Chapter 4

Allophonic Systems as a Variable within Individual Speakers

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The introduction of the linguistic variable in Labov's 1966 "The Linguistic Variable as a Structural Unit" ushered in the new subfield of variationist linguistics, with the linguistic variable as the central unit of analysis. Labov's original formulation of the linguistic variable pertained primarily to phonological variation, and a longstanding definition of the linguistic variable since has been "saying 'the same thing' in several different ways" (Labov 1972, 271). While the early field of language variation debated whether syntax and morphology could be a linguistic variable (Lavandera 1978; Labov 1978; Romaine 1981), subsequent years of the study of language variation has settled on the linguistic variable operating within all levels of the grammar, from syntax (Kroch 1989; Santorini 1993) and morphology (Miller 2013; Krejci and Hilton 2017) to phonology (Sneller 2014; Trudgill 1974) and phonetics (Podesva 2007; Labov 1963).

While linguistic variables have been demonstrated for every level of the grammar, there is more to be said about the nature of phonological variables. Most studies of phonological variables involve a single segment variably replacing another segment, such as the change in Montreal French between [ʁ] and [r] for canonical /r/ (Sankoff and Blondeau 2007) or variation between a monophthong [u] and a diphthong [aʊ] in words like house in Buckie Scottish English (Smith, Durham, and Richards 2013). Often, this variation may be between more than one variant, as in the variation between [h], [θ], and [f] for word-initial /θ/ in Glasgow English (Stuart-Smith et al. 2013), or as may occur when phonetic lenition processes or loan word phonology interact with phonological variation (Sankoff and Blondeau 2007). The study of phonology more generally from a variationist perspective, however, encompasses far more than just variation between segments; for example, chain shifts such as the Northern Cities Shift or the Southern Shift (Labov, Ash, and Boberg 2006) describe a phonological change affecting an entire subset of a phonological inventory. From

the very beginning, Labov's formal description of the linguistic variable conceived of variable nonrhoticity in New York English as a systemic variable: "It concerns the oscillations of entire phonemic categories: the set of ingliding phonemes appears and disappears as a whole" (1966, 6). In other words, Labov analyzed speakers as varying between one phonemic *system* that includes ingliding phonemes and a second system that does not include ingliding phonemes, rather than analyzing speakers as variably deleting a single segment /r/. Since Labov (1966), however, structural phonological units have typically not been the subject of analyses of intraspeaker variation, leaving some work to be done regarding the status of structural phonological targets as an intraspeaker variable.

In this chapter, I provide evidence that phonological variation does occur over a structurally abstract phonological unit: allophonic systems. This variation is found in speakers who grew up during a phonological restructuring of an allophonic split in /æ/ in Philadelphia. This chapter is structured as follows: First, I provide some linguistic background on the restructuring of /æ/ in Philadelphia. I then analyze the productions of forty-two speakers who grew up during this restructuring, finding evidence of allophonic variation in a subset of speakers, for whom I provide a more fine-grained analysis. Finally, I end with a discussion of the implications of finding intraspeaker allophonic variation on the fields of language variation and phonology.

Background: /æ/ in Philadelphia

In this section, I provide some background into the allophonic restructuring currently underway in Philadelphia. For a more in-depth analysis of this change, I refer the reader to Labov, Fisher, Gylfadottir, Henderson, and Sneller (2016).

Restructuring of /ae/ in Philadelphia

Beginning with the first treatments (Ferguson 1972), Philadelphia English has been described as producing a split in the low front vowel /æ/ into two distinct targets: tense and lax. The lax target is a nonperipheral low front vowel [æ] that is relatively shorter in duration (avg: 119 ms). The tense target is both fronted and raised along the front periphery, exhibits a longer average duration (130 ms), and is often produced with an inglide ([æ^{ə}], [ɛ^{ə}], [e^{ə}], or [i^{ə}]). For exposition, I follow the notation of Labov (1989), which denotes the lax allophone as *æ* and the tense allophone as *æh*. This traditional split is governed by a regular phonological rule, shown in (1) and henceforth referred to as PHL.

(1) PHL: æ → æh / __ [+ant] ∧ ([+nasal] ∨ [–voice +fricative])]σ

PHL is a phonologically regular rule triggered by a disjunctive set of phonological contexts: nasals or voiceless fricatives which are also anterior and syllable-final ({m, n, f, θ, s}), producing tense *æh* in *ham* but lax *æ* in *hammer*. In addition to the regular PHL rule, /æ/ in Philadelphia has also developed some lexical specificity, with some words (*mad*, *bad*, *glad*) produced as exceptionally tense and others (e.g., *and*, *ran*, *carafe*) produced as exceptionally lax. The unnatural class of phonological triggers and the existence of lexical exceptions have caused some scholars to classify this

split as phonemic (Ferguson 1972; Labov 1989; Labov, Ash, and Boberg 2006). In this chapter, I follow the position of more recent work (Labov et al. 2016), as well as Kiparsky 1995, which find evidence that speakers of Philadelphia English born after 1985 treat this split as an allophonic distinction rather than a phonemic one. Additionally, following Yang (2016), I allow productive rules, including those that are allophonic, to list a finite number of lexical exceptions. The traditional Philadelphia PHL data, along with its lexical exceptions, falls well below the tolerance threshold for lexical exceptions and can therefore be considered to constitute a productive allophonic rule. However, the traditional PHL split is rapidly being replaced by the geographically widespread nasal allophonic split, henceforth NAS (Labov, Rosenfelder, and Fruehwald 2013; Labov et al. 2016), shown in (2):

(2) NAS: æ → æh / __ [+nasal]

NAS is a phonologically simple allophonic rule that tenses /æ/ before any nasal segment with no lexical exceptions. NAS has been spreading across many dialects of North America (Labov, Ash, and Boberg 2006; Becker and Wong 2009; Wagner et al. 2016), including into the geographic area surrounding Philadelphia. Labov et al. (2016) demonstrate that NAS is prevalent in the speech of younger Philadelphians who attended elite schools in Philadelphia, and argue that it therefore constitutes a change from above likely instituted through dialect contact. This position has been supported by computational simulations in Sneller, Fruehwald, and Yang (2017), who argue that NAS could not have been endogenously innovated in Philadelphia and that, instead, dialect contact with NAS speakers moving into Philadelphia best accounts for the change from PHL to NAS.

Competition between PHL and NAS

Both PHL and NAS result in tense and lax tokens that fall into roughly the same phonetic space. This is shown in Figure 4.1, which displays normalized F1 and F2 measurements of /æ/ tokens for a classic PHL speaker (left) and a new NAS speaker (right), classified into their tenseness categories according to their respective phonological rules.

Notably, PHL and NAS share some of the same conditioning factors. Indeed, because most /æ/ words fall under the elsewhere condition, the majority of tokens would be produced identically whether the speaker was adhering to PHL or to NAS. While PHL is comprised of two phonological triggers (tautosyllabic anterior nasals and tautosyllabic anterior voiceless fricatives) and NAS is comprised of only one (nasals), analyzing the production of the whole community requires breaking these triggers down into six main conditioning factors, which either are shared between PHL and NAS or would result in different productions from a PHL speaker and a NAS speaker. The six major phonological conditions, their reflexes under PHL and NAS, and their type and token frequency are shown in Table 4.1.[1]

Figure 4.2, which is adapted from Labov et al. (2016), traces these six conditioning factors over the history of recorded data from Philadelphia. The diagonal measure, F2-2*F1, acts as a measure of tenseness: the higher along the *y*-axis, the more raised along the front periphery the token is. Data is drawn from the Philadelphia

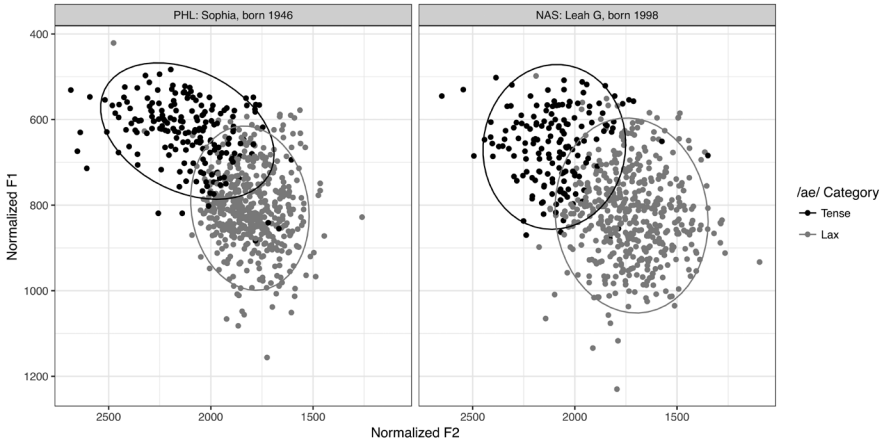

Figure 4.1. Phonetic similarities between tense and lax categories for PHL speaker (left) and NAS speaker (right)

Table 4.1. The six major phonological conditioning factors between PHL and NAS

Conditioning Factor	Example	PHL	NAS	Token freq	Type freq
Tautosyllabic anterior nasal	*hand*	**Tense**	**Tense**	.20	.19
Tautosyllabic anterior voiceless fricative	*class*	**Tense**	**Lax**	.16	.07
Intervocalic anterior nasal	*manage*	**Lax**	**Tense**	.06	.10
Velar nasal	*hang*	**Lax**	**Tense**	.03	.04
Lexical exceptions to tense	*mad*	**Tense**	**Lax**	.05	.001
Elsewhere	*cat*	**Lax**	**Lax**	.51	.60

Neighborhood Corpus (Labov and Rosenfelder 2013), as well as from the Influence of Higher Education on Local Phonology Corpus (Labov 2015). For each speaker, the mean measurement of each of the six conditioning factors is plotted. Figure 4.2 shows the long-lived stability of PHL, with the three traditionally tense categories consistently tense until the early 1980s, when some speakers begin to produce NAS. Labov et al. (2016) argued that PHL and NAS were allophonic systems in competition on the level of the community, with NAS winning out for speakers born at the end of our data set for 2000–2009.

While PHL and NAS are argued to compete on the level of the community, we are still left with the question of how this community-level pattern results from indi-

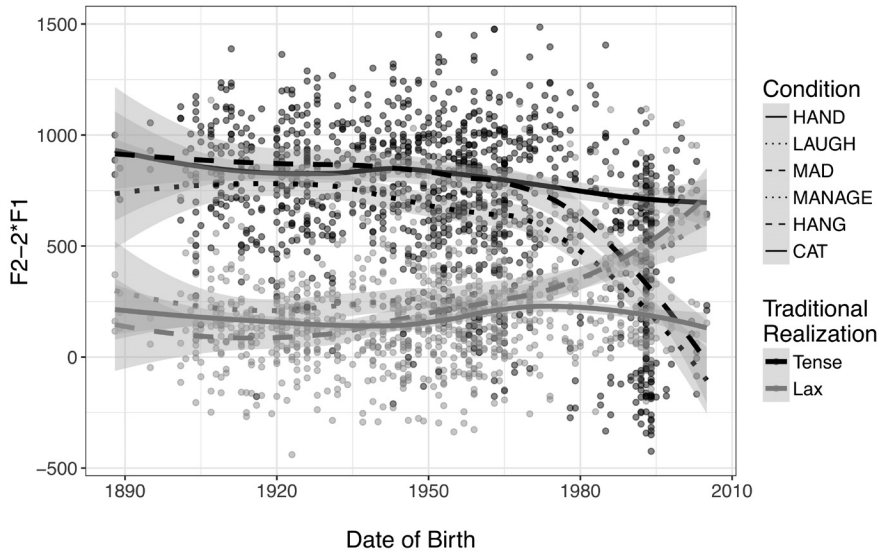

Figure 4.2 *Mean values for each phonological conditioning factor for each speaker in the PNC and IHELP data*
Source: Labov et al. 2016.

vidual speakers. One possibility, following from a strong reading of Fruehwald (2013) and Janda and Joseph (2003), is that speakers in Philadelphia acquire only one of either PHL or NAS, and stick to their one allophonic system throughout their entire life. This method of change would mean that Figure 4.2 simply shows that NAS is the allophonic system selected by a rapidly increasing number of Philadelphians. The second possibility—which is the central argument of the current chapter—is that individual speakers born during the community-wide transition from PHL to NAS have learned *both* PHL and NAS, and that these two allophonic systems act as a variable for these speakers, similarly to syntactic competition found in Kroch (1989) and posited for phonological change in Fruehwald, Gress-Wright, and Wallenberg (2013).

Individual Speaker Productions

To test whether PHL and NAS act as a single linguistic variable for individual speakers, I closely analyzed the production of forty-two speakers. Data were drawn from the IHELP corpus (Labov 2015), and analysis is restricted to white speakers born after 1980, which is the population displaying variation between the traditional PHL /æ/ split and the incoming NAS split.[2]

Analysis

To test whether PHL and NAS are both present as underlying systems for individual speakers, it is necessary to analyze individual tokens as having been produced by

either PHL or NAS. In most cases of phonological change, particularly for changes involving vowel mergers or splits, classifying individual tokens as being produced by the old or the new phonological system is near to impossible due to the overlapping distributions of tokens. The allophonic restructuring from PHL to NAS, however, provides a rare opportunity to classify each individual word token as having been produced under one system or the other. Because both rules result in phonetically distinct tense and lax targets, it is possible to classify individual tokens as being either tense or lax. If these tokens fall under one of the four conditioning factors that distinguish PHL from NAS (shown in Table 4.1), they can then be classified as having been produced by one of the two allophonic rules.

Token classification was conducted as follows. First, each speaker's /æ/ tokens were split into training data and test data. Training data were comprised of the two conditioning factors that are shared between PHL and NAS, with *hand* tokens classified as tense and *cat* tokens classified as lax. This allowed us to characterize speakers' individual tense and lax targets. An example is shown in Figure 4.3a, with 95 percent confidence ellipses drawn around the training data. Training tokens are plotted in gray. Test data were comprised of the four conditioning factors that are different between PHL and NAS. A glm classifier was created in R (R Core Team 2017)—with fixed effects of F1 measurement, F2 measurement, F3 measurement, duration, and syllable stress, as shown in (3)—and fit to the training data. These coefficients were then used to predict the probability of tense or lax for the test data set, using the predict() function, as shown in (4).

(3) predmod <- glm(tense ~ F1*F2*F3*duration*stress)

(4) testdata$tenseProb <- predict(predmod)

Using the productions of the traditional PHL and NAS speakers from Figure 4.1 as a guide, probability thresholds of .2 were selected as cutoff points for test tokens preceding a nasal and .15 for all other test tokens; tokens with a probability of being tense above this threshold were classified as tense, and those below the threshold were classified as lax. After being classified as tense or lax, each test token was then categorized as either PHL or NAS, according to which system it conformed to. Tokens categorized as PHL are orange, and tokens categorized as NAS are green. These tokens are then plotted over the set of training data, as shown in Figure 4.3b.

We can see in Figure 4.3 that, despite producing overwhelmingly NAS tokens, Leah still produces three tokens that were classified as PHL. I note that incongruent tokens are not altogether unexpected: Labov (1989) found PHL speakers to hypercorrect up to 15 percent of their tense *æh* tokens to lax in speech contexts that promote formal speech style, resulting in up to 15 percent of /æ/ tokens that are incongruous with PHL. Following Labov (1989), I consider speakers with 15 percent or fewer incongruous /æ/ tokens to be still conforming to a single /æ/ system. Since Leah produces only three out of her 256 test tokens as PHL, she is overall classified as an NAS speaker.[3]

Results

The majority of speakers in our data set produce tokens of /æ/ mainly consistent with either PHL (orange) or NAS (green), as shown in Figure 4.4.

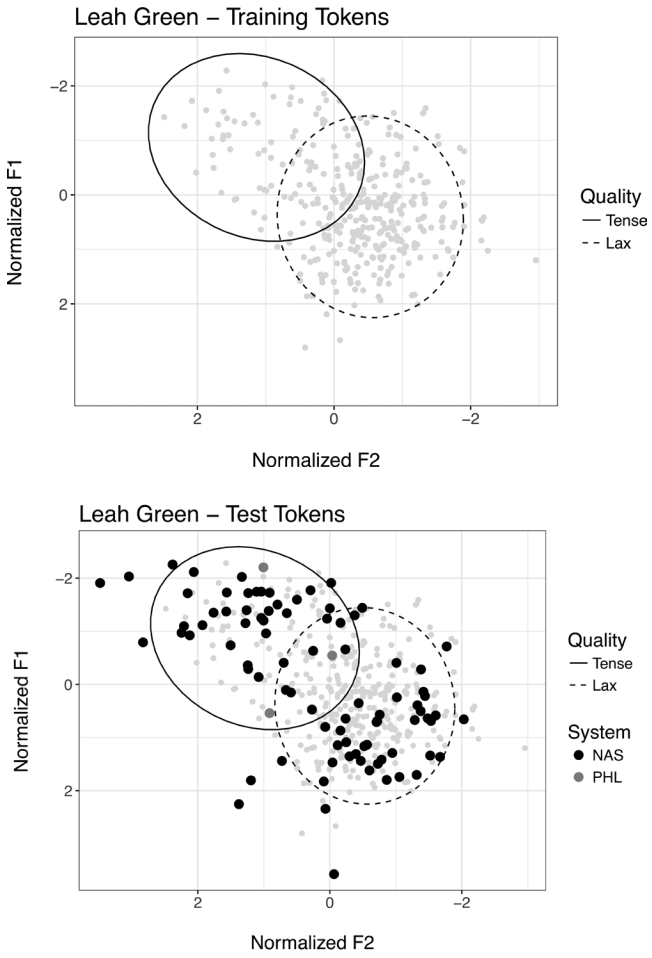

Figure 4.3. Training tokens (a) for Leah G, superimposed with test tokens (b). Green tokens are congruent with NAS only; orange tokens are congruent with PHL only

Of the forty-two speakers analyzed, ten are clearly dominated by PHL and thirty-two by NAS. For these thirty-two speakers, their allophonic /æ/ system does not vary, or at least does not vary within the confines of their sociolinguistic interview. Speakers who produce tokens consistent with only one /æ/ system could work in the aggregate to produce the community-wide competition we see in Figure 4.2. However, these speakers are not the full story. The absence of variation among these thirty-two speakers does not mean that variation does not exist for anyone; indeed, the social pattern of NAS found in Labov et al. (2016) suggests that even when looking at speakers with a similar age range, we would expect some of these speakers (particularly the graduates of elite public schools) to have completed the change to

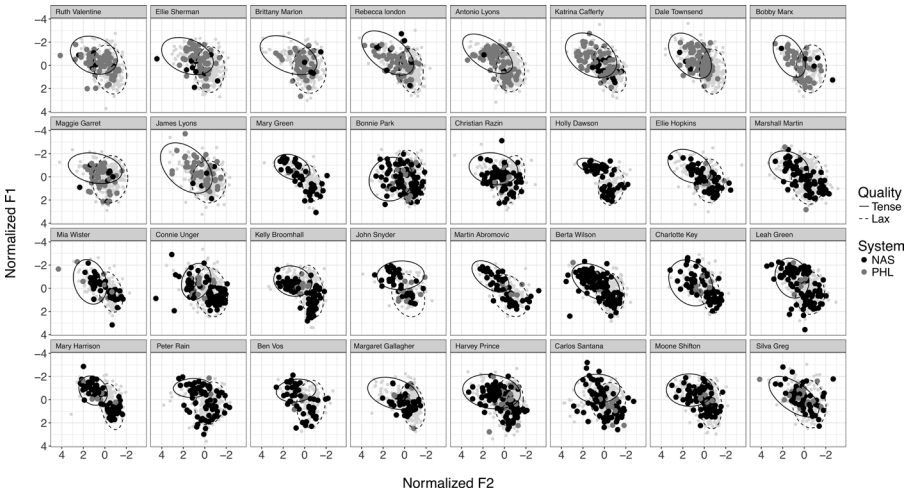

Figure 4.4. Thirty-two speakers in the dataset are classified as either PHL (orange) or NAS (green) speakers, producing fewer than 15% incongruent tokens

NAS while others (particularly the graduates of neighborhood Catholic schools) retain PHL. It is possible, then, that Figure 4.4 represents speakers from the parts of Philadelphia that either have already undergone the change from PHL to NAS or have not yet undergone it.

In support of this position, I also find several speakers producing clear variation between these two systems (Figure 4.5). These ten speakers vary in their /æ/ system, producing tokens that would be incongruous with PHL and tokens that would be incongruous with NAS. This surface-level variation between two allophonic systems suggests that the allophonic systems themselves may be a variable for these speakers. In the next section, I look closely at the productions of several of these speakers to determine the nature of the variation.

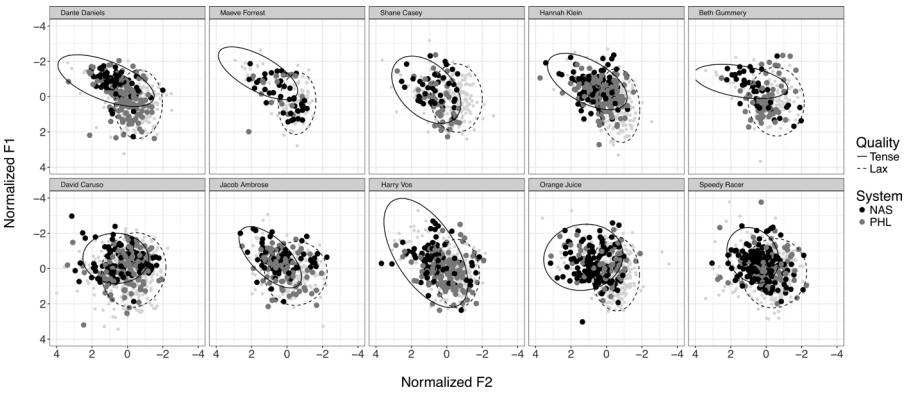

Figure 4.5. Variation between PHL (orange) and NAS (green)

Variation between PHL and NAS

Finding surface-level variation between PHL and NAS within a single individual speaker points to the possibility of intraspeaker allophonic variation. However, before concluding that these speakers are producing variation between two allophonic systems, there are several alternative explanations that must first be falsified. In this section, we take a closer look at the productions of individuals who appear to produce variation between PHL and NAS, to investigate the nature of this variation.

Disjunction

Recall that PHL is comprised of a disjoint set of phonological triggers. Indeed, while I have chosen to represent PHL as a single rule with disjoint triggers, it is also possible to represent the traditional system as two separate rules, shown in (5):

(5) a. PHL[1]: æ → æh / __ [+ant] ∧ [+nasal]]σ

b. PHL[2]: æ → æh / __ [+ant] ∧ [–voice +fricative]]σ

If speakers represent the traditional input as two distinct rules rather than a single system, it is possible that the surface variation is simply the result of a speaker discarding one of the two rules. If, for example, a speaker rejected PHL[2], they would produce tense *æh* preceding anterior tautosyllabic nasals and lax tokens elsewhere. This means that tokens preceding intervocalic nasals (*manage*) and velar nasals (*hang*) would be produced lax, appearing as surface-level PHL tokens. This same speaker would also produce lax tokens preceding voiceless fricatives (*class*), which would appear as surface-level NAS tokens. If, however, speakers are producing true variation between the allophonic system PHL and the allophonic system NAS, we should see variation between PHL and NAS within each phonological conditioning factor.

Because the frequency of test /æ/ tokens in natural speech is relatively low, I will focus this section on the two speakers with the most speech data in order to maximize the likelihood of obtaining an accurate representation of those speakers' productions. Figure 4.6 displays the productions of two speakers, referred to as Orange Juice and Speedy Racer. The top row displays clearly PHL and NAS productions of both speakers' fricative category, while the bottom row displays PHL and NAS productions of both speakers' nasal test token category. We can see, for example, that Orange Juice produces tense tokens of the fricative category (*past*, *bathroom*) as well as lax tokens of this same category (*asshole*, *last*). This within-category shows that the surface-level variation found in Orange Juice's production is not the result of her eliminating the tense fricative condition from her PHL rule. Likewise, Orange Juice and Speedy Racer both produce tense and lax tokens within their intervocalic nasal condition (*damage*, *planet* for Orange Juice; *janitor*, *panicked* for Speedy Racer) and within their velar nasal condition (*angry*, *slang* for Orange Juice; *angry*, *strangle* for Speedy Racer). Taken together, the variation that we see within each of these categories for both speakers shows that the apparent variation in Figure 4.5 is not just the result of speakers abandoning one piece of the traditional PHL rule, but instead suggests that speakers are truly producing variation between the traditional PHL rule and the new NAS rule.

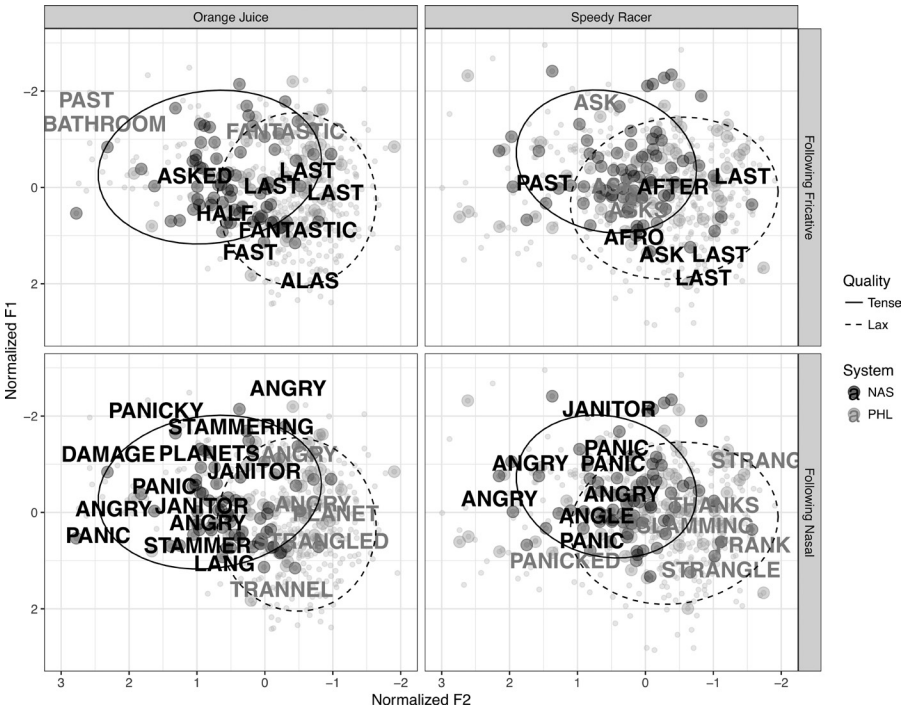

Figure 4.6. Variation between PHL and NAS within phonological category

Lexical Diffusion

With variation between PHL and NAS found within each phonological conditioning factor, this leaves us with one final alternative possibility before we can conclude that PHL and NAS are truly variable within speakers: lexical diffusion. Traditional PHL input requires speakers to memorize a list of lexical exceptions to tense and a list of lexical exceptions to lax. Furthermore, this list of exceptions has been shown to change over time, with *planet* joining the exceptionally tense class for many speakers born around 1990 (Brody 2011) and various words leaving the exceptionally lax class (e.g., *ran*, *swam*, *began* for speakers born around 1985). This raises the possibility that the variation within conditioning factors shown in Figure 4.6 is actually the result of lexical diffusion into and out of each list of exceptions. For example, if a speaker produced PHL but added *janitor* to their list of exceptionally tense tokens, this speaker would produce tense *janitor* and lax *manage*, appearing on the surface to be variation within the intervocalic nasal conditioning factor. If this same speaker added *hang* to the exceptionally tense and *class* to the exceptionally lax, the speaker would appear on the surface to produce variation within all conditioning factors between PHL and NAS. If, however, a speaker truly does produce variation between PHL and NAS overall, that speaker is expected to produce variation between PHL and NAS within a single lemma.

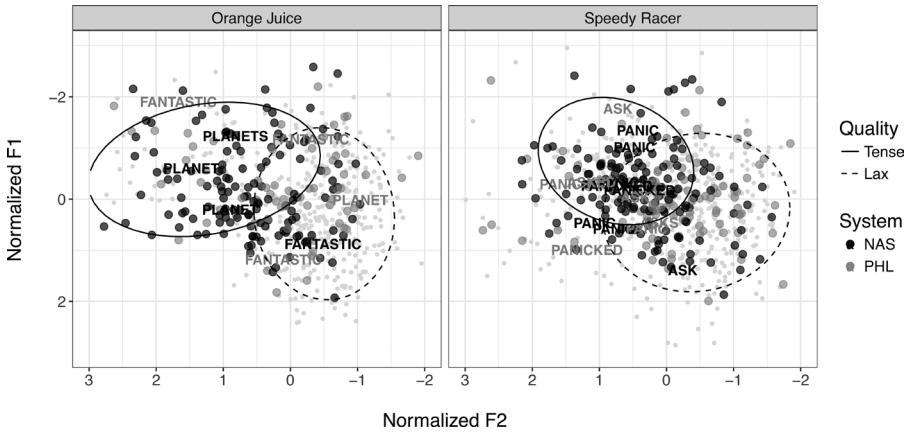

Figure 4.7 Variation between PHL and NAS within lexical item

Figure 4.7 presents a few highlighted tokens for both Orange Juice and Speedy Racer, selected for readability and for the relatively high number of tokens of each word. Orange Juice produces both tense and lax forms of the stressed vowel in *fantastic*, as well as in the word *planet*. Speedy Racer produces both tense and lax forms of *panic* and *ask*. The variation that we find within lemmas suggests that the surface-level variation between PHL and NAS for these speakers is not driven by the addition or subtraction of lexical items from the listed set of lexical exceptions. Speakers vary within phonological categories as well as within word types, leading to the conclusion that what appears on the surface to be allophonic variation is indeed intraspeaker variation between two allophonic systems.

Discussion

In this chapter, I have shown evidence that the structurally abstract unit of "allophonic rule" acts as a linguistic variable for some speakers during this allophonic restructuring of /æ/ in Philadelphia, supporting the initial position of Labov (1966). The implications of finding intraspeaker variation of this sort are relatively straightforward for the field of variation and change: namely, that allophonic systems may serve as the locus of linguistic variation and be the target of a variable rule. This finding carries with it the charge to consider the role of more abstract structures when investigating complicated surface-level variation, allowing allophonic systems themselves to be a potential variable for speakers.

I note also that the idea of phonological rules applying to abstract phonological structures is not altogether new. Fruehwald (2013) showed that diachronically, a phonological rule targeting the back raising diphthongs (/aw/, /ow/, /uw/) caused these three vowels to first front together, then back together. Chain shifts such as the Southern Shift can be analyzed as the result of a phonological rule or set of rules applying to an abstract target such as "front vowels" or "short vowels." The idea that rules can

apply to an abstract phonological target is generally a widely accepted aspect of language variation; the main extension made here is to provide evidence that not only can abstract units such as an allophonic system be the target of a phonological rule, but these abstract units can also be a linguistic variant *within individual speakers*. I claim that these abstract units can be targeted by a variable rule.

This chapter demonstrates the oscillation of two separate allophonic systems within a single speaker; the identification of such intraspeaker variation raises further questions about the social stratification of this variation. It is clear that much larger bodies of data will be required to analyze the social distribution of this oscillation as compared to the general *fact* of oscillation. However, some preliminary work on the social stratification and evaluation of PHL and NAS may point in fruitful directions. The demographics of PHL and NAS in Philadelphia show social stratification between the two (Labov et al. 2016). It remains to be seen whether Philadelphians can assign social evaluation to PHL and NAS as a whole rather than just assigning social evaluation to particular aspects of each allophonic system (such as tense */æh/* preceding voiceless fricatives). Labov and Harris (1986) and Eckert and Labov (2017) argue that the abstract system is unavailable for social evaluation, although in other work (Sneller 2017), I find evidence of social evaluation following structural rather than phonetic lines. While this change from PHL to NAS is relatively new, the strong social stratification found in Labov et al. (2016) makes this abstract variable particularly likely to attract social evaluation if evaluation of abstract structures is possible. As this change propagates throughout the community, we may see whether the allophonic systems themselves are subject to social evaluation.

Finally, this intraspeaker variation of allophonic systems occurs during the course of a phonological change. While the focus of this chapter has been on the phonological and sociolinguistic implications of demonstrating that an abstract allophonic rule can be the target of intraspeaker variation, these results have implications for theories of language change as well. Finding intraspeaker competition between PHL and NAS suggests ultimately that abstract phonological and syntactic change may propagate both through a speech community and through a similar mechanism of intraspeaker competition.

Notes

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1 For this analysis, I have excluded PHL's lexical exceptions to lax (such as *ran* and *swam*) and pre-/l/ tokens (such as *Italian*), since these categories have shown inconsistent production even within fully PHL speakers in the PNC, making them uninformative as to the underlying system for any individual tokens.

2 While there is a shift to NAS for Black Philadelphians as well, the variation there is between the traditional Philly AAE neutral /æ/ and NAS; because the traditional Philly AAE /æ/ system has a single target for /æ/, it is not possible to determine the underlying system for any individual tokens, making this change uninformative as to the status of phonological competition within individual speakers.

3 Leah's tensest PHL token is a tense production of *Castor*, a street in her childhood neighborhood, and the other two are productions of and that were classified as lax.

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