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Morféma-végi sötét /l/
L Darkening in morpheme-final environments: all 'ell breaking loose

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A HKR 346. § ad 76. § (4) c) pontja értelmében:
"...A szakdolgozathoz csatolni kell egy nyilatkozatot arról, hogy a munka a hallgató saját szellemi terméke..."

Szerzőségi Nyilatkozat

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Abstract

The subject of this thesis is L Darkening in morpheme-final environments in Standard Southern British English (SSBE). The tested hypothesis was that morpheme-final /l/ does not alternate between Clear and Dark L, but it has been lexicalised as Dark. In order to test this hypothesis an acoustic experiment was carried out during which young speakers of SSBE read out sentences. The data were analysed with the methods of acoustic phonetics. The results showed that L Darkening was not a categorical but a gradual phenomenon, which was affected by the strength of the morpheme boundary standing between /l/ and the next segment. The clearest /l/ was found before a tautomorphemic vowel, the second clearest before a morpheme boundary and a vowel, and the third before a word boundary and a vowel or a yod. The sound /l/ was found to be dark when it was followed by a consonant or a pause irrespective of the presence and the strength of the boundaries.

Contents

1 Introduction

This thesis presents L Darkening in morpheme-final environments in Standard Southern British English (SSBE). The focus of the thesis is the description of the acoustic quality of [l] and [ɫ], their distribution, and their effect on the preceding vowel. The data were gathered in an acoustic experiment, analysed with the methods of acoustic phonetics, and the main question to be answered was whether morpheme-final /l/ has been lexicalised as dark.

The aim of this thesis is to examine the quality of /l/ in morpheme-final environments. The primary question to be answered is if the quality varies between Clear L and Dark L according to the environment which follows it, as it is described in Chapter 2, or if morpheme-final /l/ has been lexicalised as Dark L. The secondary question to be answered is how [ɫ] influences the preceding vowel. The preceding vowel plays an important role because it can be treated as a cue to the quality of /l/, as Clear L is said not to influence the preceding vowel. Therefore vowels influenced by /l/ in an environment when the following /l/ is supposed to be clear, as in *feel useful*, serve as a cue for the lexicalisation of morpheme-final /l/ as dark. The hypothesis to be tested in this thesis is that morpheme-final /l/ will be dark even if it is in a canonical clear environment.

The acoustic phonetic experiment designed for this thesis aims to test this hypothesis. The goal of this experiment was to see whether verbs ending in /l/, and whose paradigm is said to have an equal number of Clear and Dark Ls have a recoverable Clear L or predominantly Dark L occurs even in the Clear L environments.

Chapter 2 discusses previous approaches to Clear and Dark L and to their distribution to explain why the lexicalisation of Dark L is a relevant subject. Chapter 3 summarises the literature on the acoustics of /l/ and the experiments on /l/. Chapter 4 describes the design and the procedure of the experiment and the acoustic characteristics of /ɪ, iː/ and [l, ɫ] which provided the basis of comparison for vowels influenced by /l/ and alternating Clear and Dark L respectively. Chapter 5 describes the findings of the acoustic experiment and Chapter 6 aims to explain these findings. Chapter 7 presents the conclusions.

2 Clear versus Dark L

The phoneme /l/ is known to have two varieties in English: the first is called Clear L [l] and the second is Dark L [ɫ] (Wells 1982, Cruttenden 2001). In some varieties of English, such as in Received Pronunciation, in South England, in East Anglia, etc. both can appear, whereas in other varieties only one is present, as for example in General American, Australian English or Scottish English, where all /l/ sounds are dark (Wells 1982). The two sounds differ in their secondary place of articulation, namely [l] is an alveolar lateral, whereas [ɫ] is a velarised sound, during whose articulation the back of the tongue is raised to and touches the soft palate (Cruttenden 2001). The sound /l/ has a coronal and apical gesture and a dorsal one as well, and the former is stronger for Clear L, and the latter is stronger for Dark L (Sproat and Fujimura 1993).

The accent this thesis focuses on is Standard Southern British English, in which both are present: Clear L is used prevcocalically and before a yod, and Dark L is used elsewhere, therefore Clear and Dark L are in a complementary distribution. The sound /l/ can also be in the nucleus of a syllable, as in *metal, people* and syllabic /l/ is always dark. Besides their difference in their place of articulation and in their distribution, Dark L can also optionally affect the preceding vowel. If the preceding vowel is /iː, ɛɪ, aɪ ɔɪ/ (Cruttenden 2001) or /iː, ɛɪ, əʊ, uː/ (Krämer 2008), a schwa may be inserted before a Dark L, and Gick and Wilson (2003) argue that it is the high tense vowels after which schwa insertion is possible. These vowels may be generalised as the long or tense English vowels because the so-called long monophthongs and diphthongs are classified as tense, and short monophthongs and /ɑː, ɜː, ɔː/ are classified as lax (Nádasdy 2006, 125; Ladefoged 2001, 81). This classification can be problematic from a phonetic viewpoint because neither length nor diphthongs are stable features of English. Namely, length is affected by pre-fortis clipping (Cruttenden 2001, 95–96), diphthongs are affected by smoothing, and long monophthongs, such as the FLEECE and the GOOSE vowels are affected by diphthongisation (Szigetvári and Lindsey 2015, Cruttenden 2001, 104). Moreover, tenseness in vowels have not been clearly defined or found playing a role. However, using the words “lax” and “tense” allows referring to these groups in an unambiguous way, and it can be used to emphasise that there is not only a length, but also a quality difference between lax /ɪ/ and tense /iː/.

The process of schwa insertion after tense vowels is called Pre-L Breaking by Wells (1990). The inserted schwa has a laxing effect on the preceding vowel, and thus the pronunciation of the word *feel* may be [fiːɫ] or [fɪəɫ] but not *[fiːəɫ]. This inserted schwa has been analysed as a phonological process (McCarthy 1991) and as a phonetic one (Gick and Wilson 2003), and there have been debates on the syllabic status of it (Lavoie and Cohn 1999). However, sources agree that it is Dark L and Dark L only that triggers an intrusive schwa.

It is also known that only Dark L can be vocalised, that is to say Dark L can lose its primary, alveolar place of articulation, but it retains its secondary, velar place of articulation. This results in Dark L becoming a back vowel (Cruttenden 2001), whose exact pronunciation is a matter of debate in the literature; however, the sounds [ö, ɤ, o, u, ʊ] have been proposed (Altendorf and Watt 2008). Thus, *people*, *feel*, and *milk* may become [ˈpɪpo, fɪɤ, mɪɤk] respectively (Wells 1982). It also has to be noted that no schwa-insertion has been reported after lax vowels, therefore *[mɪəɫk] is not a possible pronunciation of *milk*. L Vocalisation also affects the preceding vowel in the Cockney variety of English (Wells 1982), and it leads to mergers. For example [ɪi] and [ɪ] in *feel* and *fill* are merged as [ɪɤ], so both words are pronounced as [fɪɤ], and [ʉː, ʊ, oʊ] are merged as [oʊ], so *pool, pull* and *pole* become [poʊ] (Wells 1982).

Therefore, according to the descriptions of Wells (1982), Cruttenden (2001) and Altendorf and Watt (2008), Clear and Dark L are in complementary distribution, only Dark L can be vocalised and only Dark and Vocalised L affect the vowel system, and they have a different effect on tense and lax vowels.

2.1 Previous approaches to Clear and Dark L

In Standard Southern British English both Clear and Dark L are present, and they are traditionally considered to be in complementary distribution. Clear L is used when /l/ is followed by a vowel or a /j/ and Dark L is used when /l/ is followed by a consonant or a pause. This state of affairs can be captured by rule-based generative phonology or in terms of syllable structure.

2.1.1 Rule-based approach

The rule based approach captures L Darkening in terms of the following environment. Wells (1982) describes L Darkening in rule-based phonology as the following:

$$l \rightarrow ɫ / \_ \{||, \#_0 C\}, C \neq j$$

This rule is post-lexical (or structure independent), as it does not take morpheme boundaries into consideration. That is to say, a morpheme boundary may or may not be present between /l/ and the following consonant, and /l/ is dark in monomorphemic *gild*, bimorphemic *kill#ed*, and across word boundaries, as in *kill##Sarah.* However, morpheme boundaries still make a difference in this analysis: monomorphemic *gild* can only be pronounced with a Dark L, as /l/ is followed by a consonant in all occurrences of the word, whereas *kill* can be pronounced with Clear L, as in *killer, killing, kill ewes, kill Alice* and with Dark L, as in *kill*||, *killed, kills, kill Sarah.* Therefore, there are four environments in which the morpheme-final /l/ of a verb is pronounced as [l] and four in which it is pronounced as [ɫ]. However, this cannot explain why /l/ fails to alternate in words such as *metal, people*, and why it is dark in the phrases *metal music* and *metal is awesome.*

2.1.2 Syllables

The second common approach to capture the distribution of Dark L is doing so with the help of syllable structure. In this approach /l/ is always dark in the rhyme and clear in the onset. The sound /l/, as a lateral, has a high degree of sonority "and it is followed only by approximants and vowels on the sonority scale" (Giegerich 1992, 133). The environment of L Darkening shows that /l/ becomes dark when the following sound is either less sonorous than /l/ or there is no following sound. Both cases lead to a sound sequence with a falling sonority, therefore, /l/ will be in the rhyme of the syllable, not in the onset. Therefore, the L Darkening rule can state that /l/ is dark when it is in the rhyme of the syllable (Johnson and Britain 2007). This rule can offer an explanation for the fact that yod, as a sound more sonorous than /l/, patterns with the vowels and not with the consonants, and it does not treat it as an exception to the rule. However, /w/ is also more sonorous than /l/ and it patterns with the consonants, therefore an additional rule is needed that excludes */lw/ from the possible onsets.

In the syllable rhyme /l/ can occupy two positions. When it is preceded and followed by a less sonorous sound, it constitutes a sonority peak, and therefore it is in the nucleus of a syllable. Examples are *middle, metal, sickle* and *Brussels.* When it is preceded by a more sonorous sound, and followed by a less sonorous one, it is in the coda, as for example in *milk, feel, call, wild*, and *cold.*

In order to account for the alternation of Clear and Dark L in morpheme-final environments it has to be stated that coda /l/ can be resyllabified as an onset /l/ across morpheme boundaries if it is followed by a vowel or a yod, as in the analysis of Halle and Mohanan (1985). This approach can explain that syllabic /l/, which appears for example in *people* [piː.pl̩] (Upton 2008), is always dark because it cannot be resyllabified.

Another benefit of this approach is that it may provide an explanation as to why Dark L is vocalised. If Dark L is in the nucleus as in *people* and *table*, it is vocalised because vowels make better nuclei than consonants. If it is in the coda as in *feel* or *gild*, vocalisation either deletes the coda or resolves a coda cluster.

2.2 Complementary distribution

The common feature of the classical descriptions of Standard Southern British English (Cruttenden 2001, Wells 1982, Hughes and Trudgill 1996) and previous analyses (Wells 1982, Johnson and Britain 2007) is that all state that Clear and Dark L are in complementary distribution, and mention prevocalic Dark and Vocalised L as a sporadic phenomena only.

However, L Vocalisation is spreading (Altendorf and Watt 2008), and Dark and Vocalised L have been reported to appear in canonical Clear L positions. Even Wells (1982) gives one example of *peel it* pronounced as [piːɤɪʔ]. Kerswill (1990; 1995) carried out research in Cambridge and found that a large percentage of young speakers used Dark or Vocalised L in canonical Clear L environments, and the percentage of users of Dark L in clear position were larger among young speakers than among old ones (Kerswill 1995). On the other hand, Scobbie and Pouplier (2010) did not find vocalised /l/ in the /iːl#V/ environment among the speakers of Southern English; however, they did find that /l/ kept the tongue-tip contact that is typical for onset /l/, but also underwent tongue retraction that is typical to coda /l/. That is to say Scobbie and Pouplier (2010) found L Darkening in the _#V environment. On the basis of the research by Scobbie and Pouplier (2010), Bermúdez-Otero and Trousdale (2012) argue that the rules governing L Darkening and L Vocalisation go through a cycle during which their domain narrows, and at the moment of writing L Darkening is a word level rule and L Vocalisation is a phrase level rule. Consequently, *peel* is always pronounced with a Dark L, even in the phrase *peel apples*, whereas it may only be pronounced with a Vocalised L if the following morpheme begins with a consonant, as in *peel kiwis*. The result of the research of Bermúdez-Otero and Trousdale (2012) is that Clear and Dark L are still in complementary distribution, but the distribution of Clear L is more restricted now, as it cannot occur in morpheme-final environments any longer. The quality of /l/ can still be predicted on the basis of the position in which it occurs, but Dark L has been lexicalised in morpheme-final environments, and Clear L is just as irrecoverable in *feel* as in *milk*. Dark L and Vocalised L are also in complementary distribution, as it can be predicted when Dark L will be vocalised.

3 The acoustics of /l/: Literature review

The acoustics of /l/ is not a widely researched area, particularly because of the difficulties associated with analysing /l/ on a spectrogram (as it is described in Section 4.1.3). Research concerning the formants of /l/ have been made, and its formants values have been described. Unfortunately, many of these studies were made in the 1950s and deal with American English, so their data might not be useful for the present thesis because their data might be dated and describes a different variety. Experiments have also been made to differentiate between Clear and Dark L and consonantal /l/ and vocalised /l/, but these usually were articulatory experiments made with electropalatography, such as Scobbie and Pouplier (2010) or with electromyography, such as Sproat and Fujimura (1993).

3.1 The acoustics of /l/

The most detailed acoustic descriptions of /l/ come from *Minimal cues for separating /w, r, l, y/ in intervocalic position* by Lisker (1957) and from *Acoustic cues for the perception of initial /w, j, r, l/ in English* by O'Connor et al. (1957). Both experiments were made in 1957, and involved a technique called Pattern Playback during which hand-painted lines resembling formants were converted into sounds, therefore it could be examined how the modifications of the "formants" affect the perceptions of the sounds. Therefore the formants given by Lisker (1957) and O'Connor et al. (1957) were not taken from people's speech and spectrograms, but the subjects of the experiments were asked to make a perception judgement. The synthesised sounds relevant for the present thesis were /ili, ala, ʊlʊ/ in the experiment of Lisker (1957) and /le,la, lɔ/[1] in the experiment of O'Connor et al. (1957). The liquid was in a prevocalic position, which could lead to the assumption that their results would be closer to British English Clear L; however, in American English all the /l/ sounds are dark (Wells 1982). Given that their results are over fifty years old, and were gained by speech synthesis from speakers of American English, they cannot be expected to be an exact match for an experiment made in 2014 with speakers of Standard Southern

[1] Neither Lisker nor O'Connor used IPA characters, therefore these transcriptions are mine.

British English with the help of spectrograms, and rather have to be taken as guidelines for segmentation.

The F1 of /l/ was found to be between 300 Hz and 500 Hz (Lisker 1957, O'Connor et al. 1957, Cruttenden 2001). Ladefoged and Maddieson (1996) also put F1 of the apical alveolar lateral in Arrente to 381 Hz. F2 was found to be between 900 Hz and 1600 Hz (Lisker 1957, O'Connor et al. 1957, Ladefoged and Maddieson 1996, Cruttenden 2001). This relatively wide range can be explained by the distinction between Clear L and Dark L, as according to Cruttenden (2001), Dark L has an F2 at the lower end of this range. The second factor is coarticulation, as Lisker (1957) measured 1500–2400 Hz in the sequence /ili/, 1200–1300 Hz in /ala/ and 900–1300 Hz in /ʊlʊ/. Changes in the F2 of /l/ caused by the following vowels were also reported from Majorcan and Valencian Catalan by Recasens and Espinosa (2005). Lisker (1957) put the third formant of /l/ between 3000–3600 Hz, and found it to rise from /iː/ to /l/ and fall from /l/ to /iː/. F3 did not change in the other two environments, which were/ala/ and /ʊlʊ/. According to this experiment (Lisker 1957), F3 is also important in distinguishing between /l/ and /r/. The figures of Lisker (1957) also show the formant transitions from vowel to /l/ and /l/ to vowel that are typical to alveolars, thus from a vowel to /l/ a drop in F1 and a rise in F2 are expected, and from /l/ to vowel a rise in F1 and a drop in F2 are expected (except when the vowel has an extremely high F2 in which case F2 will follow the pattern of F1).

Besides the formant structures, it is also known that /l/ has antiformants due to the air escaping at both sides of the tongue. Antiformants are shown by a sudden drop of intensity between 2000 and 3000 Hz, at the level of the second and the third formant (Machač and Skarnitzl 2009).

Another effect of /l/ being a lateral and having a side branch is the presence of a zero between 2200 and 4400 Hz, but most typically at around 3500 Hz (Stevens 2000). Vocalised L is not expected to have a zero, therefore this may be used to distinguish Dark L from Vocalised L.

3.2 Differentiating between Clear L and Dark L

According to Cruttenden (2001), the F2 of /l/ falls between 900 Hz and 1600 Hz, and Dark L has an F2 at the low end of this range. According to Yuan and Liberman (2009), Dark L not only has a low F2 but a high F1 as well, whereas Clear L has a low F1 and a high F2, that is to say that the two formants are closer to each other for Dark L (Sproat and Fujimura 1993). The formants of /l/ in different environments (word-initial, word-final and intervocalic) were measured by Carter and Local (2007) in Newcastle-upon-Tyne English, which has clear /l/ in onset positions and in Leeds English which has dark /l/ only. Carter and Local (2007) gave the means of four formants of word-initial /l/ as produced by four male and four female speakers of each dialect. Their results can be seen in Table 3.1, and the difference between the second formant of /l/ in the two dialects proved to be significant both for female and male speakers.

		Clear L (Newcastle)	Dark L (Leeds)
female speakers	F1	395	452
	F2	1675	1194
	F3	2972	3054
	F4	3985	3928
male speakers	F1	342	351
	F2	1351	1028
	F3	2619	2729
	F4	3721	3793

Table 3.1: Formant values of Clear and Dark L (Carter and Local 2007)

Hawkins and Nguyen (2004) also measured the F2 of onset /l/ and found that the second formant of /l/ was at 1000–1300 Hz in those dialects which have Dark L in onsets, and at 1500 Hz, when onset /l/ is clear. However, their research might not be entirely reliable, as there were only four participants in their experiment, who represented four dialects of British English. Recasens and Espinosa (2005) also found that Majorcan Catalan Dark L had a lower F2 (around 1000–1100 Hz before /i/) than Valencian Catalan Clear L (1500–2200 Hz for /ili/). Cross-linguistic comparison of /l/ presented by Recasens and Espinosa (2005) also shows that 1000 Hz is a typical F2 for Dark L and 2000 Hz is a typical F2 for Clear L before /i/. This study also found that the F3 of Dark L was higher due to the fronting of the closure. The lower F2 of Dark L is the result of tongue dorsum backing and velarisation (Hawkins and Nguyen 2004), and according to Recasens and Espinosa (2005), it positively correlates with tongue dorsum retraction and fronting. According to Stevens (2000), the F1 of any /l/ is at 360 Hz, and its F2 is about 1310 Hz, unless it is affected by “tongue body backing,” which lowers the F2 to approximately 1100 Hz. Therefore it is possible to separate Clear L and Dark L based on their formant structures, primarily on the basis of the F2 values, and on the basis of F1 and F3 as well.

The second differentiating feature is the length of the rhyme. This is due to the articulatory differences between Clear and Dark L, as Clear L has an apical gesture, which makes it more consonantal, therefore it is used in the onset, whereas Dark L has a dorsal gesture which makes it more vocalic, therefore it is used in the syllable-final position (Sproat and Fujimura 1993). Sproat and Fujimura (1993) measured the length of the whole rhyme (vowel, transition and /l/ included), and found in their experiment that pre-boundary /l/ reached the dorsal gesture and the apical gestures at the same time in shorter rhymes and it reached the dorsal gestures earlier than the apical gestures in longer rhymes. Therefore /l/ is darker in longer rhymes. Sproat and Fujimura (1993) also found that the longest rhymes are to be found before the strongest boundaries, that is to say the rhyme was the longest in absolute final position, it was the shortest before a weak morpheme boundary, such as *hel+ic*, with a strong morpheme boundary such as *heal#ing* falling in between. Yuan and Liberman (2009) also found that the longer the rhyme, the darker the /l/; however, they disagreed with Sproat and Fujimura (1993) on explaining this fact by the timing of the dorsal and apical gesture of /l/. Sproat and Fujimura (1993) and Yuan and Liberman (2009) both found that L Darkening in American English was a gradual phenomena, and although Clear and Dark L could be separated, /l/ was darker in absolute final than in preconsonantal position. Interestingly, Yuan and Liberman (2009) also found a "syllable-final prevocalic dark /l/," which was dark, but less so than preconsonantal dark /l/, which is interesting as prevocalic /l/ is considered to be syllable-initial and clear in Standard Southern British English.

Therefore it is possible to differentiate between Clear and Dark L based on their formant structures and length; however, the difference was found to be gradient in most of the literature (Yuan and Liberman 2009, Recasens and Espinosa 2005, Scobbie and Pouplier 2010). However, what was not measured according to the best of my knowledge is the difference between Clear and Dark L in Standard Southern British English, which exhibits allophonic variation between the two. What makes SSBE even more interesting is that L Darkening seems to be a spreading phenomenon that may have turned from a phrase-level rule to a word-level rule, and therefore morpheme-final /l/ may have been lexicalised as dark.

4 Methods

4.1 Experiment design

The experiment was designed on the basis of what is known of /l/, and of Clear and Dark L in order to measure L Darkening in morpheme-final environments, and to see whether morpheme-final /l/ alternates between the allophones as would be suggested by the traditional descriptions or it is dark in morpheme-final environments regardless of the following sound as it is suggested by Scobbie and Pouplier (2010).

4.1.1 The material

The material used for analysis consisted of 48 sentences, each containing a carrier word. The carrier words of /l/ were always verbs ending in /ɪl/ or /iːl/, therefore the influence of the two vowels on /l/ can be seen. The primary reason for this is that the formants of /l/ are prone to be affected by the formants of the preceding vowel, as it was discussed in Section 3.1, therefore choosing carrier words with different vowels would have complicated comparison. Secondly, the front vowels /ɪ/ and /iː/ were chosen as the formants of Dark L are similar to that of a back vowel (Ladefoged and Maddieson 1996), therefore segmentation of *feel* seemed to be less ambiguous than that of *fool.* Thirdly, the low second formants of the back vowel (as in *fool*) affecting and lowering the formants of the following /l/ might have diminished the difference between the F2 of Clear L and Dark L. In order to provide similar intonational and stress patterns, all the sentences were in the affirmative and all the carrier words fell to the end of the sentences.

The sentences can be divided into three groups. In the first group the carrier words did not contain an /l/ but the four carrier words were *digs, give, feeds, seize* which were used to measure the length and the first and second formants of /ɪ/ and /iː/ unaffected by /l/, L Vocalisation or Pre-L Breaking. This was important because according to Cruttenden (2001), Wells (1982; 1990) only tautosyllabic, that is to say Dark L, can trigger

Pre-L Breaking[1] and only L Vocalisation can lead to the merging of the KIT and FLEECE vowels.

In the second group the carrier word had a non-alternating Clear or Dark L preceded either by /ɪ/ or /iː/. There were four carrier words *illustrate, affiliated, Felix* and *Sheila* for Clear L and *gild, built, shielded field$_v$* for Dark L, resulting in eight carrier words in eight sentences. These /l/ sounds are followed by a vowel in the same morpheme in the first four words and they are followed by a consonant in the second four words. So they are always clear in the first and always dark in the second group, and can never alternate between Clear and Dark L. This group was used to measure the length and the first and second formant of Clear and Dark L in order to get a sample of current Southern English Clear and Dark L. This was needed as the formants and acoustic qualities of /l/ are not only hard to pinpoint but also the majority of acoustic studies (Lisker 1957, O'Connor et al. 1957, Sproat and Fujimura 1993, Yuan and Liberman 2009) deal with American English. The results were used to help categorise morpheme-final /l/ and to see whether /l/ in _#(#)V environments patterns with non-alternating Clear or with non-alternating Dark L. Four of the eight words (*illustrate, affiliated, built, gild*) had a lax vowel before /l/ and four (*Sheila, Felix, shielded, field*) had a tense vowel to see how /l/ and the vowels affect each other.

In the third group the carrier word had an alternating /l/ because the /l/ fell at the end of the morpheme, so its quality could alternate between Clear and Dark L, depending on the following sound. As there are three environments in which /l/ is clear (_#V, _##V, _##j[2]) and three in which /l/ is dark (_||, _#C, _##C), there were six different environments. Three sentences were designed for each with a carrier word with /ɪ/ and three sentences were designed for each with a carrier word with /iː/. The following list provides an example for the sentences, the full list can be seen in Appendix A:

1. absolute final: *He should realise what his buddies **feel**.*[3]

2. _#C, for which the past tense or past participle was used: *The play is good so all the seats are **filled**.*

3. _##C, for which a complement was added: *It is difficult to **peel carrots**.*

4. _#V, for which the *-er* form was used: *There are a few words that are just **fillers**.*

[1] Although Wells (1990) says that a long vowel may only undergo breaking if it is followed by an /l/ in the same syllable, he transcribes *feeling*, the gerund of *feel* as [fiːəlɪŋ].

[2] The environment _#j is not possible in English because no suffix begins with /j/.

[3] The carrier words are set in bold for the convenience of the reader. Of course, the subjects of the experiment did not have the carrier words highlighted.

5. _##V for which a complement was added: *The busy cooks quickly* ***peel apples.***

6. _##j for which a complement was added: *Everybody should* ***feel useful*** *.*

The verbs in the first three environments are said to contain Dark L, whereas the verbs in the last three are said to contain Clear L. If the claim of Sproat and Fujimura (1993) holds for current Southern English as well, then the results will be gradual, and will vary according to the strength of the boundary and the length of the rhyme. If Dark L has been lexicalised all the /l/ sounds will have the same quality and there will be no difference between the first three and the second three environments as long as the preceding vowel is the same.

4.1.2 Participants and procedure

The 48 sentences were read out by 9 native speakers of English, one male and eight female. Six females and the one male speaker were born and schooled either in London or in one of the Home Counties, therefore they are considered to be native speakers of Standard Southern British English. One female speaker was born in Welwyn Garden City, Hertfordshire, but went to school in Alnwick, Northumberland from the age 4 to 14. One female speaker was born and raised in Wales. Due to the possible differences between the speakers' accent, repeated measure ANOVA tests were carried out with speaker as a factor to test interspeaker variability. The oldest speaker was born in 1986 and the youngest in 1992.

The participants read out the sentences in a random order four times, and the software *SpeechRecorder* by Draxler and Jänsch (2014) was used to randomise and project the sentences. The experiment was timed manually by the investigator. In case the speakers misread a word, made some noise, coughed, paused mid sentence etc. the sentence was repeated. However, in a few cases these misreadings were not noticed, therefore some of the recorded sentences were not used. Pausing between the verb and its complement was a common thing, which could cause a problem if the complement begins with a vowel or a yod, as these are supposed to be Clear Ls; however, pausing could make them dark, therefore these readings were not used. Namely, Speaker 6 made a long pause between the words in the phrase *chill apple juice* twice, and Speaker 3 once. Speaker 6 also paused between *kill* and *Alice*, and three times between *steal* and *yetis*. Speaker 7 paused between *kill* and *ewes* and in the phrase *steal acorn*. Speaker 2 paused in *peel apples* and in *steal acorn* and also misread the latter sentence once. Speaker 6 read *fills bookshops* instead of *fill bookshops* twice, therefore she changed a word boundary to a morpheme boundary. Unfortunately, the sentence containing *feeds* was only read three times, not four by Speakers 2, 4, 6, and 9 due to an error in the SpeechRecorder script. Therefore after excluding the misread words, the total number of words was $n = 140$ in the vowel group ($n = 72$ for lax vowels and $n = 68$ for tense vowels). The total number of words was $n = 287$ in the non-alternating group, and $n = 1282$ in the alternating group.

The recordings were made in the sound attenuated room of the Division of Language and Communication Science of School of Health Studies of the City University London, and a Marantz Professional Solid state recorder PMD660 was used with a Shure PG 81 microphone fixed in a holder. Prior to any analysis, resampling at 22050 Hz and low-pass filtering from 0 Hz to 11025 Hz were performed to avoid anti-aliasing.

4.1.3 Principles of segmentation

Annotation of the recordings was done manually on the basis of spectrogram and waveform in the software *Praat 5.3.42* (Boersma and Weenink 2013). The carrier words in the vowel group were annotated on the basis of the waveform: the beginning of the vowel was put at that point when the waveform became periodic and its end was put at that point when it stopped being periodic. This usually co-occurred with the formant transitions to and from the consonants.

When separating /l/ from the preceding vowel, drops in intensity and in the second formant were used. The starting point of /l/ was placed at that point when the second formant started to drop from the steady-phase of the preceding /ɪ/ or /iː/. When deciding on the endpoint of the vowels, the data gained from the vowel group were used to decide which is the lowest F2 that still may belong to the vowel. This principle of "what is not a vowel belongs to the /l/" lead to that the transitional phase from the vowel to the /l/ was segmented with the /l/, therefore making it longer. The transitional phase was segmented separately if there was a transition longer than 0.06 s between a steady state vowel and a steady state /l/. Therefore 0.06 s was the threshold above which the transition was treated as an inserted element. This principle was applied irrespective of the quality of /l/, therefore, long transitions were treated as inserted elements, even if the following /l/ was syllable-initial, hence traditionally considered clear.

When separating /l/ from the following sound different cues were used depending on what followed. If /l/ was intervocalic, or followed by /j/ changes in F2 were used to decide the start of the following sound. The start of the following sound was put to that point when the F2 reached the steady state at the appropriate value. This also lead to that the transitional phases were segmented with the /l/, making it somewhat longer. When /l/ was followed by a pause, the main cues to determine the end of /l/ (and that of the word) were intensity drop and the end of periodicity as shown by the waveform. When /l/ was followed by a consonant everything up to the point of closure, which was marked by an intensity drop on the waveform was segmented with the /l/.

Data were gathered automatically by Praat scripts that used the annotation to find the relevant sounds, measure their formants in the middle of the sound and their lengths. When later statistical analysis showed that the values were incorrect (for example the third formant was mistaken for the second) the values were manually corrected. In the vowel group, only F1, F2, and length were measured. In the carrier words containing an /l/ the F1, F2, and length of /l/, the length of /ɪ/ or /iː/, and the length of the inserted vowel (if there was one) were measured. The zeros of /l/ in the non-alternating group were measured manually on the spectral slice of the inverse filtered /l/ sounds. If no zero was found around 3200-3800 Hz (in accordance with Stevens 2000) /l/ was classified as vocalised.

4.2 Basis of comparison

In this section the results of the vowel group (the group of words that do not contain an /l/) and the non-alternating group (the group of monomorphemic words in which /l/ cannot alternate between clear and dark) are presented. The data gained from the vowel group were used to serve as a basis to compare L Influenced vowels to uninfluenced vowels, and thereby argue for the presence of an L Influenced Vowel and a Dark L in a canonical Clear L environment. The data gained from the non-alternating group were used to identify the features with which it is possible to differentiate between Clear, Dark, and Vocalised L, as it was assumed that in monomorphemic words /l/ is clear prevocalically and dark preconsonantally. Before comparing lax and tense vowels and non-alternating Clear L to non-alternating Dark L, repeated measures ANOVA tests were carried out with speakers as factors, and F1, F2, liquid length and vowel length as dependent variables to see if there was interspeaker variability caused by individual differences or possible accent differences.

4.2.1 Vowel group

The lax vowels showed no interspeaker variation for their first and second formants according to the ANOVA tests whose results indicated that F1 and F2 of lax vowels are not significantly affected by speaker. However, the length of lax vowels is significantly affected by the factor speaker $F(1, 8) = 96.11$, $p < 0.0001$. (Maulchy's test showed that sphericity was not violated, therefore no correction was used.) According to Bonferroni test, Speakers 1, 6, and 7 differed from the rest of the speakers. This is illustrated by Figure 4.1, which indicates that lax /ɪ/ was longer for Speaker 1, 6, and 7 than for the rest of the speakers. This may be explained by the fact that Speaker 6 is Welsh and Speaker 7 lived in Northumbria, and Speaker 1 was born and schooled in London, but he was the only male participant.

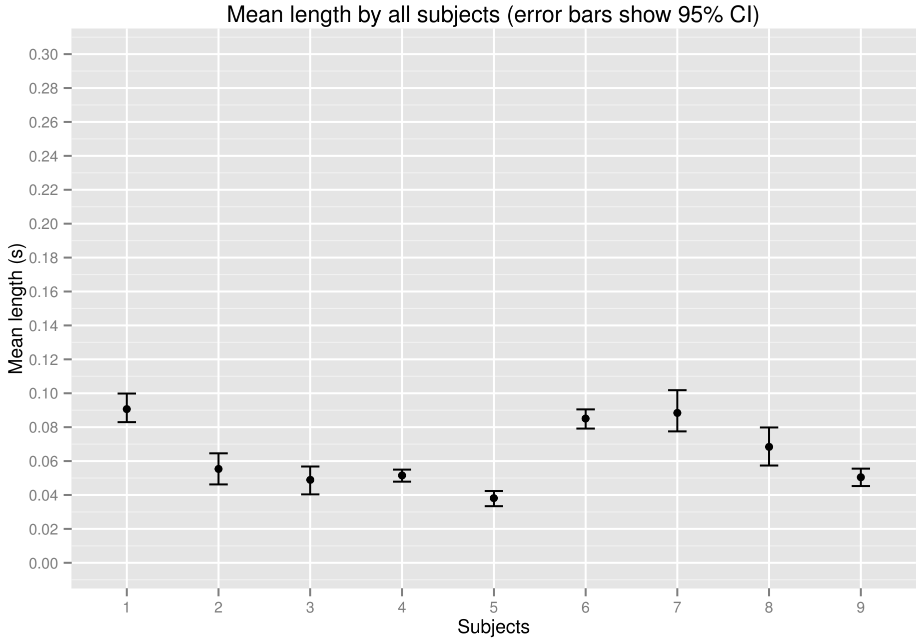

Figure 4.1: Mean length of /ɪ/ by speaker

ANOVA tests were carried out to test interspeaker variability in the tense vowels as well. The results show that F1, F2, and length are not significantly affected by the factor speaker. Given that only one variable (length of the lax vowels) showed variation out of the three measured characteristics of lax and tense vowels, the speakers were treated as a single group with respect to their vowels.

The features of tense and lax vowels differed significantly as shown by paired t-tests in Table 4.1. These values were also used when /l/ had to be separated from the preceding vowel.

4.2.2 Non-alternating group

The non-alternating group consisted of four monomorphemic words with intervocalic Clear L, and four monomorphemic word with preconsonantal Dark L. Two /l/ sounds in each subgroup were preceded by a lax vowel, and two were preceded by a tense vowel, giving four subgroups in total. The results of the ANOVA tests indicate that F1, F2, the length of /l/ preceded by a lax vowel, and the length of lax vowels, and F1 and F2 of /l/ preceded by a tense vowel are not significantly affected by the factor speaker. ANOVA was not carried out to check interspeaker variability for the length of the

		F1 (Hz)	F2 (Hz)	length (s)
lax vowels	minimum	312	1946	0.001597
	mean	469.2	2370	0.0641
	maximum	682	2876	0.1294
tense vowels	minimum	275	2021	0.00657
	mean	409.9	2641	0.11473
	maximum	597	3264	0.1887
p-values		< 0.001	< 0.001	< 0.001

Table 4.1: Minimums, maximums, and means of the measured characteristics of vowel, and the result of paired t-tests

tense vowels preceding Clear L because it did not satisfy the homogeneity of variance. Therefore it is assumed that the quality of non-alternating Clear L do not show variation across speakers.

Figures 4.2 and 4.3 provide an example for the waveform and the spectrogram of Clear L and its annotation in X-SAMPA. Annotating the spectrograms with X-SAMPA and the character <L> for Dark L instead of the X-SAMPA /l_G/ were chosen for the reasons of simplicity and practicality. Otherwise the annotations are done in X-SAMPA, and they follow the traditional Gimsonian system of transcription with respect to all the sounds except /l/ and the inserted vowel. The waveform in Figure 4.2 shows an intensity drop from the first stressed /ɪ/ to Clear L, but intensity does not rise on the waveform after [l]. The intensity difference between the two vowels and [l] can be better seen on the spectrogram, on which the lighter colour shows lower intensity. The spectrogram in Figure 4.2 also shows that the formants for [l] are less clear than for the preceding and following vowels. Figure 4.3 also shows intensity drop both on the waveform and on the spectrogram. As with 4.2, the waveform shows intensity difference between the stressed /iː/ and [l], but not between [l] and the following schwa, whereas [l] is lighter on the spectrogram than both vowels. The spectrogram in Figure 4.3 also shows less strong formants for [l] than for the vowels, and it also shows how the F2 of /iː/ starts dropping before [l]. The most interesting part of the spectrogram in Figure 4.3 is that it shows the release of [l] by a vertical black line in the middle of [l], as such release could rarely be seen. Table 4.2 shows the values of Clear L after lax and tense vowels, together with the results of the paired t-tests which were carried out to see if vowel quality has an effect on the quality of Clear L. The F1 results are in line with the previous research described in Chapter 3, but the F2 values are much higher, as they are between 2000–2200 Hz instead of the 1600 Hz which was reported in the previous studies. This high F2 value might be caused by the fact that [l] was preceded by a front vowel with a high F2, which influenced the F2 of [l].

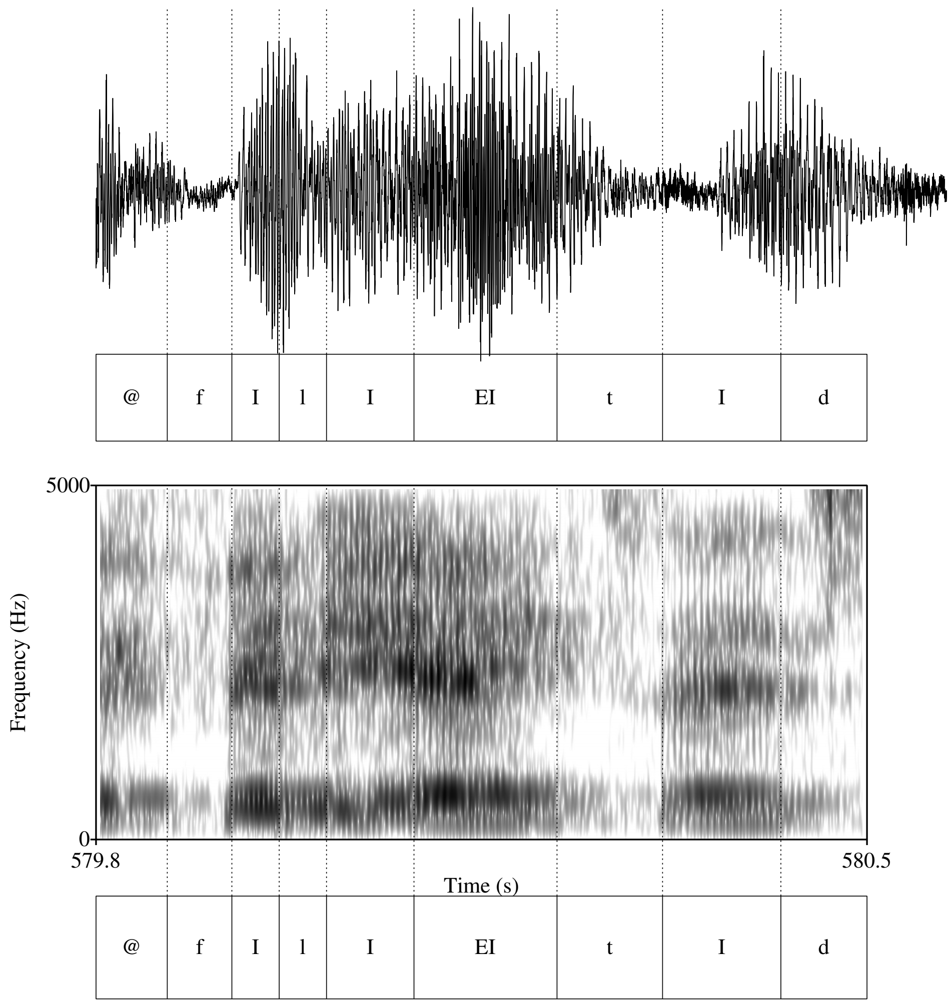

Figure 4.2: The word *affiliated* read by Speaker 6 in the second reading, annotated in X-SAMPA

Coarticulation is shown by the significant difference between the F2 of Clear L after lax and tense vowels, the F2 being higher in the latter group. Interestingly, Clear L is also longer after tense vowels than after lax vowels. Given that the results of t-tests indicated that two out of the three response variables are significantly affected by quality of the preceding vowel, these two groups were treated separately.

Preconsonantal /l/ was first divided into two groups according to the presence of a zero at 3200–3800 Hz. If a zero was present, /l/ was categorised

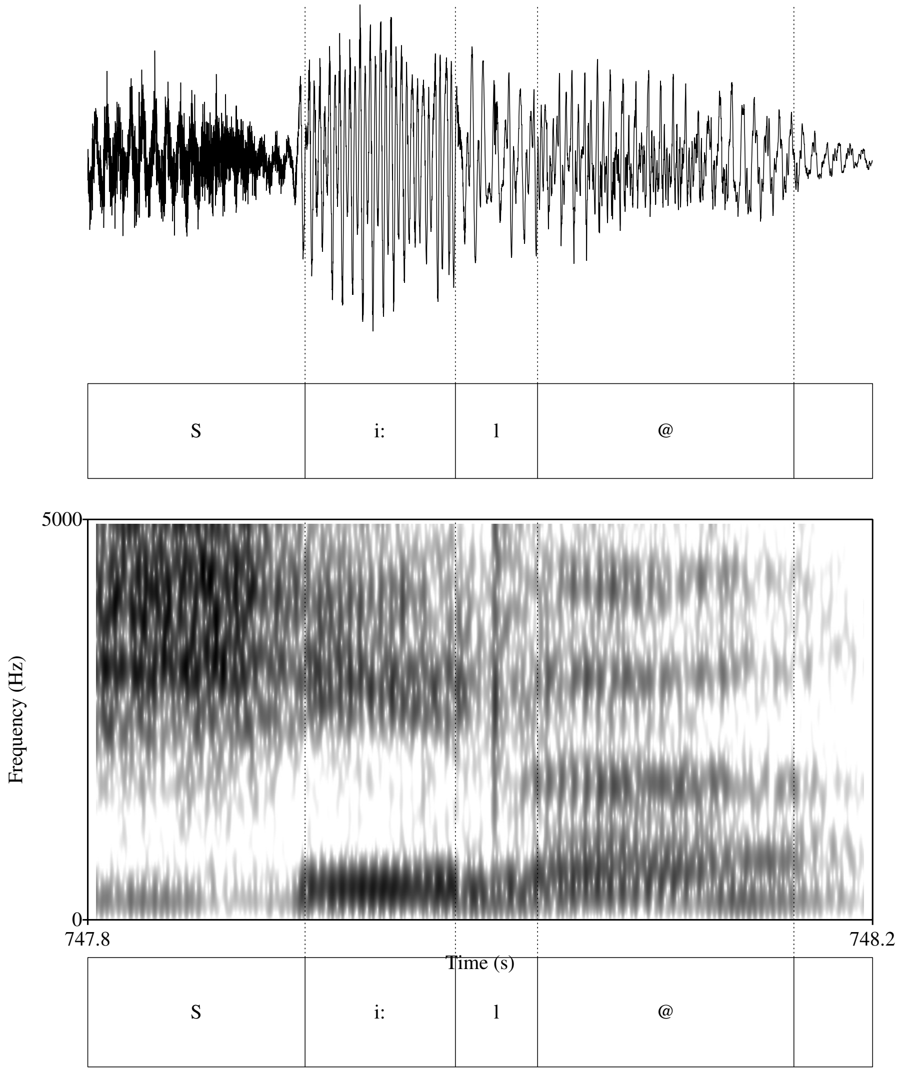

Figure 4.3: The word *Sheila* read by Speaker 6 in the second reading, annotated in X-SAMPA

as [ɫ]; if no zero was present, /l/ was categorised as Vocalised L. Figures 4.4 and 4.6 provide examples for Dark and Vocalised L respectively, and Figures 4.5 and 4.7 show the inverse filtered spectra of Dark and Vocalised L in these words to illustrate what was and what was not classified as having zeroes. Figure 4.4 shows both on the waveform and on the spectrogram that there was no intensity drop (the intensity drop at the end of [ɫ] is caused by /d/). The spectrogram also shows how F2 drops gradually from 2500 Hz to

		F1 (Hz)	F2 (Hz)	length (s)
after lax vowels	minimum	208	1466	0.0234
	mean	415.8	2056	0.053
	maximum	575	2722	0.1001
after tense vowels	minimum	173	1320	0.0347
	mean	393.8	2234	0.0682
	maximum	665	3001	0.134
p-values		0.1155	0.0019	< 0.001

Table 4.2: Minimums, maximums and means of the measured characteristics of Clear L, and the results of paired t-tests

a steady state of 1300 Hz. The drop takes a relatively long time; however it does not take 0.06 for the F2 to drop from 2000 Hz to 1300 Hz, therefore the transitory phase was segmented with [ɫ], making it long (0.13 s). The inverse filtered spectrum in Figure 4.5 shows that the sound in question in Figure 4.4 is indeed a consonant, as it has a zero of -35.1 dB at 3655 Hz, which is marked by the intersection of the straight and the dotted line. Figure 4.6 also shows the lack of intensity difference between /ɪ/ and [ɫ] and the gradual drop in F2. However, in this reading it took 0.06269 s for the F2 to reach from 2000 Hz the steady state, which was at 1200 Hz in this word. Therefore it was classified as an insertion. Figure 4.7 shows that the sound in question has to be qualified as a Vocalised L because it has no zero at around 3500 Hz. The intersection of the dotted and straight line shows that the sound had -6.1 dB at 3500 Hz; the preceding lowest point was at 2900 Hz, and the following one at 3850 Hz. Table 4.3 shows the measured values for Dark L and Vocalised L after a lax vowel, and the results of the paired t-tests to see if Dark L can be distinguished from Vocalised L based on its F1, F2 or length. Table 4.4 shows the same information for Dark and Vocalised L preceded by a tense vowel. The results are in line with the previous studies described in Chapter 3, as the F1 is between 450–500 Hz and F2 is between 1250–13500 Hz.

		F1 (Hz)	F2 (Hz)	length (s)	insertion length (s)
Dark L	minimum	319	652	0.0564	0.0617
	mean	497	1265	0.12748	0.07109
	maximum	626	1662	0.1586	0.0975
Vocalised L	minimum	274	888	0.0543	0.0593
	mean	525.6	1262	0.12214	0.07401
	maximum	759	1973	0.2043	0.1002
p-values		0.53	0.249	0.415	0.814

Table 4.3: Minimums, maximums, and means of the measured characteristics of Dark and Vocalised L after lax vowel

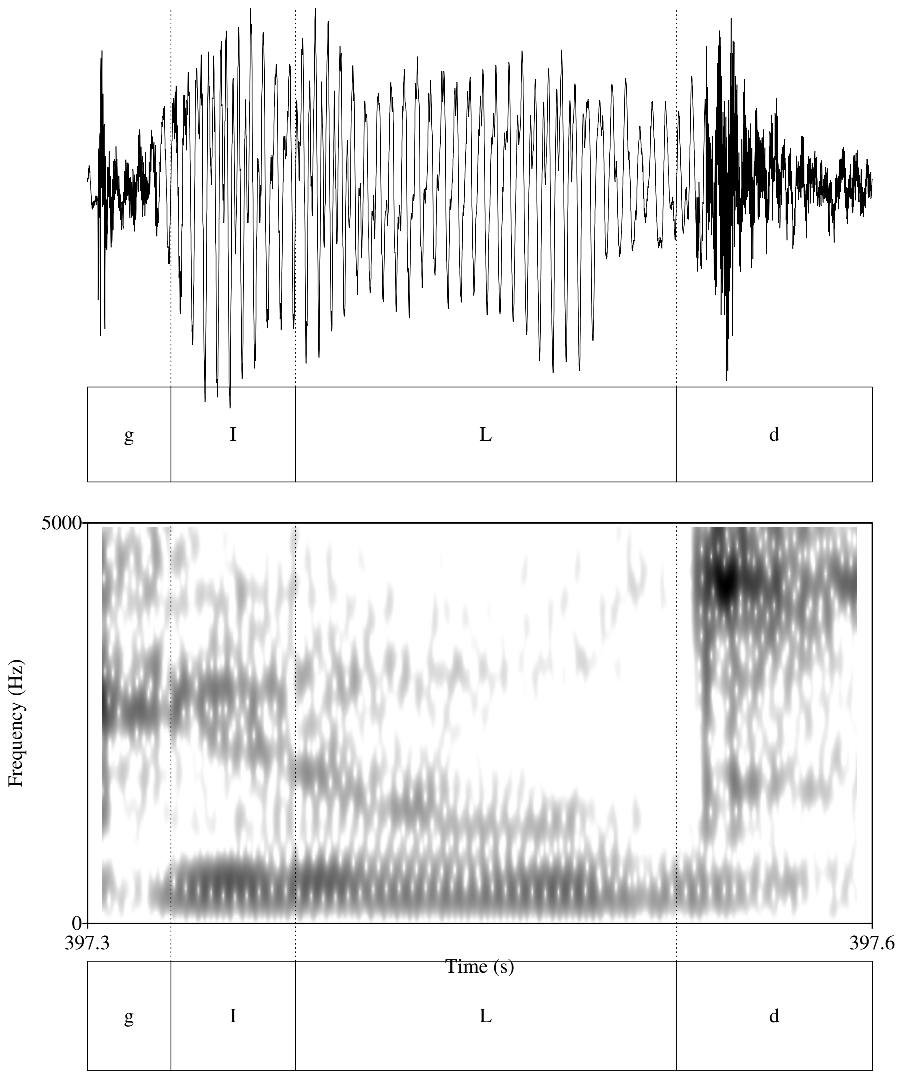

Figure 4.4: The word *gild* read by Speaker 4 in the second reading, annotated in X-SAMPA

On the one hand, out of the 72 tokens with each vowel, 40 [ɫ] were vocalised when the preceding vowel was lax, and 42 were vocalised if the preceding vowel was tense, therefore L Vocalisation is prevalent in the data. As the first formant of Vocalised L is between 467.2–525.6 Hz, and its second formant is between 1262–1322 Hz, it seems to be a near-close and central vowel. Therefore the IPA symbol used for its transcription is [ɵ] in this thesis. Insertion was found in 24 tokens when the preceding vowel was lax,

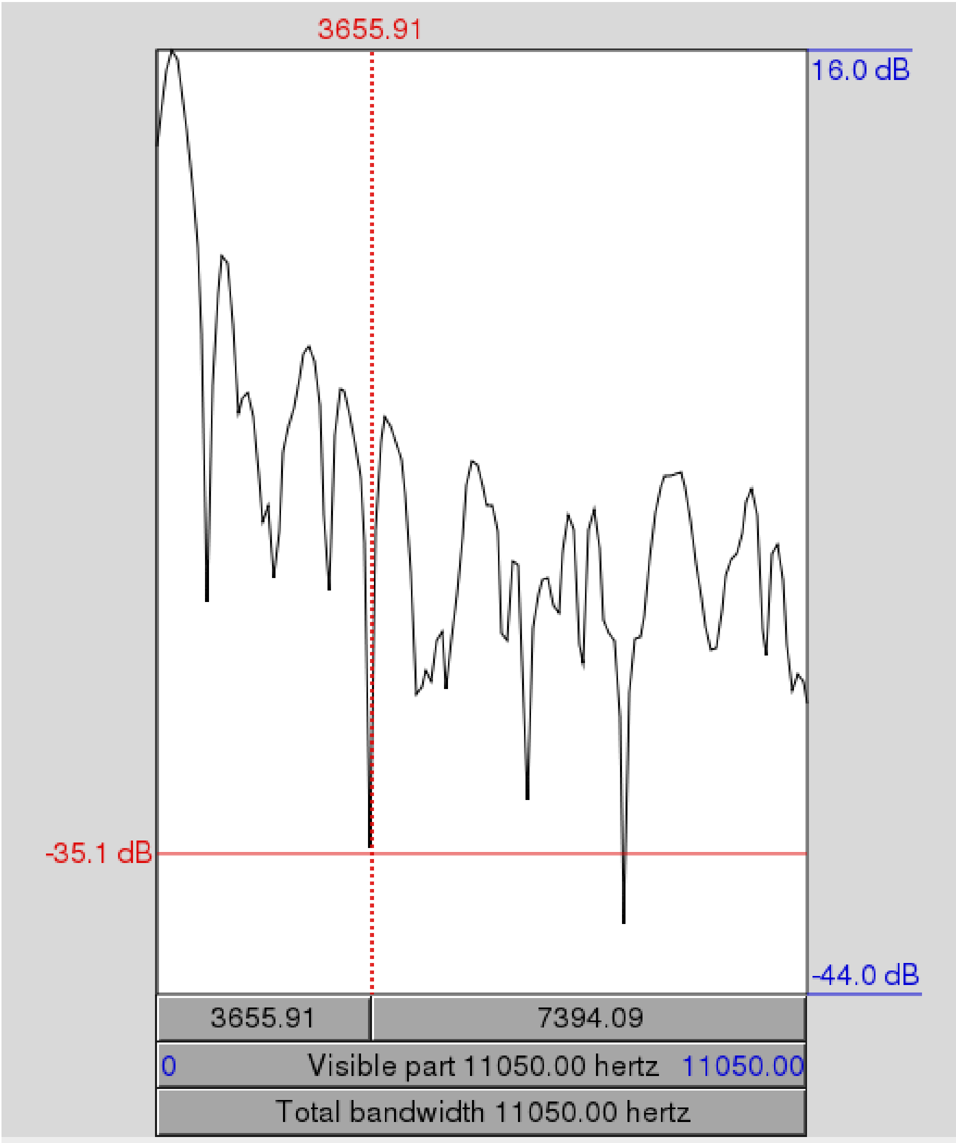

Figure 4.5: Inverse filtered spectrum of [ɫ] from the word *gild* read by Speaker 4 in the second reading

and in 25 tokens when the preceding vowel was tense. On the other hand, paired t-tests have shown that there is no significant difference between Dark and Vocalised L with respect to their formant values, length, and the length of the inserted vowel. More interestingly, vowel insertion and vocalisation did not exclude each other either: they appeared in the same tokens, namely there was an inserted vowel and [ɵ] in 16 words with lax vowel, and in 14 words with tense vowel. Neither the length of the preceding vowel differed

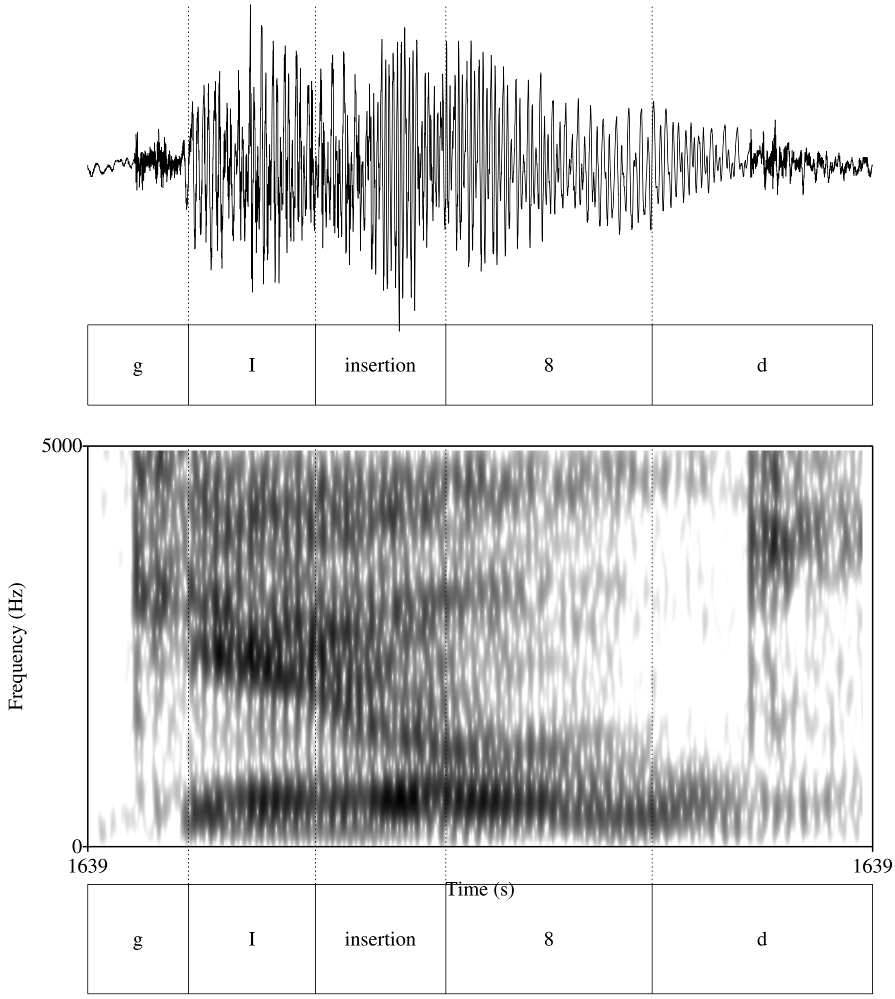

Figure 4.6: The word *gild* read by Speaker 6 in the fourth reading, annotated in X-SAMPA

between the words with Dark L and the ones with Vocalised L. The results of t-tests indicated that the length of lax and tense vowels is not affected by /l/ being vocalised ($p = 0.778$ and $p = 0.119$ respectively). Thus the only way to distinguish between Dark and Vocalised L is by the presence of a zero, and as that is not relevant for the present study, Dark and Vocalised L are treated as one group.

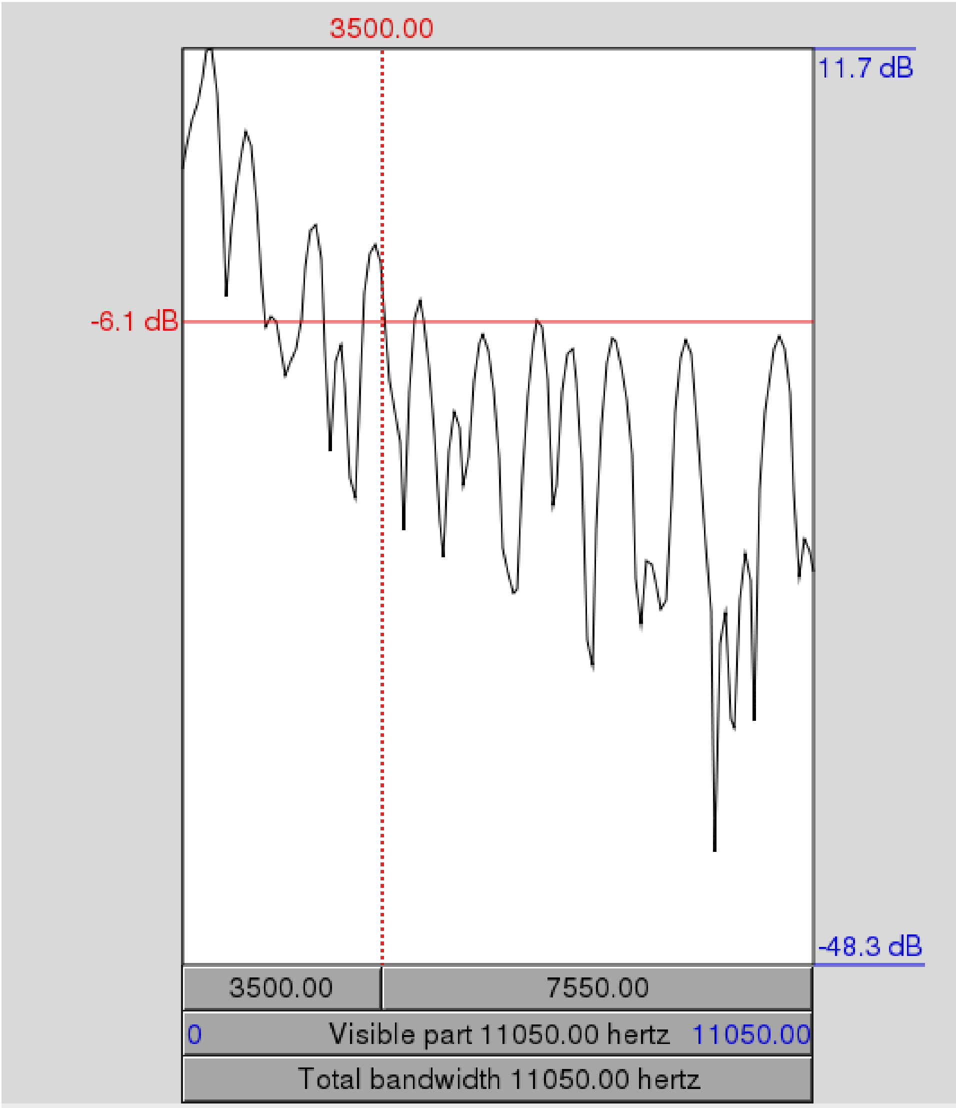

Figure 4.7: Inverese filtered spectrum of [ɵ] from the word *gild* read by Speaker 6 in the fourth reading

4.2.3 Distinguishing Clear L and Dark L

Clear and Dark L can be distinguished based on the F1, F2, liquid length and vowel length gathered from the non-alternating group. ANOVA tests were carried out between the groups of non-alternating Clear and Dark L (the latter included both [ɫ] and [ɵ]) according to the aforementioned four characteristics in order to see if there is a significant difference between the groups. The error term was liquid quality (i.e. Clear or Dark) within speaker. Table 4.5 shows the ANOVA values for Clear and Dark L.

		F1 (Hz)	F2 (Hz)	length (s)	insertion length (s)
Dark L	minimum	283	918	0.0676	0.0598
	mean	469.4	1345	0.1122	0.06885
	maximum	561	2008	0.0158	0.0924
Vocalised L	minimum	348	710	0.0435	0.0597
	mean	467.2	1322	0.1154	0.06482
	maximum	664	1803	0.201	0.0729
p-values		0.788	0.984	0.582	0.086

Table 4.4: Minimums, maximums, and means of the measured characteristics of Dark and Vocalised L after tense vowel

Vowel	Dependent variable	Df	F	*p*
Lax vowel	F1	1	53.82	<0.0001
	F2	1	274.4	< 0.0001
	length	1	102.1	<0.0001
	vowel length	1	36.44	0.000311
Tense vowel	F1	1	19.6	0.0022
	F2	1	93.65	< 0.0001
	length	1	62.2	< 0.0001
	vowel length	1	49.2	0.000111

Table 4.5: ANOVA results for the difference between Clear and Dark L if preceded by lax or tense vowels respectively

Based on these results, and the values corresponding to Clear and Dark L, as provided in Table 4.2 for Clear L and in Table 4.3 and 4.4 for Dark L, it is possible to classify the /l/ sounds in morpheme-final environment as either Clear or Dark, irrespective of the following environment. Clear L has a lower F1, a higher F2, and it is shorter than Dark L. Thus it is possible to test whether morpheme-final prevocalic /l/ is clear or dark.

It was also tested whether the quality of vowels in the vowel group differ from the quality of the vowels followed by a non-alternating Dark L. Therefore paired t-tests were used to compare the F1, F2, and the length of /ɪ/ and /iː/ between the two groups. The results were p<0.001 for all comparisons, except for the length of the lax vowel which was not affected by a following [ɫ], as the result was $p = 0.0883$. The mean of F1 was higher and the mean of F2 was lower for the vowels influenced by [ɫ] than for "plain" vowels. The mean length of /iː/ was 0.11535 s when it was not influenced by [ɫ], and 0.06445 when it was influenced by [ɫ]. That is to say Dark L seems to have a centralising effect on /ɪ/ and /iː/ and a shortening effect on /iː/. Therefore, if there is a KIT-FLEECE Merger, its result seems to be that FLEECE is going towards KIT.

5 Results

This section contains the data gained from the experiment, and the results of the statistical analysis of the sound /l/ in 12 groups, and the differences between these groups. The 12 groups can be seen in Table 5.1, in which the rows show the two preceding vowels, and the columns show the environment following /l/. The measured acoustic features, which also were the dependent variables, were F1, F2, length of /l/, the length of the preceding vowel, and the length of the inserted vowel if there was one. The used statistical tests were ANOVA to see if there are any significant differences between the features of /l/ in different environments and Bonferroni correction to see which environment caused the difference in the features of /l/.

	_#V	_##V	_##j	_#C	_##C	_||
lax vowel	*filler, chiller, killer*	*kill Alice, spill apple juice, chill apple juice*	*kill ewes, chill yeast, fill Yorkshire*	*killed, filled, chilled*	*kill Sarah, fill bookshops, spill secrets*	*kill, fill, chill*
tense vowel	*dealer, peeler, stealer*	*peel apples, feel accepted, steal acorn*	*feel useful, steal yetis, steal yaks*	*appealed, sealed, peeled*	*feel cold, peel carrots, steal jewellery*	*deal, feel, steal*

Table 5.1: Phrases in the alternating group

Interspeaker variability was tested before analysing the data to see if any speaker differed from the rest with respect to their /l/ sounds in the different environments. Interspeaker variability was tested separately in the 12 groups for each dependent variable with ANOVA with speaker as a factor, when the data did not violate variance homogenity. The ANOVA tests did return significant *p*-values for four dependent variables in three different groups. These were the F2 and length of [ɫ] in the [ɪɫ||] group, the F2 of [ɫ] in the [ɪɫ#C] group, and the F2 of [ɫ] in the [iːɫ#C] group. However, there was no such speaker who consistently differed from the rest with respect to one or more features, and those whose accents could have been influenced by non-southern variety of English did not differ from those speakers who were from the Home Counties. Therefore none of the speakers' data was removed, no subgroups were made based on accents, and the group was treated as homogeneous. However, it has to be noted that further research is needed with more robust statistics, such as mixed effects models, or MANOVA which can handle variability between the speakers.

First, ANOVA tests were used to compare alternating Clear L to non-alternating Clear L and alternating Dark L to non-alternating Dark L to see if the alternating liquid differed from the non-alternating ones. The four factors were the four environments (no boundary, morpheme boundary, word boundary, and pre-yod/absolute final), and post-lax and post-tense /l/ were tested separately. Significant differences were found. Therefore secondly the effect of the boundary and the effect of the following environment were tested to see if there were any significant differences within the group of alternating Clear and Dark L according to the four following environments. These ANOVA results also returned significant *p*-values. Lastly, alternating Clear L was compared to non-alternating and alternating Dark L to see if they can be considered dark according to their acoustic features. The mean of the measured characteristics can be seen in Figures 5.1–5.8, which show the data gained from all the speakers in all the morpheme-final and morpheme-internal environments as well. Figures 5.1–5.4 show data from the words in which /l/ was preceded by a lax vowel, Figures 5.5–5.8 show data from those words in which /l/ was preceded by a tense vowel. In the figures the environments were transcribed with a modified X-SAMPA, in which Dark L is marked by <L> instead of <l_G>, a morpheme boundary is marked by <#>, and a word boundary by <##>. This transcription was chosen for the sake of practicality.

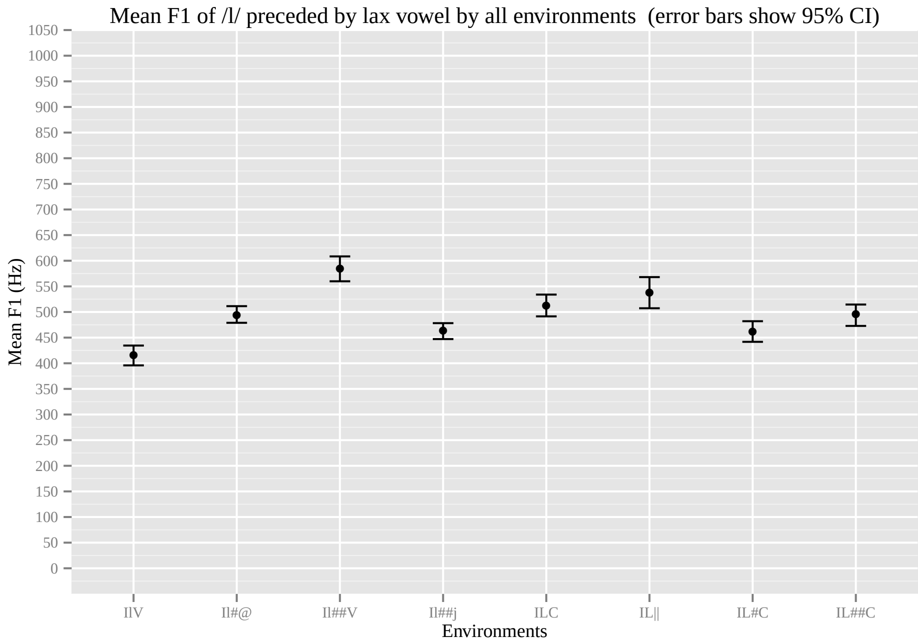

Figure 5.1: F1 of /l/ preceded by lax vowel

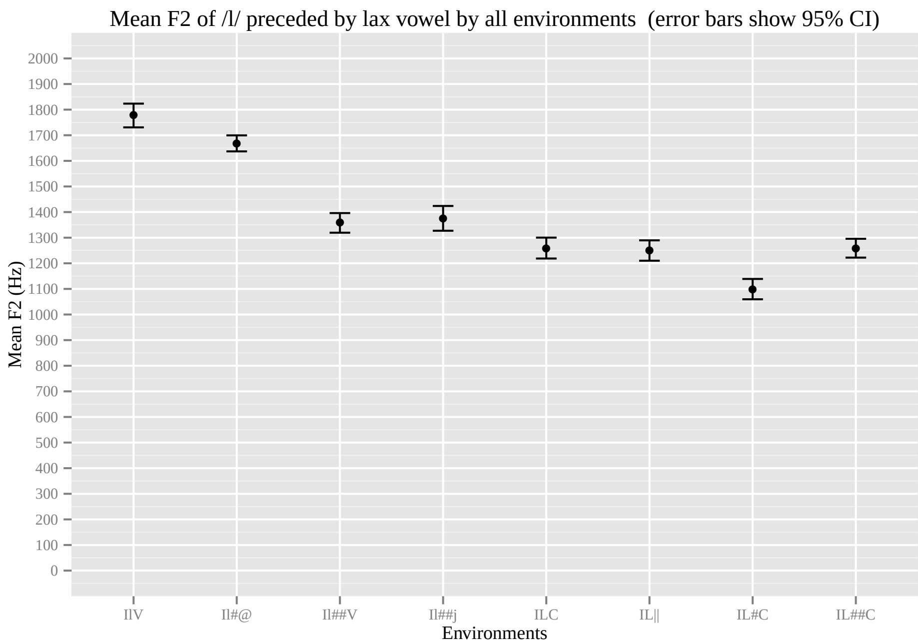

Figure 5.2: F2 of /l/ preceded by lax vowel

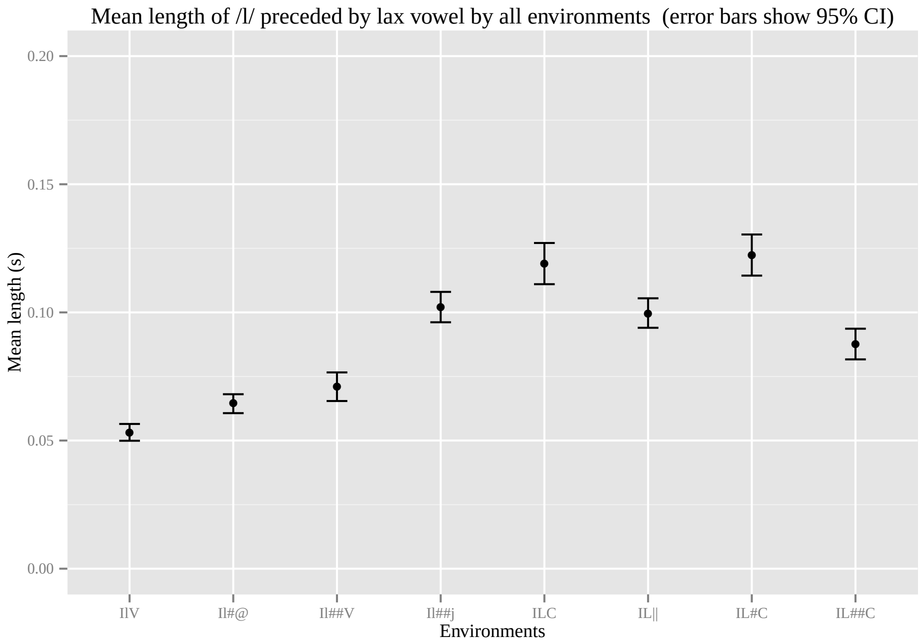

Figure 5.3: Length of /l/ preceded by lax vowel

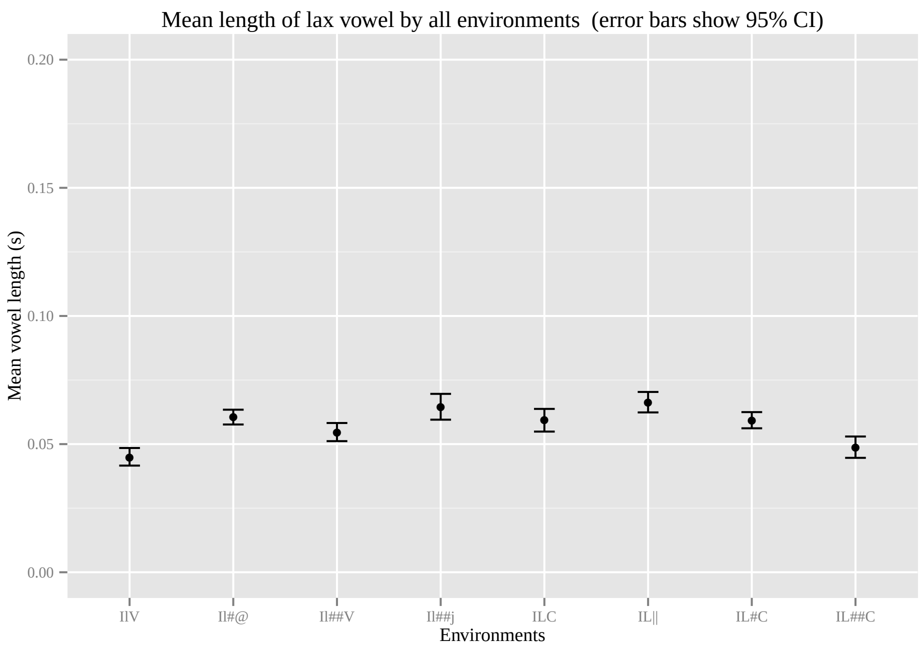

Figure 5.4: Length of lax vowel

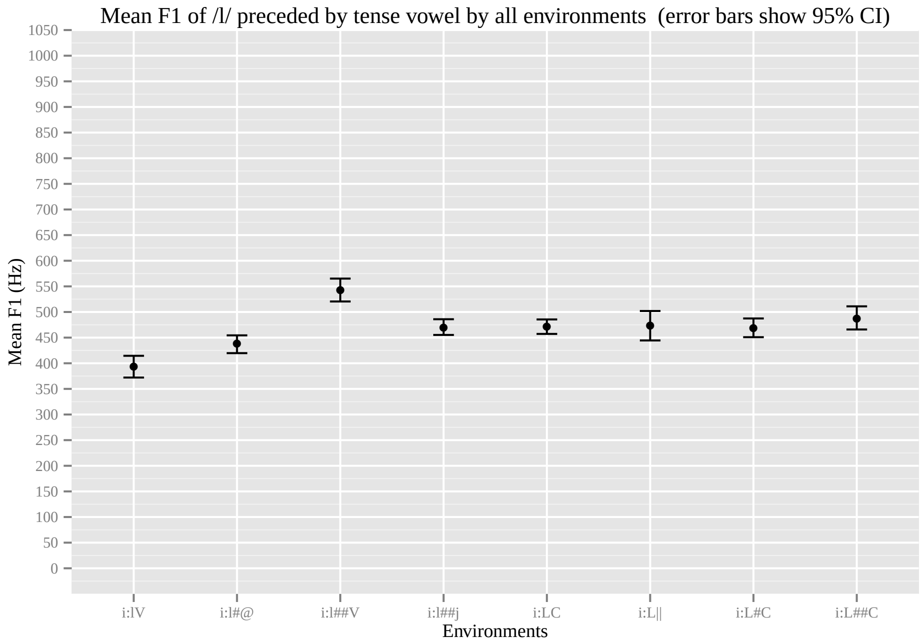

Figure 5.5: F1 of /l/ preceded by tense vowel

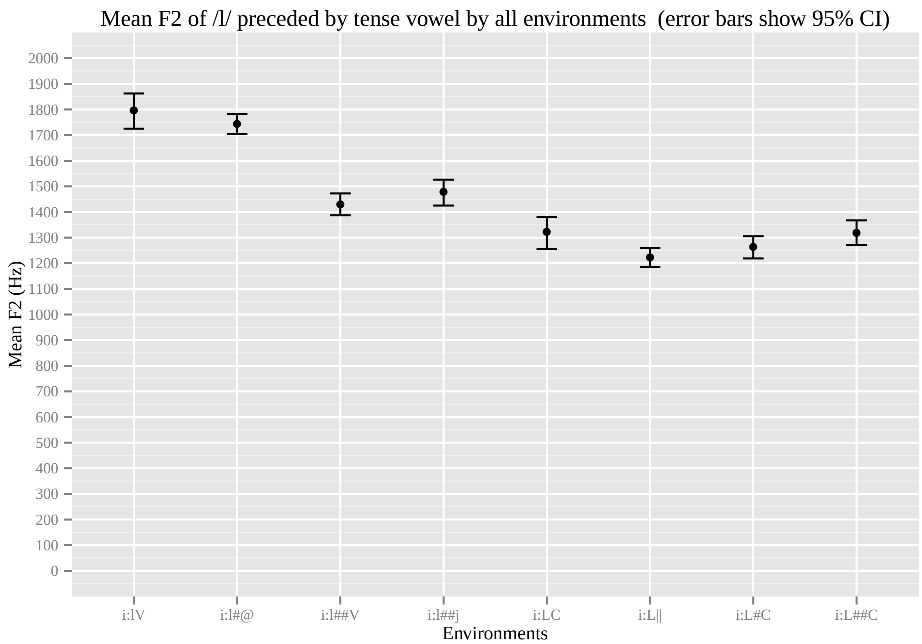

Figure 5.6: F2 of /l/ preceded by tense vowel

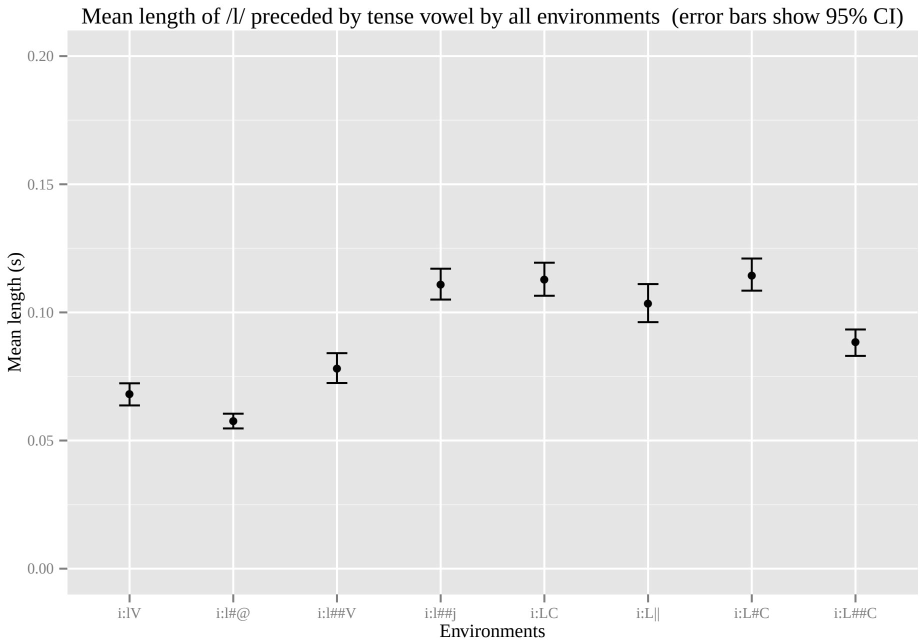

Figure 5.7: Length of /l/ preceded by tense vowel

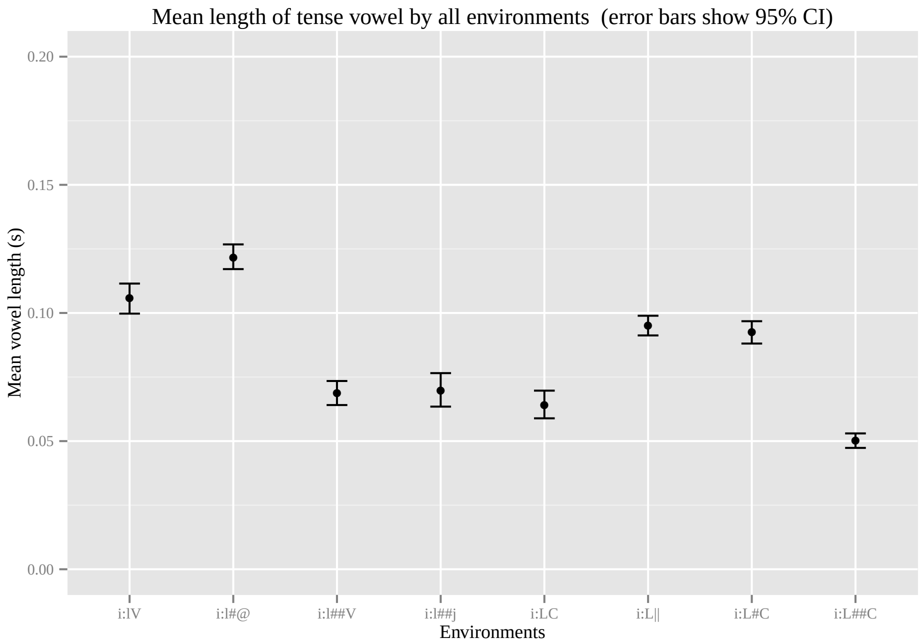

Figure 5.8: Length of tense vowel

5.1 Clear L

The number of the analysed words (which were read without pausing, coughing, etc.) was $n = 636$, but in 34 cases no /l/ or /ɵ/ was visible after the vowel. In these 34 cases only the length of the vowel was measured, and /l/ was considered to have been deleted, therefore $n = 636$ words were used to gain data on the length of the vowel preceding /l/ and $n = 602$ words were used to gain data on Clear L. The results are given in Table 5.2, which also shows that contrary to the previous studies, insertion was found before Clear L in 69 times out of the 319 tokens with lax vowel and 88 times out of the 317 tokens with tense vowel. These data were compared with the data gained from the non-alternating group. The results of the ANOVA tests can be seen in Table 5.3.

environment		F1 (Hz)	F2 (Hz)	length (s)	vowel length (s)	insertion length (s)
/ɪl#ə/	min.	305	1262	0.0247	0.0294	0.0612
	mean	493.9	1710	0.06451	0.05986	0.06317
	max.	733	2231	0.1129	0.0967	0.0656
/ɪl##V/	min.	369	833	0.0208	0.0228	0.0610
	mean	588.9	1360	0.07102	0.05878	0.08409
	max.	1060	1831	0.1496	0.5002	0.1574
/ɪl##j/	min.	193	740	0.03820	0.0273	0.0607
	mean	463.6	1508	0.10308	0.05669	0.06264
	max.	681	3169	0.2063	0.1287	0.0663
/iːl#ə/	min.	192	1400	0.03040	0.066	0.603
	mean	438	1978	0.05758	0.1223	0.06465
	max.	790	2955	0.1025	0.2009	0.0731
/iːl##V/	min.	296	1045	0.0239	0.025	0.0606
	mean	542.5	1497	0.07815	0.0687	0.0779
	max.	874	2414	0.1977	0.1406	0.1223
/iːl##j/	min.	315	1025	0.054	0.0239	0.0606
	mean	469.7	1486	0.11187	0.06968	0.06941
	max.	671	2175	0.201	0.1709	0.1071

Table 5.2: Minimum, mean, and maximum of F1, F2, length, vowel length, and insertion length when the liquid was in a canonical clear position

The ANOVA results in Table 5.3 indicate that morpheme-final /l/ in a canonical clear position differs significantly from [l] in the non-alternating group with respect to all dependent variables, except for the length of the preceding lax vowel. This latter result agrees with the findings of the vowel group as the length of the lax vowel in the vowel group did not differ signif-

Vowel	Dependent variable	Df	F	p
Lax vowel	F1	3	39.88	<0.001
	F2	3	32.95	<0.001
	length	3	20.25	<0.001
	vowel length	3	2.546	0.0798
Tense vowel	F1	3	27.83	<0.001
	F2	3	56.9	< 0.001
	length	3	46.25	<0.001
	vowel length	3	34.45	<0.0001

Table 5.3: ANOVA results for alternating and non-alternating Clear L

icantly from the length of lax vowel followed by a non-alternating Dark L either. Bonferroni post hoc tests indicate that all the dependent variables in all the three environments within the alternating group differ significantly from the dependent variables in the non-alternating environment with one exception. The only exception being the length of /l/ which does not differ between /iːlV/ and /iːl##V/. Therefore these results seem to indicate that morpheme-final /l/ differs from morpheme-internal /l/, even if both are followed by a vowel. As Figures 5.1–5.8 show, F1 is higher, F2 is lower and the liquid is usually longer in morpheme-final canonical clear environments than in a morpheme-internal clear environment. These might indicate that alternating /l/ is more open and front, or more central than the non-alternating Clear L. This difference between non-alternating and alternating Clear L is also supported by the length of tense vowel which is shorter if it is followed by a morpheme-final /l/, even if the /l/ is prevocalic. The fact that insertion is found before a prevocalic but alternating /l/, but not before a non-alternating Clear L may also indicate that an alternating /l/ may not be considered clear, although it is prevocalic.

The results of Bonferroni tests also indicate that F1, F2, and the length of /l/ varies within the alternating group according to the three following environments. Figures 5.1-5.2 and 5.5-5.6 indicate that /l/ has the highest F1 and lowest F2 if it is followed by a vowel at the beginning of the next word, therefore /l/ may be considered the "darkest" of the three if it is followed by a word boundary and a vowel. The sound /l/ has the shortest duration, the highest F2, and in case of a preceding tense vowel the lowest F1 as well if it is followed by the suffix *-er*, therefore /l/ may be considered the clearest if it is followed by a morpheme boundary and a vowel. Pre-yod /l/ seems to be in between the other two, as it is always the longest, and length seems to correlate with darkness. Its F2 is also low compared to the F2 of non-alternating Clear L, and it does not differ significantly from the F2 of /l/ in the /iːl##V/ environment, which also suggests that it is relatively dark. However, its F1 is closer to that of an /l/ found before a morpheme boundary and a vowel than to that of an /l/ found before a word boundary and a vowel. Therefore /l/ in the group which is called “alternating Clear L” does not appear to be clear at all, and its darkness appears to be gradual.

5.2 Dark L

The number of analysed words was $n = 646$, but in 30 words the /l/ was deleted, so $n = 616$ words were used to gain data on Dark L, and 646 to measure the length of the preceding vowel. Insertion was common, as it was expected on the basis of literature, and it was found 230 times out of the 324 words with tense vowel. However, it was also found 193 times out of the 322 words with lax vowel. The results can be seen in Table 5.4, and the results of the ANOVA tests comparing alternating Dark L to non-alternating Dark L can be seen in Table 5.5.

Environment		F1 (Hz)	F2 (Hz)	length (s)	vowel length (s)	insertion length (s)
	min.	182	569	0.0159	0.0243	0.0606
/ɪl#d/	mean	461.9	1098.6	0.13278	0.05922	0.08897
	max.	774	1559	0.2744	0.1312	0.1836
	min.	218	685	0.0308	0.0207	0.0611
/ɪl##C/	mean	486.4	1239	0.08719	0.05627	0.07437
	max.	716	1737	0.1765	0.14161	0.1338
	min.	247	829	0.0392	0.027	0.0607
/ɪl||/	mean	537.4	1249	0.1005	0.06618	0.08239
	max.	996	1741	0.2054	0.1368	0.1328
	min.	240	844	0.0546	0.0435	0.6
/iːl#d/	mean	468.9	1263	0.11634	0.09253	0.08921
	max.	737	1894	0.2234	0.1836	0.1543
	min.	218	685	0.0308	0.027	0.06110
/iːl##C/	mean	486.4	1239	0.08719	0.05627	0.07437
	max.	716	1737	0.1765	0.1416	0.1338
	min.	218	815	0.0466	0.0298	0.0606
/iːl||/	mean	473.2	1224	0.1056	0.09515	0.08525
	max.	878	1740	0.2378	0.1536	0.13

Table 5.4: Minimum, mean, and maximum of F1, F2, length, vowel length, and insertion length when the liquid was in a canonical dark environment

The ANOVA results in Table 5.5 might indicate that there is a significant difference between alternating and non-alternating Dark L; however, Bonferroni correction showed that most of the variation was caused by the

Vowel	Dependent variable	Df	F	p
Lax vowel	F1	3	4.25	0.0153
	F2	3	10.47	0.000136
	length	3	13.59	<0.0001
	vowel length	3	13.61	-
Tense vowel	F1	3	0.208	0.89
	F2	3	2.643	0.0723
	length	3	5.26	0.00653
	vowel length	3	85.89	<0.0001

Table 5.5: ANOVA results for alternating and non-alternating Dark L

differences within the alternating group. Alternating Dark L differed from non-alternating Dark L with respect to its F2 in one group, and with respect to its length in three groups. Significant difference was found between the F2 of non-alternating Dark L and the F2 in the /ɪl#d/ environment. Significant differences were found between the length of non-alternating Dark L and the length of /l/ in the absolute-final and pre-word boundary environment, if the preceding vowel was lax. If the preceding vowel was tense, only the length of pre-word boundary Dark L differed from the length of the non-alternating Dark L. Therefore it seems that the /l/ in the alternating Dark L group is indeed dark.

However, there is a difference within the group of alternating Dark L which appears to correlate with the environment that follows it. When [ɫ] is preceded by a lax vowel, F2 and length show significant differences according to the following environment. Namely, [ɫ] has a lower F2 and it is longer in the /ɪɫ#d/ environment than in the other two ([ɫ] does not show difference between the other two). As length and low F2 correlate with the darkness of /l/, it seems that [ɫ] is darker before the past tense suffix than before a pause or a word boundary and consonant. When the preceding vowel was tense, only the length of [ɫ] showed variation, as it was significantly shorter in the /iːl##C/ environment than in the other two.

5.3 Clear versus Dark L: revisited

Lastly, alternating Clear L was compared to non-alternating and alternating Dark L as well in order to see if morpheme-final /l/ may be called dark. The results appear to be contradictory. Morpheme-final Clear L tended to differ significantly both from non-alternating Clear L and from morpheme-internal and morpheme-final Dark L as well with respect to its F2, irrespective of the vowel that preceded it. Its F1, however, did not differ from the F1 of Dark L when it was followed by the suffix *-er* or a yod, and this was found both after the lax and the tense vowel. The F1 of morpheme-final Clear L differed significantly from that of the Dark L when it was followed by a morpheme boundary and a vowel, but it differed significantly because it was even *higher* than the F2 of Dark L. The length of morpheme-final Clear L differed from that of Dark L when the preceding vowel was lax, and it did not when the preceding vowel was tense and the following sound was yod. Therefore it seems that the F1 of morpheme-final Clear L tends to be closer to the F1 of Dark L; however, the F2 of morpheme-final Clear L suggests that morpheme-final Clear L is halfway between a non-alternating Clear L and a Dark L. It also might seem that a following yod does not pattern as unambiguously with the vowels as the literature suggested.

The length of the lax vowel did not show significant difference before Clear or Dark or morpheme-final or morpheme-internal /l/, but it was not expected to, as it did not show any difference between the vowel group and non-alternating Dark L either. However, the length of tense vowel before a morpheme-final Clear L differed both from the length of the tense vowel before a non-alternating Clear L and before a Dark L.

Inserted vowels, which are only supposed to appear before a Dark L, were found before morpheme-final Clear L, and were not found at all before non-alternating Clear L. However, it was only found in 21.6% and 27.7% of the tokens before Clear L and after lax and tense vowels respectively, whereas it was found in 59% of the tokens before Dark L and after a lax vowel, and 71% before a Dark L and after a tense vowel. Therefore it seems that insertion is indeed the most common after a tense vowel and before a Dark L, but it also does happen after a lax vowel, and before Clear L as well. It also seems that the number of insertion is approximately the same after lax and tense vowels, if the following sound is a morpheme-final prevocalic /l/.

Thus the data suggest setting up a scale for L Darkening: the startpoint is non-alternating Clear L, the endpoint is Dark L, as /l/ appears to be dark if it is followed by consonant or a pause irrespective of the morpheme-boundaries. The intermediate part is formed by morpheme-final /l/ followed by a vowel. This groups is not homogeneous, therefore it can only be used as an umbrella term to cover the three environments that form it. The sound /l/ is neither clear nor dark in this group, but it appears to tend toward Dark L.

6 Discussion

As it can be seen in Chapter 5, morpheme-final /l/ is dark, and it forms a relatively homogeneous group when it is followed by a consonant or nothing. However, morpheme-final prevocalic /l/ shows significant differences both from non-alternating Clear L and Dark L, and interestingly from morpheme-final Dark L as well. Moreover, there are also significant differences between the different environments that form the group called morpheme-final Clear L. This section aims to explain these discrepancies and analyse how the following environment and different boundaries (morpheme boundary and word boundary) affect the clearness of /l/.

6.1 Morpheme-final "Clear" L

Morpheme-final "Clear" L appears to share some of the characteristics of Dark L, but none of the characteristics of non-alternating Clear L. The features suggesting that morpheme-final prevocalic and pre-yod /l/ might be dark are its high F1, the shortness of pre-Clear L tense vowel, and the presence of an inserted vowel. The characteristics suggesting that it forms an intermediate category are its length and F2, as it is longer and has a lower F2 than non-alternating Clear L, but any Dark L (morpheme-final and morpheme-internal) is longer and has a lower F2. Therefore it is possible to argue that L Darkening is a gradual phenomenon, in which morpheme-final /l/ in a canonical clear position is neither Clear nor Dark, but Semi-dark.

Firstly, the F1 of morpheme-final Semi-dark L does not differ significantly from the F1 of Dark L if it is followed by the suffix *-er* or a yod. This holds both for /l/ preceded by lax and by tense vowels as well, so it seems that the lower F1 of a tense vowel does not have a lowering effect on the F1 of /l/. It also appears that the morpheme boundary and word boundary have the same effect, as the F1 is equally high before a word boundary and a yod and before the suffix *-er*. The odd one out is the F1 of /l/ followed by a vowel at the beginning of the next word, which is not only higher than the F1 of a non-alternating Clear L, but it is also even higher than the F1 of a Dark L. This may be explained by the fact that the words following /l/ in this environment were *apple, apple juice, Alice, accepted* and *acorn.* Three out of the five begins with /æ/ or /a/, depending on which dictionary is consulted, as Wells (1990) uses /æ/, and Szigetvári and Lindsey (2015) uses /a/. One word begins with /ɛ/ and one with /ə/. Therefore, /l/ is followed by an open vowel in three sentences, once by a mid-open, and once by schwa, and these vowels, as open vowels, are known to have a high F1 (Stevens 2000, 268–277). For example, RP English /æ/ has an F1 at 1018 Hz for female speakers and /ɛ/ in /ɛɪ/ at 581 Hz for female speakers (Cruttenden 2001, 98-99). Schwa has an F1 between 550–650 Hz in Arrente (Ladefoged and Maddieson 1996, 288), and the F1 of/ɜː/, which often coincides with schwa, is at 650 Hz (Cruttenden 2001, 99,125), and can be even higher for word-final schwa, which is more open (Cruttenden 2001, 127). Therefore, this high F1 may be caused by coarticulation, which /l/ is prone to (as it was discussed in Chapter 3). It is also possible that the F1 of word-final /l/, which was higher than that of morpheme-internal Clear L to begin with, was further raised by the open vowel, and if the carrier phrase had been *steal earrings* or *steal Italy*, the F1 would have only shown significant differences between non-alternating Clear L and the rest of the environments.

When analysing the possibility of coarticulation, it also has to be noted that both the sounds preceding morpheme-final /l/ and the following yod had a low F1. According to this experiment, the preceding /ɪ/ and /iː/ have a mean F1 of 469.2 Hz and 409.9 Hz respectively (see Table 4.1). The following yod has a low F1 (around 360 Hz according to Lisker 1957 and between 250–300 Hz according to Stevens 2000, 532). Even though /l/ was put into an environment with low F1 values, and Clear L itself is supposed to have a low F1, the F1 of /l/ is high in a morpheme-final prevocalic environment. Therefore it seems that the F1 of a morpheme-final /l/ in a canonical clear position strongly tends towards the F1 of Dark L.

Secondly, the F2 of /l/ in morpheme-final Clear L environment differs significantly both from non-alternating Clear L and from Dark L. The F2 values are lower than in the non-alternating Clear L group, but higher than for Dark L in all the six subgroups. Coarticulation does not appear to influence the F2 as much as it appears to influence the F1 of these words, as the F2 of /l/ followed by /æ/ with a low F2 and by /j/ with a high F2 are rather close to each other. Bonferroni correction between these two groups (/l##j/ and /l##/V) yielded $p = 1.00$, if /l/ was preceded by tense vowel. Although Bonferroni correction yielded $p = 0.0047$ when /l/ was preceded by lax vowel, this significant difference is most likely due to the few outlier F2 values in the pre-yod group that were extremely high (around 3000 Hz) and which also lead to a non-normal distribution. Examination of Figure 5.2 shows no significant difference, therefore it is assumed that the F2 of /l/ in the /ɪl##V/ and /ɪl##j/ environment did not differ from each other. This similarity can also be seen in Figures 5.2 and 5.6. However, the subgroup in which /l/ was followed by *-er* differed significantly from the other two ($p < 0.0001$), when it was preceded by a lax vowel, and also when it was preceded by a tense vowel. The mean F2 in this subgroup was 1710 Hz and 1978 Hz if /l/ was preceded by a lax or a tense vowel respectively, whereas it was between 1360–1508 Hz for the other subgroups (see Table 5.2). This difference appears to be the result of the different boundaries after /l/. The F2 of morpheme-final Semi-dark L is significantly lower if it is followed by a word boundary than if it is followed by a morpheme boundary. Therefore, based on this experiment it seems that /l/ has the highest F2, and thus it is the clearest if it is followed by a vowel in the same morpheme, the F2 is lower if it is followed by a morpheme boundary and a vowel, as in *killer*, and F2 is even lower if it is followed by a word boundary and a vowel as in *kill aliens*. Thus, with respect to F2, L Darkening appears to happen in canonical Clear L positions. L Darkening in canonical clear environments also seems to be a gradual process in which the strength of the boundary may be the key factor, as the stronger the boundary the darker the /l/. This result is in line with the strength of boundaries assumed by both Sproat and Fujimura (1993) and by Chomsky and Halle (1968, 13) and with the results of Sproat and Fujimura (1993), who found /l/ to be the darkest before strong boundaries. The F2 results also suggest that /l/ is not clear but it may tend toward [ɫ] in canonical Clear L positions.

The length of /l/ in the subgroup in which /l/ is preceded by a lax vowel also might confirm this pattern. When /l/ was preceded by a lax vowel, it was the shortest when it was followed by a vowel in the same morpheme, it was longer when it was followed by a vowel in the suffix, it was even longer when it was followed by a vowel at the beginning of the next word. /l/ was the longest when it was followed by a yod, which is most probably the result of the segmentation. As it was stated in Section 4.1.3, the sound following /l/ started when the formants reached the steady-state value typical to that sound. Given that the mean F2 of /l/ was 1508 Hz before /j/, and the typical F2 for /j/ is well above 20000 Hz (Lisker 1957), there were considerable differences between the steady state of F2, which made the /l/–/j/ transitions longer. These complications aside, it still seems that the presence of a boundary (any kind of boundary in this case, not just word boundary) makes /l/ darker, but not dark. Thus, duration also suggests that L Darkening is a gradual process and morpheme-final prevocalic /l/ may form the intermediate group between Clear and Dark.

Unfortunately, this is not the case for /l/ preceded by a tense vowel. The longest /l/ sound was found when it was followed by a yod, as it follows from the principles of segmentation. But there were no significant differences between /l/ followed by a tautomorphemic vowel and /l/ followed by a heteromorphemic vowel, and in fact the shortest /l/ was not found before a tautomorphemic vowel, but before the suffix *-er*. However, it must be noted that this is the only case in which a word boundary did not have a darkening effect; however, it is not the only case in which a morpheme boundary did not darken /l/. It is also the only case (except for shortening the preceding vowel of course) in which /l/ preceded by a tense vowel did not follow the same pattern as /l/ preceded by a lax vowel.

The length of lax vowel was not influenced by a following morpheme-final Semi-dark L, but this was expected as it was not influenced by a following Dark L in the non-alternating group either. It was also expected because /l/ has a shortening effect on the preceding vowel and it does not affect lax /ɪ/ which is short to begin with. However, a prevocalic /l/ affected the preceding tense vowel if the /l/ was followed by a word boundary. The length of /iː/ did not differ between the non-alternating Clear L group and the group in which /l/ was followed by a morpheme boundary. However, it was significantly shorter when it was followed by a word boundary, so much so that /iː/ was found to be significantly *shorter* before a word boundary and a vowel than before a canonical Dark L such as absolute-finally or before the past tense suffix. Therefore it seems that a morpheme boundary does not affect /l/ to such an extent that /l/ should make the tense vowel shorter; however, when /l/ is followed by a word boundary, it shortens the tense vowel, therefore that /l/ may be considered dark.

The strength of the boundary also affected the presence of an inserted vowel before /l/. An inserted vowel was marked during annotation if the transition from the steady-state vowel to steady-state /l/ was longer than 0.06. According to the previous literature, insertion is found before Dark L and after a tense vowel. However, 69 inserted vowels were found after a lax vowel and before a prevocalic /l/, which means 21.6% of all the tokens. The number of least inserted vowels (6) was found when /l/ was followed by a morpheme boundary. Fourteen were found when /l/ was followed by a yod and 49 when /l/ was followed by a word boundary and a vowel. The same pattern held when /l/ was preceded by the tense vowel, except that the number of inserted vowels was higher. In this group 88 inserted vowels (27.7%) were found, 16 of which appeared before a morpheme boundary and a vowel, 24 appeared before a yod and 48 before a word boundary and a vowel. Interestingly, relatively few inserted vowels appeared before a yod, which means that few transitions were long enough to reach the 0.06 s threshold. This meant that transition was segmented with /l/, and this could have contributed to that /l/ was found to be extremely long before yod. The fact itself that insertion appears in a canonical Clear L position may support that morpheme-final /l/ tends toward a darker /l/. Insertion also seems to support that L Darkening is gradual, and a word boundary makes /l/ darker than a morpheme boundary.

The sound /l/ was also deleted in canonical clear positions; however, according to the literature, only Dark L can be vocalised, in which case [ɫ] becomes [ɵ]. To the best of my knowledge, prevocalic L Deletion has not been described as a feature of SSBE, but it did appear occasionally during the present experiment. In 29 words which were supposed to contain a prevocalic /l/ neither [l], [ɫ] nor [ɵ] was found, and instead the spectrogram

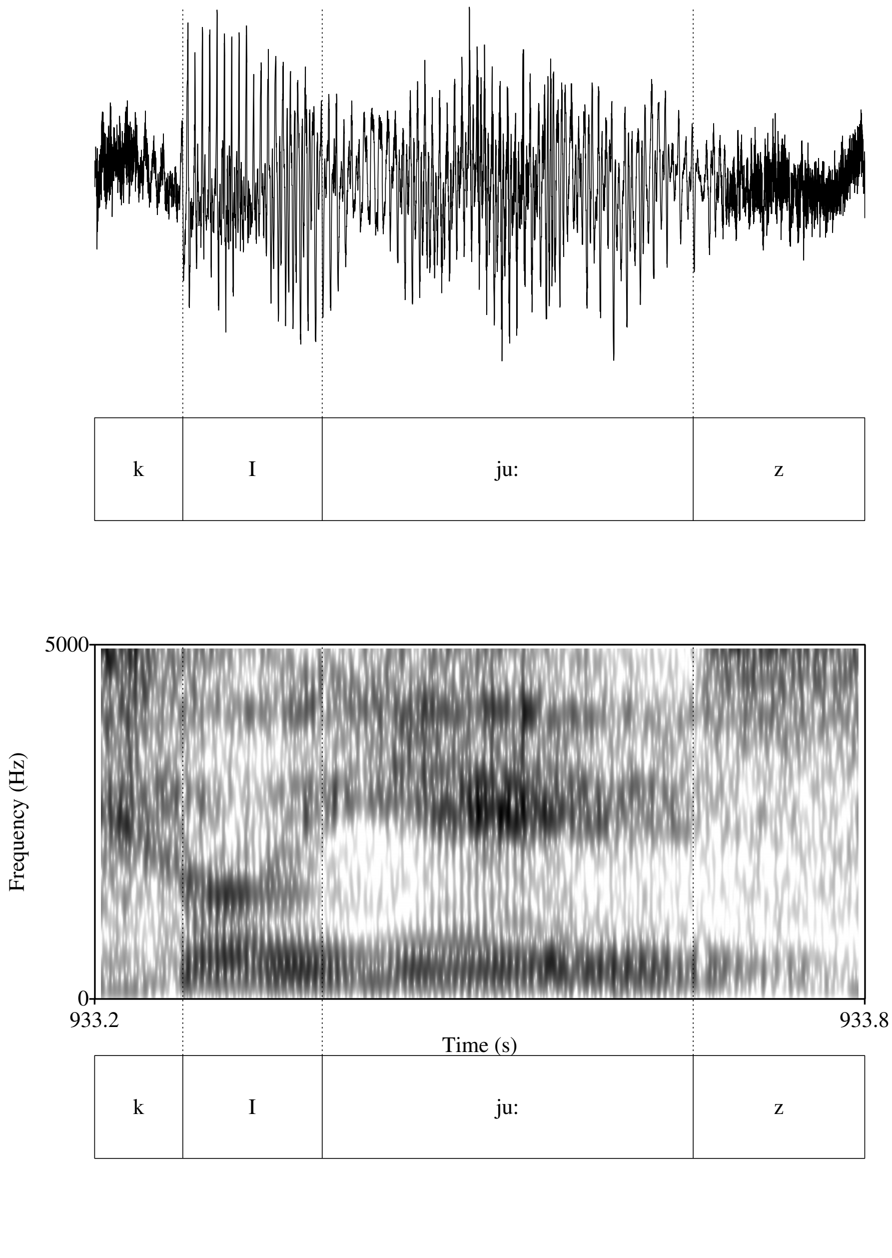

Figure 6.1: /l/ deletion in the phrase *kill ewes* read by Speaker 5 in the fourth reading, annotated in X-SAMPA

showed a vowel with no change in its formants, as it can be seen in Figure 6.1. Such deletion occurred only once before the suffix *-er* in the word *chiller*. It occurred four times between a lax vowel and a word boundary followed by a vowel, and three out of the four deletions were produced by one speaker. The majority of deletions occurred before a yod: 16 was deleted after a lax vowel and 13 after a tense vowel. Interestingly, yod appeared to trigger either an extremely long /l/ or a deleted /l/.

6.2 Morpheme-final Dark L

Morpheme-final Dark L showed much less variation than morpheme-final Semi-dark /l/. Firstly, the F1 of morpheme-final Dark L never returned any significant difference from the F1 of non-alternating Dark L. Bonferroni correction for variance within the group returned a significant difference only once, namely between the F1 of absolute-final [ɫ] and [ɫ] before the past tense suffix when these were preceded by a lax vowel. The most probable explanation for that single difference is that the F1 of absolute-final [ɫ] is the highest and the F1 of [ɫ] before the past tense suffix is the lowest. None of them differ significantly from the F1 of [ɫ] in the /_C/ and in the /_##C/ environment, whereas they do differ significantly from each other, as they are the extreme values. However, this does not give sufficient ground for arguing for dividing morpheme-final Dark L into any smaller categories. Therefore morpheme-final Dark L may be considered equally Dark in any morphemic environments with respect to its F1.

Secondly, the F2 of morpheme-final Dark L did not differ significantly from the F2 of non-alternating Dark L, moreover, no variation was found between the different environments. The only exception was the F2 of [ɫ] before the past tense suffix when the preceding vowel was lax, which was even lower than the F2 of [ɫ] in other environments (including the F2 of non-alternating Dark L). Given that eight groups were compared (two groups based on the preceding vowel, and four based on the following environment), finding a significant difference between two does not seem to be a strong enough argument for setting up further subgroups, especially because the odd-one out has a *lower* F2, which is expected from a Dark L, and not a higher one, which would call for an explanation. Therefore, based on its F2 values, morpheme-final Dark L appears to be equally Dark across all environments.

Thirdly, the length of [ɫ] was the only quality of [ɫ] which not only showed accidental significant differences but seemed to have a pattern. When [ɫ] was preceded by a lax vowel, [ɫ] was the longest, and therefore the darkest in the /_C/ and /_#C/ environments, that is to say when it was not followed by a word boundary. When [ɫ] was preceded by a tense vowel, there was one that was shorter than the rest: the [ɫ] followed by a consonant at the beginning of the next word. This may suggest that boundaries have a slight effect on the quality of [ɫ] as well: the weaker the boundary, the longer, hence the darker the [ɫ]. This may suggest that a weak boundary draws /l/ towards that end of the scale where it is "supposed to be" based on the following environment (more sonorous or less sonorous).

Contrary to the length of [ɫ], tense vowels were the shortest in the /ɫ##C/ environment, and a short, therefore influenced by /l/ tense vowel is a cue for a darker /l/. This appears to contradict that /l/ was the shortest in this environment, as shorter /l/ is the cue for a clearer /l/. Figure 5.8 and Bonferroni correction both suggest that this is a significant difference; however, the result of Bonferroni corrections may not be reliable, as variance homogeneity was violated for vowel length. The length of lax vowels again was not affected by Dark L.

Additionally, vowel insertion was also the least frequent in the /_ɫ##C/ environment. It was the most frequent when the preceding vowel was tense and [ɫ] was followed by the past tense suffix (99 times out of the 108). The second most frequent environment for insertion was/iː_ɫ||/ with 97 inserted vowel. Vowel insertion was less frequent after lax vowels (88 if [ɫ] was word final and 87 if [ɫ] was followed by the past tense). However, vowel insertion happened only 34 times after tense vowel and 18 times after lax vowels if [ɫ] was followed by a consonant at the beginning of the next word. That is to say, more inserted vowels were found in the [_l##V] than in the [_ɫ##C] environment, which might be taken as the sign of L Darkening in a canonical Clear L environment. Interestingly, a monophthong instead of an /ɪ/ or /iː/ and an [ɫ] only occurred in the /##C/ environment (26 times when the word was supposed to contain a lax vowel and four times when it was supposed to contain a tense vowel). Therefore it seems that in the /_ɫ##C/ environment the whole word is shorter than in the other environments, as both /_ɫ/ and the preceding tense vowel are shorter and insertion is rare. Consequently, it may be suggested that these data that appear to contradict the general tendencies of the length of Dark L and the length of tense vowel before a Dark L are the result of the whole word becoming shorter. However, Dark L is otherwise equally dark in all the canonical dark positions, and it does not appear to be necessary to divide Dark L into further subgroups on the basis of morpheme boundaries.

6.3 Messy Semi-dark L versus Homogeneous Dark L

When the patterning of morpheme-final /l/ in the canonical clear and canonical dark environments is compared, /l/ in the canonical dark position seems to form a homogeneous group, whereas morpheme-final /l/ in the canonical clear positions seems to differ from non-alternating Clear L, and it might be better to call it semi-dark instead of clear. This Semi-dark L seems to form different groups with respect to different boundaries, which can be seen in Figure 6.2.

$$\text{lV} < \text{l\#V} < \text{l\#\#V}, \text{l\#\#j} < \#_0\text{C}, \text{l}||$$

Felix < peeler < peel apples, steal yetis < peel, peeled, peel potatoes, field
illustrate < killer < kill Alice, kill ewes < kill, killed, kill Sarah, guild

Figure 6.2: Scale of L Darkening from Clear to Dark

Moreover, different boundaries affect different features of /l/ to different extents. Namely, boundaries do not seem to affect the F1 of /l/ in a canonical clear position, as the F1 of morpheme-final [l] has reached the height of Dark L. But boundaries do appear to affect its F2, its length, the length of the preceding tense vowel and vowel insertion. The effect is such that morpheme-final [l] in canonical clear positions resembles to non-alternating Clear L the most if it is followed by a morpheme boundary and it resembles to a non-alternating Dark L the most if it is followed by a word boundary. However, morpheme-final Semi-dark L still tends to differ from non-alternating Dark L in most of the environments with respect to all its features except its F1. It must be emphasised that morpheme-final Dark L never differs from morpheme-internal Dark L, whereas Semi-dark L always differs from non-alternating Clear L, but not always differs from Dark L. Therefore the acoustic features of Semi-dark L tend toward Dark L. Also, only Semi-dark L is influenced by boundaries, Dark L is not. These might point to that Semi-dark L will be recategorised by speakers as Dark L in the future.

7 Conclusion

The aim of this thesis was to argue for the lexicalisation of Dark L in morpheme-final environments. This goal was not met completely because morpheme-final Semi-dark L tended to differ from Dark L; however, it was met to that extent that the data suggest that morpheme-final /l/ differs from non-alternating Clear L. Moreover, the differences indicate that morpheme-final Clear L tends toward Dark L. The F1 of morpheme-final /l/ is already as high as the F1 of Dark L, and morpheme-final Clear L also has a significantly higher F2 and a significantly longer duration than non-alternating Clear L. Moreover, morpheme-final /l/ in canonical clear environments also significantly shortens the preceding tense vowel and triggers vowel intrusion, and formerly these have been described as the results and the cues for Dark L. Based on these, it seems that /l/ may not be said to have two allophones, as there is a Clear L, which appears before a tautomorphemic vowel, a Dark L, which appears before a consonant and a pause, and an in-between Semi-dark L which can only be used as an umbrella term for those /l/ sounds which appear before a heteromorphemic vowel or yod, but the only thing in common about these is that they are neither Clear nor Dark. Therefore, morpheme-final /l/ still alternates, but none of the alternants may be considered a Clear L. Thus, L Darkening and its influence on vowels are not fully recoverable processes, and this points to the lexicalisation of Dark L in morpheme-final environments. The fact that it still differs from Dark L and it has not reached it yet is just a typical feature of a change in progress.

The other major finding of this thesis is that the strength of the morpheme boundary does influence L Darkening. Whereas the classical formulation of the rule was that zero or more morpheme boundaries may stand between /l/ and the following sound (Wells 1982, 258), these data suggest that the presence and the strength of morpheme boundaries influence L Darkening, as the group Semi-dark L is far from being homogeneous. It appears that its F1 is the only feature which is not influenced by boundaries, most likely because it has already reached the height of Dark L. However, those measured features which differ from the features of Dark L are influenced by the strength of the following boundary. Namely, a word boundary pushes morpheme-final /l/ toward Dark L in canonical clear environments to a greater extent than a morpheme boundary. However, the lack of a word boundary does not make morpheme-final /l/ fully clear either, and also the boundaries do not have an effect on Dark L. Given that the sounds that have been labelled as Semi-dark L do not form a homogeneous group, it is not possible to describe L Darkening as an alternation of three allophones instead of two, or as an alternation of allophones. These data suggest that L Darkening may be even considered a gradual process: the starting point of the scale is /l/ followed by a tautomorphemic vowel, which may be considered clear, the second clearest is /l/ followed by a morpheme boundary and a vowel, the third is /l/ followed by a word boundary and a vowel or a yod, and the fourth is /l/ followed by zero or more boundaries and a consonant or pause. Thus L Darkening may not be treated as a post-lexical rule any longer, and if L Darkening is aimed to be captured by syllables it may not be argued that its resyllabification is possible across a word boundary. Thus the findings that morpheme-final Clear L is not recoverable any longer, and that L Darkening may not be considered a post-lexical allophonic rule, and that the acoustic features of morpheme-final /l/ in canonical clear environments are in-between non-alternating Clear L and Dark L suggest that the process of lexicalisation of Dark L, and the phonemicisation of morpheme-final /l/ as dark have already started.

Further research is needed to examine the exact effect of morpheme-final /l/ on the preceding vowel to see if /l/ influences the preceding vowel even if /l/ is followed by a vowel or a yod, and to see if the effect of /l/ on the vowel is recoverable. It also needs to be tested if the FLEECE vowels are indeed merged with the KIT vowel before Dark L and /l/ followed by a morpheme- or word boundary. The results of this thesis seem to suggest that the FLEECE vowel might be merged with the KIT vowel before a non-alternating Dark L (see Chapter 4.2.1), and the non-recoverability of Clear L in morpheme-final environments, and the impressions of the F2 of the vowels gained during the annotation of the spectrograms all suggest that the FLEECE vowel is affected by /l/ even in canonical clear position. However, further research is needed to test this, and the effect of /l/ on the vowel system of SSBE. Further research is also neccessary to see if L Vocalisation appears in canonical clear environments, and if it does, how often. Based on the results of this thesis it would not be surprising to find morpheme-final Vocalised L in canonical clear positions; it is possible that this could be measured more accurately with the methods of articulatory phonetics instead of acoustic phonetics, as L Vocalisation is defined as the loss of the contact between the tip of the tongue and the alveolar ridge. Nonetheless, the effect of L Vocalisation on the vowel system may be researched by acoustic methods, as if Vocalised L is indeed the closest to /ɵ/, as the data from this experiment seem to suggest, then it may be compared and contrasted with the FOOT vowel which is argued to have a central vowel in present-day SSBE (Szigetvári and Lindsey 2015).

A Test sentences

Appendix A contains the list of sentences used in the experiment. The numbers in parenthesis mark the number of syllables in the sentence.

1. It is said that Harry digs a grave. (9)
2. To the pretty girl, they give flowers. (9)
3. The happy old lady feeds the puppies. (10)
4. Brave people are supposed to seize the day. (10)
5. Very gifted artists illustrate books. (9)
6. Five subgroups will be affiliated .(10)
7. Please give this bag of chips to Felix. (10)
8. Please tell this crazy story to Sheila. (10)
9. This is the highest tower that was ever built. (11)
10. Baroque artists used to gild pictures. (9)
11. All throughout his life, he was shielded. (9)
12. The press office is supposed to field calls. (10)
13. There are a few words that are just fillers. (10)
14. That pricey tool there is called chiller. (9)
15. The scary guy is a cruel killer. (10)
16. The guy who wears a tux is the dealer. (10)
17. I bought a yellow potato peeler. (10)
18. The correct word is thief, but you said stealer. (11)
19. The hero of the book has to kill Alice. (11)
20. The pretty waiters spill apple juice. (9)

21. Wealthy rockstars always chill apple juice. (10)
22. The busy cooks quickly peel apples. (9)
23. By this tribe you should feel accepted. (9)
24. It is illegal to steal acorn. (9)
25. Butchers are always allowed to kill ewes. (10)
26. It is always horrible to chill yeast. (10)
27. Beautiful purple flowers fill yards. (9)
28. Everybody should feel useful. (9)
29. Creative explorers rarely steal yetis. (10)
30. Evil but beautiful thieves steal yaks. (9)
31. The leader ordered his soldiers to kill. (10)
32. This is the place where the water should spill. (10)
33. Give the tasty cocktails a day to chill. (10)
34. They believe that it is drug that they deal. (10)
35. He should realise what his buddies feel. (10)
36. Pickpockets have to be careful to steal.
37. The play is good so all the seats are filled. (10)
38. Wars are ugly because people are killed. (10)
39. Cocktails are better if they are chilled. (9)
40. All the potatoes have to be peeled. (9)
41. Wax was used for letters to be sealed. (9)
42. The verdict was biased so Jack appealed. (10)
43. Vicious people try to kill Sarah. (9)
44. The successful writer's works fill bookshops. (10)
45. I love you because you rarely spill secrets. (11)
46. Due to this chilly weather I feel cold. (10)
47. It is difficult to peel carrots. (9)
48. Greedy thieves like to steal jewellery. (10)

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