral Liquid
All Subjects (25)	{ /æ/	66/83	77/80	71/93	65/73
	{ /ɛ/	83/83	96/96	91/91	92/92
Hispanic Heritage (17)	{ /æ/	64/81	76/80	71/93	61/72
	{ /ɛ/	82/82	97/97	93/93	92/92
Mixed Heritage (5)	{ /æ/	69/83	73/80	73/93	71/84
	{ /ɛ/	87/87	92/92	88/93	86/86
Anglo Heritage (3)	{ /æ/	77/94	89/89	67/100	75/79
	{ /ɛ/	81/86	100/100	88/100	100/100
Hispanic Identity (19)	{ /æ/	65/84	75/79	70/93	61/73
	{ /ɛ/	82/82	96/96	91/91	91/91
Anglo Identity (5)	{ /æ/	70/89	87/87	73/93	78/80
	{ /ɛ/	87/87	100/100	88/93	94/94

Note: Scores should be read as % accuracy/% agreement (not a ratio).

of /æ/ before voiceless obstruents and voiced obstruents. The Anglo heritage group is also more accurate than the Hispanic heritage group with prelateral /æ/. In terms of identity, the Anglo identity group is universally more uniform in its judgments than the Hispanic identity group, and preserves this distinction for tokens of /æ/ before voiced obstruents and lateral liquids. All groups in general had their lowest scores with /æ/ before voiceless obstruents and lateral liquids. Figures 3.3 through 3.6 on the following pages demonstrate these facts graphically; these graphs may show only the whole group and heritage groups, but their most striking conclusions tend to hold for identity groups as well as explained above.

### 3.3.1 Perception Before Voiceless Obstruents

A perfunctory glance at the distribution of the 22 tokens of /æ/ and /ɛ/ produced by our voice actor reveals almost no clear patterns other than a significant amount of overlap. When considering the accuracy/agreement scores for these tokens, this comes as little surprise. Upon a

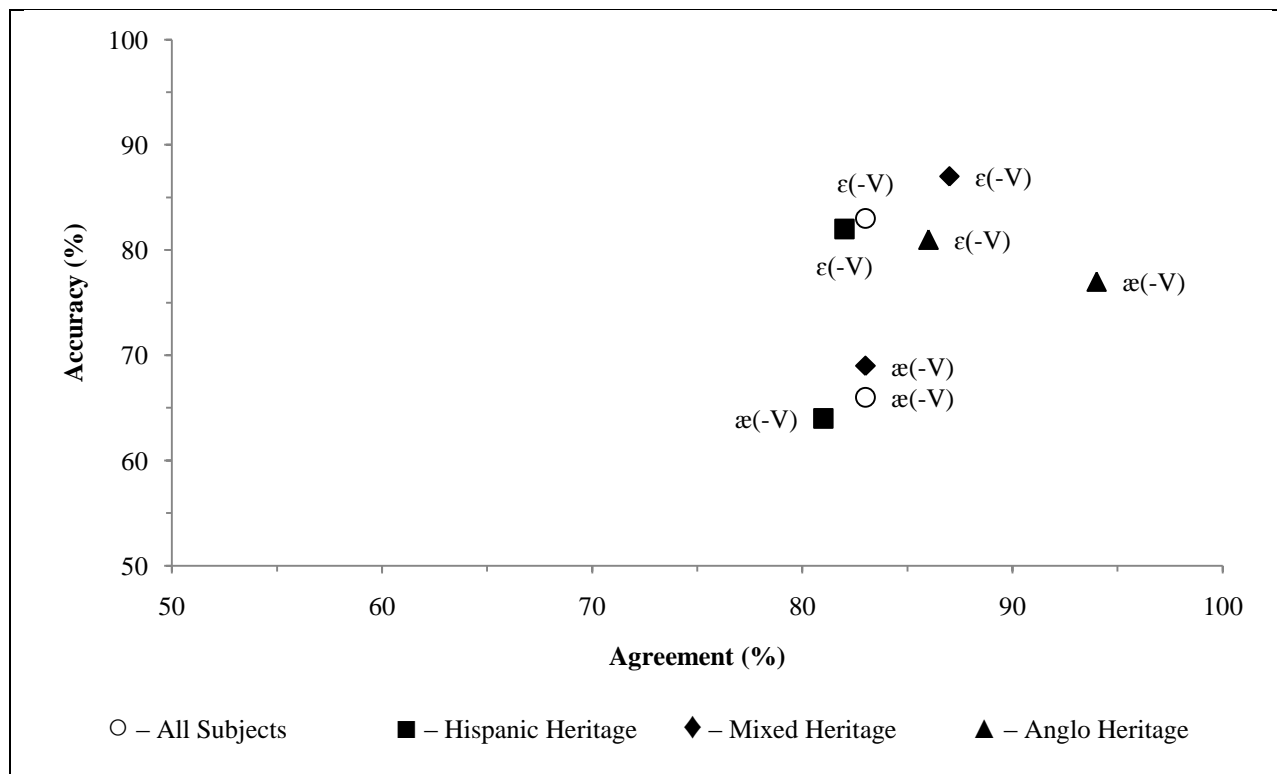


Figure 3.3. Perception scores for /æ/ and /ε/ before voiceless obstruents by heritage group.

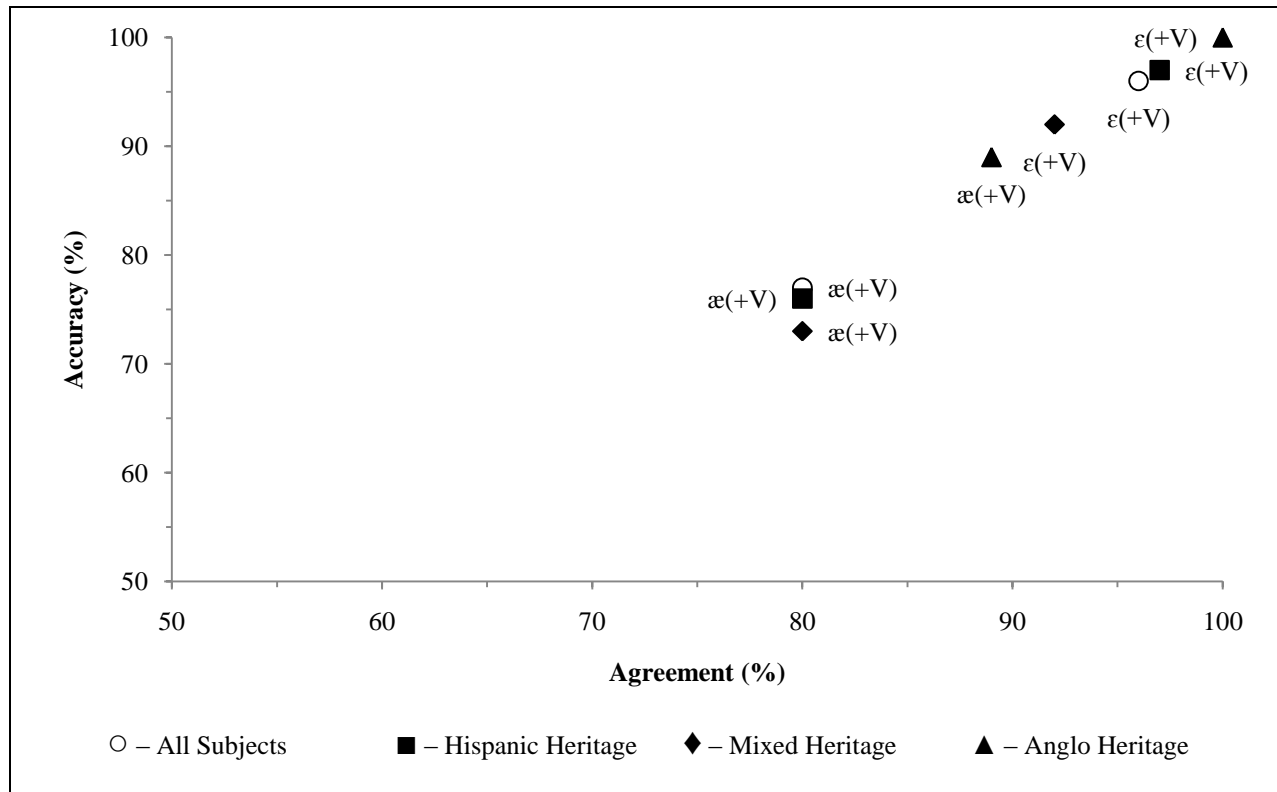


Figure 3.4. Perception scores for /æ/ and /ε/ before voiced obstruents by heritage group.

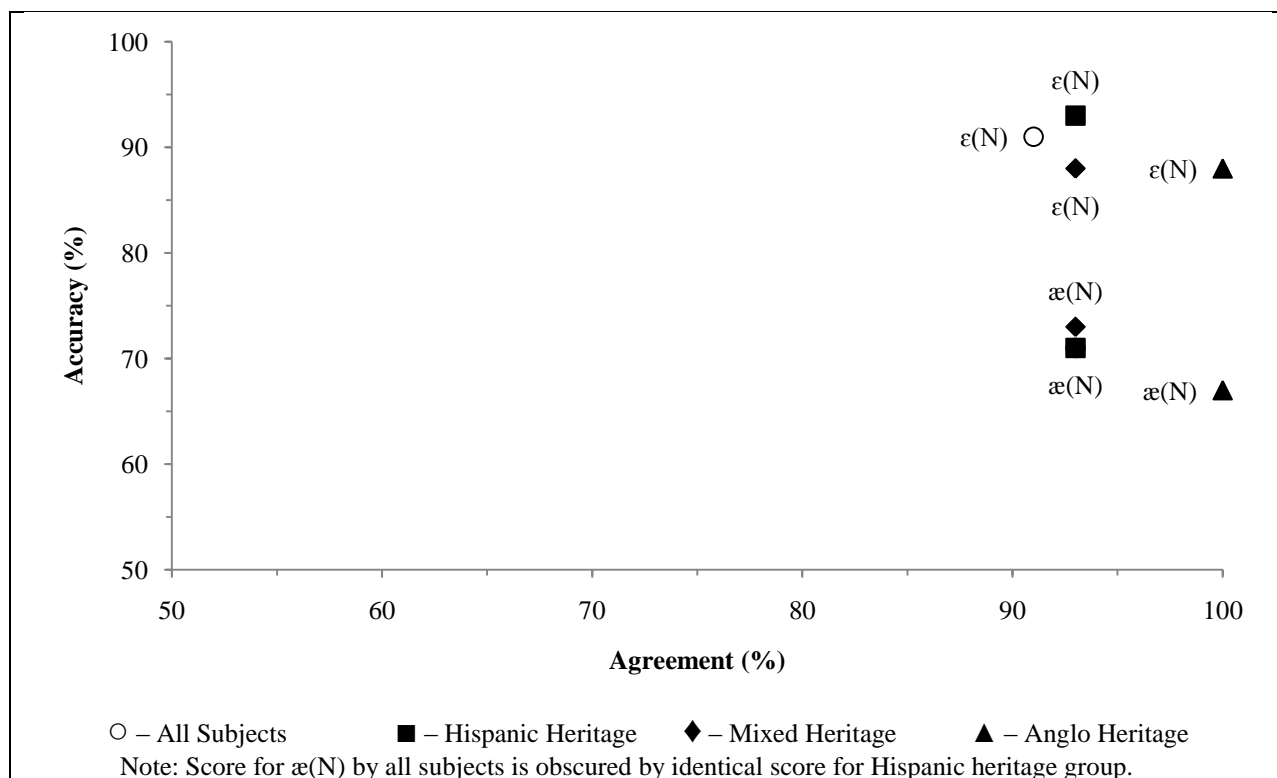


Figure 3.5. Perception scores for /æ/ and /ε/ before nasals by heritage group.

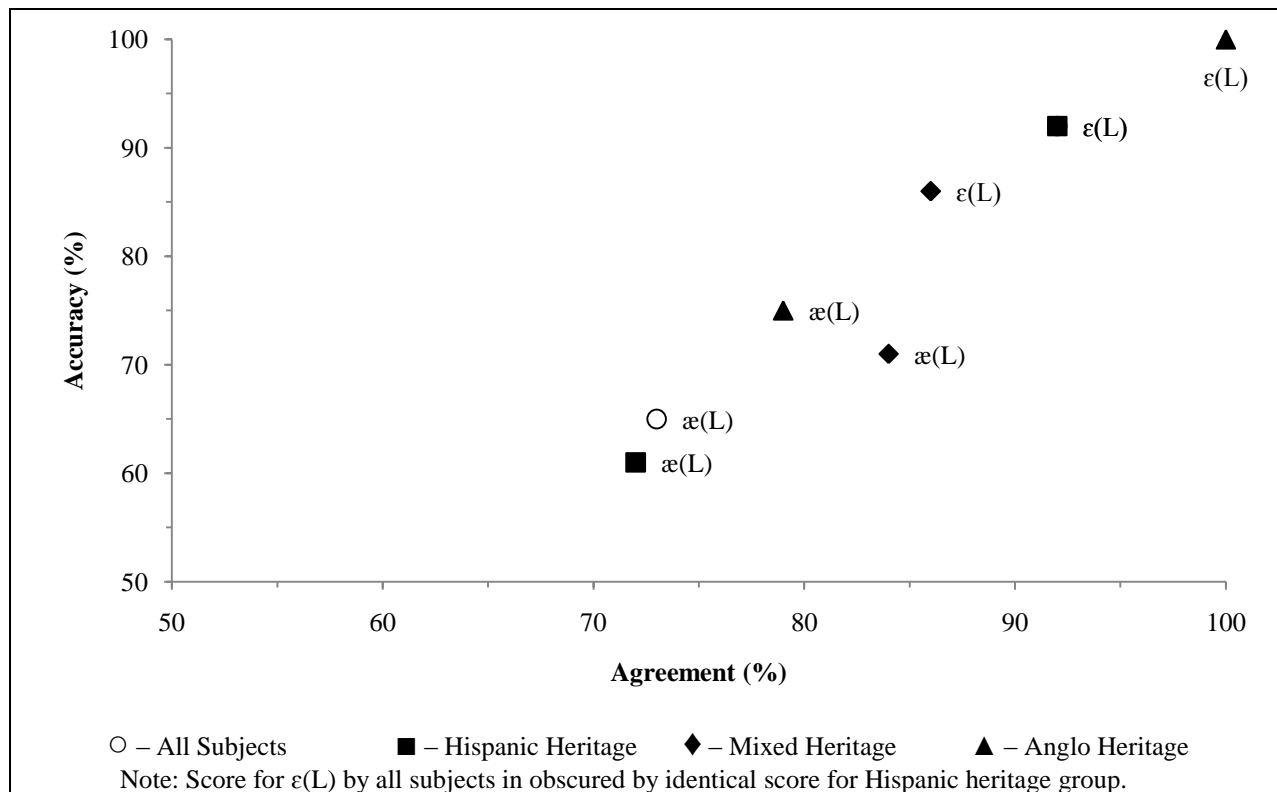


Figure 3.6. Perception scores for /æ/ and /ε/ before lateral liquids by heritage group.

closer examination of the tokens, it appeared that prosodic factors played a large role, as indicated by the rather apparent effect of vowel length. This analysis was performed by looking at more specific environments: tokens before /t/, tokens before /p/, tokens before /k/, tokens before /s/, and tokens before /ʃ/, comparing all these smaller groups to the reference tokens BAT0, MASS, and GUESS1 on which all of our subjects agreed on the correct interpretation. The plots for these groups of tokens also contain vowel lengths on them as they are so central to the discussion of these particular results.

Let us begin with tokens before /t/, as shown in Figure 3.7; by an accident of design all these tokens were of /æ/. It is apparent from most of the tokens that perception is fairly consistent before /t/ with the very notable exception of SAT1, perceived with only 4% accuracy. Comparing it to the nearest token, MATT1, which was perceived with 74% accuracy overall despite being higher in the vowel space, we can see a drastic difference in vowel length which

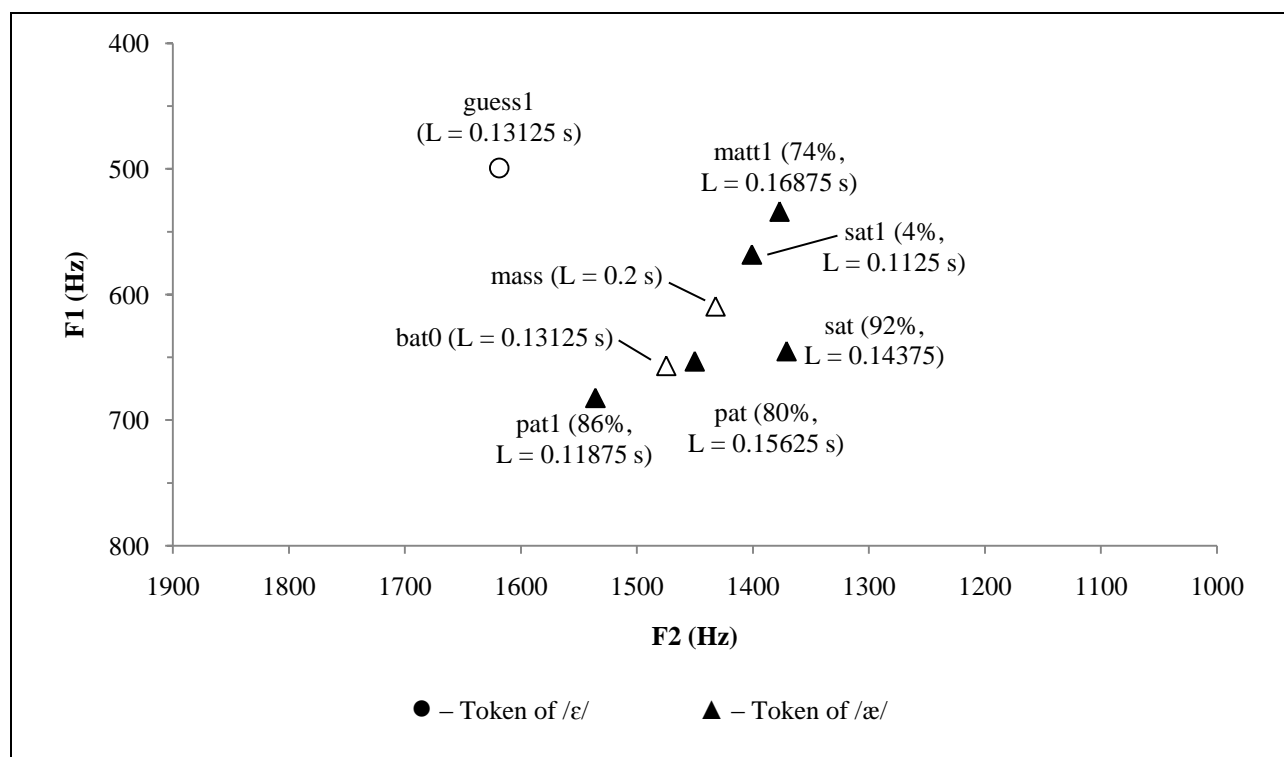


Figure 3.7. Perception of tokens of /æ/ and /ε/ before /t/ with length values given.

may account for this anomalous difference in success. Interestingly, the Anglo heritage group shows a score of 100% accuracy and agreement for these tokens once SAT1 is eliminated; also very interesting is that all members of this group agreed that SAT1 was the word *set*, preserving their uniformity of judgment either way. The Hispanic heritage group, with SAT1 eliminated has accuracy and agreement scores for this set of tokens ranging from 71% to 100%, with reference token BAT0 being the only perfect score. The mixed heritage group shows scores ranging from 80% to 100% when analyzed the same way. As for groups by identity, the Anglo group displays scores from 90% to 100%, while the Hispanic group displays scores from 74% to 100% (with BAT0 again being the only perfect score).

For tokens before /p/, shown in Figure 3.8, we can see that CAPPED1 and SLAPPED1 are perceived with the lowest accuracy; also, they have by far the shortest vowels lengths of the set of data. As in the case of tokens before /t/, once these problematic tokens are accounted for, the Anglo heritage group shows 100% agreement and accuracy; the Hispanic heritage group has scores ranging from 76% to 94%, and the mixed heritage group has scores ranging from 50% to 100%. The Anglo identity group shows scores from 70% to 100%, and the Hispanic identity group shows scores from 74% to 100%; this is one of the small points at which Hispanics scored higher than Anglos, though certainly not enough to change the overall picture suggested so far. (There is a possibility of a word frequency difference between *capped* and *kept* affecting the results for token CAPPED1, but its proximity to reference tokens BAT0 and MASS along with the observed variation with respect to vowel length give us reason to conclude otherwise.)

Tokens before /k/, both tokens of /æ/ by accident of design, are all fairly long in length compared to the tokens of /t/ and /p/ we have examined so far. Probably due to the lack of confusion due to short vowel lengths, the scores for these tokens are generally very high, but

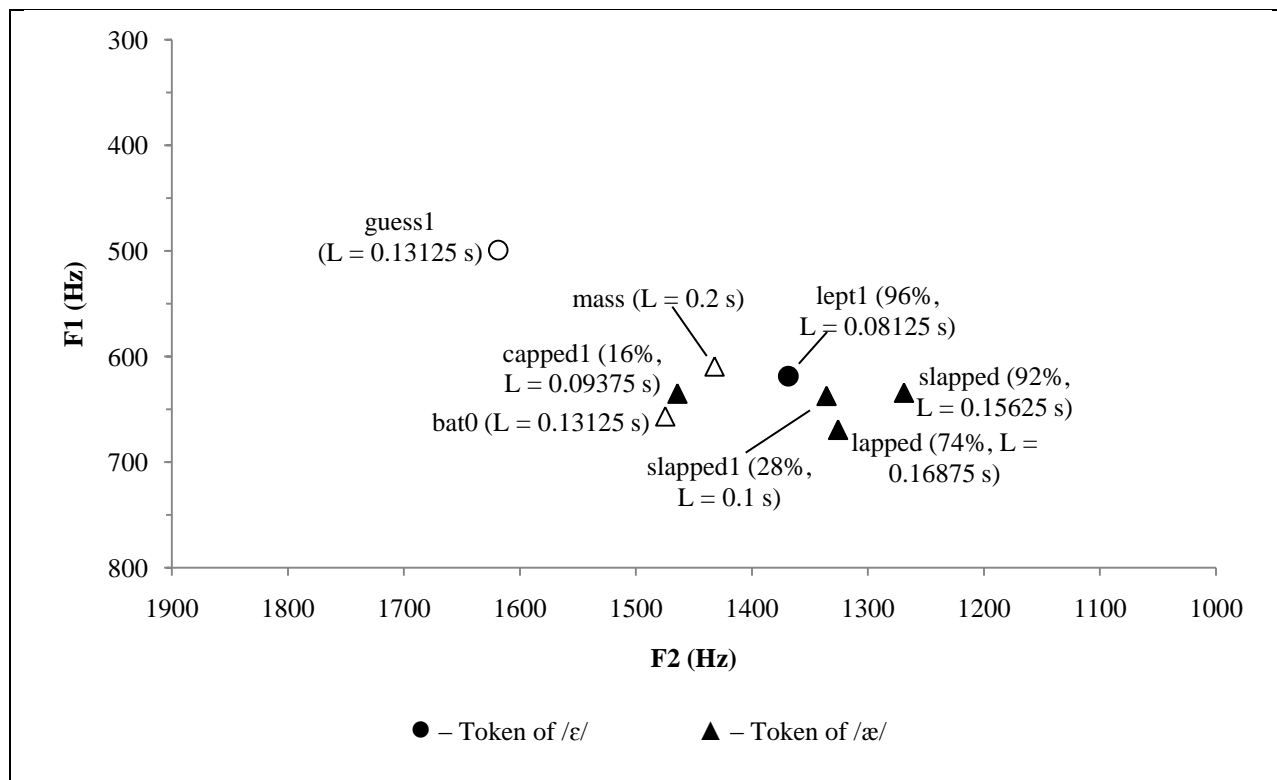


Figure 3.8. Perception of tokens of /æ/ and /ε/ before /p/ with length values given.

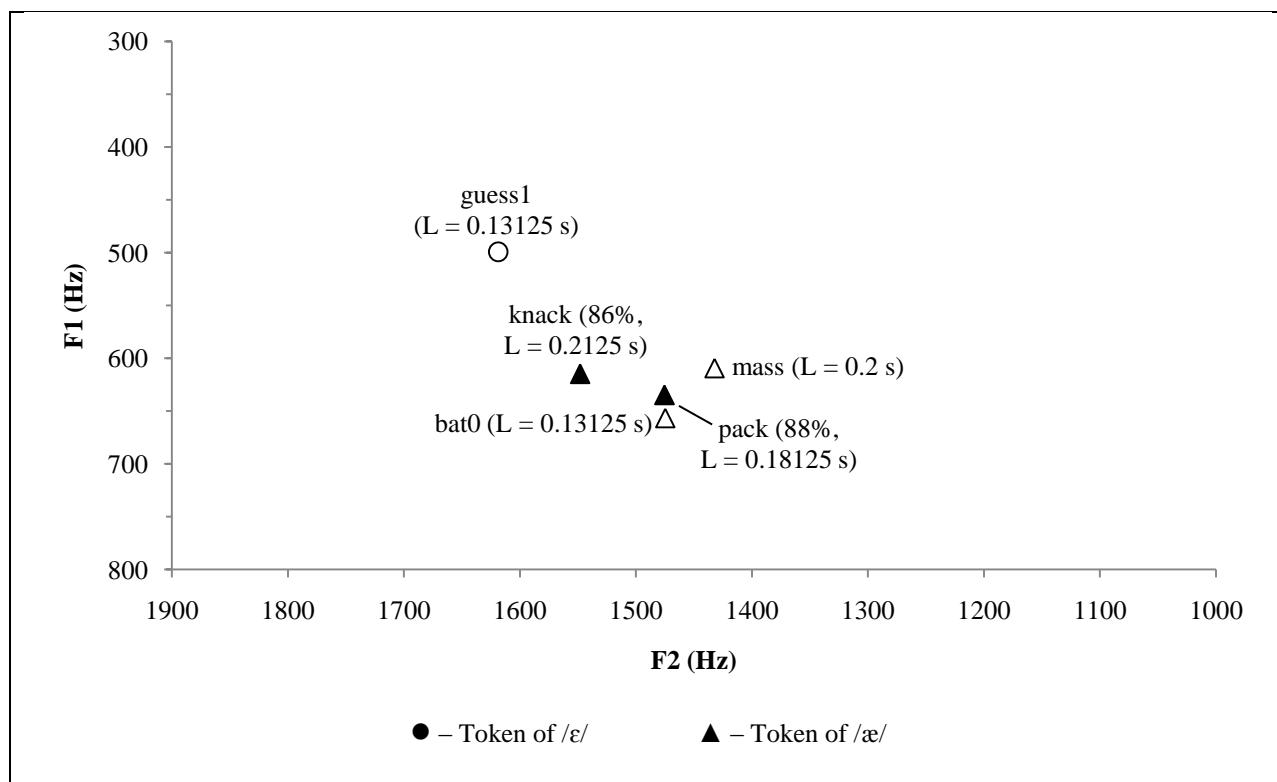


Figure 3.9. Perception of tokens of /æ/ and /ε/ before /k/ with length values given.

again considering ethnicity, the Anglo heritage group scores highest with another perfect score for both tokens, with the mixed and Hispanic heritage groups showing respective scores of 90% and 85% for PACK and 90% and 82% for KNACK. For the Anglo identity group, the scores are 90% and 90%, and for the Hispanic identity group, the scores are 87% and 84%. Data for these tokens are displayed in Figure 3.9.

For tokens before /s/, shown in Figure 3.10, again we can see a very short vowel length is directly correlated with a low accuracy score. And like in other environments, once these problematic tokens are accounted for, the Anglo groups again maintain higher scores, with the overall scores for tokens before /s/ by heritage group as 96% for Anglo, 90% for mixed, and 85% for Hispanic, and the scores by identity group as 95% for Anglo and 86% for Hispanic.

Finally there are the tokens of /æ/ and /ɛ/ before /ʃ/, shown in Figure 3.11. These present no apparent perceptual difficulties due to vowel length. This group of tokens is a bit more interesting in that the Anglo heritage and identity groups have less apparent difficulty with the token MASH, getting it correct 100% of the time, but being outperformed by the Hispanic and mixed groups with respect to the tokens MESH and MESH1. This confusion may be due to phonological conditioning that raises *mash* towards *mesh*.

What the overall picture of perception of /æ/ and /ɛ/ before voiceless obstruents might suggest is that there is a region of potential overlap between the reference tokens MASS and GUESS1 for both groups; however, under the right conditions, notably sufficient vowel lengths, the Anglo groups can be exceptionally adept at making distinctions in this region, while Hispanics on average will be less consistent. Again, however, these results may have varied if a



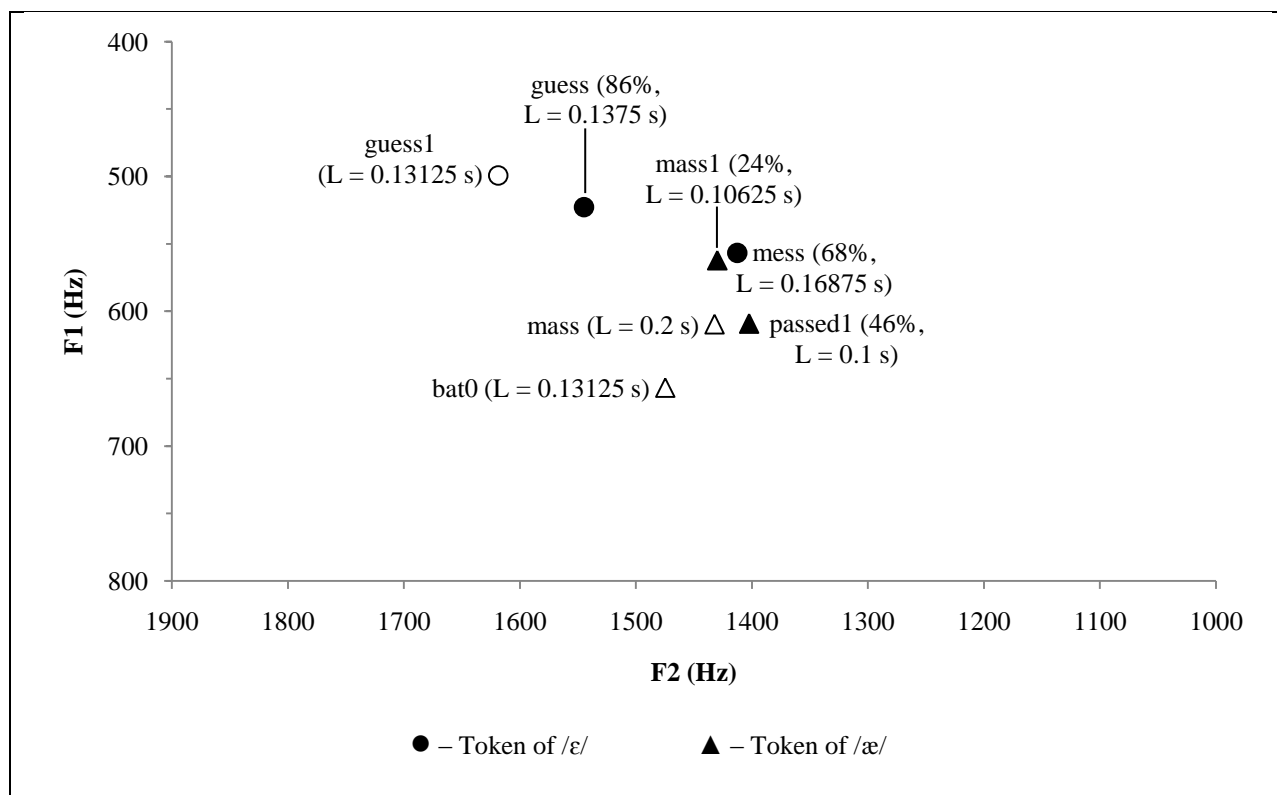


Figure 3.10. Perception of tokens of /æ/ and /ɛ/ before /s/ with length values given.

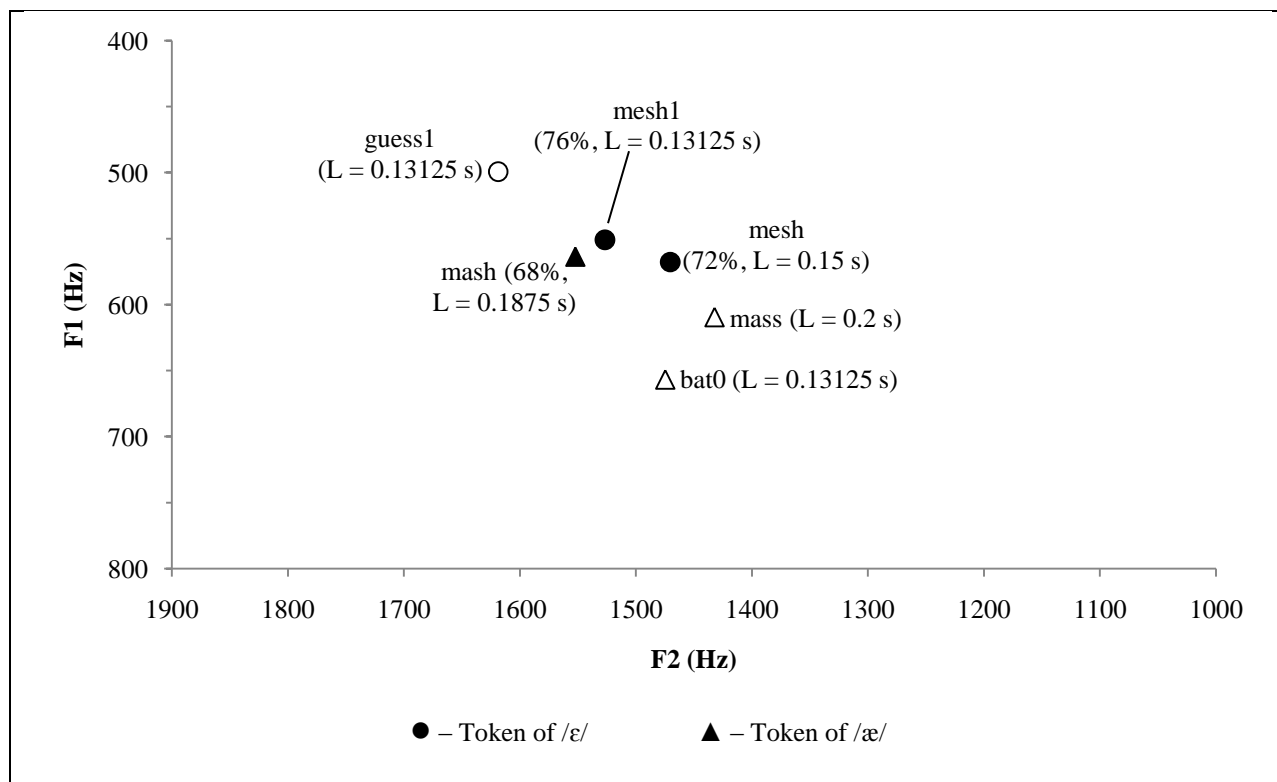


Figure 3.11. Perception of tokens of /æ/ and /ɛ/ before /ʃ/ with length values given.

Hispanic voice actor were used instead, as his prosodic cues may be more consistent with those a Hispanic speaker would rely on than those of an Anglo speaker.

### 3.3.2 Perception Before Voiced Obstruents

Unlike the case of /æ/ and /ɛ/ before voiceless obstruents, we see much more consistent production on the part of our voice actor (see Figure 3.12). Likewise, and most likely not for unrelated reasons, the judgments made by our participants are more consistent, with 77% accuracy for tokens of /æ/ and 96% for tokens of /ɛ/, the highest scores of any environment. Of the 13 tokens in this group, 7 were judged with 100% accuracy, 3 with 96%, and 1 each with 86%, 72%, and 46%, for an average success rate of 92%. The token of 86% success rate, codenamed PLAID, is extremely close to the token PADDLE which was judged with 100% accuracy; there is no reason apparent from the recording or the numerical data why there should

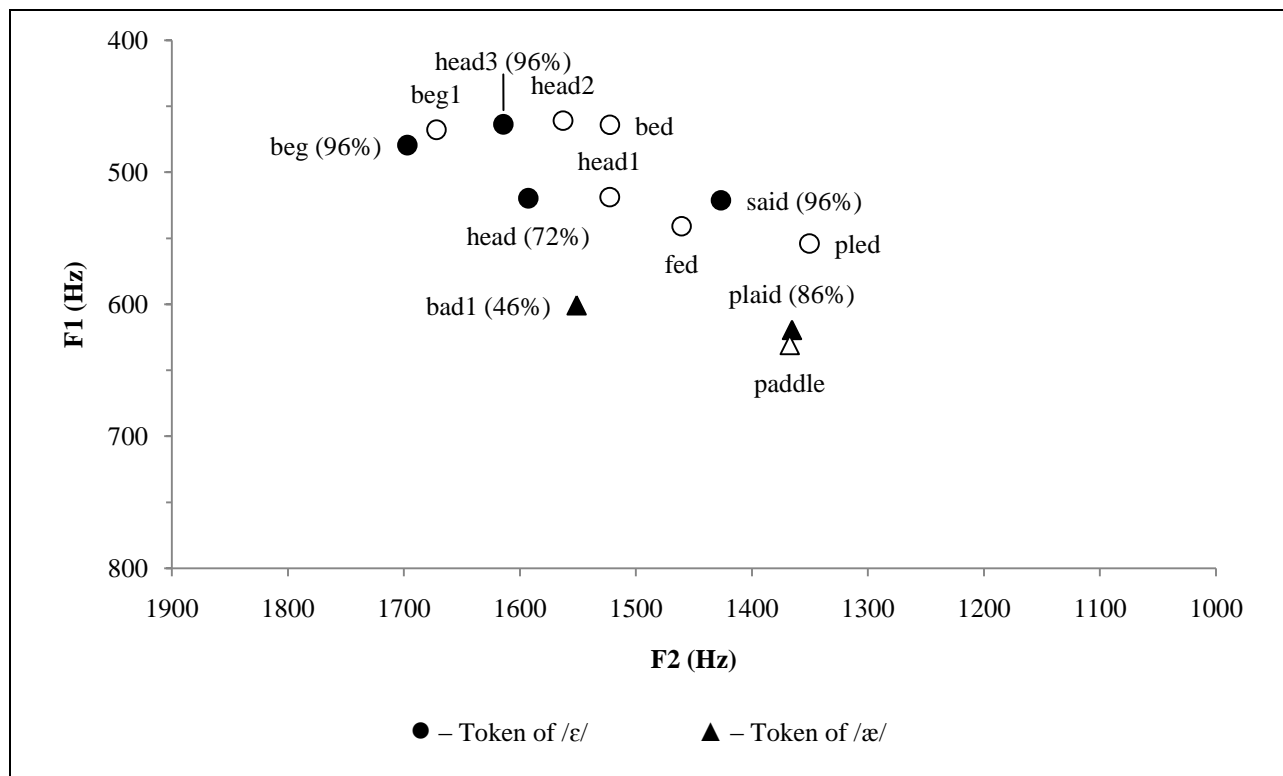


Figure 3.12. Perception of tokens of /æ/ and /ɛ/ before voiced obstruents.

be such a large difference in success between these two tokens (as they have pitch values which both round off to 120 Hz). One possible explanation for this is confusion with the word *played*, due to equivocation with the word pair *pay/paid*; this is not without some supporting evidence, as one subject who heard the word *plaid* wrote “plad [sic]” in the blank on his answer sheet instead of circling the word *plaid* that was offered to him as a default choice. The fact that even one subject who recognized the word misspelled it might also attest to the rarity of the word *plaid* in print, another confounding variable. (This also might raise the question of why more participants did not just write in the word *plaid* even if they could not spell it properly; this is explained in further detail ahead.) The token of 72% accuracy is a token of *head* (codenamed HEAD) close to another token of *head* (HEAD1) judged with 100% accuracy at a nearly identical height; it appears that a difference in pitch (113 Hz for HEAD versus 137 Hz for HEAD1, where the set of 13 tokens has a mean pitch of 125 Hz with a standard deviation of approximately 8 Hz) could be responsible for the difference in perception in this case as the relative pitch values make HEAD seem lower in the vowel space and HEAD1 seem higher. In a similar vein, the token perceived with only 46% accuracy, a token of the word *bad*, which is slightly higher but much fronter than the other two tokens of /æ/ in this group, has a comparatively high pitch (142 Hz, more than two standard deviations from the mean) that may be affecting the perceived height of the vowel such that it perceptually drifts towards the region where the two tokens of *head* lie. With all these discrepancies accounted for it seems safe to say that our participants in general make a clear distinction between /æ/ and /ɛ/ before voiced obstruents, with a narrow band of F1 values for which there might be some overlap.

### 3.3.3 Perception Before /n/

In the case of the 11 prenasal tokens of /æ/ and /ɛ/, our voice actor showed—at least with respect to mean F1 and F2 values—apparent overlap between the two vowels. Though we had only two quality tokens of /æ/ from this group, it is apparent from the data that our voice actor tenses and raises /æ/ prenasally, placing prenasal tokens of /æ/ in or near the range of formant values for prenasal tokens of /ɛ/ (see Figure 3.13). It should be noted that these tokens of /æ/, with a notable exception discussed below, were distributed above the mean vowel length for all prenasal tokens, suggesting vowel length may be a relevant factor in forming contrasts in this region. Our subjects showed 100% accuracy on 6 tokens, and then 96%, 94%, 78%, 56%, and 16% for an average of 85.4% accuracy, with 92% agreement among themselves; the token of 16% is arguably excludible for reasons explained below, and with its exclusion the average accuracy of our subjects reaches 92%. There are plausible explanations for the three tokens where below average accuracy was displayed, all of which follow from the suggestion that vowel length is crucial to maintaining the contrast between prenasal vowels in this region. The highest and frontest token of the entire group, by far the highest and frontest, was also the shortest in length; it was a token of the name *Annie Moore* (the first immigrant processed at Ellis Island, actually), which impressionistically sounds so much like *anymore* (as playback of the recording will reveal) that it is no surprise that it was correctly identified as *Annie Moore* by only 16% of the subjects; the infrequency of the name *Annie Moore* relative to the word *anymore* could also play a role. The token MEN where only 56% of participants identified the token as such had the longest length of any prenasal tokens of /ɛ/, and the next worst was the token PEN at 78%, whose vowel length was the next longest among prenasal tokens of /ɛ/. These two tokens are also lower than the other /ɛ/ tokens, which may also be a reason for confusion if the general

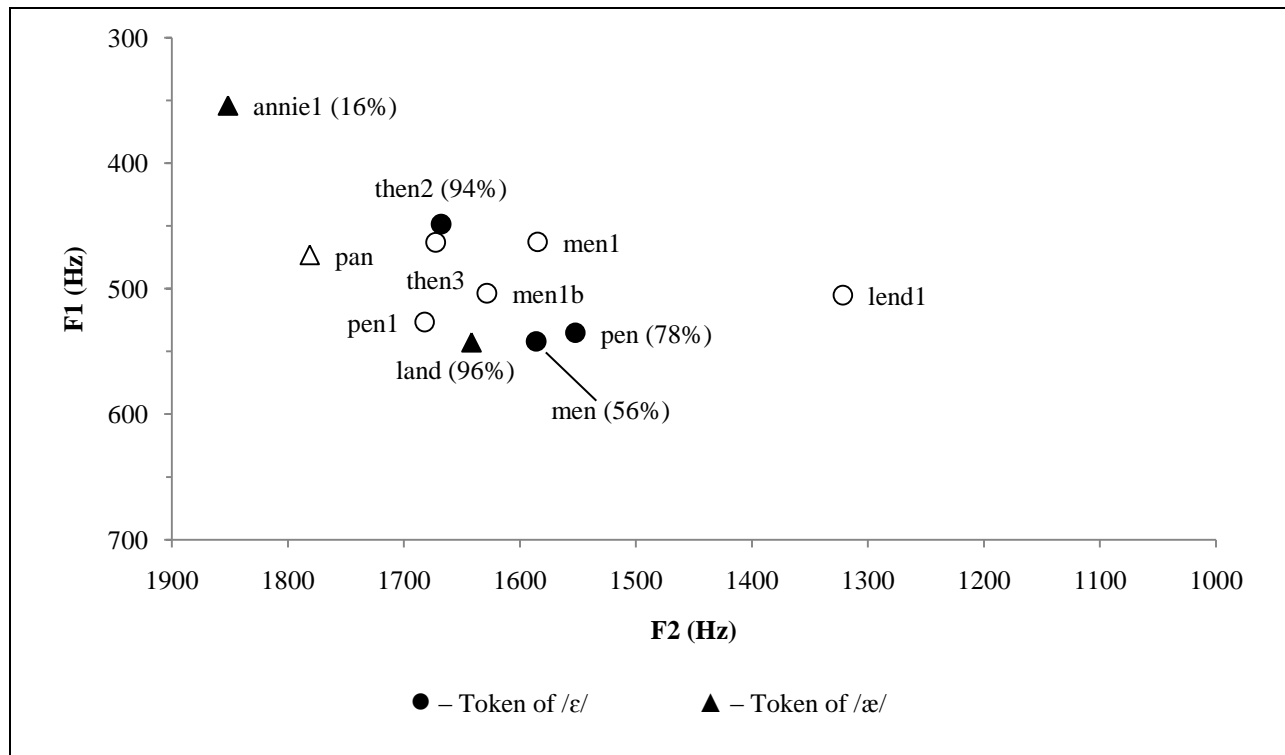


Figure 3.13. Perception of tokens of /æ/ and /ɛ/ before /n/.

contrast by height between /æ/ and /ɛ/ does indeed hold prenasally; unfortunately, the small number of tokens is not enough to clear this matter up entirely. It does appear, however, that vowel length as at least a partial explanation is supported by the patterns observed among tokens before voiceless obstruents. As in the case of perception /æ/ and /ɛ/ before voiced obstruents, our participants show well-differentiated perception in general before nasals, if the discrepancies noted have indeed been accounted for by the explanations offered for them. In this case it should be stressed that this is not the same as saying there is no overlap in perception before nasals at all, but only that the overlap in perception appears to be rather narrowly restricted and perhaps predictably mediated by other variables.

In terms of ethnicity, the Anglo heritage group shows 100% agreement on prenasal vowels in this set even before problematic tokens are removed. Though it is certainly understandable why this entire group might have perceived the token of *Annie Moore* as

“anymore”, all three perceived the token MEN as *man*. When two of the participants from the mixed heritage group are added to form the Anglo identity group, we get some perception of MEN as *men*., though not without some perception of PEN as *pan*; it is interesting to note that on the basis of F1 alone these two vowels are not very far from LAND, which was universally agreed upon by the Anglo groups. It is also noteworthy that once the token ANNIE1 is accounted for, perception of prenasal /æ/ does not appear to be significantly different between Anglo and non-Anglo groups. All groups did well with perception of prenasal tokens of /æ/ and /ɛ/, all things considered, as indicated by the high scores in Table 3.1 even without accounting for the difficult tokens.

### 3.3.4 Perception Before /l/

All tokens where a de facto dichotomy between interpretation as /æ/ and /ɛ/ existed were given a special analysis. Values of F1 and F2 in this case were taken from the onset of the vowel and not as mean values since the glide before the following velar /l/, it was suspected, would necessarily skew mean values; in fact, a plot of mean formant values that was attempted showed no clear patterning of production of /æ/ and /ɛ/ by our voice actor, but a plot of the initial formant values showed the two vowels clearly patterned with respect to F1, with a restricted region of overlap (as we would expect of a native English monolingual who could make the distinction of these vowels consistently in production and perception). With respect to F2 there are some complications that are discussed as they arise below, though as a rule of thumb it is not contrastive for the tokens in question. For reference, three tokens from the general data set on which all participants agreed (at 100% accuracy as well, fortunately) and which featured relatively unmarked environments—codenamed BAT0, MASS, and GUESS1—were also plotted; unlike the other sets of data an external reference was needed since no internal one

existed, plus more could be said about how /l/ may condition the preceding vowel in this case by having unmarked environments for comparison. (These were still plotted with mean formant values over their length as these vowels were unglided, so any changes in F1 and F2 were more akin to oscillations about an average vowel formant location.) The plot of these tokens can be seen in Figure 3.14.

This approach highlights what appear to be some key patterns in the data. However, it should first be noted that all tokens of /æɪ/ were higher than BAT0 in the vowel space, while distributed both above and below MASS, with tokens of /ɛɪ/ distributed on both sides of GUESS1 with respect to height. This unfortunately seemingly uneven distribution of tokens has nothing to do with the production of tokens of /æɪ/ and /ɛɪ/ by any speaker *per se*, let alone the production of our participants, and it does not necessarily provide a universal insight as much as

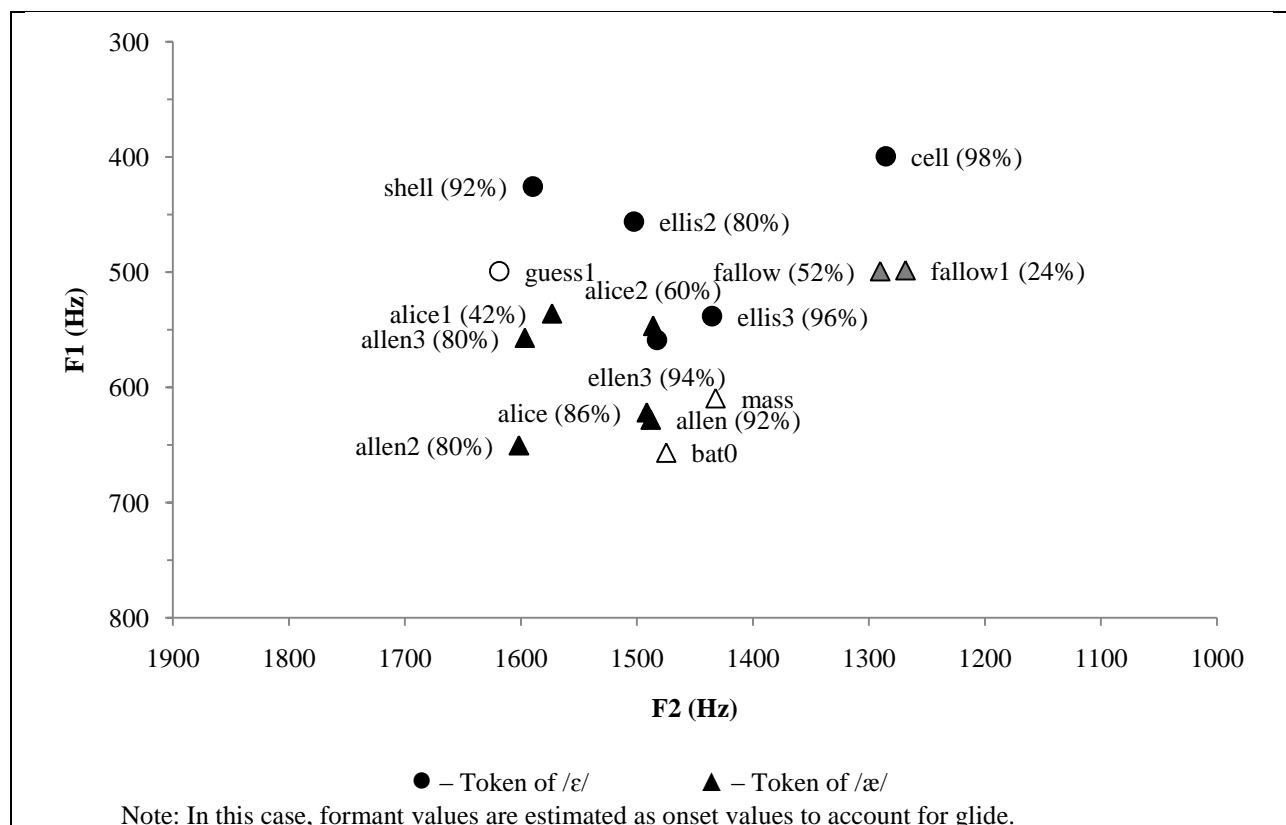


Figure 3.14. Perception of tokens of /æɪ/ and /ɛɪ/ before /l/.

it is just a feature of this particular set of data and a limitation of the current methodological design.

As for patterns in the data which appear to be of more pertinence, the three lowest (highest F1) tokens, also sandwiched between MASS and BAT0 with respect to height, were perceived as /æ/ between 80% and 92% of the time, the highest scores of any tokens of /æ/. The three highest tokens of the set, all /ɛ/ and all above reference token GUESS1, were also generally agreed upon to be /ɛ/, perceived as /æ/ 80% to 98% of the time. This is not to gloss over the dissenting judgments in these regions, as those would seem to necessarily establish overlap in perception for those participants who dissented, and this will be discussed later in more detail, but this does apparently establish certain regions in the vowel space where one could reliably predict in a general sense the responses of our participants upon further examination.

Also apparent from our plot is a range of F1 values, between reference tokens GUESS1 and MASS with F1 varying from about 535 Hz to 560 Hz, for which there was overlap in our voice actor's production (at least on the basis of F1 and F2 values), but where participants were able to more consistently perceive tokens of /ɛ/ but not /æ/, with 94% and 96% success at tokens of /ɛ/ in this region but 42%, 60%, and 80% success at tokens of /æ/ in this region. The /æ/ tokens are biased towards the front in comparison to the tokens of /ɛ/ in this region, but the positions of the tokens of 42% and 60% throw into doubt whether frontness is sufficient to predict our subjects' perception in this region. Looking for another explanation, the tokens of 42% and 60% success rates did also have lower than average vowel lengths (measured from vowel onset to the point of constriction at the velum for the following /l/, which coincided with a relative minimum of F2 values that indicated peak backness of the tongue). This would be consistent with the observations made for short vowel lengths of /æ/ negatively affecting



perception within the region of overlap for less marked pre-voiceless obstruent tokens. More to this point is that the shortest and longest vowel tokens in this region are the tokens of /ɛl/ which were the most successfully judged in the region; it would appear that without sufficient vowel length in this region, tokens of /æɫ/ default to being perceived as /ɛl/.

There appears to be at least one other variable which could affect the saliency of the prelateral vowel. Fortunately (though perhaps controversially as will be explained below), there are two tokens of the word *fallow* which on the plot find themselves significantly backer than the rest of the tokens. These tokens also exhibited some of the lowest successful perception rates in the entire group, 24% and 52%, well below the average success rate of 74% for all tokens. One explanation is that the relative starting backness of these vowels (possibly a result of their proceeding phonological environment delaying the onset of voicing, resulting in an imperceptible “pre-glide”) compromised their perceptual saliency. However, the current methodology does not allow us to tease this apart from the possible effect of word frequency skewing participant judgments. *Fallow*, while being significantly less common than *fellow* and the rest of the tokens presented in general, could also be unfortunately confused with the word *follow*, as the progression of the cot-caught merger and other historical alternations between orthographic *a* and *o* conspire on a larger scale to make word pairs like *hallow* and *hollow* a rhyming pair rather than a minimal pair. Because of this complication, analyses following from this one were performed to account for this.

One analysis of these contentious tokens that was performed excluded participants who did not report hearing *fallow* for either token. This produced some rather interesting results; the percent of correct responses shot up to 40% and 87%, with the slightly fronter token reporting the much higher percentage. For what appeared to be an only slightly fronter vowel, a 47% jump

in accurate perception seemed quite a leap, so raw formant values were examined. Upon this examination, the apparently only slightly fronter token, codenamed FALLOW, revealed a delay in the transition from its initial position before gliding back to the position of the following /l/, as indicated by sustaining F2 values close to its initial value over a significant portion of its length (see Figure 3.15). The other token, codenamed FALLOW1, glided back immediately, as a consistent decrease in F2 over its length indicates. The presence of a delayed glide, in this case, does not correlate to an increase in overall length; in fact, the overall length in FALLOW was shorter than that of FALLOW1. However, the presence of this delay in the glide could enhance perception of the starting point of the glide, and it does suggest that contour with respect to F2 could be vital to contrasting prelateral /æ/ and /ɛ/ for our subjects when F1 values alone are not enough.

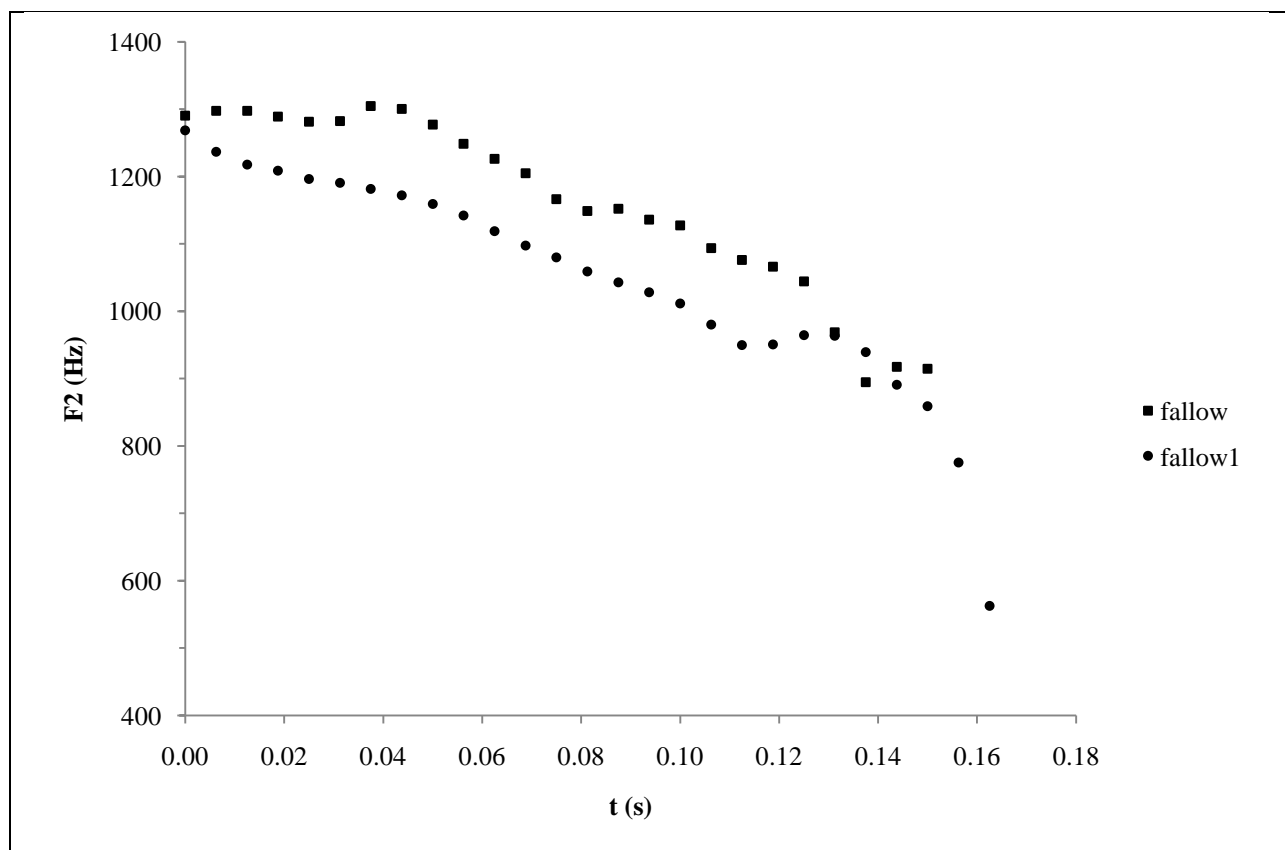


Figure 3.15. Change in F2 over length of vowel for tokens FALLOW and FALLOW1.

What these results do suggest in general is that there is a broader region of overlap between prelateral /æ/ and /ɛ/ for our subjects as a group, but that for sufficiently low or high tokens which are not pre-biased towards the velum, the contrast is nearly always clear (though not with the same rate of success as in other environments we have examined). As a final note, as has been the case in other environments, Anglo groups display more accurate and consistent perception of these tokens as well (see Table 3.1).

### **3.4 Group Performance vs. Individual Performance**

It should be noted that within the Hispanic group, some participants scored as well as or even higher than some of our Anglo participants in certain areas; however, there were enough low scores in the Hispanic group to counterbalance these scores. What it does show is something that has already been hinted at by the consistently low agreement scores among our Hispanic groups, and that is that there is a great deal of variation in perception among Hispanics in El Paso. Anglos as a group, once other variables were accounted for, were much less variable in making the perceptual distinction between /æ/ and /ɛ/ on the basis of vowel height—most notably in environments thought to be unmarked—while at least a number of Hispanics must be making the distinction on the basis something else in addition to vowel height, possibly vowel length at least. Therefore, we might expect to see some overlap of /æ/ and /ɛ/ on the basis of F1 among Hispanics that we might not expect to see among Anglos in production. In looking at our production data, it will also be interesting to see whether uniformities and non-uniformities in perception correlate to uniformities and non-uniformities of production, with wide variation in to what extent different Hispanic speakers make the distinction in production between /æ/ and /ɛ/ consistently by height. We might also see in those areas where perception among groups

appeared more unitary whether production is not also, suggesting some linguistic variables may be widespread in the speech community while others are not.

## **CHAPTER 4 – RESULTS OF PRODUCTION TASK**

### **4.0 Production Analysis**

In order to analyze the production of our participants, average F1 and F2 values for each token of /æ/ and /ɛ/ of sufficient quality to be extracted were recorded. Means for four following environments were calculated, in what were thought to be increasingly marked environments which would condition the preceding vowels: voiceless obstruents, voiced obstruents, nasals, and prelateral liquids. Voiceless obstruents and voiced obstruents will generally be considered unmarked environments for the purposes of this analysis, though especially the former. The environment preceding the vowel was not considered in this study. Only tokens in primary or secondary stress were included to avoid complications due to vowel reduction for vowels in tertiary and quaternary stress.

### **4.1 Comparison to Delattre's Canonical Formant Values**

The general results (in Tables 4.1 and 4.2) of the production task reveal that both /æ/ and /ɛ/ on average across all participants are higher in the vowel space than their canonical formant values for synthesized speech from Delattre (1964) would predict. Based on mean formant values before voiceless obstruents—used instead of means across all environments to mitigate the effects of more marked environments on our analysis—/æ/ on average is much higher than its own canonical value than /ɛ/ is, bringing the two vowels closer together than they would be if speakers produced canonical formant values for both. An examination of F1 values for tokens of /æ/ produced by our participants suggests that Delattre's canonical F1 value of 750 Hz for /æ/ is either outside or near the lower end of the range of production shown by our participants. Participants P008 (Hispanic) with an F1 of 739 Hz and P025 (Anglo) with an F1 of 779 Hz come

close to canonical values for /æ/ in the presumably unmarked environment of a following voiceless obstruent; no other participants come within 50 Hz of Delattre's F1 value for /æ/ for this environment, and the mean F1 for /æ/ before voiceless obstruents for all participants is 636 Hz, 114 Hz lower than Delattre's value. With respect to /ɛ/ before voiceless obstruents, we see many more participants, 19 in total, within 50 Hz of Delattre's F1 value of 550 Hz for /ɛ/. All 6

**Table 4.1. Production of /æ/ by subject, mean formant values (Hz) by following environment.**

Subject	Voiceless Obstruent			Voiced Obstruent			Nasal			Prelateral Liquid		
	n	F1	F2	n	F1	F2	n	F1	F2	n	F1	F2
P001	9	617	1675	2	631	1801	8	558	1725	1	664	1598
P002	6	651	1587	2	674	1715	6	567	1775	1	707	1281
P003	5	674	1666	2	646	1785	12	647	1792	1	685	1436
P004	5	666	1610	1	579	1617	6	597	1758	1	621	1084
P006	7	505	1744	2	481	1629	8	467	1850	1	601	1410
P007	12	585	1587	5	544	1664	13	560	1688	1	654	1366
P008	9	739	1743	3	690	1693	8	666	1696	1	740	1519
P009	10	627	1553	3	663	1503	10	622	1753	1	637	1242
P010	8	614	1508	2	569	1496	10	539	1623	1	660	1410
P011	6	647	1576	3	653	1529	9	610	1639	1	675	1427
P012	7	607	1614	3	559	1751	9	577	1715	1	624	1406
P013	7	526	1643	0	-	-	8	546	1720	1	591	1374
P014	9	699	1728	5	673	1808	9	599	1813	1	732	1332
P015	9	628	1562	3	594	1648	10	557	1726	1	620	1270
P016	9	645	1601	4	631	1613	10	519	1801	1	611	1395
P017	6	606	1473	5	589	1407	13	523	1520	1	634	1311
P018	6	639	1513	2	545	1418	10	557	1628	1	638	1442
P019	7	618	1599	4	592	1537	11	537	1752	1	576	1444
P020	7	662	1455	4	574	1444	5	634	1682	1	653	1196
P021	4	669	1765	3	648	1603	12	589	1780	1	626	1376
P022	12	699	1698	3	695	1713	13	582	1903	2	739	1314
P023	8	594	1494	2	619	1422	8	543	1646	1	615	1213
P024	8	635	1546	1	669	1512	12	553	1678	1	643	1395
P025	7	779	1704	2	671	1701	8	656	2026	2	702	1316
P026	9	567	1401	3	520	1493	8	512	1551	1	565	1114
Mean		636	1602		613	1604		573	1730		649	1347

participants outside of 50 Hz from 550 Hz display values below 500 Hz, which is higher in the vowel space than Delattre's canonical value. The mean F1 value for /ε/ across all participants is 521 Hz, only 29 Hz above Delattre's value.

A similar comparison of F2 values before voiceless obstruents suggests that /æ/ among our participants is generally backer than predicted by Delattre's given value, as well as /ε/. 20 of

Table 4.2. Production of /ε/ by subject, mean formant values (Hz) by following environment.

Subject	Voiceless			Voiced			Nasal			Prelateral		
	n	F1	F2	n	F1	F2	n	F1	F2	n	F1	F2
P001	5	528	1746	5	499	1860	3	494	1863	4	569	1426
P002	5	483	1660	2	502	1709	4	465	1737	6	529	1297
P003	2	528	1731	2	565	1907	4	490	1898	4	572	1224
P004	5	526	1658	4	520	1840	4	516	1731	5	640	1268
P006	6	464	1774	3	457	1833	2	451	1856	6	527	1312
P007	6	522	1685	8	484	1769	8	507	1658	8	533	1283
P008	5	545	1751	4	571	1927	3	602	1837	5	651	1448
P009	8	545	1562	5	518	1713	5	553	1828	5	599	1144
P010	1	516	1576	4	476	1797	7	479	1636	6	569	1313
P011	5	546	1693	3	504	1737	3	543	1676	5	575	1301
P012	3	487	1737	4	437	1831	3	513	1785	6	536	1300
P013	4	498	1715	4	467	1819	3	540	1665	6	574	1357
P014	5	550	1759	2	499	1937	2	428	2181	3	623	1318
P015	3	536	1661	3	501	1769	3	513	1836	7	592	1226
P016	3	512	1715	4	436	1806	4	477	1847	4	559	1381
P017	4	509	1587	3	484	1638	2	479	1605	3	523	1212
P018	4	523	1635	3	531	1694	3	622	1574	7	579	1318
P019	3	528	1667	3	510	1686	3	447	2042	6	509	1303
P020	3	585	1464	3	499	1654	3	523	1620	5	546	1199
P021	4	526	1677	4	515	1872	3	604	1707	5	620	1325
P022	4	560	1691	3	576	1842	3	550	1892	5	593	1243
P023	4	464	1549	3	454	1689	2	498	1558	5	505	1211
P024	5	501	1634	4	504	1761	2	474	1718	6	573	1343
P025	5	573	1715	4	508	1974	5	491	1953	4	587	1144
P026	4	458	1447	5	446	1526	2	513	1429	6	482	1004
Mean		521	1660		499	1784		511	1765		567	1276

25 participants have a lower F2 for /æ/ than Delattre's given value of 1700 Hz before voiceless obstruents, and 25 of 25 display F2 values for /ε/ before voiceless obstruents lower than Delattre's value of 1800 Hz. 18 of 25 participants are more than 50 Hz below Delattre's F2 value for /æ/, and 22 of 25 are more than 50 Hz below Delattre's F2 value for /ε/. The mean F2 for /æ/ before voiceless obstruents among all participants is 1602 Hz, 98 Hz behind Delattre's given value, and for /ε/ this mean is 1660 Hz, 140 Hz behind Delattre's given value. So although /ε/ among our participants appears to be closer to Delattre's canonical height than /æ/, it also appears to be farther from Delattre's canonical frontness than /æ/. It would appear that Delattre's canonical value is possibly inapplicable to the El Paso speech community, and draws back into question the general notion of establishing standard formant values amidst abundant linguistic variation. Figures 4.1 through 4.4 demonstrate this to hold by environment and group.

#### **4.2 Comparison to *The Atlas of North American English* Data**

According to *The Atlas of North American English* (Labov, Ash, & Boberg, 2005), the range of production for /æ/ before non-nasals in El Paso is within 816 to 935 Hz for F1 and within 1742 to 1843 Hz for F2. However, the participant means for F1 for /æ/ before obstruents (voiceless and voiced, since both environments were included in the data from the ANAE) in the current study range from 481 to 779 Hz, and F2 ranges from 1401 to 1808 Hz, suggesting that the vowel is higher and backer than previously established, and the larger range of values suggest variation unknown to or not accounted for by the ANAE. /æ/ before nasals, taken from the ANAE, should have an F1 range within 729 to 1011 Hz and an F2 range within 1654 to 1968 Hz; the collected data shows a mean F1 range of 467 to 666 Hz and a mean F2 range of 1520 to 2026 Hz. This suggests prenasal /æ/ is higher and backer than previously established, as well; taking into account the combined range of /æ/ before obstruents and prenasal /æ/ from the collected data



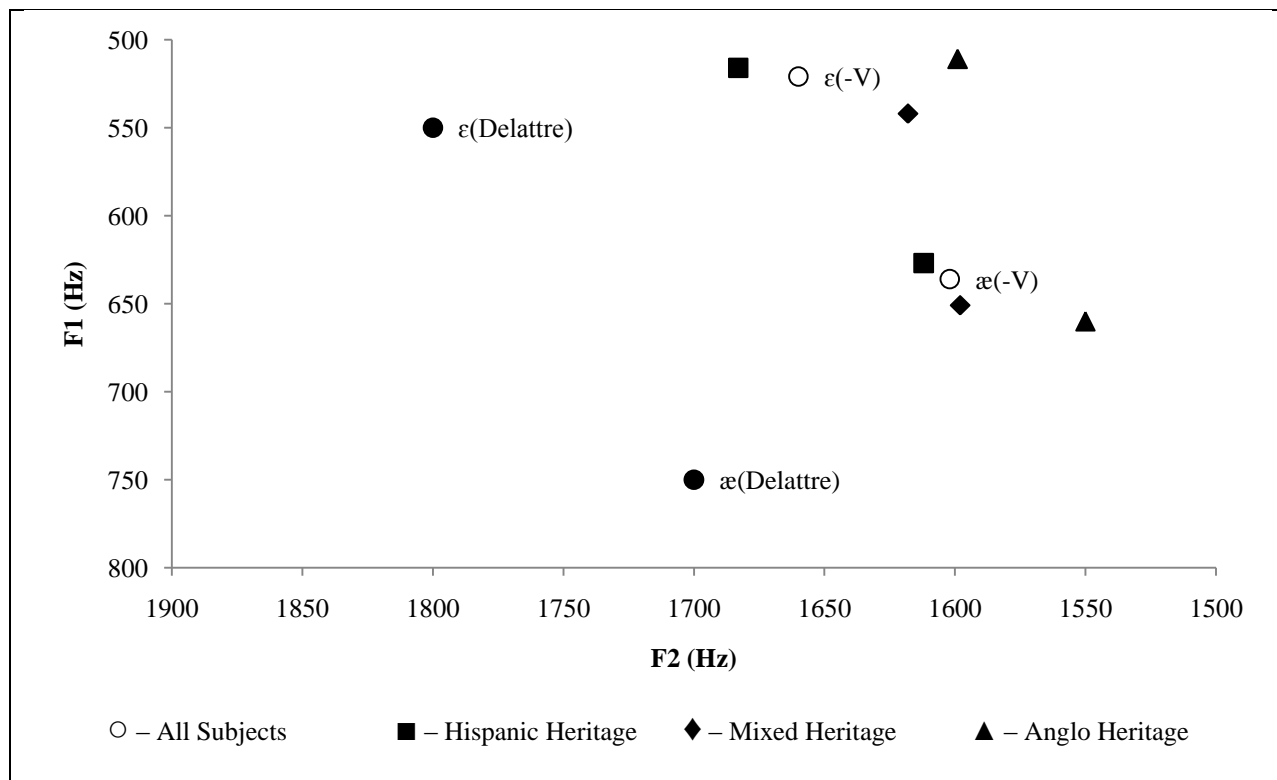


Figure 4.1. Comparison of production of /æ/ and /ε/ before voiceless obstruents by group.

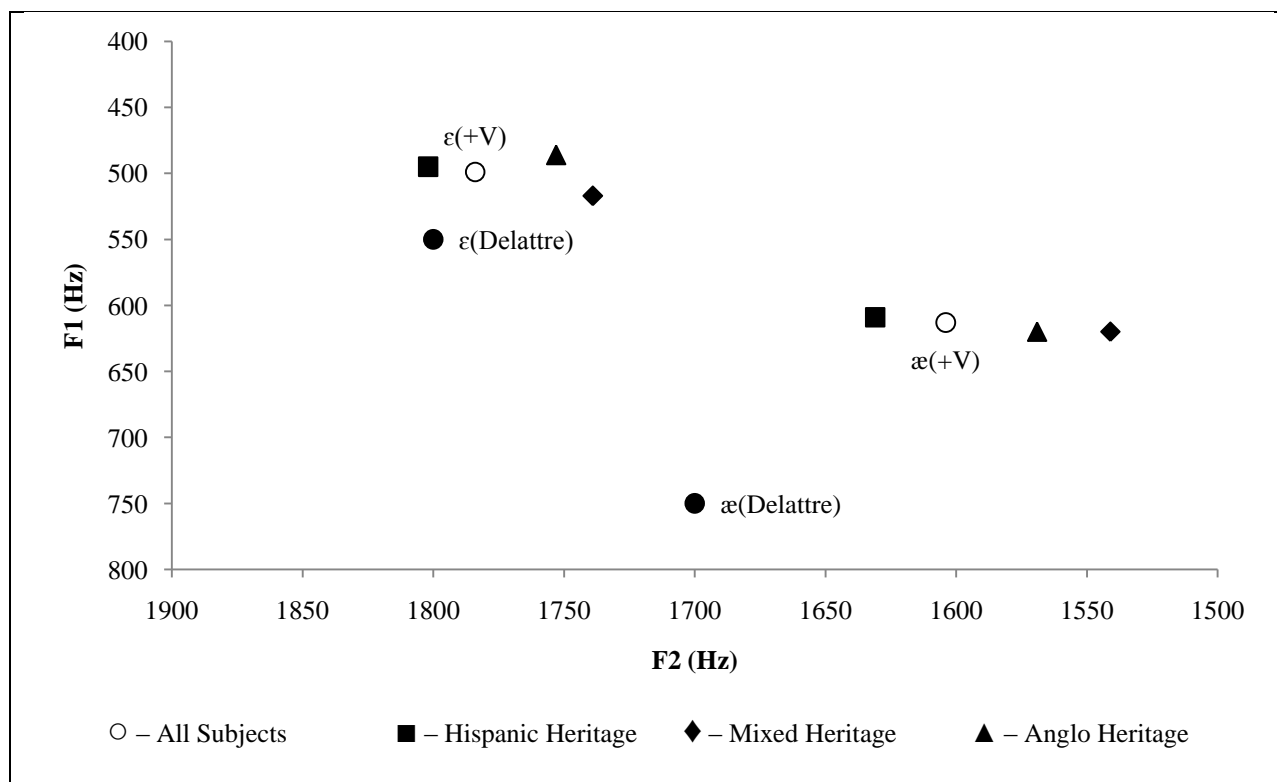


Figure 4.2. Comparison of production of /æ/ and /ε/ before voiced obstruents by group.

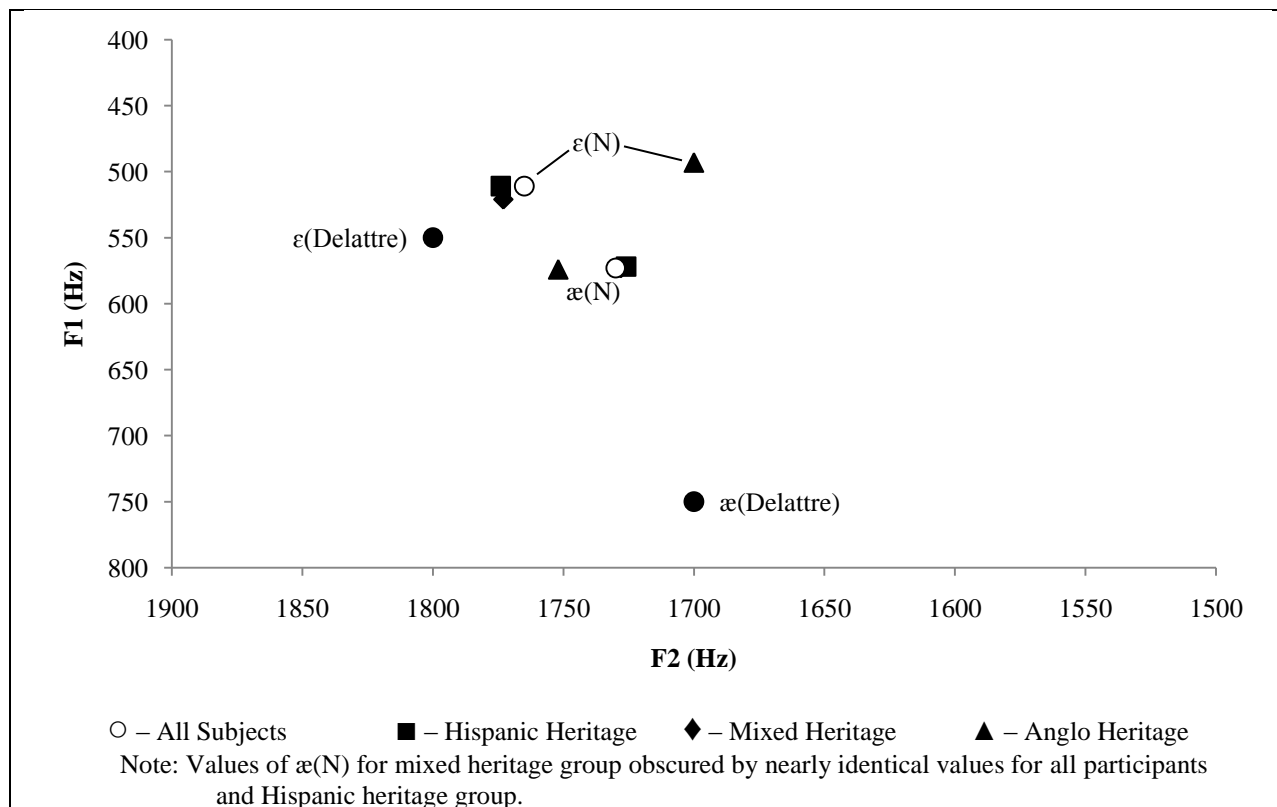


Figure 4.3. Comparison of production of /æ/ and /ε/ before nasals by group.

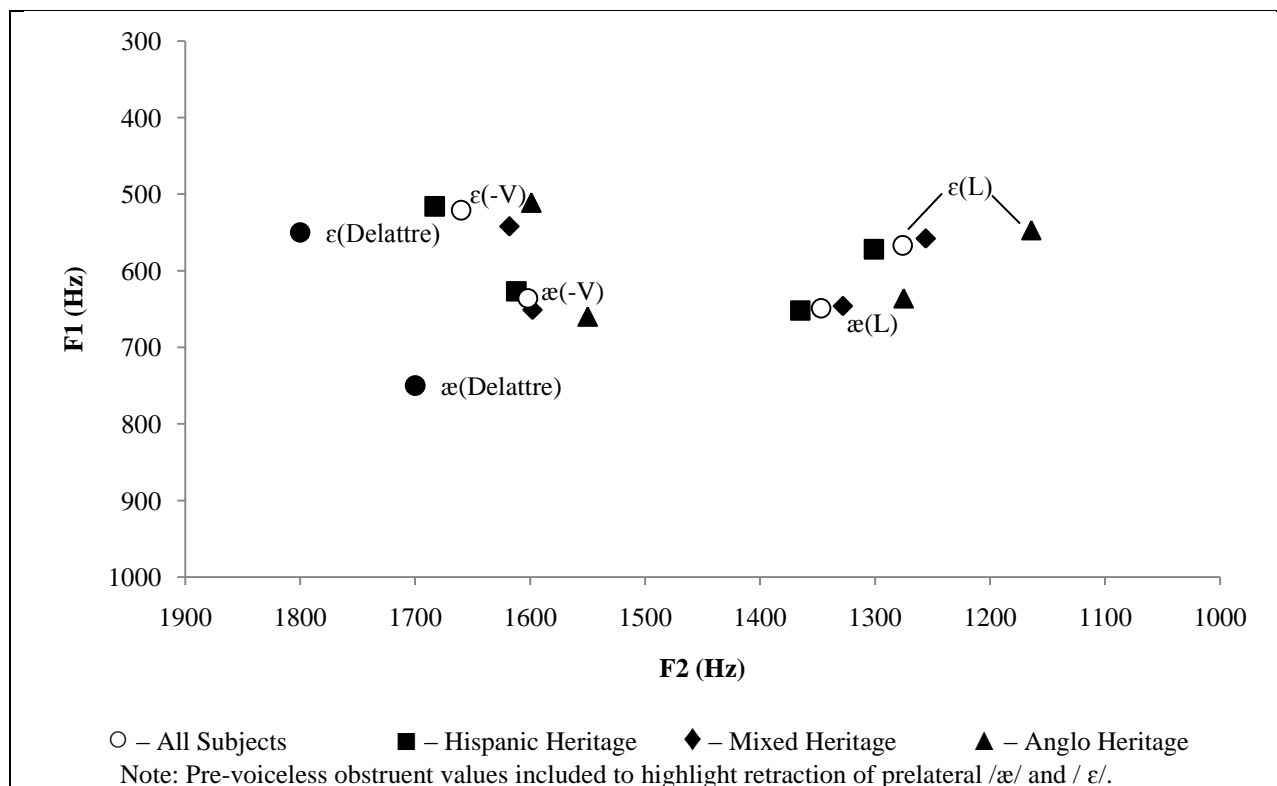


Figure 4.4. Comparison of production of /æ/ and /ε/ before prelateral liquids by group.

and comparing to ANAE data, there also appears to be a larger difference in frontness/tenseness in general between /æ/ before obstruents and prenasal /æ/ than given by the ANAE. With respect to non-nasal /ɛ/, the ANAE gives an F1 range of 503 to 624 Hz and an F2 range of 1922 to 2227 Hz; our data shows a mean F1 range of 436 to 585 Hz and a mean F2 range of 1447 to 1974 Hz before obstruents. As with /æ/, there is greater diffusivity of production of /ɛ/ than predicted by ANAE values with respect to both F1 and F2. The vowel /ɛ/ would also appear to be both higher and backer than predicted by the ANAE; unlike /æ/, the fundamental height difference indicated by the disparity between observed and ANAE values is not as large for /ɛ/.

As stated, even when accounting for ethnicity and identity, comparisons to Delattre's values are maintained; comparisons to data from the ANAE are similar (see Tables 4.3 through 4.5). However, on the basis of mean F1 and F2 by environment alone, some differences between Anglo and Hispanic subjects do appear to emerge. In relatively unmarked pre-obstruent environments, Anglo speakers on average may be pronouncing /æ/ lower and backer than Hispanic speakers; however, looking at the individual mean formant values by environment (Table 4.1), there appears to be a good deal of variation among even our Anglo participants. Participants P024, P025, and P026 form our Anglo heritage group, and their pre-obstruent mean F1 values for /æ/ range from 520 to 779 Hz; our Hispanic heritage group shows a range of mean F1 values from 481 to 739 Hz, suggesting that on average, /æ/ may be higher for Hispanic speakers. These numbers hold when participants are regrouped by identity. We also see that /æ/ may be backer for Anglo than Hispanic speakers on the basis of mean F2 values. As for pre-obstruent /ɛ/, grouped by heritage, F1 values for Hispanics are lower than for Anglos, but the mixed heritage group has higher values than both. Regrouped by identity, the Hispanic identity group actually displays a range of mean F1 values for pre-obstruent /ɛ/ that encompasses the

Table 4.3. Production of /æ/ by group, mean formant values (Hz) by following environment.

Group	Voiceless Obstruent		Voiced Obstruent		Nasal		Prelateral Liquid	
	F1	F2	F1	F2	F1	F2	F1	F2
Hispanic Heritage (17)	627	1612	609	1631	572	1726	652	1365
Mixed Heritage (5)	651	1598	620	1541	573	1728	646	1328
Anglo Heritage (3)	660	1550	620	1569	574	1752	636	1275
Hispanic Identity (19)	629	1603	607	1615	574	1725	648	1360
Anglo Identity (5)	651	1578	619	1543	567	1711	634	1303

Table 4.4. Production of /ɛ/ by group, mean formant values (Hz) by following environment.

Group	Voiceless Obstruent		Voiced Obstruent		Nasal		Prelateral Liquid	
	F1	F2	F1	F2	F1	F2	F1	F2
Hispanic Heritage (17)	516	1683	495	1802	511	1774	572	1301
Mixed Heritage (5)	542	1618	517	1739	521	1773	558	1256
Anglo Heritage (3)	511	1599	486	1753	493	1700	547	1164
Hispanic Identity (19)	520	1670	496	1788	509	1780	568	1296
Anglo Identity (5)	513	1612	491	1754	512	1682	557	1206

Table 4.5. Comparison of formant values by group to literature values for pre-obstruent /æ/ and /ɛ/.

Data Source	Range of /æ/ (Hz)		Range of /ɛ/ (Hz)	
	F1	F2	F1	F2
Delattre	750	1700	550	1800
ANAE	816 to 935	1742 to 1843	503 to 624	1922 to 2227
All Subjects (25)	481 to 779	1401 to 1808	436 to 585	1447 to 1974
Hispanic Heritage (17)	481 to 739	1418 to 1808	436 to 550	1549 to 1937
Mixed Heritage (5)	574 to 699	1407 to 1765	484 to 585	1464 to 1872
Anglo Heritage (3)	520 to 779	1401 to 1704	446 to 573	1447 to 1974
Hispanic Identity (19)	481 to 739	1418 to 1808	436 to 585	1464 to 1937
Anglo Identity (5)	520 to 779	1401 to 1765	446 to 573	1447 to 1974

range for our Anglo identity group. For mean F2 values for pre-obstruent /ɛ/, the Anglo heritage and identity groups encompass the range of both Hispanic and mixed heritage and identity groups.

### 4.3 Prenasal Production of /æ/ and /ɛ/

As mentioned above, prenasal /æ/ already appears to be higher in the vowel space than established by data from the ANAE. Looking closer at Tables 4.1 and 4.2, we can see that for many participants, we can see a tendency for many participants to have a lower F1 mean value for prenasal /æ/ and /ɛ/, and in some case, higher F2 mean values, hinting at prenasal raising and tensing of these vowels. Formant values for prenasal /æ/ and /ɛ/ compared to formant values for these same vowels before voiceless obstruents 24 of 25 participants display lower mean F1 values for prenasal /æ/ than pre-voiceless /æ/, suggesting widespread prenasal raising of /æ/, while 24 of 25 participants display higher mean F2 values for prenasal /æ/ than pre-voiceless /æ/, suggesting possible fronting/tensing of prenasal /æ/ as well; the union of these two sets is 23 participants out of the 25, suggesting the two are correlated and may be the result of a single phonological process. By a similar analysis for prenasal tokens of /ɛ/, 18 of 25 participants appear to raise /ɛ/ prenasally, while 21 of 25 appear to front/tense prenasal /ɛ/; the union of these two sets is 15 out of 25 participants, suggesting it is not necessarily correlated with similar behavior of /æ/ prenasally. Extending this same method, 17 participants raise both vowels prenasally, and 20 front/tense both vowels prenasally. The union of the set of 23 participants who both raised and fronted/tensed prenasal /æ/ and the 15 who did the same for prenasal /ɛ/ (or the union of the sets of 17 and 20 mentioned) is equivalent to the set of 15. For 21 of 25 participants, the difference between mean F1 values of prenasal /æ/ and /ɛ/ is lower than the same difference before voiceless obstruents. For 11 of the 25 participants, the average F2 value for prenasal /æ/ is higher than that for prenasal /ɛ/, suggesting the possibility of more pronounced fronting/tensing for prenasal /æ/ than prenasal /ɛ/ for some participants.

However, since these numbers are generated by an analysis which did not take regard to how large these formant differences were, they provide only a crude upper limit of the number of speakers, and it is still necessary to examine the vowel plots for each speaker to establish the phonological processes described. By visually comparing the distribution of each vowel in less marked, pre-obstruent environments to that in prenasal environments for each participant, it is possible to suggest which participants are displaying these tendencies. 13 out of 25 participants showed a cloud so large for prenasal /æ/, which consisted of a mixture of raised and unraised tokens, that it encompassed the entirety or the majority of the cloud of prenasal /ɛ/, and 2 more displayed diffuse clouds for prenasal /æ/ with at least some remarkable overlap with the cloud of prenasal /ɛ/; 4 participants showed evidence of generally raising /æ/ prenasally such that the clouds for prenasal /æ/ and prenasal /ɛ/ appear to occupy identical regions in the vowel space. 5 participants' with raised /æ/ clouds showed only partial, sometimes very small, overlap between the range of prenasal /æ/ and /ɛ/, generally confined to the upper limit of the former and the lower limit of the latter. Only 1 participant's vowel cloud showed no apparent overlap between the two vowels in this environment. Whether a merger is in progress or regress based on the totality of these observations is unclear, though the lowness of prenasal /æ/ in El Paso suggested by the ANAE is certainly thrown into question; assuming ANAE data was conclusive, then it seems prenasal /æ/ has risen in the vowel space since ANAE data was collected, constituting evidence of a sound change. In either case, the raising and tensing of prenasal /æ/ is much more widespread in El Paso English than the ANAE data establishes, and this process has spread to both Hispanic and Anglo groups. A qualitative description of each speaker's prenasal vowel clouds is delineated in Table 4.6. It should be noted that tokens of /æ/ and /ɛ/ before /ŋ/ were excluded in this analysis, as explained further ahead.

Table 4.6. Description of distribution of prenasal /æ/ and /ɛ/ by subject.

<b>Description of Distribution</b>	
<b>P001</b>	Prenasal /æ/ raised, heavy overlap with prenasal /ɛ/
<b>P002</b>	Prenasal /æ/ and prenasal /ɛ/ generally distinct, small overlap possible
<b>P003</b>	Prenasal /æ/ and prenasal /ɛ/ generally distinct, small overlap possible
<b>P004</b>	Prenasal /æ/ and prenasal /ɛ/ generally distinct, small overlap possible
<b>P006</b>	Prenasal /æ/ raised, heavy overlap with prenasal /ɛ/
<b>P007</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P008</b>	Prenasal /æ/ and prenasal /ɛ/ show no apparent overlap
<b>P009</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P010</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P011</b>	Prenasal /æ/ and prenasal /ɛ/ generally distinct, small overlap possible
<b>P012</b>	Prenasal /æ/ raised, heavy overlap with prenasal /ɛ/
<b>P013</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P014</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P015</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P016</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P017</b>	Prenasal /æ/ and prenasal /ɛ/ generally distinct, small overlap possible
<b>P018</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P019</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P020</b>	Prenasal /æ/ raised, noticeable overlap with prenasal /ɛ/
<b>P021</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P022</b>	Prenasal /æ/ raised, heavy overlap with prenasal /ɛ/
<b>P023</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P024</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P025</b>	Diffuse prenasal /æ/ cloud envelops prenasal /ɛ/
<b>P026</b>	Prenasal /æ/ raised, noticeable overlap with prenasal /ɛ/

#### 4.4 Prelateral Production of /æ/, /ɛ/, and /e/

One of the main questions raised earlier was whether evidence of /ɛ/ tending to /æ/ prelaterally might be found. Unfortunately, a flaw in the apparatus which was not noticed until after data collection led to the collection of only a small number of tokens of prelateral /æ/, which complicated this analysis; all but two participants, P022 and P025, produced only one token of prelateral /æ/. However, by careful examination of each speaker's vowel token formant

plot, some patterns emerged, and it appears that the behavior of prelateral /e/ may be interrelated with the behavior of prelateral /æ/ and /ɛ/.

To begin, there was at least some degree of retraction of all three vowels before /l/ by all participants, especially /ɛ/. Prelateral /ɛ/ was also lowered by a large number of participants; in many, this resulted in F1 values for prelateral /ɛ/ in the general range of all tokens of /æ/. For some participants, this placed their one and only token of /æ/ well within the cloud of prelateral /ɛ/. There were also cases where the cloud of prelateral /ɛ/ was diffuse over a range of F1 values encompassing a range of F1 values for most of a subject's general production of both /æ/ and /ɛ/; in some participants, the cloud of prelateral /ɛ/ was so diffuse as to include tokens of prelateral /e/ as well. A striking pattern was the retraction and lowering—consistent with laxing—of prelateral /e/ in many participants such that its formant values generally placed it within the non-prelateral range of vowel /ɛ/ and the height difference between prelateral /e/ and /ɛ/ was at least partially neutralized. There were 3 participants where this laxing of prelateral /e/ is so pronounced that it makes a *fell/fail* merger appear more likely than an *Allen/Ellen* merger, but most participants seem to be showing less contrast between prelateral /æ/ and /ɛ/ than prelateral /ɛ/ and /e/. This laxing of /e/ might be indirectly responsible for the retraction of prelateral /ɛ/, which could be pushed back in the vowel space by the invading /e/ in order to maintain contrast; /ɛ/ could also be compensatorily lowered due to this laxing of /e/ to maintain contrast between the two, explaining why it may be phonetically trending towards /æ/. As with prenasal overlap between /æ/ and /ɛ/, it does not appear to be restricted to only one ethnic group by heritage or identity. A summary of the descriptions of each speaker's prelateral production of the three vowels is in Table 4.7. Also, Figure 4.5 includes a selected vowel plot for speaker P015, showing these tendencies for overlap among both nasals and prelateral liquids.



Table 4.7. Description of distribution of prelateral /e/, /ɛ/, and /æ/ by subject.

Description of Distribution
<b>P001</b> /e/ and /ɛ/ lowered; /e/, /ɛ/, and /æ/ appear distinct
<b>P002</b> /e/ slightly lowered; /ɛ/ within range of /e/; /e/, /ɛ/, and /æ/ appear distinct
<b>P003</b> /e/, /ɛ/, and /æ/ appear distinct
<b>P004</b> /æ/ raised; /e/, /ɛ/, and /æ/ at nearly the same height, appear distinct by F2
<b>P006</b> /e/ and /ɛ/ lowered; /e/, /ɛ/, and /æ/ appear distinct
<b>P007</b> /æ/ lowered; /e/, /ɛ/, and /æ/ appear distinct
<b>P008</b> /ɛ/ lowered; /e/, /ɛ/, and /æ/ appear distinct
<b>P009</b> /ɛ/ diffuse, includes /æ/; /e/ lowered, /e/ and /ɛ/ overlap slightly
<b>P010</b> /e/, /ɛ/, and /æ/ lowered, appear distinct
<b>P011</b> /e/, /ɛ/, and /æ/ appear distinct
<b>P012</b> /ɛ/ diffuse, includes /æ/ and /e/; mean /e/ very close to mean /ɛ/ (possible fell/fail merger)
<b>P013</b> /e/ and /ɛ/ lowered; /ɛ/ diffuse, includes /æ/
<b>P014</b> /e/ and /ɛ/ lowered; /e/, /ɛ/, and /æ/ appear distinct
<b>P015</b> /ɛ/ lowered and diffuse, includes /æ/; /e/ and /ɛ/ appear distinct
<b>P016</b> /e/ lowered and diffuse, includes /æ/; /e/ and /ɛ/ appear distinct
<b>P017</b> /e/ lowered; /e/ and /ɛ/ overlap (possible fell/fail merger); /æ/ distinct from /e/ and /ɛ/
<b>P018</b> /e/ lowered and diffuse, includes /æ/; /e/ and /ɛ/ appear distinct
<b>P019</b> /e/ lowered; /e/ and /ɛ/ overlap (possible fell/fail merger); /æ/ distinct from /e/ and /ɛ/
<b>P020</b> /e/ lowered; /e/, /ɛ/, and /æ/ appear distinct
<b>P021</b> /e/ and /ɛ/ lowered; /ɛ/ includes /æ/; mean /e/ very close to mean /æ/ (possible Allan/Ellen merger)
<b>P022</b> /e/, /ɛ/, and /æ/ lowered, appear distinct
<b>P023</b> /e/ and /ɛ/ lowered; /e/ and /ɛ/ overlap (possible fell/fail merger); /æ/ distinct from /e/ and /ɛ/
<b>P024</b> /e/ and /ɛ/ lowered; /e/, /ɛ/, and /æ/ appear distinct
<b>P025</b> /e/, /ɛ/, and /æ/ appear distinct; /æ/ and /ɛ/ may overlap slightly
<b>P026</b> /e/ lowered; /e/, /ɛ/, and /æ/ appear distinct

## 4.5 Other Possible Conditioning Environments

Impressionistic observations of the data revealed a possibility of raising and/or tensing of /æ/ and /ɛ/ before voiced velar consonants, as well as some raising of /æ/ before palatal fricatives and affricates; however, the apparatus was not specifically designed to collect tokens in these environments, resulting in insufficient data sets to analyze behavior in these environments across all participants *per se*. Between the two, however, raising and/or tensing before voiced velar consonants appeared to be more widespread in the speech community. On the basis of what was observed, and examination of vowel formant plots, at least 11 participants (out of 19 with data in

this environment) showed possible evidence of raising and/or tensing /æ/ before /g/, at least 22 participants (out of 24 who produced relevant data) showed some evidence of raising and/or tensing /æ/ before /ŋ/ (even to the point where /æ/ was realized in what is presumably the range of /e/), at least 22 participants (of all 25 in this case) displayed raised and/or tensed tokens of /ε/ before /g/, and 14 participants (all of whom for such a token was collected in this case) showed evidence of raising and/or tensing /ε/ before /ŋ/. No participant with data in three or more of

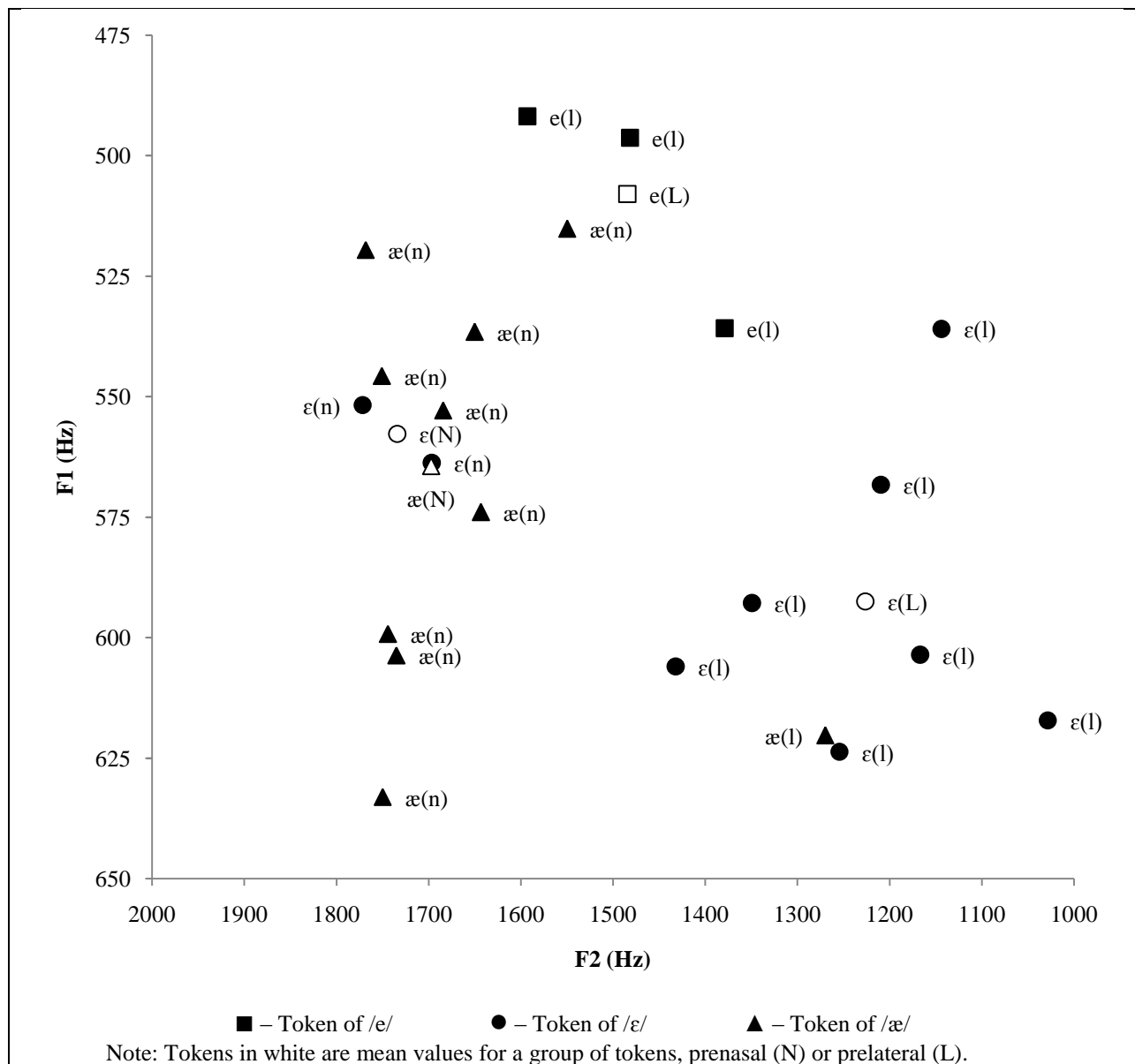


Figure 4.5. Production plot for P015, showing overlap of prenasal and prelateral /æ/ and /ε/.

these environments showed evidence of this process in fewer than two of the four total environments, and only one participant with data in only two of these environments showed the tendency in only one environment. The process appears to have become extant among Hispanic, Anglo, and mixed groups. More will be said about palatal obstruents below.

#### 4.6 General Overlap of /æ/ and /ɛ/

With the most likely conditioning environments accounted for, it appears that the distinction between /æ/ and /ɛ/ is reasonably established for most of our participants in unmarked pre-obstruent environments, with little to no apparent overlap between /æ/ and /ɛ/ in such environments. 17 out of 25 participants displayed at least some overlap between pre-obstruent /æ/ and /ɛ/, but much of this was attributable to suspected marked environments, such as /g/ and

Table 4.8

Degree of overlap for pre-obstruent /æ/ and /ɛ/ for subjects showing overlap.

	<b>Description of Overlap (Upward Drifting Tokens Where Applicable)</b>
<b>P004</b>	Small overlap (/t/, /d/, /ʃ/)
<b>P006</b>	Apparent total overlap; mean /æ/ easily within range of /ɛ/
<b>P007</b>	Diffuse /æ/ range includes most of range of /ɛ/ (/t/, /d/, /ʃ/)
<b>P008</b>	Small overlap (/g/, /ʃ/)
<b>P012</b>	Small overlap (/g/)
<b>P013</b>	Apparent total overlap; mean /æ/ easily within range of /ɛ/
<b>P014</b>	Small overlap (/g/)
<b>P015</b>	Small overlap (/d/, /g/)
<b>P016</b>	Small overlap (/ʃ/ [x 2])
<b>P017</b>	Small overlap (/ʃ/ [x 2])
<b>P018</b>	Diffuse /æ/ range includes most of range of /ɛ/ (/g/, /t/, /d/, /ʃ/)
<b>P019</b>	Large overlap (/g/, /d/, /ʃ/)
<b>P020</b>	Large overlap (/g/ [x 3], /t/)
<b>P022</b>	Large overlap (/t/ [x 3], /ʃ/)
<b>P023</b>	Small overlap (/t/, /č/, /ʃ/)
<b>P025</b>	Small overlap (/k/, /g/)
<b>P026</b>	Small overlap (/k/, /g/, /t/)

palatal obstruents /č/ and /š/, causing /æ/ to raise into the range of /ε/. The remaining 8 participants showed no evidence of overlap between pre-obstruent /æ/ and /ε/. The presence of quite a number of pre-/t/ and /d/ tokens of /æ/ in the region of overlap may also suggest that these environments are not as unmarked as usually assumed, at least for this speech community. On another small note, participants P025 and P026, both Anglo, showed tokens of /æ/ before /k/ in the range of /ε/, suggesting that these two speakers may be extending the apparent process of prevelar raising to include /k/ as well as /g/ and /ŋ/. Table 4.8 shows which participants displayed any degree of overlap; for those who displayed overlap on the basis of only a few upward-drifting tokens of /æ/ within the range of /ε/, the environments for these tokens were listed.

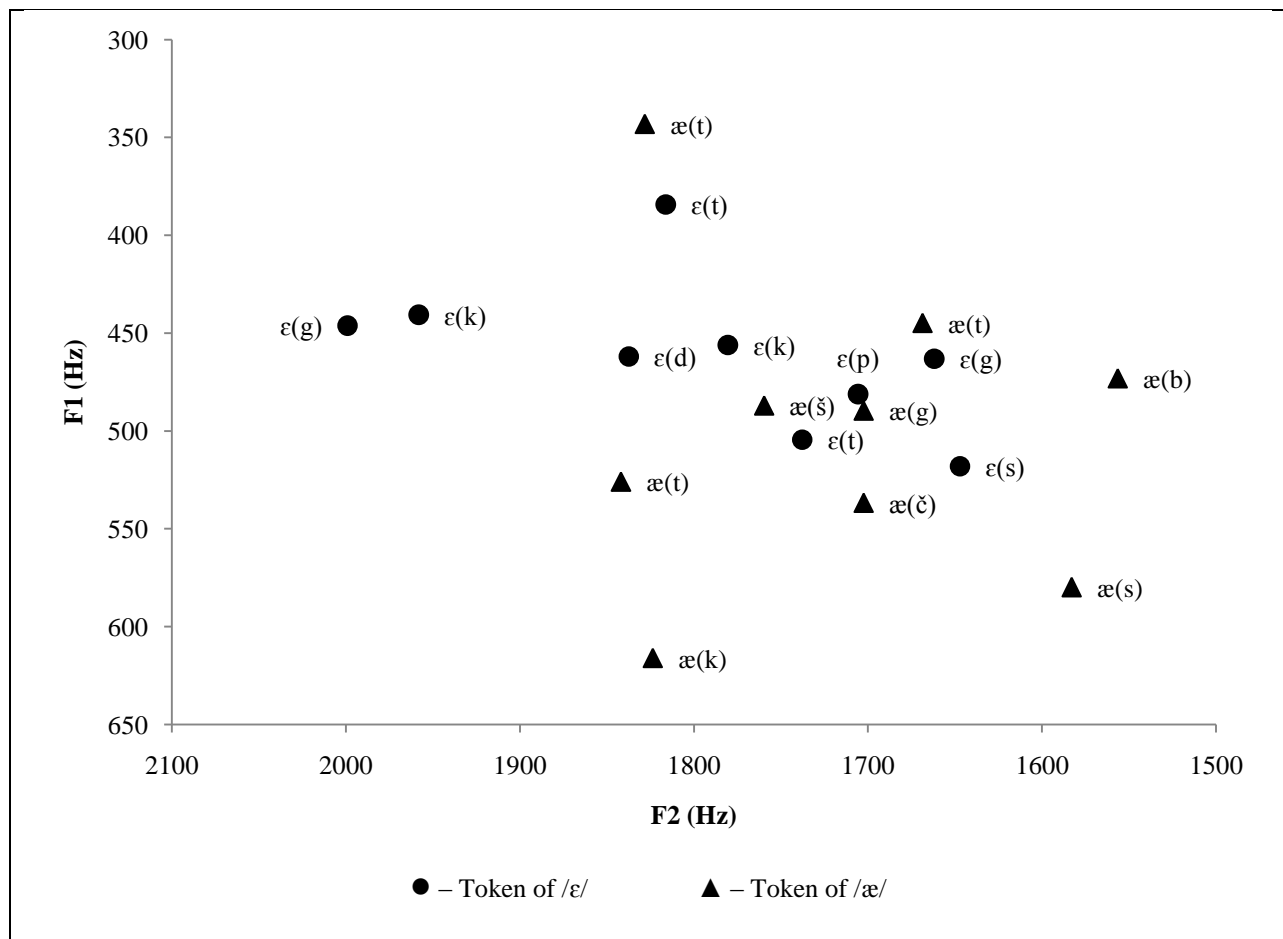
Four speakers in particular stand out among the set: P006, P007, P013, and P018. P007 and P018 displayed very diffuse ranges of pre-obstruent /æ/ which all but encompassed the range of pre-obstruent /ε/. It is interesting to note that both of these speakers were actually born in Juárez and learned English largely in school, and their display of overlap here may be an artifact of learning English as a second language in a academic environment, though both—in another interesting coincidence—attested to speaking English with their sisters. The other two speakers, P006 and P013, displayed noticeably raised ranges of pre-obstruent /æ/ to where the clouds of pre-obstruent /æ/ and pre-obstruent /ε/ appear to totally overlap one another, with the mean formant values of pre-obstruent /æ/ well within the range of pre-obstruent /ε/. Between these two subjects, both speak English as a first language, and their overlap cannot be attributed to second language acquisition. P006 is in fact the only participant to have claimed no Spanish ability of all 25 participants; P013 claimed to begin learning Spanish at around age 4 or 5, but attests to abilities no better than “good” in Spanish. Both participants heavily prefer English,

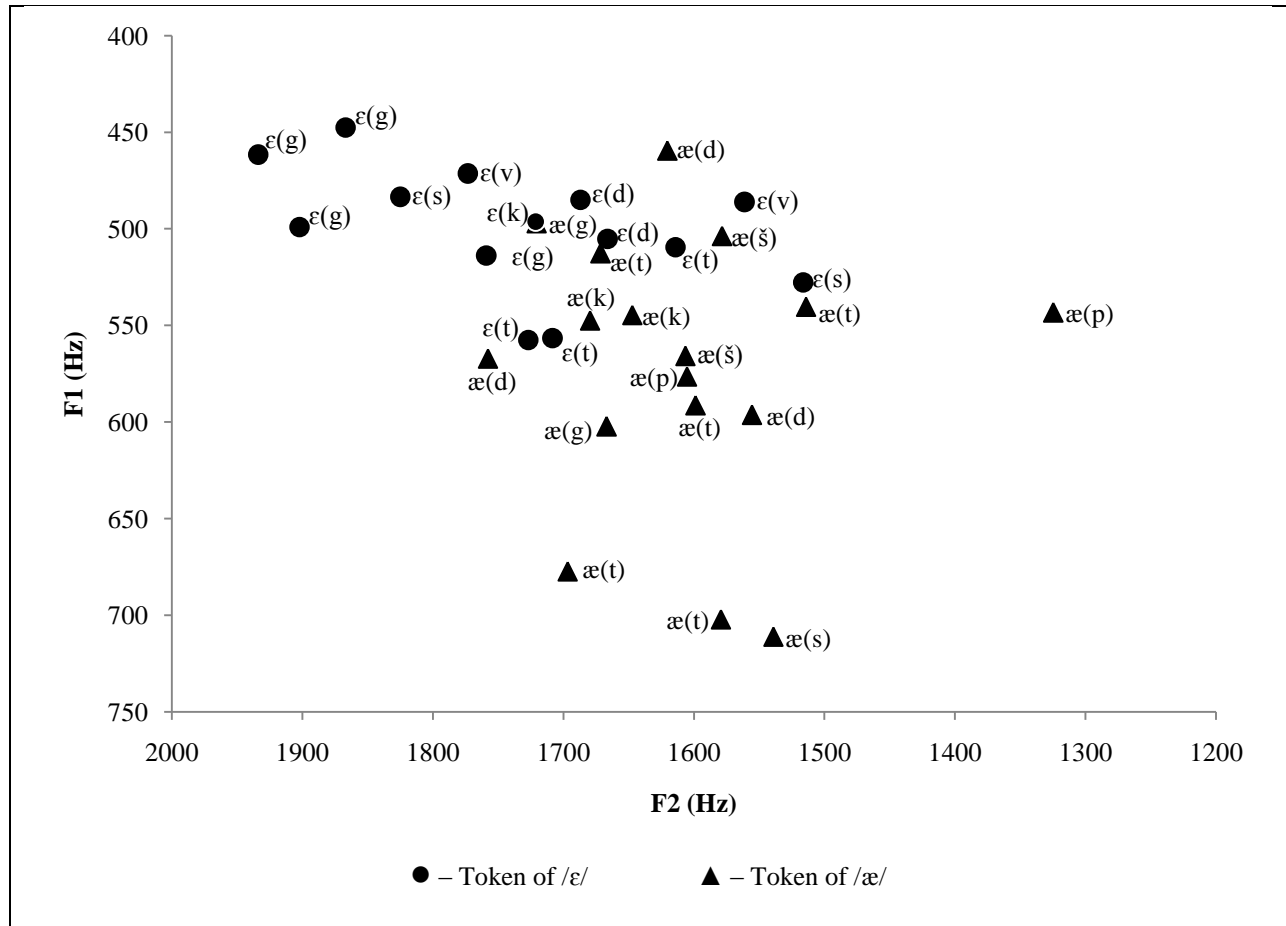
with P006 claiming to hear almost nothing but English (90% or more to 10% or less of Spanish) on an average daily basis, and P013 claiming to hear mostly English (between 60% to 80% English). It is safe to say that neither fit the description of a balanced English-Spanish bilingual. (P006, 22 years old, was one of the youngest subjects in the study, while P013 at 30 was one of the older subjects, so age would appear to not be relevant here.) Perhaps most important is that both P006 and P013 strongly identified as Hispanic. Figures 4.6 and 4.7 on the following pages demonstrate P006's and P007's respective production of /æ/ and /ɛ/ in unmarked environments.

In terms of ethnic heritage and identity, no Anglo heritage or identity group participants showed a large degree of overlap for pre-obstruent /æ/ and /ɛ/, and where overlap was produced it was constrained almost categorically to suspected marked environments. Production of /æ/ certainly appears to be more diffuse or otherwise non-standard for Hispanics in even an unmarked environment, and the production of participants P006 and P013 in context of the production of P007 and P018 suggests that there is a real possibility that acquisition-like production can exist for what are basically monolingual speakers of a Hispanic-colored variety of English.

#### **4.7 Connection between Perception and Production of /æ/ and /ɛ/**

In our discussion of the perception of /æ/ and /ɛ/ by our speakers, it was noticed that perception of /æ/ before voiceless obstruents, what is usually considered an unmarked environment, was much less consistent among Hispanics as a group than it was among Anglos as a group. Our examination of the data from the production task suggests that Anglos as a group are also more consistent in maintaining a distinction between /æ/ and /ɛ/ in unmarked environments. It is also notable that perception of /ɛ/, which was more consistent among





to consider a greater range of social variables in future investigation, in order to understand what is responsible for the apparent lack of unity among the Hispanic ethnic group.



## **CHAPTER 5 – DISCUSSION**

### **5.1.0 Limitations of Experimental Design**

As this was a pilot study in an understudied speech community for some understudied linguistic variables, especially the tendency of /ɛl/ to [æɪ], the open-ended questions brought up earlier could only be partially addressed, as what few bases of comparison we had did not appear to agree well with the collected data. In addition, partly because there were so many open-ended questions raised by the study, it was difficult to design an apparatus that could satisfactorily address all of them to equal depth given the scope and timeframe of the study. Because of this, it was thought better to use an exploratory approach to examining the data rather than a statistically robust one to at least establish the presence and nature of the linguistic variables which demand closer examination. It should also be noted that some of the difficulty in analyzing the results is admittedly due to flaws in the experimental apparatus which—due to the clarity of hindsight—made themselves apparent as the data was being analyzed. Ideas on what went wrong and how to improve things for future studies are discussed below.

### **5.1.1 Non-Standard Production of Voice Actor**

It appears the results may have been skewed by some non-standard production on the part of our voice actor. Using Delattre's (1964) recommended formant values for synthetic English vowels as a basis of comparison, we can see that our voice actor's mean formant values for /æ/ and /ɛ/ before voiceless obstruents does not compare well, and may have been the source of the all-around lower perception scores for /æ/. Our voice actor produced tokens of /æ/ before voiceless obstruents at a mean F0 of 128 Hz, mean F1 of 619 Hz, and mean F2 of 1428; the F0 is close to Delattre's recommended 120 Hz, but F1 and F2 are far from Delattre's recommended 750 Hz and 1700 Hz, respectively. In the case of /ɛ/ before voiceless obstruents, our voice actor

produced average F0, F1, and F2 values of 123 Hz, 553 Hz, and 1490 Hz, while Delattre recommends an F1 of 550 Hz and an F2 of 1800 Hz at an F0 of 120 Hz. Our voice actor's formant values for /æ/ would easily place it higher in the vowel space than Delattre recommends for synthetic speech, and it should not then be a surprise that for so many tokens, it was not uncommon for our subjects to perceive what was intended as /æ/ as /ɛ/; /æ/-raising is not unheard of in the Midwest United States, and our voice actor's affiliation with that region may be behind this. (One interviewee remarked that he thought the person on the recording had a "Southern accent.") /ɛ/ as produced by our voice actor is near the proper height recommended by Delattre, but it is significantly backed, which would superficially present a problem; however, given that the contrast between /æ/ and /ɛ/ was consistently made along the dimension of height by our participants, and their generally good scores on perception of tokens of /ɛ/, it appears that it was not a problem after all. It should be noted that the voice actor used was not a professional voice actor but a contact of the interviewer. For future studies, it will help to seek a better trained voice actor.

It is also possible that using an Anglo voice actor favored the Anglo participants, leading to their better perception scores as a group, perhaps due to more similar linguistic systems to begin with. It is possible that using a voice actor speaking a Hispanic variety of Spanish might turn the tables in favor of Hispanic listeners. In future studies, multiple voice actors could be used to address this question.

### **5.1.2 No Controlling for Speech Styles**

In a more traditional and thorough sociolinguistic interview, speech style is usually controlled for. In this study, simply put, it was not. The picture naming task was hoped to be a

wonderful “distraction” to draw the focus of the interview away from linguistic production and more towards the “game,” and while some subjects probably approached the interview with a more casual demeanor due to the semi-playful nature of things, one cannot rule out the possibility that some felt “under the gun” trying to remember the names of random objects on a screen, or just plain took a more “formal” approach just because they knew they were being “interviewed”; this tendency to alter one’s responses and behavior either consciously or subconsciously in experimental situations has been referred to as the observer’s paradox by Labov (1972). This alteration makes the validity of any data questionable. Perhaps if the picture-naming task is reused in future research, a reading task can be added to establish a baseline reading style of production, in the vein of Labov (1972).

### **5.1.3 Improving the Picture Naming Task**

Over the course of the interviews and upon examining the data more closely, it became clear that it is necessary and possible to improve on the picture naming task for future studies if it is used again. Despite making efforts to select stimuli that were common, and asking the opinions of several colleagues and friends not involved in the study to name the pictures and verify that the stimuli were well-chosen, there was still some occasional unforeseen lexical variation that led to the loss of potential tokens from each participant. Also, some lack of knowledge in seemingly random specific areas made it difficult for some participants to recognize the stimulus. One solution would be selecting even easier stimuli to name, perhaps pictures of easily recognizable celebrities, which could also mitigate the problem of lexical variation significantly, if not eliminate it altogether.

#### **5.1.4 Better Control for Phonological Environments**

Because the picture-naming task was focused on finding concrete objects that could be easily named, it left some gaps in the possibility of phonological environments that could be explored. One possible solution to this is to introduce nonsense words to the set of stimuli, similar to Thomas & Hay (2005); these nonsense words may also serve to highlight word class-dependent contrast and neutralization. These nonsense words could be either read by the interviewee or played back depending on whether the task is one for testing production or perception.

Another way to better control for phonological environments would be to perhaps interview fewer subjects but design the apparatus such that each subject produces more tokens. Having more tokens per participant, while presenting different challenges for analysis, can lead to a high-resolution picture of the linguistic system of a speaker, revealing deeper insights than can sometimes be ascertained from casting a broader net.

### **5.2 Conclusion**

Despite the many flaws in the experimental design that have been discussed, there appears to be enough reliable data to suggest several hypotheses, any of which can be tested to greater depth, possibly falsified, in future study. Among these is the proposition that perception of prelateral /æ/ and /ɛ/, while distinguished primarily by height, also depends significantly on the starting position and contour of the glide to velar position more than it depends on average formant values per se. Another testable proposition is that the effect of vowel length and F0—prosodic factors, perhaps—are a decisive factor in distinguishing between /æ/ and /ɛ/, especially in regions where F1 and F2 values do not favor either vowel per se as some of the data suggests.

These prosodic factors, upon further study, could prove to be vital pieces to the puzzle of acquisition of /æ/ by El Paso speakers. Prosodic prominence has in fact been suggested as a possible vehicle for both acquisition and long term sound change (i.e., chain shifting) of English vowels in other American speech communities (Jacewicz, Fox, & Salmons, 2006). Acquisition was addressed perhaps only tangentially by this particular study, but we have every reason to suspect that it plays no small role in the overall picture; if findings pan out, more conclusive evidence of an ongoing vowel shift in the El Paso speech community may one day arise.

As indicated by the generally lower accuracy and agreement scores on the perception tests among our Hispanic groups in comparison to our Anglo groups, especially with respect to the vowel /æ/, and considering the wide range of individual perception scores and production in the Hispanic group, at least two things can be said: 1) there are obstacles to acquisition of /æ/ that are presenting themselves to Hispanics, though in perhaps uneven amounts, in the El Paso speech community, and 2) there is reason to suspect that the Hispanic population of El Paso is far from being a unified speech community. In future studies, a greater number of social factors will need to be controlled for to completely flesh out the reasons for such diffusivity among El Paso Hispanics; socioeconomic status, neighborhood, school choice, gang affiliation, and level of educational attainment all come immediately to mind as possible pressures which could cause linguistic stratification and/or dispersion in the Hispanic population of El Paso. If we could establish a concrete stratification, we could certainly move on to investigate the underlying social evaluation responsible.

The issue of Chicano English, or any English as spoken by Hispanics, and its interaction with Anglo varieties of English spoken in El Paso is still not entirely clear as well. In parts of the experiment, such as perception and production of prenasal /æ/ and /ɛ/, there were some

apparent similarities in Anglos and Hispanics; on the other hand, perception and production before what are usually considered unmarked environments (before voiceless obstruents, namely) were so different between Hispanics and Anglos that there might have already been a widespread fundamental, phonemic reorganization of the vowels /æ/ and /ɛ/ in the region on the part of Hispanics. It is still unclear whether /æ/ and /ɛ/ have any stigmatic or prestigious variants in this community, and which direction those variants may be migrating (i.e., into the speech of Hispanics from the speech of Anglos or into the speech of Anglos from the speech of Hispanics). There is a possibility that the Anglo speech community of El Paso is also diffuse; much of El Paso's Anglo population arrives to the city via Ft. Bliss, the local military base, resulting in an Anglo population that is largely a transient one.

It should also be noted that the origin of some of the linguistic processes that were observed, such as prenasal raising of /æ/ and /ɛ/ tending towards [æɪ], may not happen for the exact same reasons for Anglos as they do for Hispanics. In the ANAE (Labov, Ash, & Boberg, 2005), the data does not suggest that the *fell/fail* merger is occurring in El Paso, but some of the evidence observed here suggests it is possible, and that such movement could also be triggering a push chain involving /eɪ/, /ɛɪ/, and /æɪ/ as contrasts are re-established by reorganization of the vowel space. Whether this movement of these particular prelateral vowels has spread from another region of the United States or arisen independently in El Paso has yet to be determined due to the understudied nature of the question. According to the ANAE, the *fell/fail* merger should not even be in progress in El Paso, and there is no commentary for any region about possible mergers involving /æɪ/ and /ɛɪ/. The raising of /æ/ observed in general as well as before nasals is also not predicted by the ANAE, nor is El Paso adjacent to any regions claimed by the ANAE to be showing such a process. Roeder (2009) and Thomas (2001) concur that prenasal

raising of /æ/ is not typical of Mexican Americans, and Thomas, Carter, & Cogshall (2006) claim that Mexican Americans in nearby South Texas have resisted prenasal raising of /æ/ typical of that region. It is possible that Hispanics in El Paso have failed to resist the influence of Anglos who are practicing this raising or may practice it as a matter of speech style. El Paso's periphery to more well-established dialect regions may be part of the cause of the variation observed, though none of the processes observed would be predicted by the data in regions adjacent to El Paso, such as Albuquerque and southern New Mexico, southern Arizona, and the nearest parts of Texas, from the ANAE or other previous studies. El Paso has historically not been intimately connected to the rest of Texas; it was not truly integrated into Texas until 1848 upon the outcome of the Mexican War, and the result of the Texas Revolution of 1836 was basically unfelt in the region. California comes to mind as another nearby region which could be influencing El Paso, which could begin to explain the relative raising and backing of /æ/. There was also no data suggesting an immediately recognizable Hispanic influence on Anglo speakers; it is also possible that the interviewer identity—mixed heritage, but with an Anglo name and no strong Hispanic accent—may have influenced participants.

At the beginning of this study, there were some major questions raised. One was about the effect of neighboring dialects on El Paso English, and the answer to this is yet unclear, if for no other reason than the underexamined nature of the El Paso speech community. In future research, it may benefit to look for correlations between some of the processes seen here and other known sound changes in some of the regions El Paso may be in linguistic contact with, for example /ow/-fronting from the South or /u/-fronting out of California.<sup>2</sup> It may also help to

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<sup>2</sup> Some casual observations suggest the possibility that some El Pasoans, especially young females, may be acquiring this feature, as well as prenasal diphthongization of /æ/ similar to what has been observed in Northern California. This also highlights the need of expanding study of the target variables to more social groups.

focus study on how all vowels behave prelaterally in El Paso to see if the suspected push chain between /eI/, /ɛI/, and /æI/ is not part of a much larger scale shift. What pursuing such future studies may ultimately reveal is a speech community with an identity that is the product of a unique blend of influences from nearby Anglo and Hispanic communities due to El Paso's long standing tradition as a cultural and linguistic crossroads with a demographic unlike any other major city of the United States.

One was the question of whether the production of acquisition-like features typical of Spanish-speaking ELLs might be found in the speech of (especially monolingual) Hispanic L1 English speakers. The answer to this question appears to be yes, though the relatively limited sample of participants makes it difficult to say exactly how widespread this might be. Future research could investigate whether this applies to more linguistic variables than those currently investigated. It may also surface in future studies that even Anglo L1 English speakers show these features, though the current study produced no evidence to believe this is the case for these particular variables. Studies in L1 English acquisition by children in El Paso might also show different acquisitional paths which reflect the differences in adult perception and production that has been and will likely continue to be observed.

The question of the dynamic between the “minority” and “majority” dialects of El Paso remains unanswered, if not found to be even more complicated than originally thought, as the evidence of a diffuse Hispanic speech community especially throws into doubt whether there are any well-defined dialects within the group. It would also be fallacious to name a new variety of English based on the behavior of only the few linguistic variables currently investigated in El Paso. There was also nothing in the current apparatus to examine the social evaluation of these linguistic variables; it is unclear how the differences in perception and production might have



been socially motivated, or if these variables are even considered socially diagnostic among El Pasoans *per se*. Certainly, some linguistic behaviors of great theoretical interest have been observed in El Paso, but their interaction with social variables and other linguistic variables can only be firmly established by future studies with more precise methodologies and larger data sets for the purposes of robust statistical analyses which may illuminate our understanding.

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## **APPENDIX A – CONSENT FORM**

**University of Texas at El Paso (UTEP) Institutional Review Board**

**Informed Consent Form for Research Involving Human Subjects**

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**Protocol Title:** Trends in El Paso English

**Principal Investigator:** Lance Williams

**UTEP Department of Languages & Linguistics**

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In this consent form, “you” always means the study subject. If you are a legally authorized representative (such as a parent or guardian), please remember that “you” refers to the study subject.

### **1. Introduction**

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You are being asked to take part voluntarily in the research project described below. Please take your time making a decision and feel free to discuss it with your friends and family. Before agreeing to take part in this research study, it is important that you read the consent form that describes the study. Please ask the study researcher or the study staff to explain any words or information that you do not clearly understand.

### **2. Why is this study being done?**

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You have been asked to take part in a research study of linguistic trends in the El Paso region. You will be asked a few simple questions about your linguistic and social background, then asked to describe some photographs, and then asked to give your opinion of some recordings which will be played for you.

Approximately 20 subjects will be enrolling in this study at UTEP.

You are being asked to be in the study because you are a native El Pasoan age 18 or older.

If you decide to enroll in this study, your involvement will last about as long as it takes to set up and perform a short interview. The interview should not take more than 10 minutes.

### **3. What is involved in the study?**

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If you agree to take part in this study, the research team will take the biographical data you provide about your linguistic and social background and try to find a connection between that and your responses in the rest of the interview. Your data will be part of an analysis involving all subjects to find larger patterns which may apply to all or most participants as members of the El Paso speech community. The interview must be audio-recorded for reasons which will be explained after your interview is over; this is only to ensure that your responses are as unbiased as possible.

### **4. What are the risks and discomforts of the study?**

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There are no known risks associated with this research.

### **5. What will happen if I am injured in this study?**

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The University of Texas at El Paso and its affiliates do not offer to pay for or cover the cost of medical treatment for research related illness or injury. No funds have been set aside to pay or reimburse you in the event of such injury or illness. You will not give up any of your legal rights by signing this consent form. You should report any such injury to Lance Williams (915-202-1160) and to the UTEP Institutional Review Board (IRB) at (915-747-8841) or [irb.orsp@utep.edu](mailto:irb.orsp@utep.edu).

### **6. Are there benefits to taking part in this study?**

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There will be no direct benefits to you for taking part in this study. This research may help us to understand language trends in the El Paso region.

## **7. What other options are there?**

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You have the option not to take part in this study. There will be no penalties involved if you choose not to take part in this study.

## **8. Who is paying for this study?**

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Funding for this study is provided by the UTEP Department of Languages and Linguistics.

## **9. What are my costs?**

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There are no direct costs. You will be responsible for travel to and from the research site and any other incidental expenses.

## **10. Will I be paid to participate in this study?**

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You will not be paid for taking part in this research study.

## **11. What if I want to withdraw, or am asked to withdraw from this study?**

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Taking part in this study is voluntary. You have the right to choose not to take part in this study. If you do not take part in the study, there will be no penalty.

If you choose to take part, you have the right to stop at any time. However, we encourage you to talk to a member of the research group so that they know why you are leaving the study. If there are any new findings during the study that may affect whether you want to continue to take part, you will be told about them.

The researcher may decide to stop your participation without your permission, if he or she thinks that being in the study may cause you harm, or there is an error or discrepancy in the collection of your responses which may affect the integrity of the results of the study.

## **12. Who do I call if I have questions or problems?**

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You may ask any questions you have now. If you have questions later, you may call or email Lance Williams at (915-202-1160) or [llwilliams@miners.utep.edu](mailto:llwilliams@miners.utep.edu), respectively.

If you have questions or concerns about your participation as a research subject, please contact the UTEP Institutional Review Board (IRB) at (915-747-8841) or [irb.orsp@utep.edu](mailto:irb.orsp@utep.edu).

## **13. What about confidentiality?**

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Your part in this study is confidential. None of the information will identify you by name. All records will be kept on a computer to which only the researcher (Lance Williams) will have authorized access.

## **14. Mandatory reporting**

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If information is revealed about child abuse or neglect, or potentially dangerous future behavior to others, the law requires that this information be reported to the proper authorities.

## **15. Authorization Statement**

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I have read each page of this paper about the study (or it was read to me). I know that being in this study is voluntary and I choose to be in this study. I know I can stop being in this study without penalty. I will get a copy of this consent form now and can get information on results of the study later if I wish.

Participant Name: \_\_\_\_\_

Date: \_\_\_\_\_

Participant Signature: \_\_\_\_\_

Time: \_\_\_\_\_

Consent form explained/witnessed by: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

Time: \_\_\_\_\_



## APPENDIX B – SUBJECT QUESTIONNAIRE

Subject Number:

Subject Gender/Age:                      Male      Female

Self-identity:                      Latino/Hispanic                      Anglo                      Other

Age when English was learned:

Self-assessed English ability:                      Fluent      Very Good                      Good      Not Good                      Poor      None

Situations where English is spoken:                      Home      School      Work      Out on the Town

Age when Spanish was learned:

Self-assessed Spanish ability:                      Fluent      Very Good                      Good      Not Good                      Poor      None

Situations where Spanish is spoken:                      Home      School      Work      Out on the Town

Comfort level:

Comfortable only in English

Much more comfortable in English

A little bit more comfortable in English

Equally comfortable with English and Spanish

A little bit more comfortable in Spanish

Much more comfortable in Spanish

Comfortable only in Spanish

Interlocutor languages:

Only English

Almost all English

Mostly English, but a lot of Spanish

Half English, half Spanish

Mostly Spanish, but a lot of English

Almost all Spanish

Only Spanish

Lived outside El Paso:

Other languages:

## APPENDIX C – LISTENING TASK ANSWER CHOICES

Circle the word in each pair that you hear in each recording as it is played. If you hear a completely different word from the choices offered, write the word you hear down in the blank. Remember that there is no right answer. Just go with your first instinct. If you think that both choices are “right”, circle both words.

mash	mesh	(something else): _____
had	head	(something else): _____
gas	guess	(something else): _____
mass	mess	(something else): _____
mash	mesh	(something else): _____
man	men	(something else): _____
sad	said	(something else): _____
bag	beg	(something else): _____
bat	bet	(something else): _____
mass	mess	(something else): _____
pack	peck	(something else): _____
plaid	pled	(something else): _____
lapped	leapt	(something else): _____
paddle	pedal	(something else): _____
plaid	pled	(something else): _____
Allen	Ellen	(something else): _____
bad	bed	(something else): _____
Sal	sell	(something else): _____
slapped	slept	(something else): _____
fad	fed	(something else): _____
Alice	Ellis	(something else): _____
mat	met	(something else): _____
had	head	(something else): _____
Alice	Ellis	(something else): _____
man	men	(something else): _____
mash	mesh	(something else): _____
fallow	fellow	(something else): _____
Annie Moore	anymore	(something else): _____
gas	guess	(something else): _____
Alice	Ellis	(something else): _____
pan	pen	(something else): _____
than	then	(something else): _____
Alice	Ellis	(something else): _____
pat	pet	(something else): _____
bag	beg	(something else): _____
mass	mess	(something else): _____

land	lend	(something else): _____
knack	neck	(something else): _____
shall	shell	(something else): _____
lapped	leapt	(something else): _____
Alice	Ellis	(something else): _____
past	pest	(something else): _____
had	head	(something else): _____
land	lend	(something else): _____
fallow	fellow	(something else): _____
man	men	(something else): _____
slapped	slept	(something else): _____
pan	pen	(something else): _____
pat	pet	(something else): _____
pan	pen	(something else): _____
than	then	(something else): _____
Mary	merry	(something else): _____
Allen	Ellen	(something else): _____
had	head	(something else): _____
Allen	Ellen	(something else): _____
Sal	sell	(something else): _____
sat	set	(something else): _____
capped	kept	(something else): _____
gel	Jill	(something else): _____
Allen	Ellen	(something else): _____
bad	bed	(something else): _____
sat	set	(something else): _____
Sal	sell	(something else): _____
Mary	merry	(something else): _____

## **CURRICULUM VITA**

Lance Levi Williams was born in El Paso, Texas, the third of four children. Upon graduating from Eastwood High School, El Paso, Texas, in 2002, he entered The University of Texas at El Paso as a Margaret Jean Abernethy Scholarship awardee. In May 2006, he received his B.S. in mechanical engineering at UTEP. After a break from school, he returned to UTEP in January 2008 to pursue his M.A. in linguistics. During the course of his studies, he has worked as math, science, ESOL, and linguistics tutor in various on- and off-campus locations in El Paso. He will be pursuing doctorate studies at McGill University in Montreal, Quebec, Canada, beginning September 2010.

Permanent Address: 3110 Dundee Street  
El Paso, TX 79925