VOWEL ACCOMMODATION STRATEGIES USED BY ESL TEACHERS IN FOREIGNER-DIRECTED SPEECH

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ABSTRACT

Laura Barnes: Vowel Accommodation Strategies Used by ESL Teachers in Foreigner-Directed Speech
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In this study, features of Foreigner-Directed Speech (FDS) are investigated by measuring the durations of tense and lax vowels in the speech of ESL teachers to both a nonnative speaker of English and a native speaker of English. Comparing tense and lax vowel pairs within subjects from both a group of ESL teachers and a control group of native English speakers (with no experience teaching ESL), it is investigated whether vowel duration is lengthened in both tense and lax vowels, or whether vowel duration is hyperarticulated in tense and lax pairs—lax vowels shorter, tense vowels longer—to see if duration is key in aiding L2 English speakers. It was found that the ESL teacher group did not display any significant features of FDS when compared to the control subject group, and that both groups showed greater durational distance within the tense-lax pair /e/-/ɛ/ than within /i/-/ɪ/. Other patterns were found that could be attributed to FDS, though the statistical significance of these patterns could not be established to confirm this conclusively.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

In acquiring a second language as an adult learner, being able to perceive nonnative phonetic contrasts is no easy task (Brosseau-Lapre, Rvachew, Clayards, and Dickson, 2013; Flege, Bohn, and Jang, 1997; Tsukada et al., 2005; Werker, Gilbert, Humphrey, and Tees, 1981). But, since successful perceptual learning is important to successful production of a language, categorizing sounds into their phonemic categories in the acquisition process is clearly essential to productivity (Brosseau-Lapre et al., 2013). The ability to perceive and categorize vowels in particular in acquiring a second language has been found to positively correlate to successful speech production, no matter what age the learner first began to acquire the second language (Flege, MacKay, and Meador, 1999; Bundgaard-Nielsen, Best, Kroos, and Tyler, 2012).

The role of vowel perception in acquiring the phonemic categories of a second language is important for the second language learner, and this has led to some studies examining what type of input native speakers produce directly in conversation with nonnative speakers, and how a native speaker may modify his or her speech in conversation with a nonnative speaker to provide more readily understandable speech, or stereotypical examples of speech to the listener. Some of these modifications of normal speech towards nonnative speakers can be seen in slower overall speech rate, elongated vowels in stressed syllables, hyper-articulation of vowel duration contrasts, and hyper-articulation of vowel formant frequencies (Rahimian, 2013; Scarborough et al., 2007; Uther et al, 2007).

This kind of speech modification is known as Foreigner-Directed Speech (FDS), and has been examined both in native speakers' conversing directly with nonnative speakers, and in

native speakers' conversing with an imaginary nonnative speaker (Scarborough et al., 2007). However, a study has not yet been implemented that examines FDS as used by ESL teachers, who converse extensively with nonnative speakers. It is possible that this experience in interacting with nonnative speakers of English produces not only the characteristics of FDS in the teachers' speech, but to an even greater degree than in the speech of native English speakers with no experience teaching English to nonnative learners.

This present study will focus specifically on ESL teachers, whose occupation entails that they have experience working extensively with nonnative English speakers, in order to see if vowel duration hyper-articulation is one of the aspects of FDS they employ in speaking with students, or if vowel elongation occurs in their speech. It would be useful to know, both theoretically and in the interests of applied linguistics, if teachers are using accommodation strategies to help nonnative speakers phonemically categorize vowels; or if not, perhaps being aware of various accommodation strategies that can be used in Foreigner-Directed Speech would help them be more effective in the classroom.

In addition, as Scarborough et al (2007) note in the conclusion of their study, further research needs to be done that tests what other phonetic features are altered from native-directed speech to FDS. In this study, I seek to expand research that explores the hyper-articulation of vowels in Foreigner-Directed Speech, particularly in that of lax and tense vowel pairs, in order to see if a stronger effect can be found in the speech of ESL teachers, in comparison with native speakers of English who have no experience teaching ESL. In this way, some of the nuances of FDS as realized in lax and tense vowels can be further explored as they relate to Second Language Acquisition.

CHAPTER 2: BACKGROUND LITERATURE

2.1. Foreigner-Directed Speech (FDS)

Foreigner-Directed Speech (FDS) has been researched as a phenomenon similar to Infant Directed Speech (IDS), in that particular phones in each are hyper-articulated, for the presumed reason of aiding phonemic categorization in both infants and nonnative speakers of a target language (Rahimian 2013). Vowels in particular are noted in both IDS and FDS for having lengthened durations compared to Native-Directed Speech (or in speech directed to adults). Some studies also suggest that vowels produced in FDS have hyper-articulated formant frequencies (where low formants become lower, and high formants become even higher) resulting in an expanded vowel space, and these along with longer vowel durations are both used by native speakers to accommodate to nonnative speakers (Rahimian, 2013; Scarborough et al 2007). Studies such as Rogers et al (2013) disagree with Scarborough, however, in terms of the importance of vowel formant hyper-articulation, and instead put forth vowel duration as the primary distinguishing factor in FDS. According to Rogers, vowel duration is what nonnative speakers rely on to recognize and categorize vowels they are acquiring in their phonology, especially when acquiring an L2 later in life (Rahimian 2013).

To continue other studies which have investigated formant hyper-articulation in Infant-Directed Speech (IDS) (Kuhl et al, 1997; Andruski et al, 1999,Burnham et al, 2002), Uther et al (2007) compared IDS with FDS. They investigated the corner vowels /i/, /u/, and /a/ in the speech of mothers to their children and to nonnative speakers, to see if the mothers' vowel space was expanded in Infant-Directed Speech (IDS) and FDS, when compared to Adult-Directed

Speech (ADS). When the vowel space is expanded, the first and second formants (F1 and F2) become proportionally higher or lower for each vowel being hyper-articulated, resulting in a larger phonetic contrast between vowels, as well as a larger perceptual space (Uther et al, 2007). For example, the high close vowel /i/ has a low F1, and a high F2, and if these two formants are hyper-articulated, F1 will be lower and F2 will be higher than usual, pushing the acoustic differences between /i/, /u/, and /a/ further apart in the vowel space. In this way, the perceptual and phonetic distance between vowels can be enhanced for the listener (Uther et al, 2007).

It was found that the subjects' vowel space was expanded (hyper-articulated) in both IDS and FDS, which Uther et al (2007) suggest indicates that hyper-articulation is used to aid both infants and nonnative speakers in distinguishing phonetic contrasts in the target language. In fact, studies on hyper-articulation in have shown that vowel space expansion in IDS is a factor in English, Russian, Swedish, and Japanese (Kuhl et al, 1997; Andruski et al, 1999; Burnham et al, 2002). Both IDS and FDS use similar adjustments on the part of the speaker to the perceived needs of the listener, but the ways in which FDS is realized is still understudied. Uther et al (2007) further state that the environments in which FDS occurs still requires further study, as does the investigation of the benefits of FDS to the nonnative speaker.

It has not been researched in depth whether FDS is more strongly apparent in the speech of those who regularly interact with nonnative speakers of English in a teaching role, though Rahimian's study looked at the speech of native English speakers who had experience working with nonnative speakers in a peer-to-peer role. If duration is key in nonnative speakers' acquisition and perception of English vowels, as Rogers et al (2013) indicate, and since duration is the most obvious feature in distinguishing tense from lax vowels in English (Thomas 2011), then one might expect to see tense and lax vowel distinctions hyper-articulated in FDS, with

tense vowels lengthened and lax vowels shortened, to make their distinctions more salient. For example, it is possible that the durational difference within tense/lax vowel pairs would be greater in FDS, as opposed to Native-Directed Speech (NDS).

On the other hand, it is possible that both tense and lax vowels would be lengthened in FDS, and if so, this could indicate that a slower rate of speech is being used overall, which would serve to lengthen all vowels. If overall lengthening is occurring in FDS, rather than hyper-articulation of durational contrasts, then it might be that the speaker is relying on a slower speech rate to assist the listener in comprehension, instead of providing the listener with stereotypical versions of vowel contrasts.

2.2. L2 segmental perception and vowel contrasts

One study that investigates the importance of vowel categorization in learning a second language was carried out by Bundgaard-Nielsen et al in 2012, and focuses on a subject pool of Japanese learners of English, who were studying abroad in Australia in an English immersion program. Their study tests the idea that L2 vocabulary size and L2 vowel intelligibility are positively related; that is, these learners of English were predicted to perform better on both production and perception tasks if their L2 vocabulary size was bigger than that of their peers, who did not differ from them on time spent learning English, or time spent in the immersion setting. It was found that vocabulary size positively correlated with both perception and production for these English learners. Bundgaard-Nielsen et al (2012) also discuss vowel duration as a perceptual cue for phonemic categorization, stating that other studies have shown duration to be a much more distinguishable characteristic of vowel contrasts to the L2 learner than spectral differences.

Bundgaard-Nielsen et al (2012) focus on Japanese learners of English in particular, because Japanese has a very small set of vowel categories (5 distinct vowels only) compared with Australian English (18 distinct vowels, both monophthongs and diphthongs). This means that Japanese learners of English must "divide their phonetic and phonological space more finely in order to accommodate all the L2 vowels" (Bundgaard-Nielson et al 2012). This study demonstrates the importance of vowels in the acquisition of English as an L2, and any accommodation strategies teachers are using to help students better categorize vowels early on in their acquisition should theoretically facilitate vocabulary expansion, and fine-tune both perception and production of English vowels. Whether FDS as used by ESL teachers is instrumental in aiding learners of English in categorizing vowels remains to be studied.

According to Flege et al (1999) and Bundgaard-Nielsen et al (2012), successfully perceiving vowels positively relates to vowel production. Since perceiving certain nonnative phonetic contrasts is difficult for those whose native language does not contain these contrasts, it follows that producing these contrasts is also difficult for the second language learner (Brosseau-Lapreet al 2013; Flege et al 1997; Tsukada et al., 2005; Werker et al 1981). Tsukada (2012) investigated whether or not native Arabic and native Japanese speakers were able to use knowledge from their L1s, which both contain vowel duration contrasts, to perceive similar vowel contrasts in a nonnative language. It was found that despite having this knowledge of vowel length contrasts available in their L1s, the subjects were still unable to perceive many nonnative vowel contrasts accurately, and did not perform any better than the control group, who did not have vowel length contrasts in their L1.

2.3. Tense and lax vowel distinctions

Though an exact definition of the distinction between lax and tense vowels is not currently agreed upon in the literature, one basic, distinguishing feature within these vowel pairs is that tense vowels are typically longer in duration than their lax counterparts (Thomas, 2011). In addition to this description, Thomas (2011) also notes that tense vowels can be breathier than lax vowels, while lax vowels can be creakier by comparison, and that tense vowels are more diphthongal in most dialects of both English and Dutch. Articulatory movements are responsible for the formant value differences between tense and lax vowels, which can be seen in the tongue root being more advanced, and the ridge of the tongue closer to the roof of the mouth in tense versus lax vowels (Thomas 2011).

Acquiring tense and lax vowel distinctions in English can pose a challenge for second language learners, depending on the vowel systems already present in their native languages. As seen above, Japanese has a much smaller vowel system than English, as does Mandarin Chinese. According to Chen (2006), Mandarin phonology contains only tense vowels, and has no lax vowels, so acquiring the tense-lax distinction in English (and in other Germanic languages containing tense-lax distinctions) can be difficult for native Mandarin speakers. Chen's (2006) study also reported that duration seemed to be the main factor for native Mandarin speakers in perceiving tense versus lax vowels in English, while American English speakers seemed to rely more on spectral differences to perceive the tense-lax distinction, which is consistent with Rogers et al.'s findings (2013).

2.4 Areas for further research

So far, there is little research on whether or not those who regularly interact with nonnative speakers of English in a teaching role have more fine-tuned or exaggerated features of Foreigner-Directed Speech. Rahimian's (2013) study used subjects who had at least one year working closely with nonnative speakers of English, but not in a teaching context, and Scarborough et al's (2007) study focused on native speakers of English without any specific background of interaction with nonnative speakers.

The goal of this study is to build on the research accomplished by these two studies, with the context of phoneme categorization in SLA in mind, and to focus on the features of FDS that may be evident in ESL teachers' speech versus that of regular native English speakers' speech, specifically in terms of lax and tense vowel durational differences. Rahimian focused on lax and tense vowel pairs, while Scarborough et al focused on vowels in stressed syllables. Similarly to Rahimian (2013), I will focus on lax and tense vowel pairs, with the prediction that these vowel pairs will be hyper-articulated in FDS—lax vowels shorter, tense vowels longer—rather than both tense and lax vowels being lengthened.

CHAPTER 3: METHODOLOGY

3.1. Subjects

The subjects were native English speakers with at least two semesters' experience teaching ESL at the adult level, whether in community college, at a university, or through other organizations. Four ESL teachers were recruited; three male teachers and one female teacher.

Teachers recruited for this study were given a questionnaire asking about the language backgrounds of students they teach, the length and type of experience they have had teaching English so far, and whether or not they have had formal pedagogical training in the ESL/TESOL/TEFL field.

The female teacher (Subject 1) had taught ESL through a volunteer program, had taught English abroad in Nicaragua, and had more than 2 semesters of experience teaching ESL. One male teacher (Subject 2) had experience teaching English abroad in both Vietnam and Russia in various paid positions; he was also the only teacher recruited with any pedagogical training in ESL. The other two male teachers (Subjects 3 and 4) were undergraduate students who had at least 2 semesters experience teaching ESL through UNC's Enrich ESL volunteer program.

The control group for the ESL teacher subjects was a group of native English speakers who had no experience teaching English to nonnative speakers of English. One male and three female subjects were recruited.

3.2. Confederates

Two confederates volunteered to interact with the ESL teachers in this study. One native English speaking confederate was used as the control for the experiment, and one Chinese native speaker, who is learning English, was used to test what accommodation strategies are being used by the teachers vs. those used by the native English speakers who are not teachers. Both confederates were MA students in the Linguistics program at UNC.

Since different L1s seem to affect the type of cue one relies upon to differentiate nonnative contrasts in one's L2, it is possible that the cues given in Foreigner-Directed Speech are adjusted by the native speaker according to the L1 background of the nonnative speaker (Chen, 2006). Because of this possibility, choosing just one nonnative English speaking confederate from one L1 background, rather than multiple, seemed to be a wise choice for this study, as well as choosing a confederate with a first language that does not contain tense-lax vowel contrasts.

3.3. Design

For the experiment task, subjects carried out a mini lesson plan that involved a short "get to know you" activity, in order to have time interacting back and forth so as to familiarize the subjects with the speech of each confederate, then read two short narrative paragraphs to the Chinese L1/English L2 speaker and the native English speaker, one-on-one. Following each paragraph read, the subject then asked each confederate three short comprehension questions about the material read. The warm-up questions, the paragraphs, and the comprehension questions were provided for the teachers to read, so that all vowels needed for analysis were

present in all recordings. The recordings were analyzed by measuring the durations of lax and tense vowels where they occur between voiceless consonants (Scarborough et al 2007).

All recordings took place in the phonetics lab soundproof booth on UNC's Chapel Hill campus, and Praat was used to both record and annotate the sound files (Boersma et al, 2013). Vowel duration was measured for each token by marking the beginning and end of each vowel in Praat, using both F1 and F2 and the voicing bar as landmarks, and measuring the duration in between. The beginning of the vowel was determined to be at the onset of the second formant (F2) together with the voicing bar, and the end of the vowel was determined to be at the offset of voicing, and where F2 was still clearly visible (before trailing off).

3.4. Stimuli

Tense and lax vowel pairs were selected to be used in the stimuli. The pairs /i/-/ɪ/ and /e/-/ɛ/ were measured where they occur between voiceless consonants, for the purpose of comparing their durations within each subject in both Native-Directed Speech and Foreigner-Directed Speech. Each vowel being analyzed was used in three different real words, with three repetitions of each word in the mini lesson plan activity script (with the exception of /e/, which had ten total tokens recorded per subject, rather than nine), yielding 74 tokens per subject.

Table 3.4.1 Stimuli

Vowel	Stimuli
/i/	cheap, keep, sheets
/ɪ/	fish, chips, sips
/e/	take, fate, cake
/ɛ/	pet, chef, shepherd

3.5. Procedure

A short warm-up activity, composed of three "get to know you" questions, was used before the main lesson plan tasks. This was intended to familiarize the subjects with the speech of the confederates before completing the actual task, so that the subjects' speech would be potentially adjusted according to their perception of the confederates' speech. Written instructions were provided for the subjects to read so they knew what procedure to follow upon entering the soundproof booth with each student.

The actual tasks were composed of two short narrative paragraphs containing the stimuli listed above. Three follow-up comprehension questions followed each paragraph, and the subjects read them to the students and asked them to give their answers aloud. These tasks were meant to mimic a short, in-class reading comprehension activity that might be found in ESL classrooms, so that the speech recorded would be similar to the type of speech the teachers typically use in the classroom, or in one-on-one tutoring sessions performing a similar activity.

Before entering the soundproof booth to carry out the mini lesson plan, subjects were able to quickly look over the script, and the instructions were explained to them as described below. No subject read the lesson plan material before arriving at the soundproof booth, nor did they practice reading it aloud before recording with the first confederate. The native English-speaking and native Chinese-speaking confederates recorded with the subjects in alternating order, in case the subjects changed their speech due to increased familiarity with the reading material for their second recording. In between each subject's recording sessions with each confederate, there was a break of one minute or less. What the subjects read to the confederates is as follows:

Instructions: Please read through the warm-up questions below with the student first to get to know him/her a little bit. Then, read the following two paragraphs along with the comprehension questions provided one-by-one, to test the student's understanding of each narrative.

1. Warm-up questions

    A. Where are you from?

    B. Do you have any siblings?

    C. What's your major?

2. Paragraph One

Every Saturday, I take a walk down to the waterfront with my German Shepherd, Achilles. I get fish and chips and a bottle of soda from my favorite food truck, and people passing by usually pet Achilles. People usually ask first if they can pet him, but the chef from

the restaurant down the road knows us well enough not to bother asking. The other chef from that restaurant is scared of big dogs, though, and won't approach even a German Shepherd as friendly as Achilles. Today while we were walking along the waterfront, a student walked by us and dropped his notebook, and sheets of paper flew all over the place. I tried to help him pick up the paper, but most of the sheets had already blown away, and carrying soda and my meal of fish and chips made it too cumbersome to help the guy. We walked on further, and I took a few pictures of the waterfront before I had to take Achilles home.

Questions:

1. Does each chef in the story feel comfortable enough to pet Achilles?

2. When does the narrator usually take his German Shepherd to the waterfront to get fish and chips?

3. Was the narrator able to pick up all the sheets of paper the student dropped?

3. Paragraph 2

I had a weird dream last night, where I had to bake a cake and cook some soup in a chicken coop for a homework assignment. Needless to say, baking a cake inside a cramped coop was no easy task, and neither was making soup. As fate would have it, feathers kept sticking to the cake in my dream, and I couldn't keep the soup pot from falling over. Oddly enough, there was a bottle of whiskey in the coop as well, and I took sips of it as I tried my best to finish the task before me. Then, a guy in a suit came in to the chicken coop and told me to keep trying, but to regulate my sips of whiskey, because it wasn't cheap. The suit guy said the cake baking materials weren't cheap, either, so if I had to keep starting over on it I'd fail my assignment. I

got really nervous then, and took two huge sips of whiskey, and the suit guy said “it’s fate! You’ll never succeed!” Then, I woke up.

1. What did the student have to do in her dream?

2. Was the student’s fate to succeed or fail in her dream?

3. What in this story wasn’t cheap?

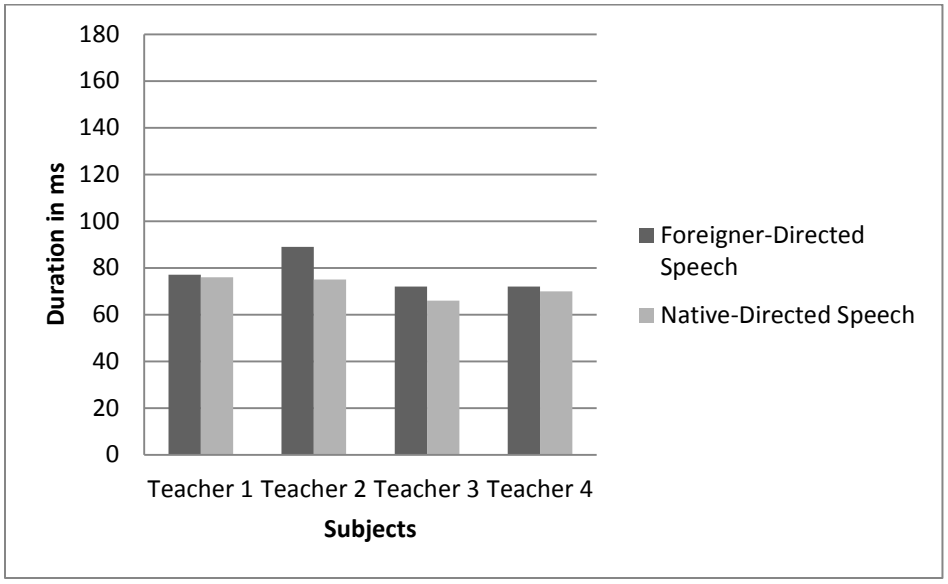
CHAPTER 4: RESULTS AND DISCUSSION

4.1. ESL Teachers' Results

The prediction of this study was that ESL teachers would hyper-articulate tense and lax vowels, so that the durational difference between the longer tense vowels and shorter lax vowels would be more salient in FDS versus NDS. It was found that three out of four of the ESL teacher subjects exhibited some durational hyper-articulation in FDS vs NDS, in which cases their average lax vowel durations were shortened, and their average tense vowel durations were lengthened, though these differences between FDS and NDS were very small. The data were analyzed using the GLM (General Linear Model) procedure with appropriate follow up contrasts, which shows that though some apparent patterns indicate a trend towards ESL teachers elongating tense vowels and shortening lax vowels in FDS, the durational differences between lax and tense vowels in FDS versus NDS are not statistically significant. As a result, these data do not definitively answer whether the observed patterns are due to chance or are indeed caused by hyper-articulation in FDS. However, some salient details can be discussed in the speech of individual subjects from each group, as well as each group as a whole.

All four teachers showed, on average, a longer tense vowel /i/ in FDS than in NDS.

Figure 4.1.1 Average /i/ durations for ESL teachers in ms



Three of the teachers also showed, on average, a shorter lax /ɪ/ and a longer tense /e/ in FDS, as predicted.

Figure 4.1.2 Average /ɪ/ durations for ESL teachers in ms

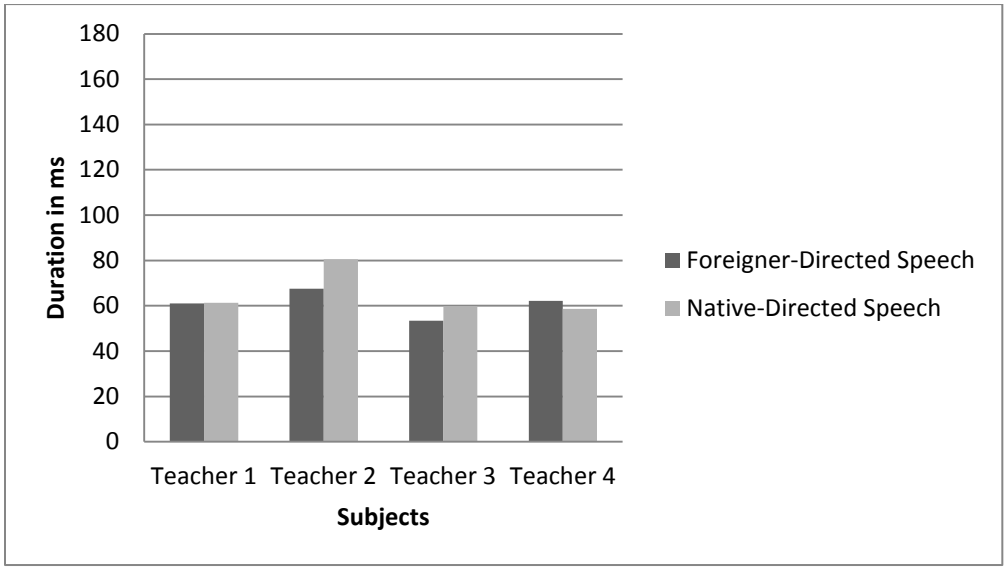
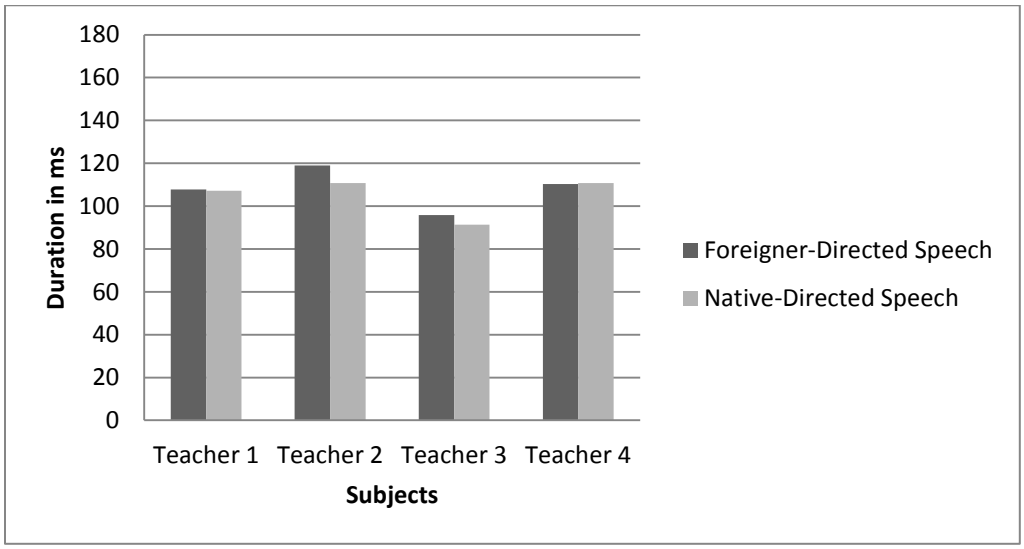
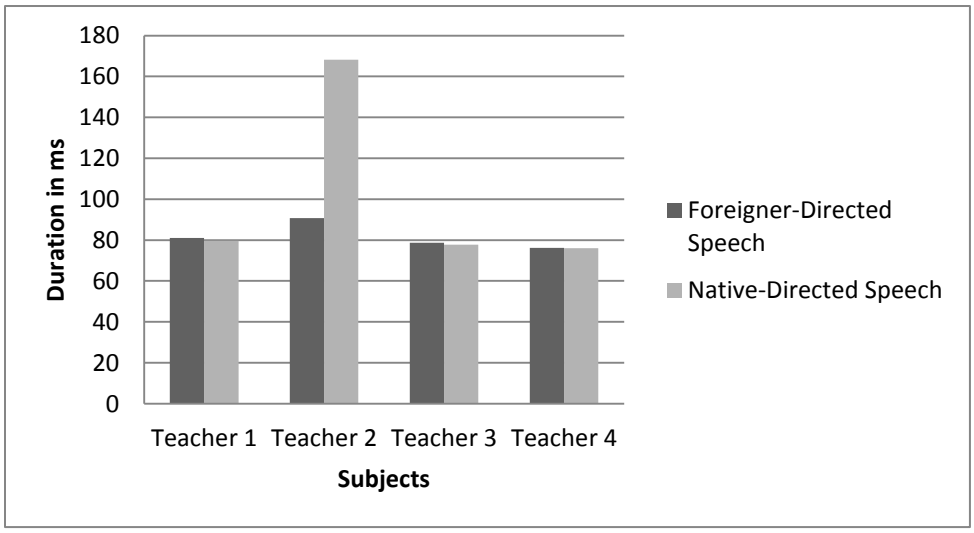


Figure 4.1.3 Average /e/ durations for ESL teachers in ms



However, only one of the teachers (Teacher 2) exhibited a shorter lax /ɛ/ in FDS, which was unexpected. There was also a seemingly large difference in duration between his NDS /ɛ/ and FDS /ɛ/ (77 ms), which contrasts sharply with the other teachers' results, where /ɛ/ for them in FDS was longer, rather than shorter, by roughly 1 ms.

Figure 4.1.4 Average /ɛ/ durations for ESL teachers in ms



In addition, one teacher only lengthened /i/ in FDS (Teacher 4), while the other tense vowel /e/ was shorter in FDS; his two lax vowels were longer in FDS, contrary to what was predicted.

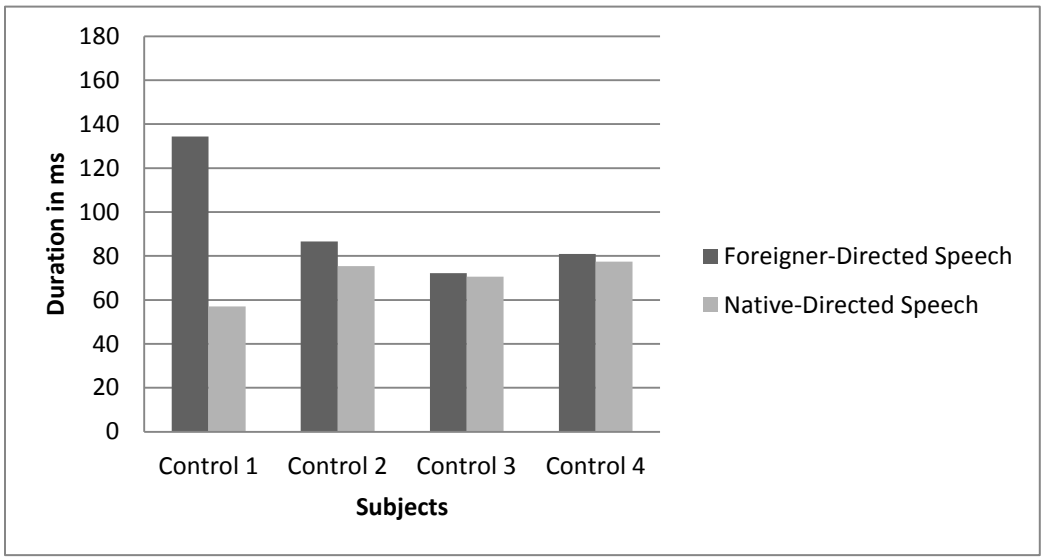
In the ESL teacher group, one out of the four teachers exhibited results that confirmed both tense vowels used in the stimuli were longer on average and both lax vowels were shorter on average in his Foreigner-Directed Speech. Two of the other teachers had similarly consistent results, though with the exception of the lax vowel /ɛ/, which did not produce the expected result of being shorter in FDS. Finally, one of the teachers had such varied duration results that only one tense vowel /i/ behaved as expected in his speech. It is possible that vowel height was a factor in this result, since high vowels are known to have shorter durations than low vowels, which explains why the low-mid lax vowel /ɛ/ might have been produced with a longer duration than its slightly higher counterpart /e/ at times (Thomas, 2011).

4.2. Control group subjects' results

The control subjects also displayed some variance across speakers, and like the ESL teacher subjects, the lax vowel /ɛ/ stands out in their data. But, setting their data apart from that of the ESL teachers, the pattern three out of four participants followed was to lengthen both tense and lax vowels in FDS (with the exception of the lax vowel /ɛ/, in two out of three of these same subjects).

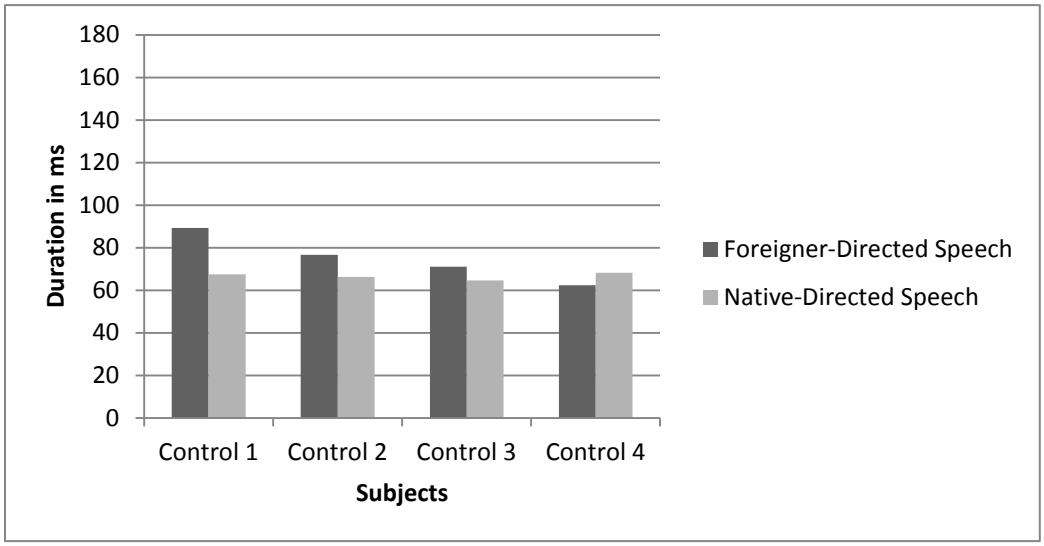
For the tense vowel /i/, Control 1's average duration appears much longer in FDS compared with NDS than for the other speakers, with an average duration of 134.4 ms in FDS, and 57 ms in NDS. The other three control subjects also lengthened /i/ in FDS vs NDS, but the group results as a whole are not statistically significant.

Figure 4.2.1 Average /i/ durations for control participants in ms



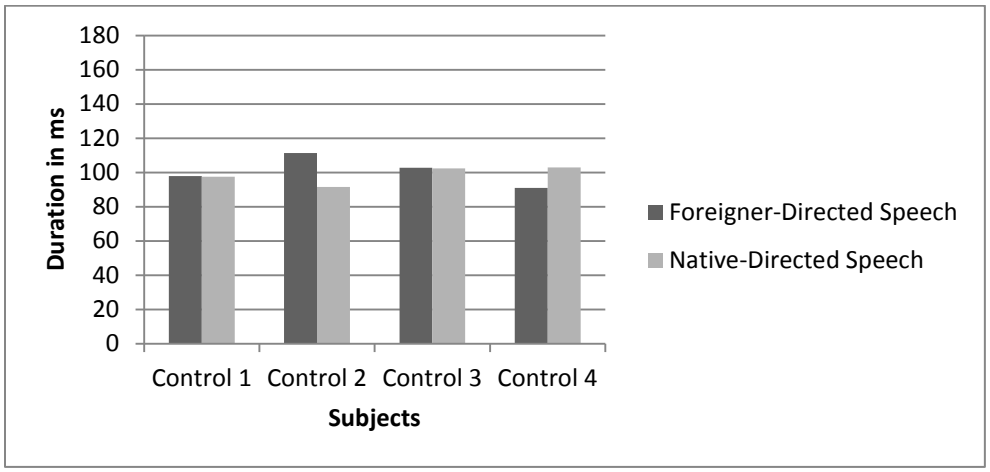
With the exception of Control 4, the other subjects all lengthened the lax vowel /ɪ/ in FDS on average. As with /i/, Control 1 lengthened this vowel more than the other subjects did, but the group results were not significant for this contrast.

Figure 4.2.2 Average /ɪ/ durations for control participants in ms



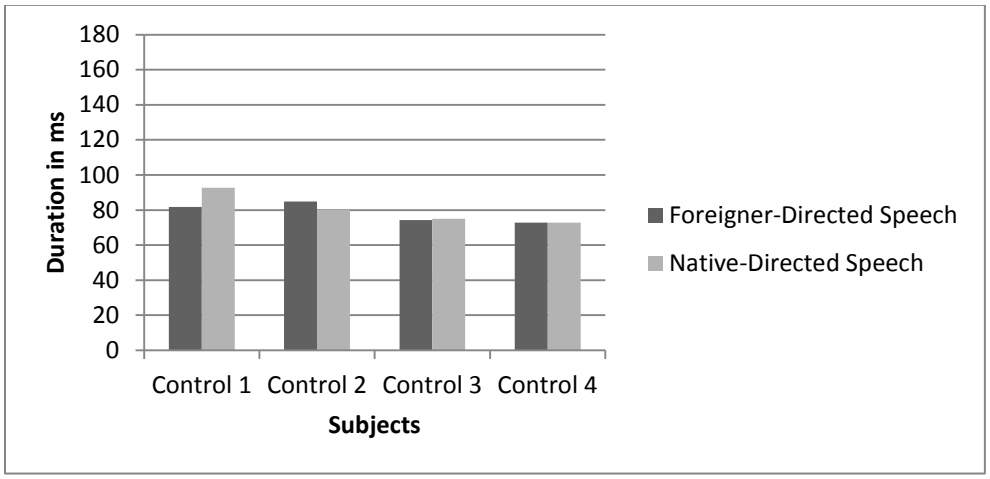
The control group results for /e/ showed very small differences between FDS and NDS, and /e/ was not significantly longer or shorter in FDS for any speaker. However, the pattern, while extremely small, shows /e/ lengthened in FDS for all subjects except for Control 4.

Figure 4.2.3 Average /e/ durations for control participants in ms



The control subjects did not consistently lengthen /ɛ/ in FDS, and the differences between FDS and NDS were tiny. Control 2 was the only subject displaying an average lengthening of /ɛ/ in FDS vs NDS, but this difference was very small.

Figure 4.2.4 Average /ɛ/ durations for control participants in ms



On average, three of the control group participants exhibited longer overall vowel durations for both tense and lax vowels in Foreigner-Directed Speech. The second control participant had longer vowel durations for each vowel examined in FDS, and the first and third participants had longer vowel durations for /i/, /ɪ/, and /e/, but not /ɛ/ in FDS. The fourth participant only had a longer average duration for /i/ in FDS, and for /ɪ/ and e/, exhibited a shorter average duration in FDS. Her average /ɛ/ duration in FDS was equal to her average /ɛ/ in NDS.

4.3. Comparison of ESL teacher group and control group results

The GLM Procedure was used to ascertain contrastive significance within both the ESL teacher group and the control group, and between the two groups, where a significant difference is <0.05 for PR > |t|. It was found that there was no significant difference between the average durational differences within each vowel pair of the ESL teacher group compared to the average durational difference within each vowel pair of the control group in FDS vs NDS (see table 4.3.1 below).

Table 4.3.1 Significance of ESL teacher group (NDS vs FDS difference) vs control group (NDS vs FDS difference) for tense/lax pairs

Parameter	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
/i/-/ɪ/	-0.01199444	0.01276342	-0.94	0.3477
/e/-/ɛ/	0.00404611	0.01244024	0.33	0.7451

Despite the variance displayed in these speakers, when the data of the ESL teacher group as a whole are examined, some interesting patterns emerge. First, when the average distances within tense and lax pairs in FDS versus NDS are compared, a greater distance in the /i/-/ɪ/ pair can be found in FDS. The average durational distance between the tense and lax vowels in this pair is a difference of 9.4 ms from NDS to FDS. This indicates that the tense-lax distinction for this pair could be undergoing hyper-articulation in FDS, emphasizing the tense-lax distinction in terms of duration. This difference, while small and lacking statistical significance, was the most consistent trend in the ESL teachers' data that shows possible evidence of hyper-articulation in terms of vowel duration.

In addition, though individual differences were observed across speakers in the control group, when the group's average tense/lax distance was compared in FDS versus NDS, a different pattern than that found in the ESL teacher group was found here. For the tense-lax pair /e/-/ɛ/, the durational difference was exaggerated in FDS compared to NDS on a very small level, with the durational difference within this pair greater in FDS by 3.86 ms.

It was also found that there was no significant difference when comparing durational difference between FDS and NDS in both the ESL teacher group and control subject group for both tense/lax pairs (see tables 4.3.2 and 4.3.3 below).

Table 4.3.2 Significance of FDS vs NDS durational difference for /i/-/ɪ/

Parameter	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Teachers	-0.00940833	0.00902510	-1.04	0.2976
Controls	0.00258611	0.00902510	0.29	0.7746

Table 4.3.3 Significance of FDS vs NDS durational difference for /e/-/ɛ/

Parameter	Mean estimate	Standard Error	t Value	Pr > |t|
Teachers	0.00011833	0.00879658	0.01	0.9893
Controls	-0.00392778	0.00879658	-0.45	0.6554

Though the contrast of FDS vs NDS for durational difference within the tense/lax pair /e/-/ɛ/ was not significant for either group, the average durational distance between /e/ and /ɛ/ was significant within both FDS and NDS for both groups (see tables 4.3.4 and 4.3.5 below).

Table 4.3.4 Statistical analysis for durational difference between /e/ and /ɛ/ for ESL teachers

Parameter	Mean estimate	Standard Error	t Value	Pr>|t|
NDS	0.0267375	0.00622012	4.3	<.0001
FDS	0.02661917	0.00622012	4.28	<.0001

Table 4.3.5 Statistical analysis for durational difference between /e/ and /ɛ/ for control group

Parameter	Mean estimate	Standard error	t value	Pr>|t|
NDS	0.01835778	0.00622012	2.95	0.0033
FDS	0.02228556	0.00622012	3.58	0.0004

For the ESL teacher group, the average durational difference within /e/-/ɛ/ was 26.73 ms in NDS, and 26.62 ms in FDS (see figure 4.3.6). In the control subject group, the average

durational difference within /e/-/ɛ/ was 18.37 ms in NDS, and 22.23 ms in FDS. Though the control group seems to increase the distance between /e/ and /ɛ/ in FDS compared to NDS (see figure 4.3.7), the increase is not statistically significant.

Figure 4.3.6 Durational difference between /e/ and /ɛ/ for ESL teachers

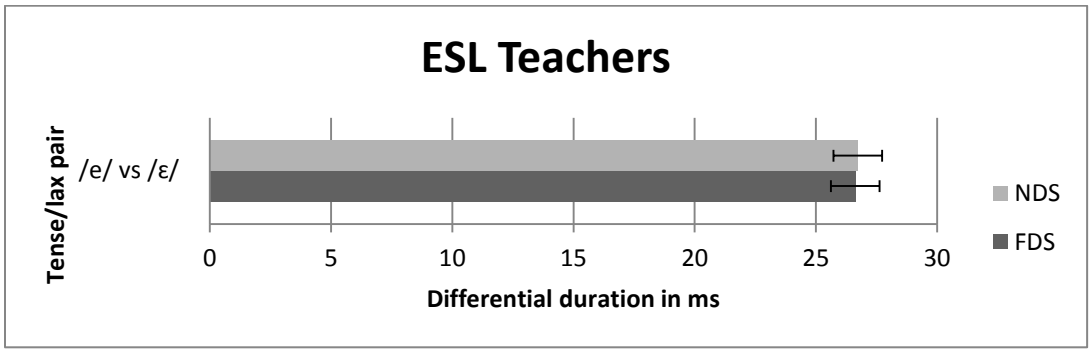
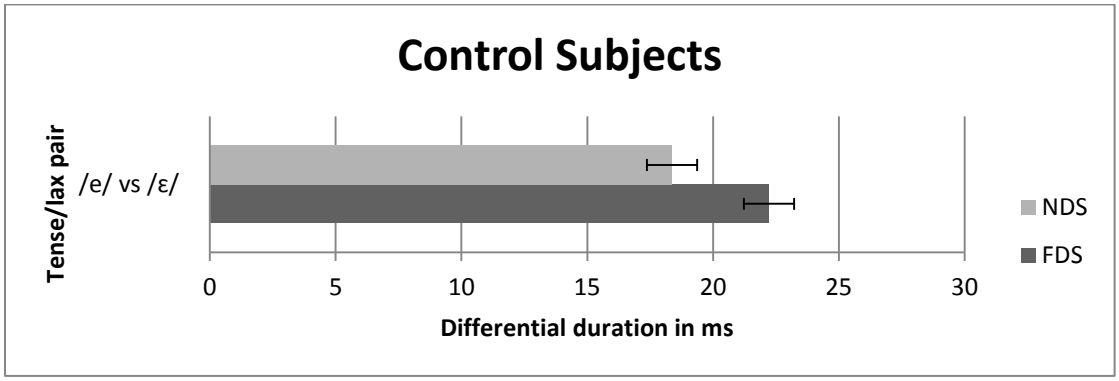


Figure 4.3.7 Durational difference between /e/ and /ɛ/ for control subjects



It was found that the durational difference in FDS vs NDS within the tense/lax pair /i/- /ɪ/ was not significant for either group (as seen above in example 4.3.2), and the average durational distance between /i/ and / ɪ / was not significant within either FDS and NDS for either group (see tables 4.3.8 and 4.3.9 below).

Table 4.3.8 Statistical analysis for durational difference between /i/ and /ɪ/ for ESL teachers

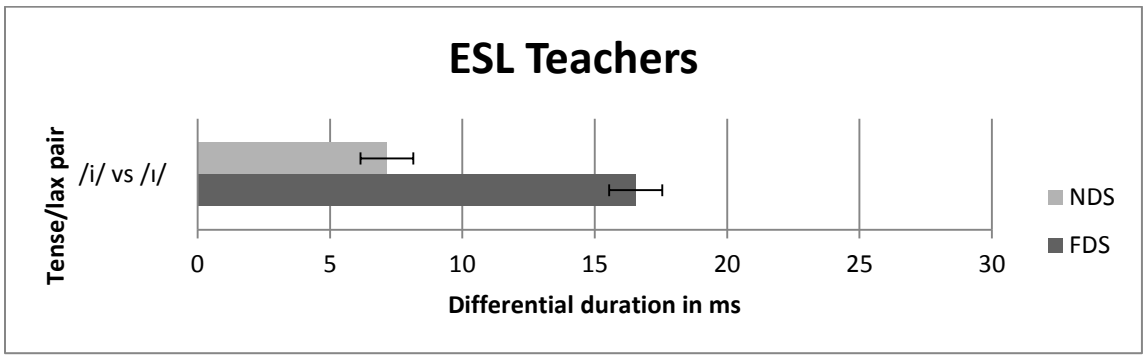
Parameter	Mean estimate	Standard error	t Value	Pr>|t|
NDS	0.00714722	0.00638171	1.12	0.2632
FDS	0.01655556	0.00638171	2.59	0.0097

Table 4.3.9 Statistical analysis for durational difference between /i/ and /ɪ/ for control subjects

Parameter	Mean estimate	Standard error	t Value	Pr>|t|
NDS	0.00349444	0.00638171	0.55	0.5842
FDS	0.00090833	0.00638171	0.14	0.8869

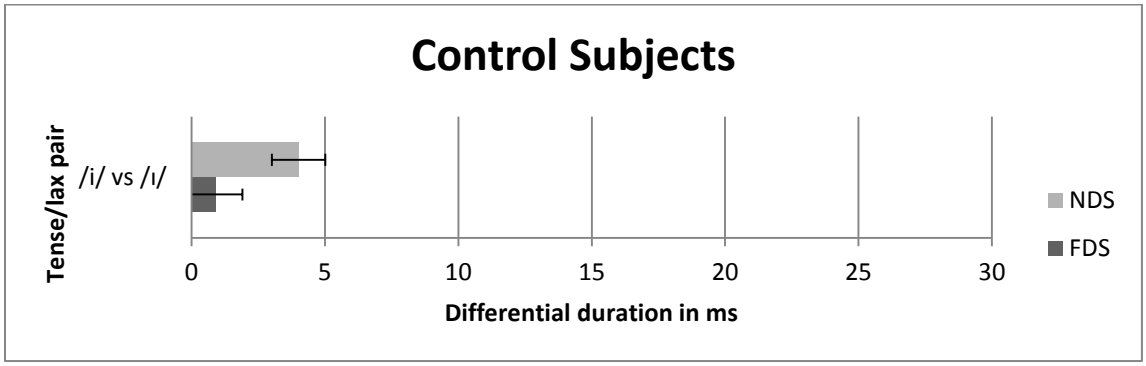
For the tense/lax pair /i/-/ɪ/, the ESL teacher group's durational difference was 7.15 ms in NDS, and 16.55 ms in FDS, making the durational difference in FDS greater than that in NDS by 9.4 ms (see figure 4.3.10 below). While the proportional difference between these two numbers looks noteworthy, the difference is still not able to be statistically established as significant. below).

Figure 4.3.10 Durational difference between /i/ and /ɪ/ for ESL teachers



The control subjects' durational difference for this same pair was 4.01 ms in NDS, and 0.91 ms in FDS, though this difference was also not found to be statistically significant (see figure 4.3.11). In addition, this difference between FDS and NDS is opposite of what was predicted, with the durational difference in FDS being shorter than NDS.

Figure 4.3.11 Durational difference between /i/ and /ɪ/ for control subjects



When the durational difference within each tense/lax pair was compared between the ESL teacher group and the control subject group, the ESL teachers were not found to hyper-articulate tense and lax vowel duration distinctions more than the control group in any significant way. It is interesting to note, however, that each group put significant durational distance between /e/ and /ɛ/, but not between /i/ and /ɪ/. And, though the ESL teachers did not seem to hyper-articulate the /e/- /ɛ/ contrast by exaggerating the durational differences in FDS versus NDS, they did seem to do this for the /i/-/ɪ/ contrast in FDS versus NDS, though the durational distance within this pair was not large.

Contrary to what was expected, the control group seemed to produce more homogeneous results than the ESL teacher group—the durational distances between /i/-/ɪ/ and /e/- /ɛ/ in FDS versus NDS were, respectively, 3.1 ms and 3.86 ms. In contrast, the ESL teacher group produced durational distances for the same pairs in FDS and NDS with a difference of 9.4 ms for

/i/-/ɪ/, and a difference of 0.11 ms for /e/- /ɛ/. Again, this seems like an interesting proportional difference, but the statistical analysis does not support that this difference is significant, and without more subjects to confirm this apparent trend, cannot be claimed as a definitive proof of vowel duration hyper-articulation in FDS.

CHAPTER 5: GENERAL DISCUSSION

In this study, it was found that there was a significant durational difference between /e/ and /ɛ/, but not between /i/ and /ɪ/, for both the ESL teacher group and the control subject group. Neither group significantly exhibited features of FDS in either tense /lax vowel durational exaggeration or in overall vowel lengthening from NDS to FDS. However, though the differences were small and insignificant, the ESL group displayed a trend more in line with vowel hyper-articulation, while the control group displayed a trend more consistent with overall vowel lengthening. Whether these vowel length modifications have anything to do with experience interacting with nonnative speakers, or are completely due to chance, remains to be studied further.

Past studies have shown that in both Infant-Directed Speech (IDS) and Foreigner-Directed Speeh (FDS), vowels are altered from normal speech, presumably to aid the listener to better perceive phonetic contrasts in the target language (Uther et al, 2007; Scarborough et al, 2007; Kuhl et al, 1997; Andruski et al, 1999; Burnham et al, 2002). However, whether tense and lax vowels are hyper-articulated in FDS by expanding the vowel space within each pair, or by emphasizing their durational differences, is still unclear.

In the future, this study could be improved upon and expanded in several different ways. First, increasing the number of subjects would be helpful in determining the patterns found in this study more definitively, and in establishing whether the features of FDS analyzed in this study can be seen across a large number of subjects, in order to see which trends are due to

chance, and which are not. Along with testing vowel duration contrasts, it might also shed more light on the nuances of Foreigner-Directed Speech to perform a study that compares formant frequencies within and across subjects, to see if there is a marked difference in formant values from NDS to FDS. This would bring more information to the discussion of whether formant frequencies (vowel space expansion) or vowel duration contrasts are more hyper-articulated in Foreigner-Directed Speech by native English speakers, and would also aid further research investigating what perceptual cues are actually helpful to nonnative learners of English in the process of phoneme categorization.

Since this study did not definitively conclude that ESL teachers use FDS in a more exaggerated manner than other native English speakers, and did not show significant effects of FDS in the speech of either group as a whole, this raises the question of how much features of FDS vary between individual speakers. Again, testing this question would require a larger number of subjects for recording and analysis. Since FDS appears to be used for the purpose of aiding nonnative speakers to perceive nonnative phonetic contrasts, and is adapted to the specific needs of the intended listener (Uther et al, 2007), it is possible that an individual speaker might vary his or her use of FDS according to the situation and the interlocutor, and might not vary this use of FDS the same way another native English-speaking peer might. It would be advantageous to continue analyzing both durational and formant hyper-articulation in the speech of native English speakers to nonnative speakers, to uncover any over-arching patterns that may exist in FDS.

A longitudinal study, focusing on the production and perception of nonnative vowel contrasts, (specifically by second language learners who are exposed to English teaching from subjects who hyper-articulate tense-lax distinctions), would be useful in understanding what

features of FDS may be advantageous in phoneme categorization, and whether some types of hyper-articulation (either formant-related or duration-related) are more helpful than others. There is still a great deal to be studied and learned about how perception and production work together in the acquisition of a second language, and what cues native speakers give nonnative speakers to help categorize nonnative phonemes and contrasts. Whether or not ESL teachers do hyper-articulate contrasts such as tense and lax vowel durations more so than other native English speakers, and in what conditions native English speakers do use durational cues to hyper-articulate lax and tense vowels, remains to be studied more extensively in the future.

APPENDIX A: INDIVIDUAL RESULTS

1. ESL teachers

Figure 1.1 Teacher 1: /i/

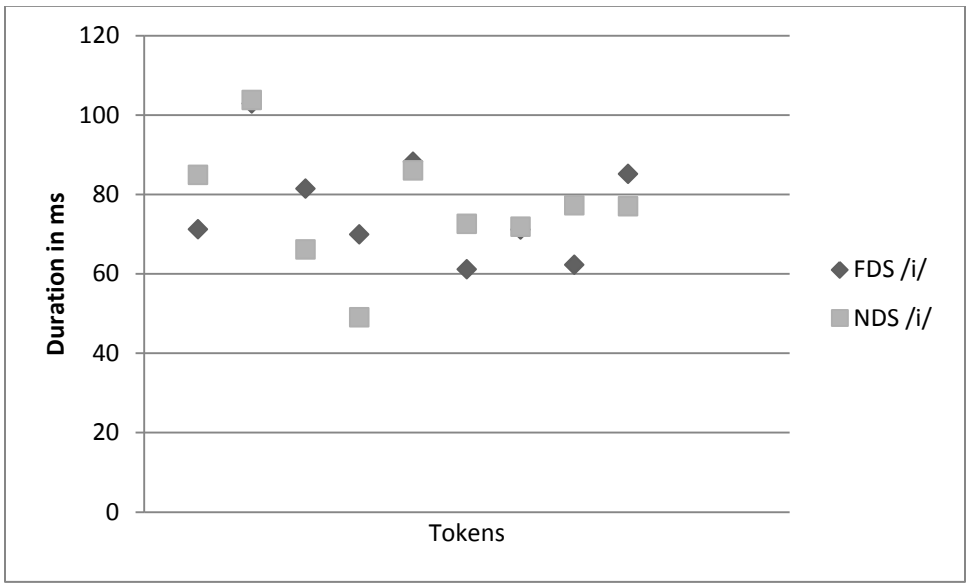


Figure 1.2 Teacher 1: /ɪ/

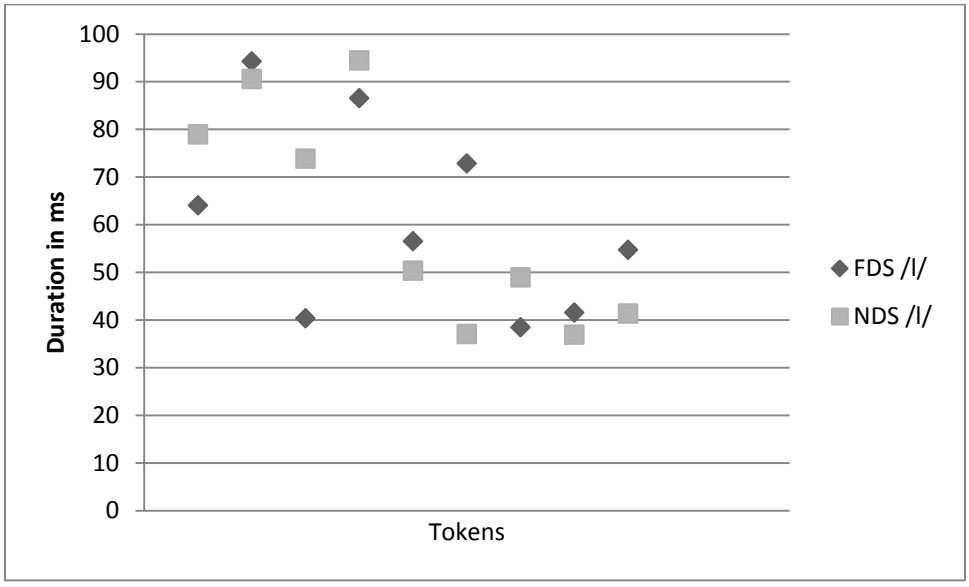


Figure 1.3 Teacher 1: /e/

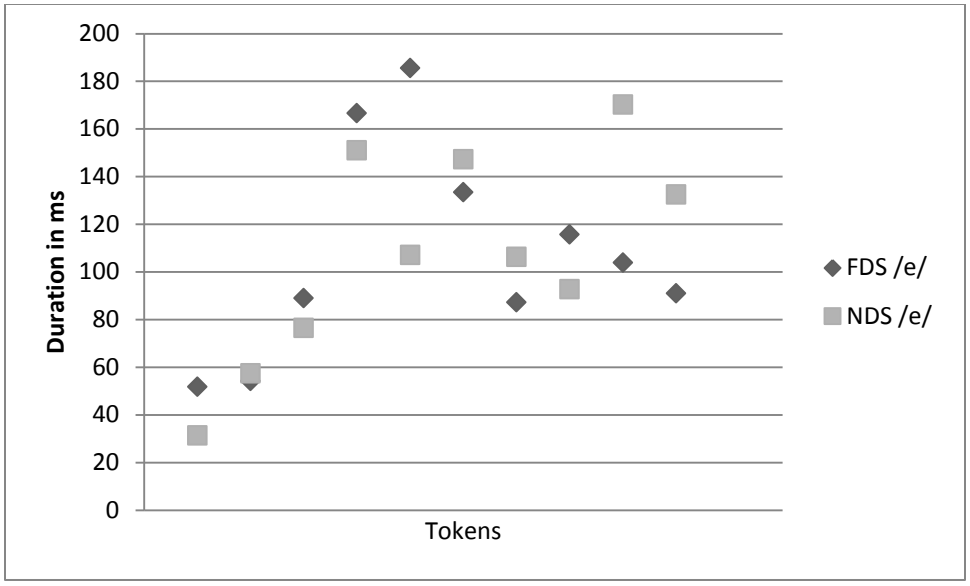


Figure 1.4 Teacher 1: /ɛ/

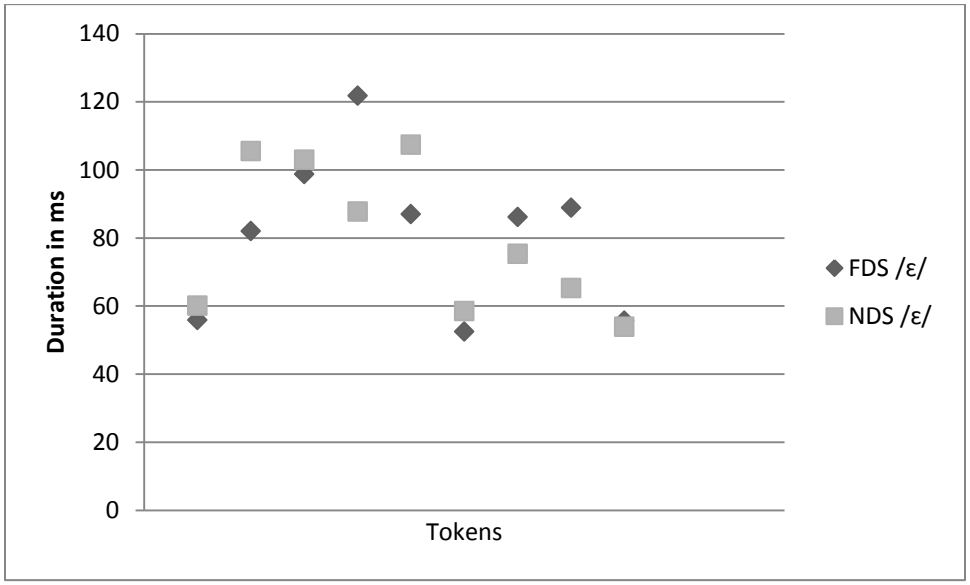


Figure 1.5 Teacher 2: /i/

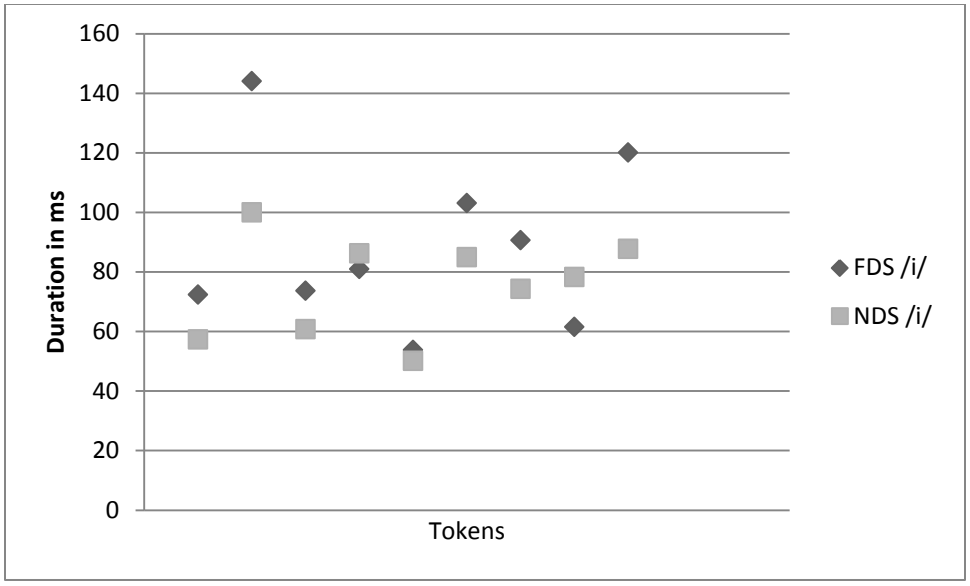


Figure 1.6 Teacher 2: /ɪ/

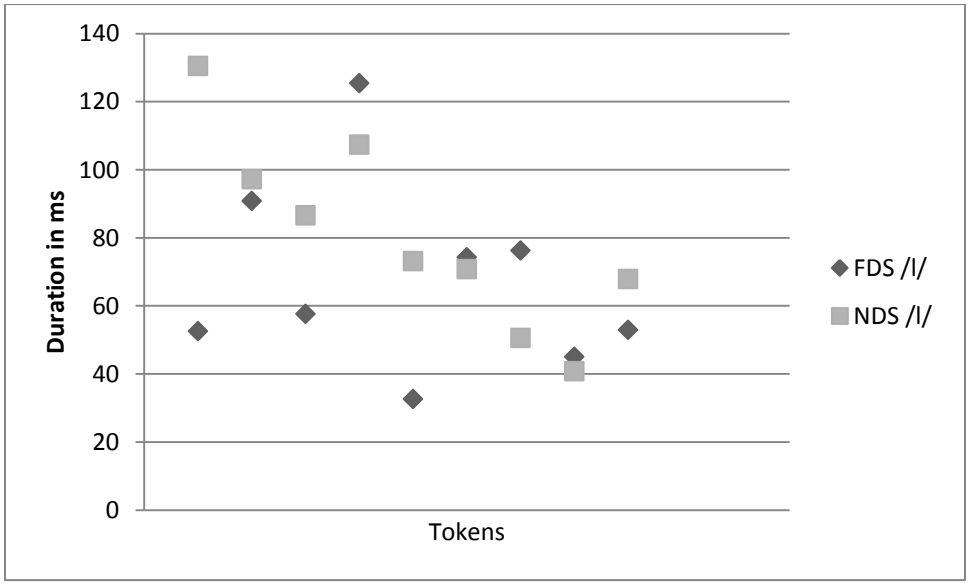


Figure 1.7 Teacher 2: /e/

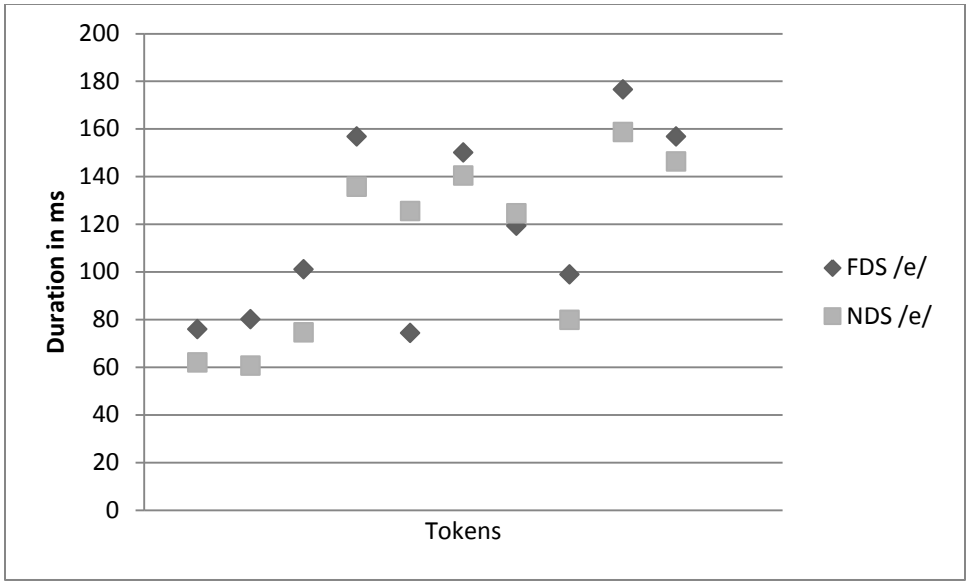


Figure 1.8 Teacher 2: /ɛ/

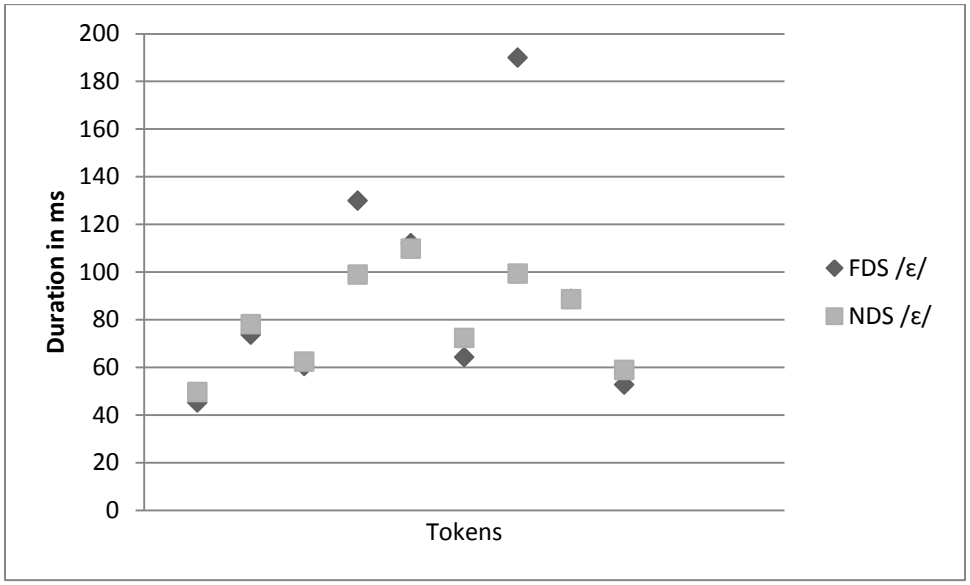


Figure 1.9 Teacher 3: /i/

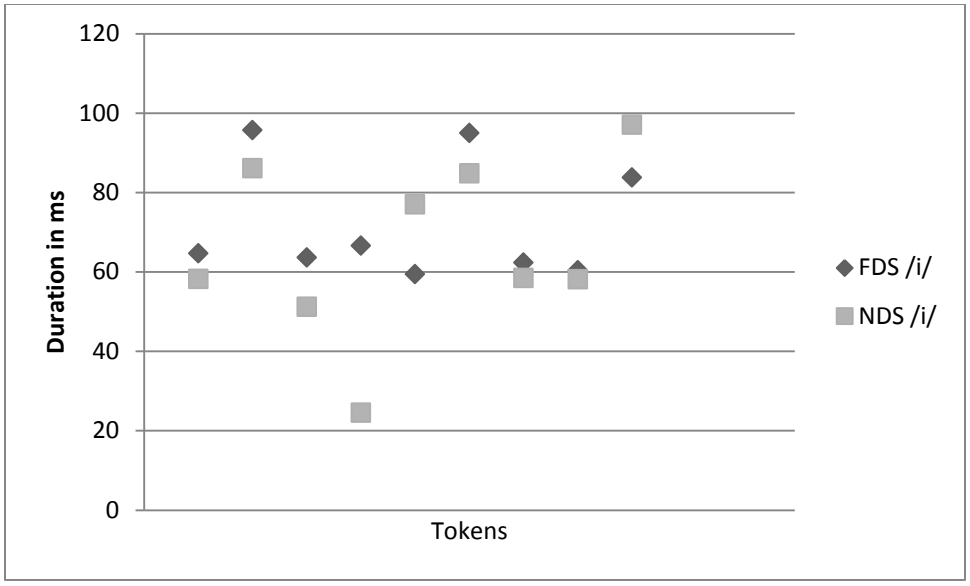


Figure 1.10 Teacher 3: /ɪ/

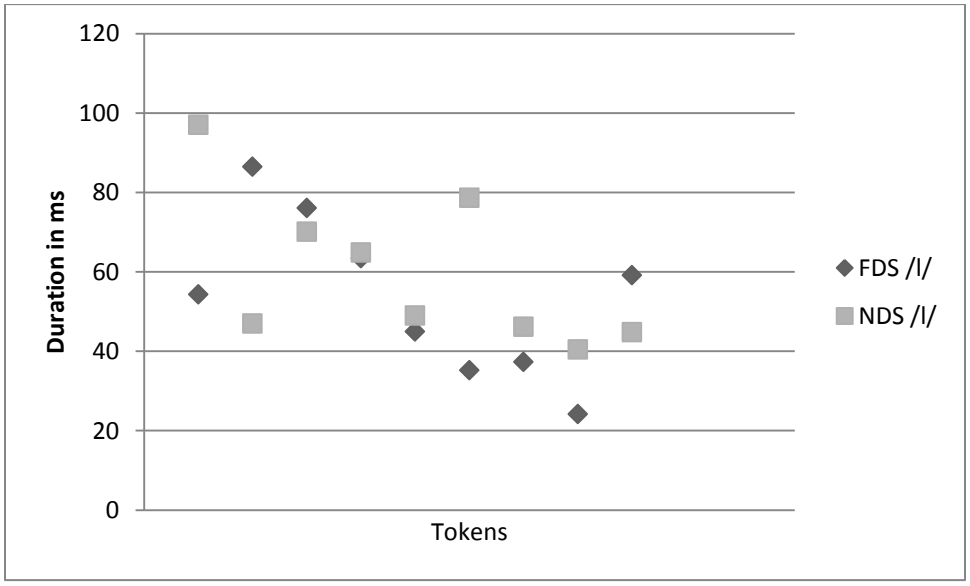


Figure 1.11 Teacher 3: /e/

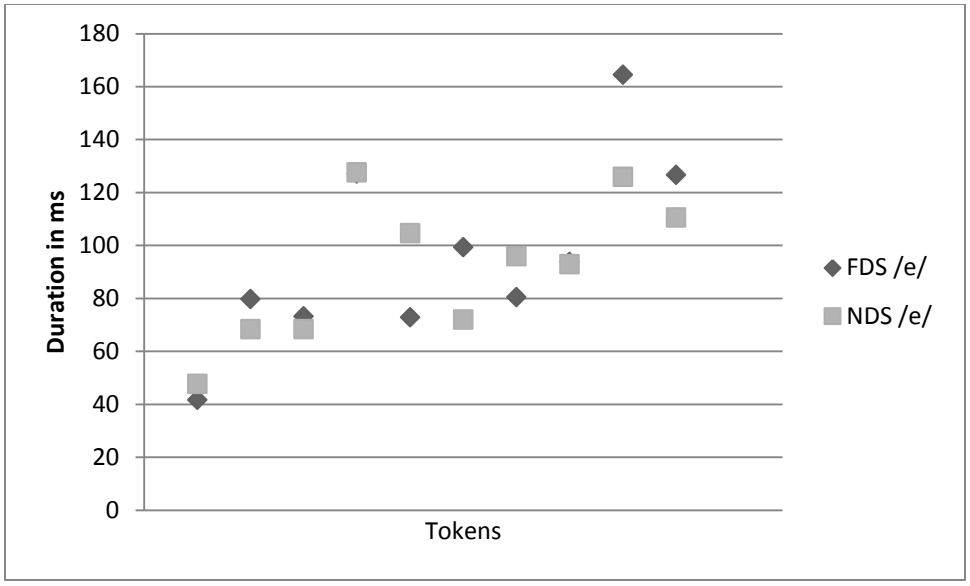


Figure 1.12 Teacher 3: /ɛ/

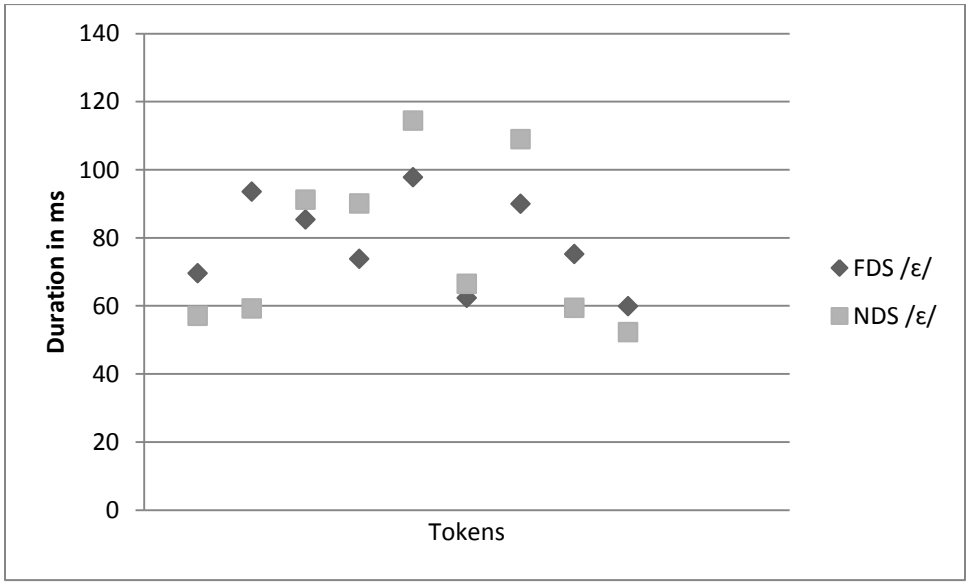


Figure 1.13 Teacher 4: /i/

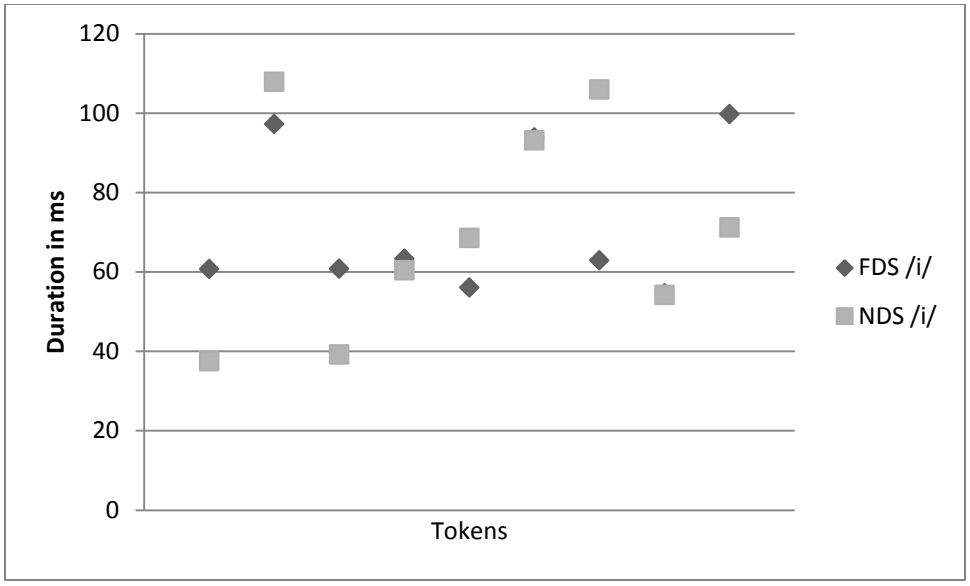


Figure 1.14 Teacher 4: /ɪ/

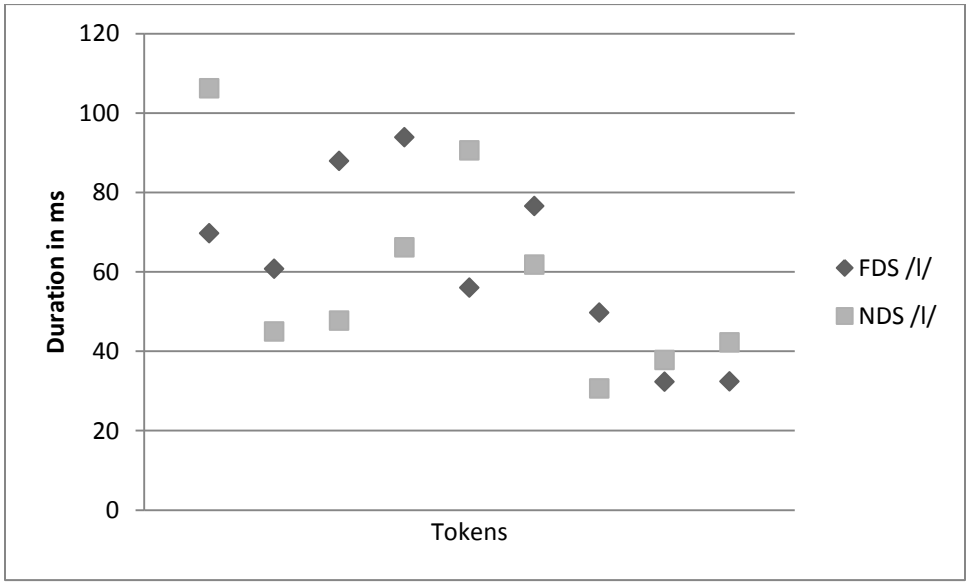


Figure 1.15 Teacher 4: /e/

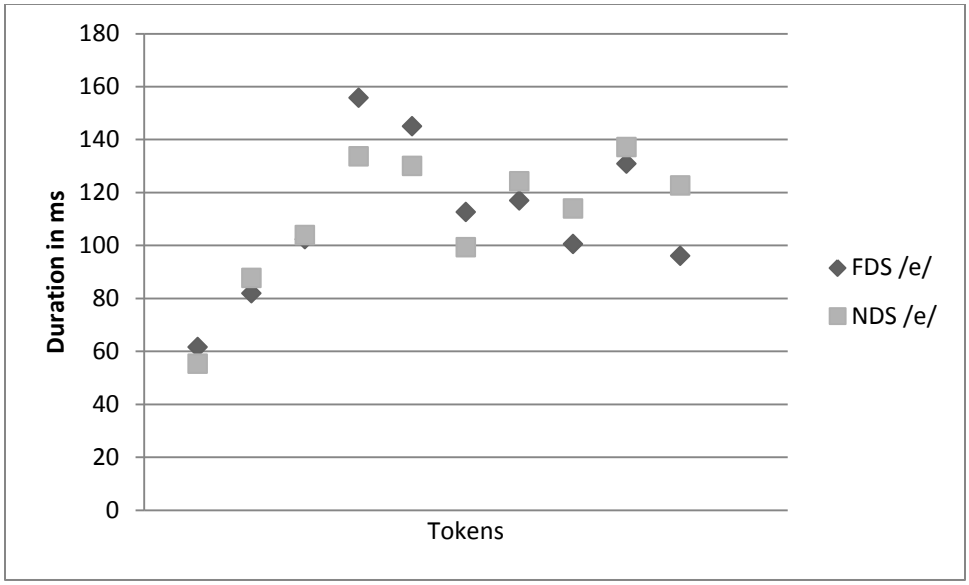
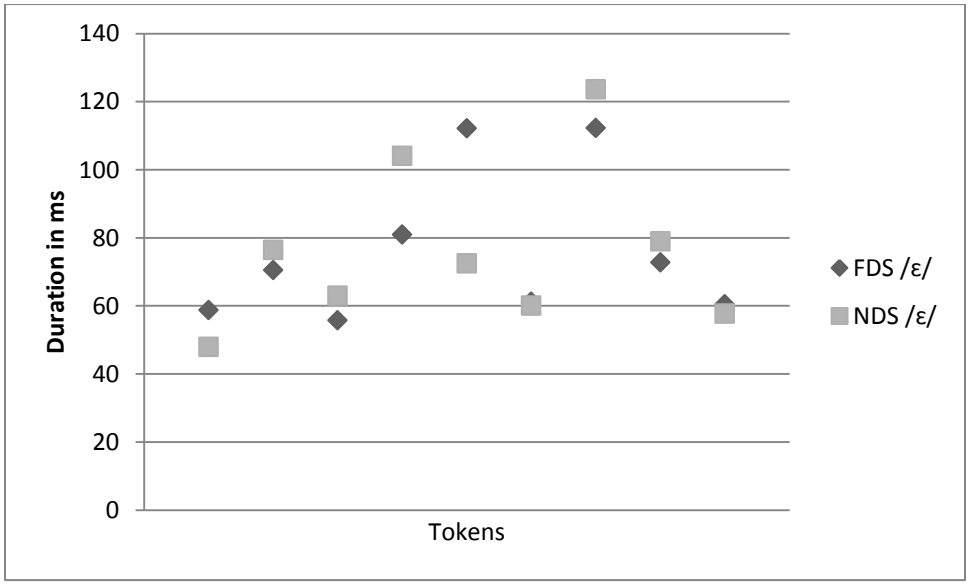


Figure 1.16 Teacher 4: /ɛ/



2. Control subjects

Figure 2.1 Control 1: /i/

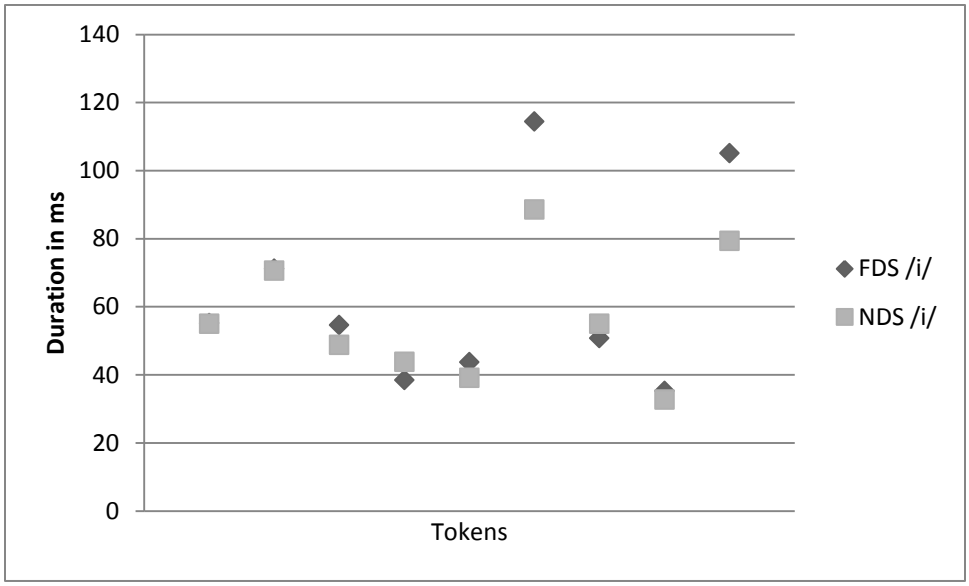


Figure 2.2 Control 1: /ɪ/

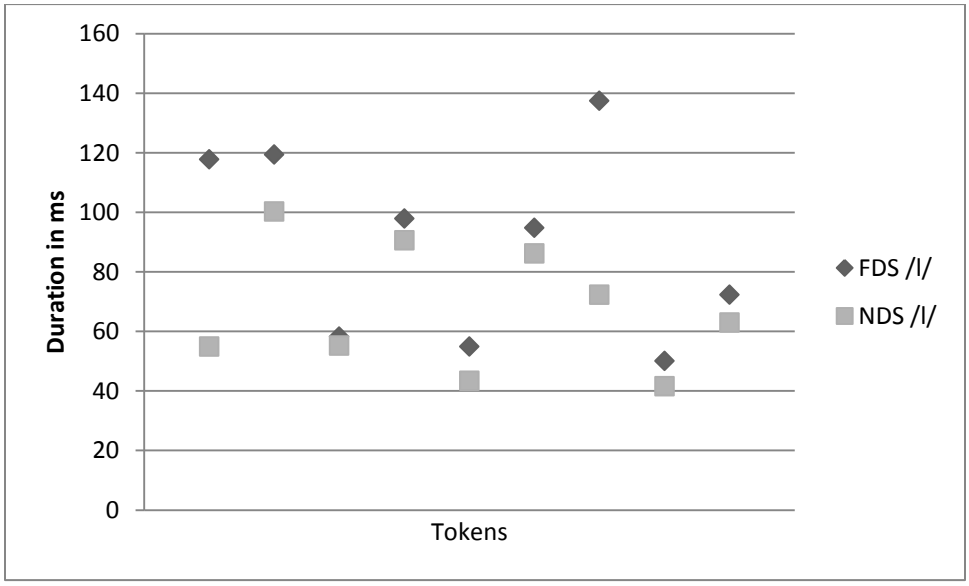


Figure 2.3 Control 1: /e/

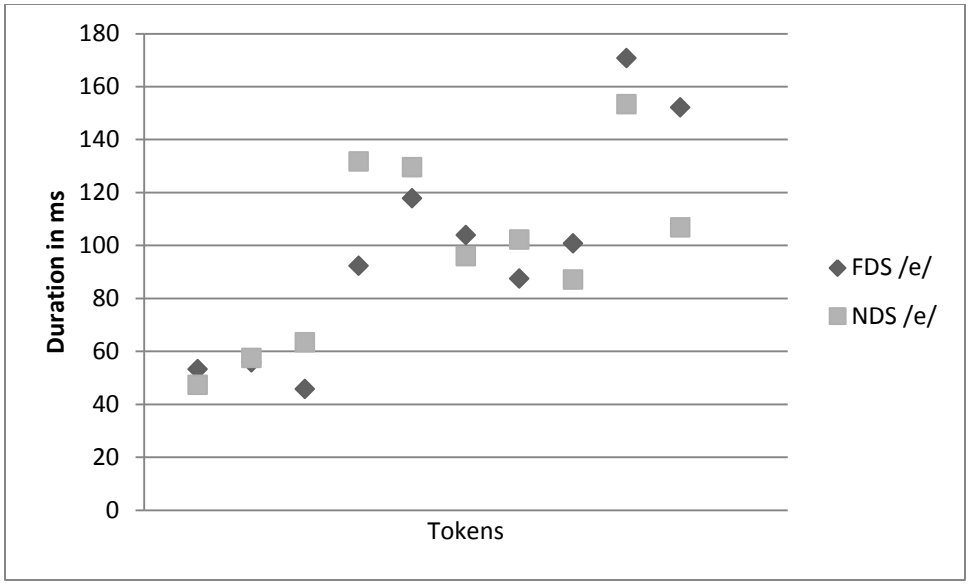


Figure 2.4 Control 1: /ɛ/

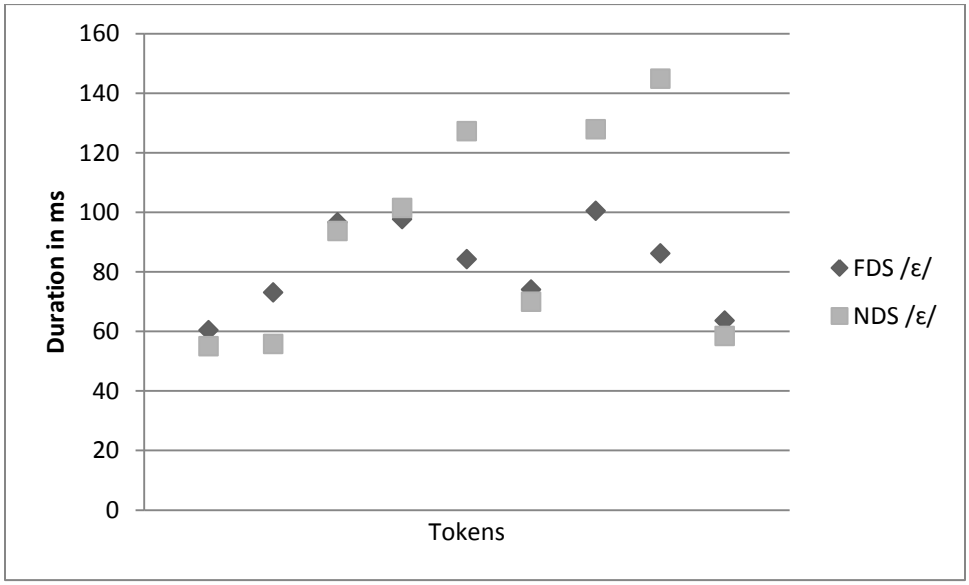


Figure 2.5 Control 2: /i/

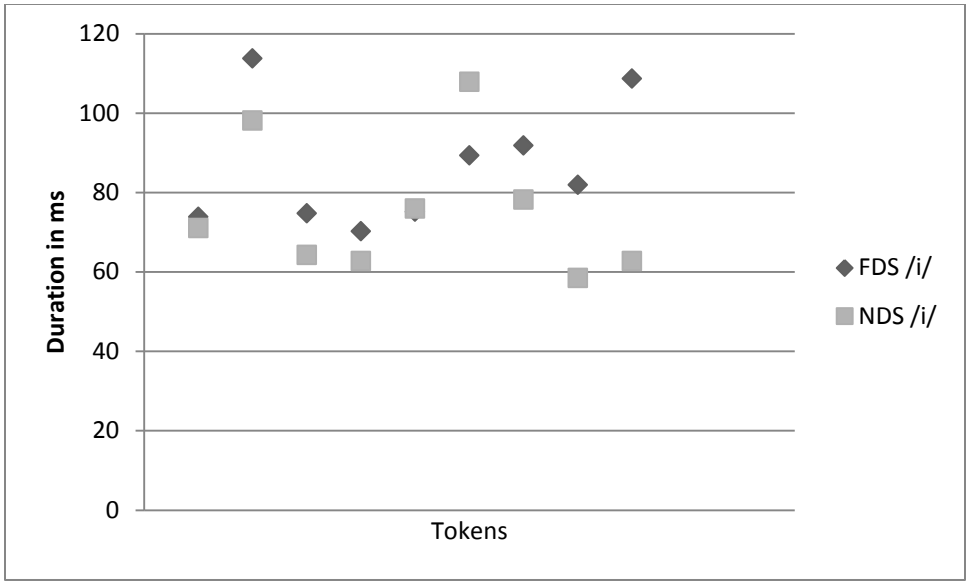


Figure 2.6 Control 2: /ɪ/

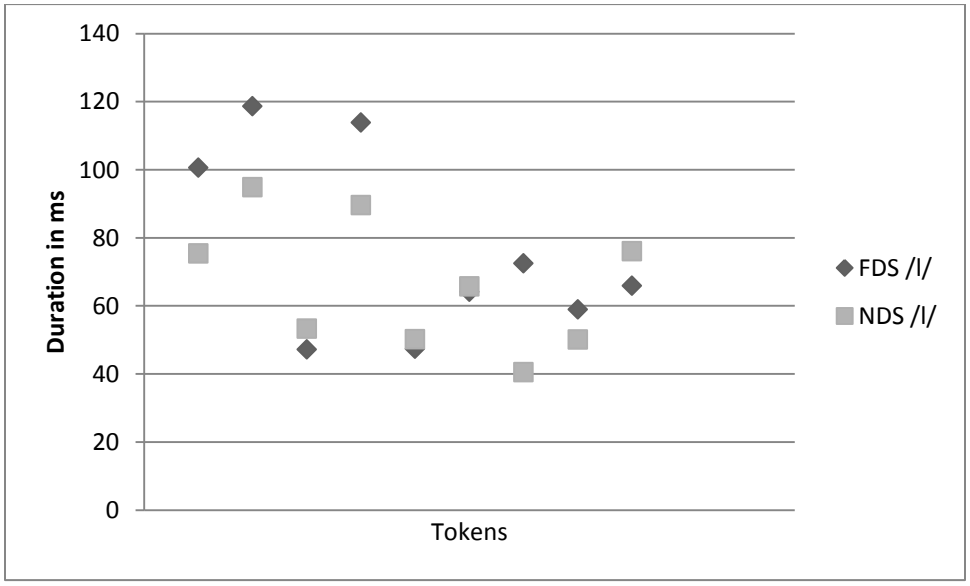


Figure 2.7 Control 2: /e/

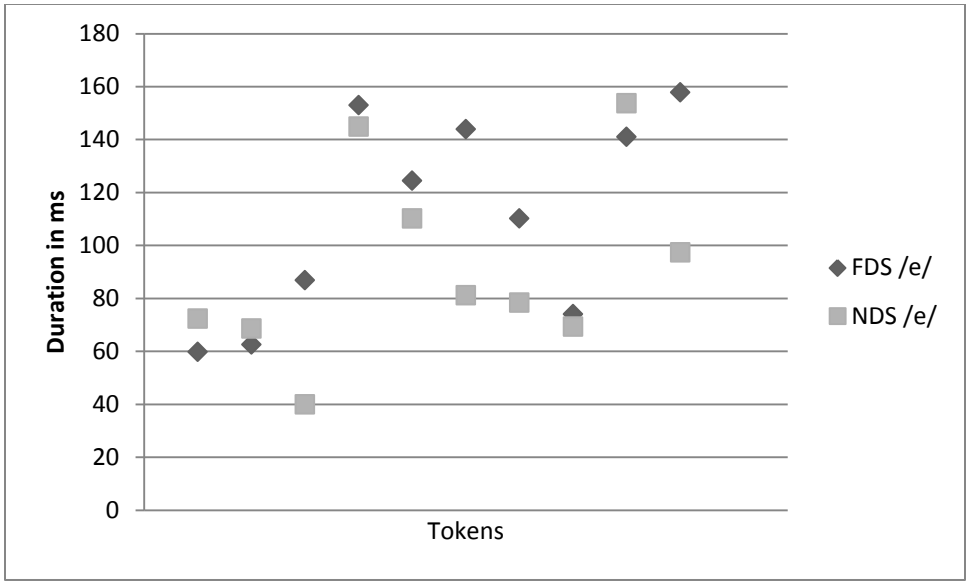


Figure 2.8 Control 2: /ɛ/

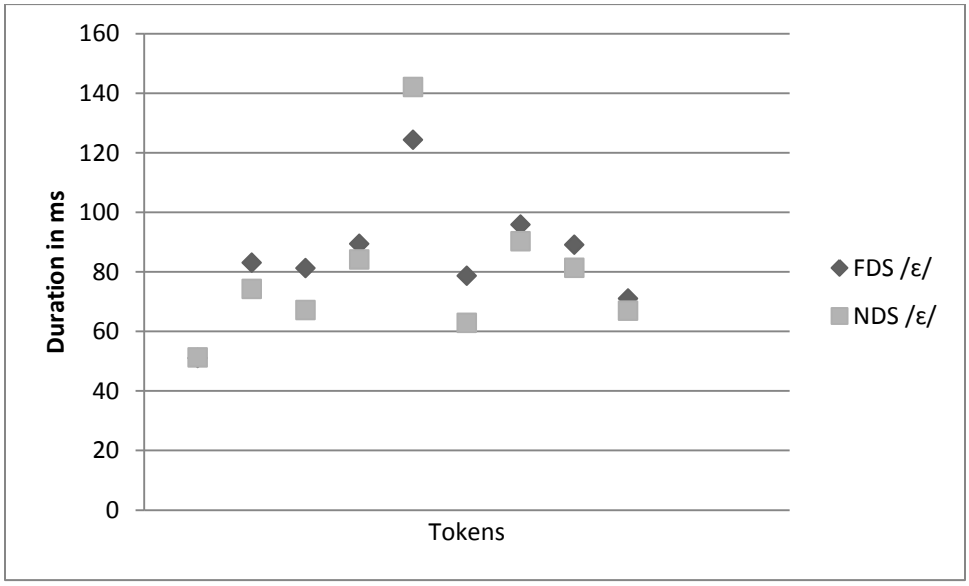


Figure 2.9 Control 3: /i/

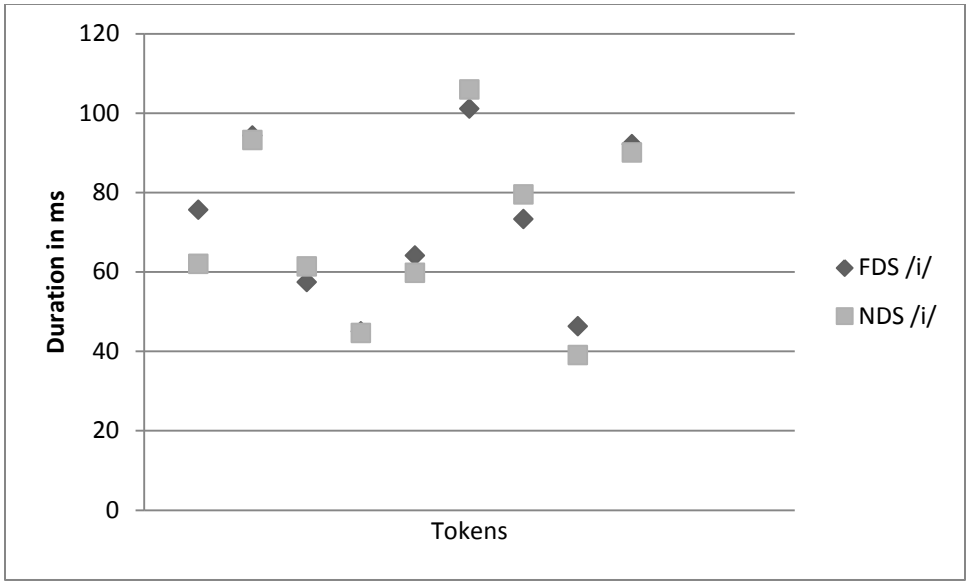


Figure 2.10 Control 3: /ɪ/

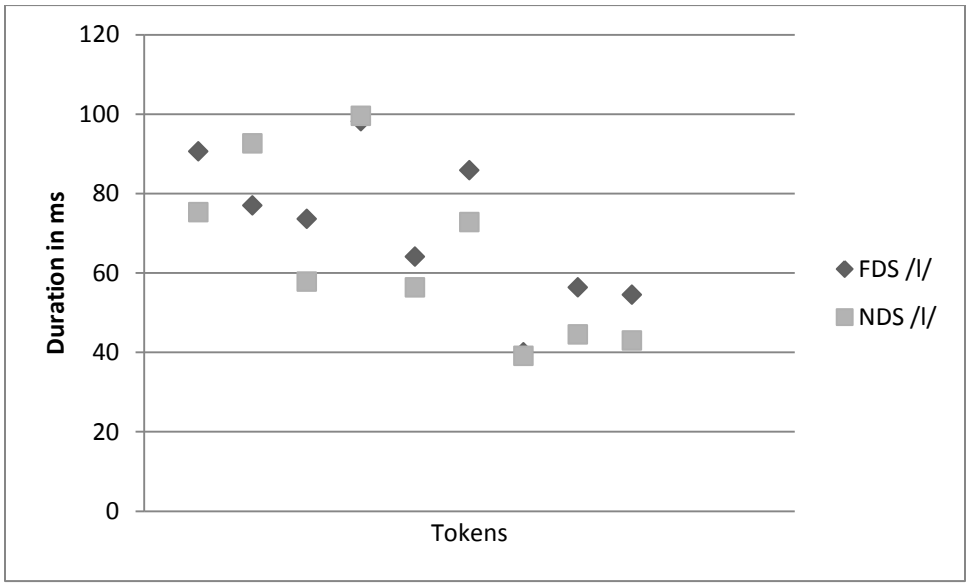


Figure 2.11 Control 3: /e/

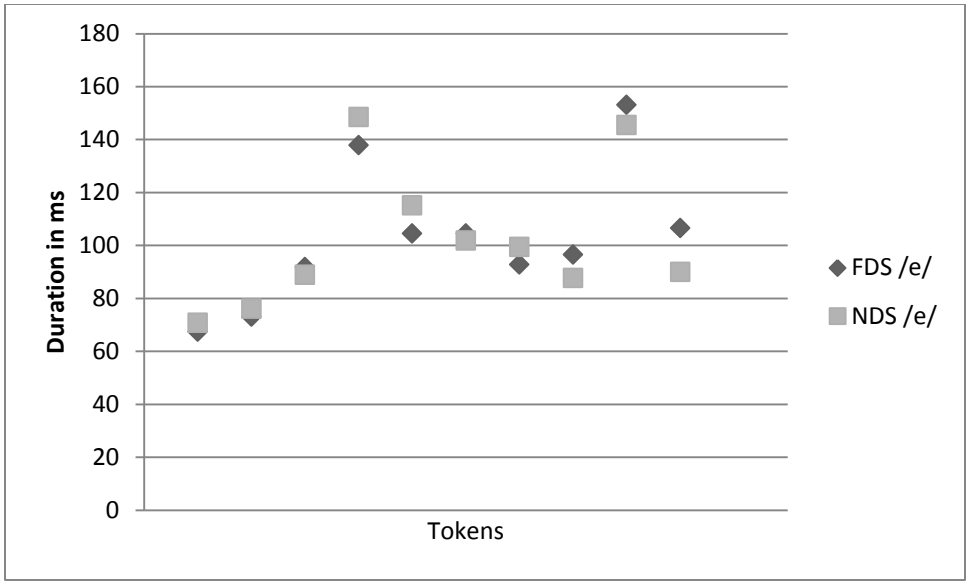


Figure 2.12 Control 3: /ɛ/

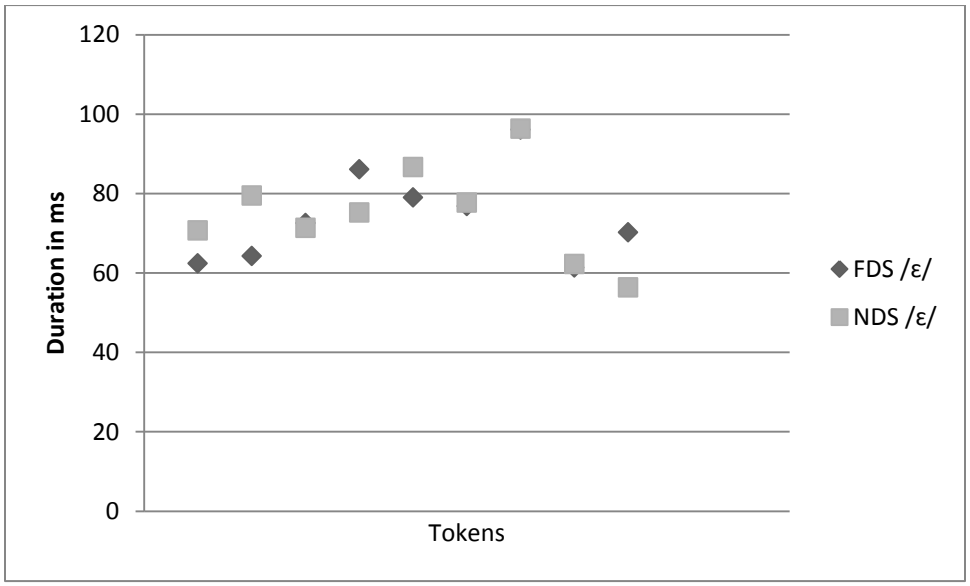


Figure 2.13 Control 4: /i/

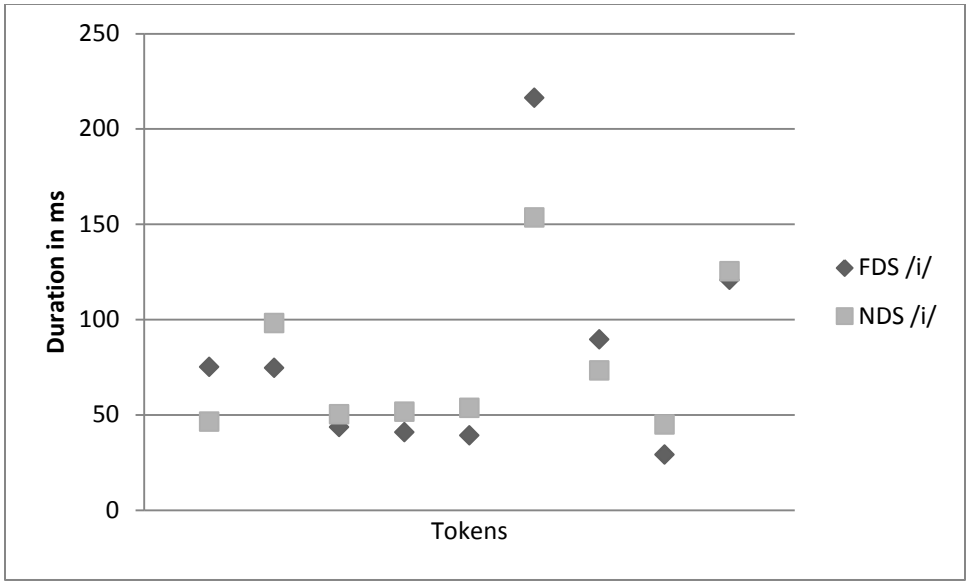


Figure 2.14 Control 4: /ɪ/

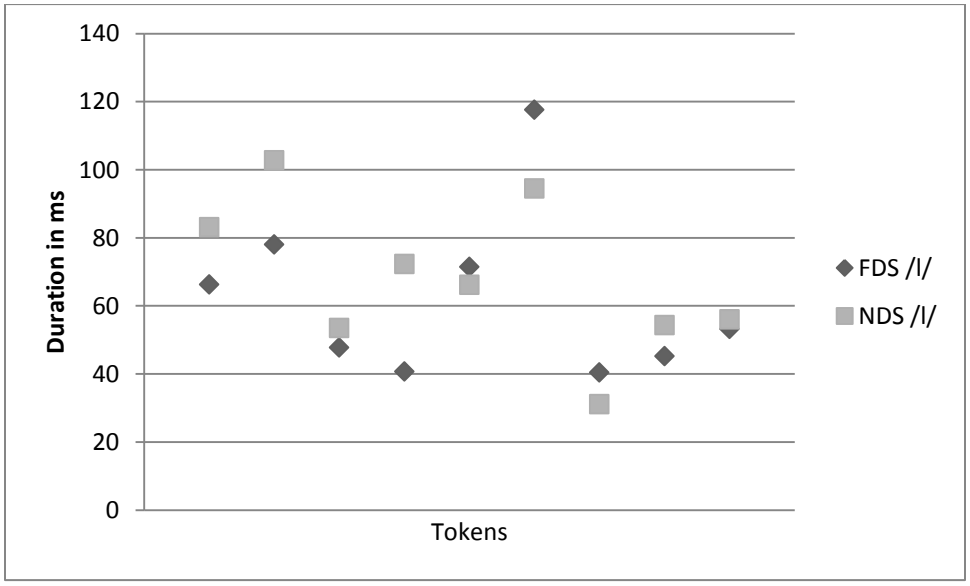


Figure 2.15 Control 4: /e/

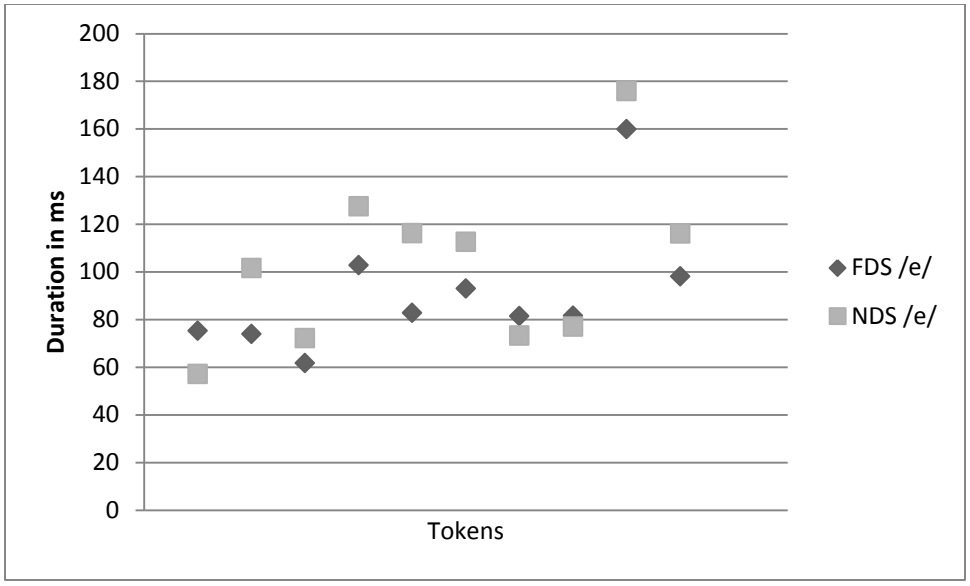
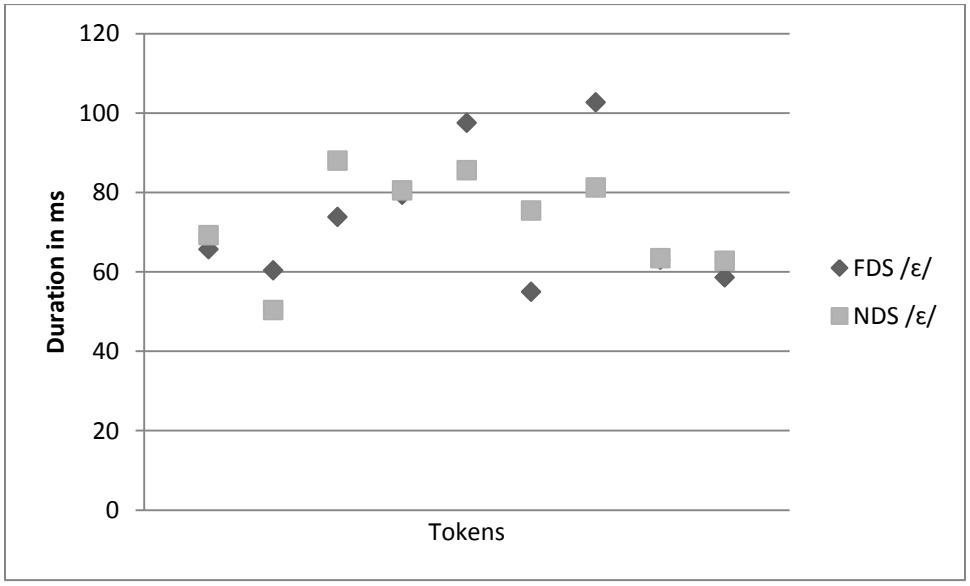


Figure 2.16 Control 4: /ɛ/



APPENDIX B: GROUP RESULTS

Group results

1. ESL teachers

Figure 1.1 Average durational distance between ESL teachers' /i/-/ɪ/ in FDS

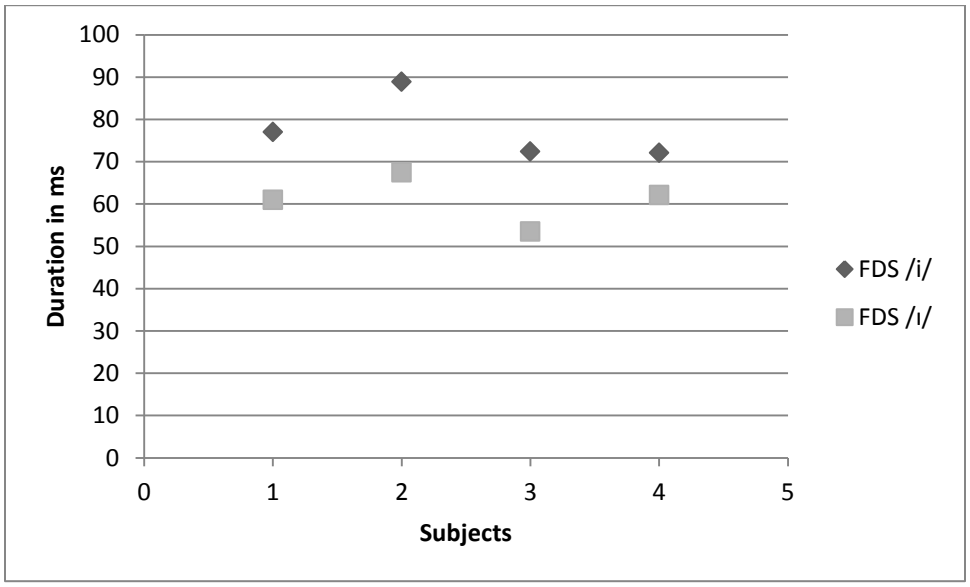


Figure 1.2 Average durational distance between ESL teachers' /e/-/ɛ/ in FDS

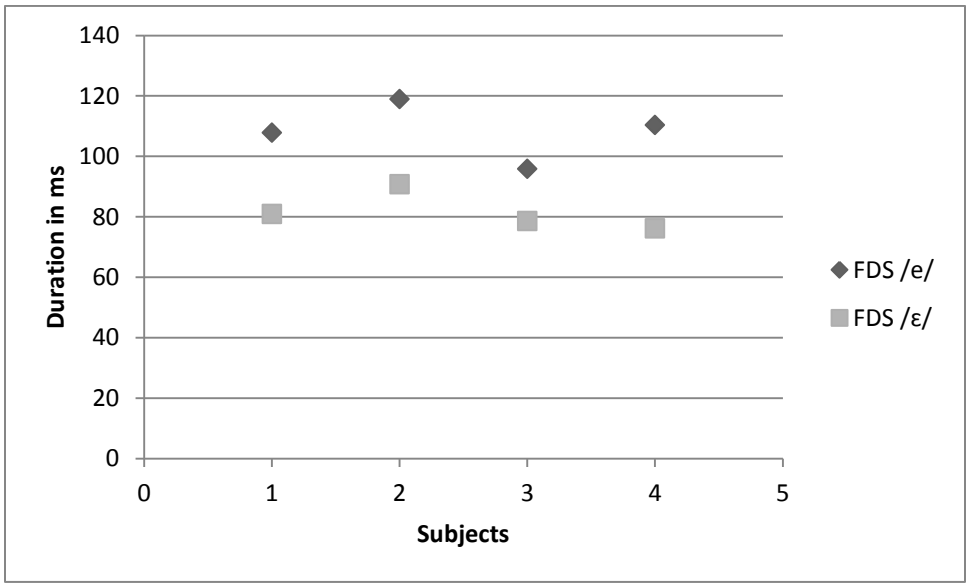


Figure1.3 Average durational distance between ESL teachers' /i/-/ɪ/ in NDS

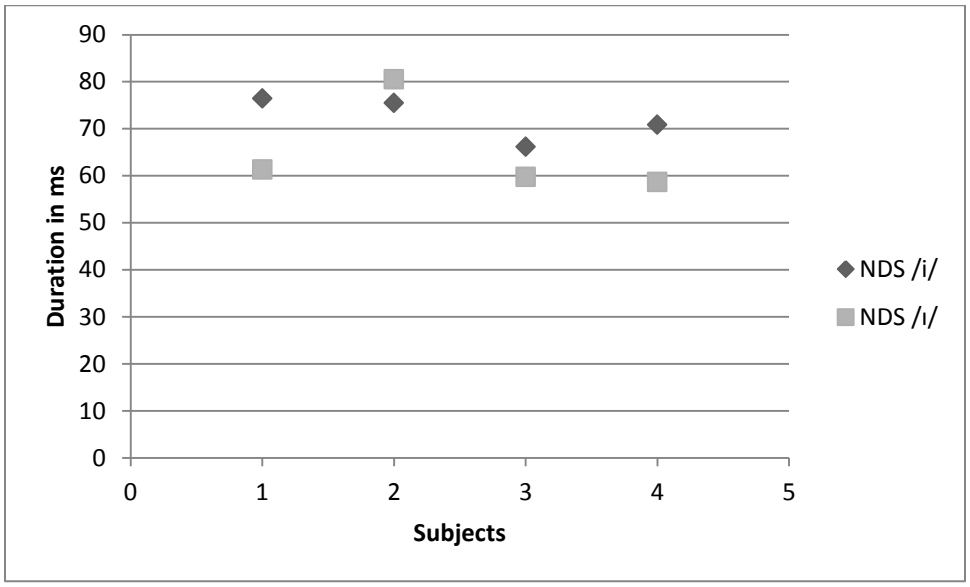
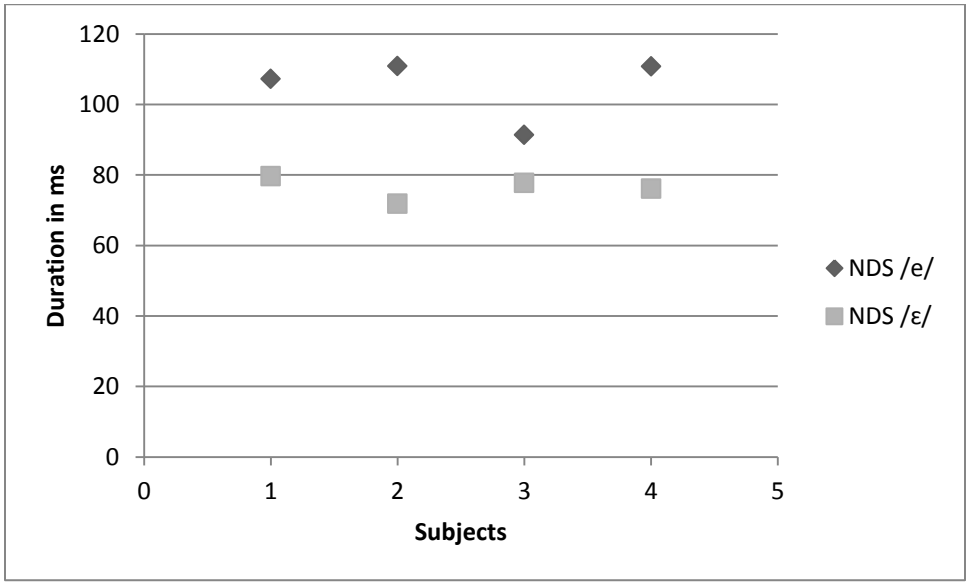


Figure1.4 Average durational distance between ESL teachers' /e/-/ɛ/ in NDS



2. Control subjects

Figure 2.1 Average durational distance between control subjects' /i/-/ɪ/ in FDS

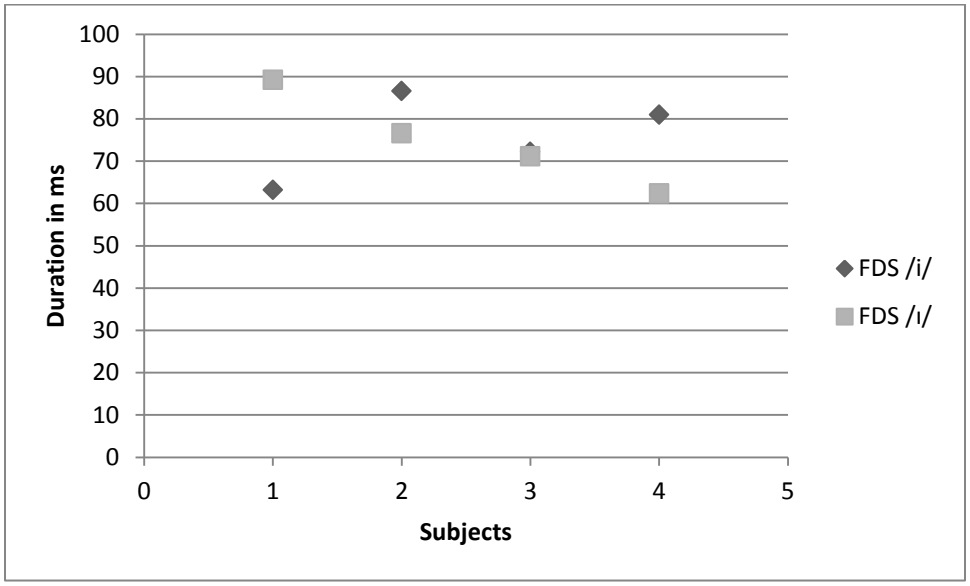


Figure 2.2 Average durational distance between control subjects' /e/-/ɛ/ in FDS

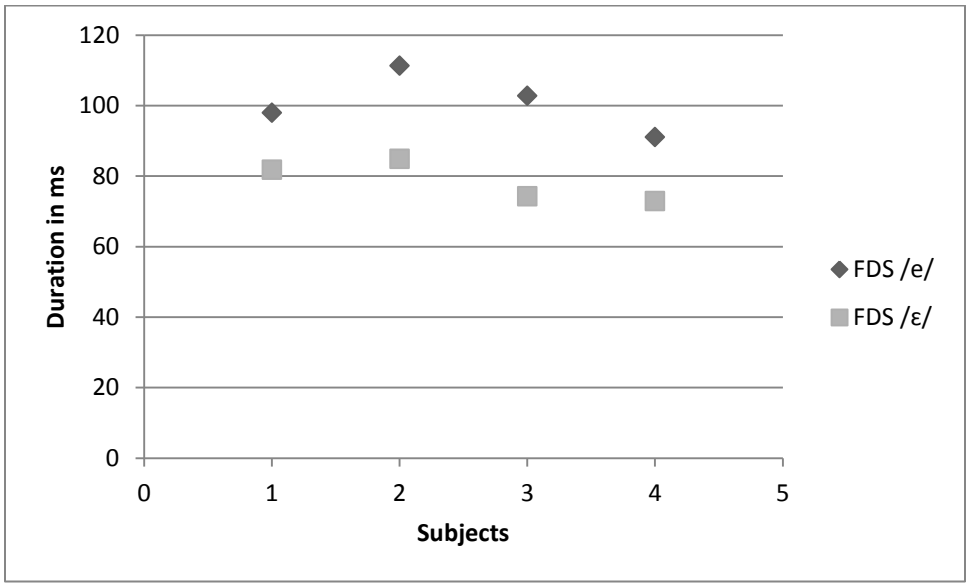


Figure 2.3 Average durational distance between control subjects' /i/-/ɪ/ in NDS

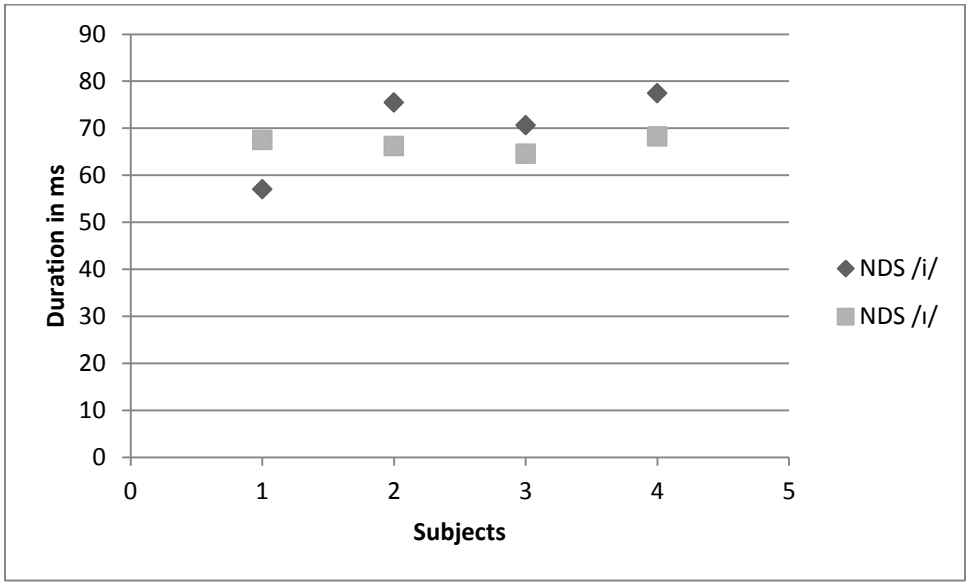
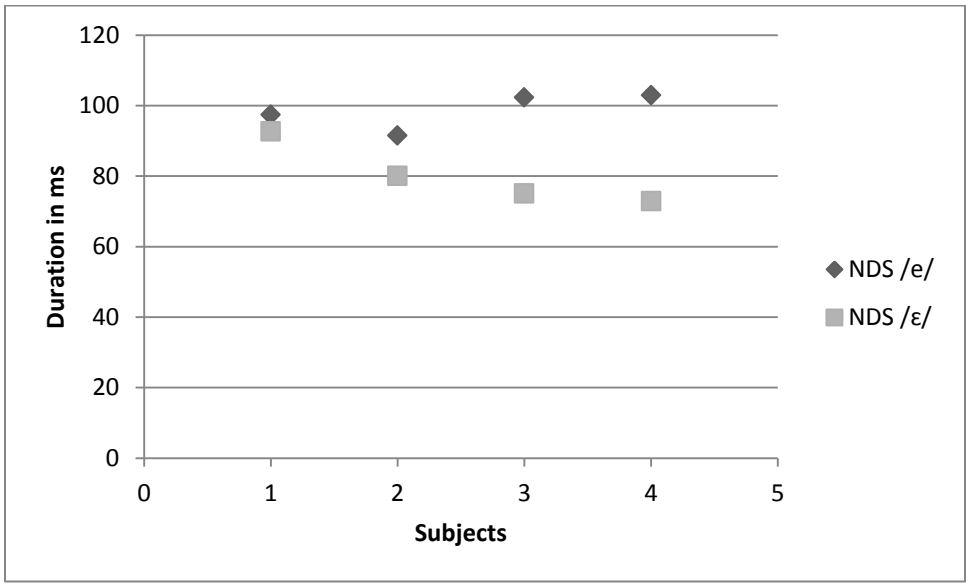


Figure 2.4 Average durational distance between control subjects' /e/-/ɛ/ in NDS



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