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Andrea Sudbury

Jennifer Hay

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1 Introduction

It is well known that nearly all non-rhotic dialects of English exhibit linking and/or intrusive /r/. This sandhi process occurs both word-internally across morpheme boundaries, and across word boundaries. What is not known is the process through which linking and intrusive /r/ emerge. Does linking /r/ emerge after the loss of rhoticity, or do speakers simply start to lose rhoticity in non-boundary positions? Does intrusive /r/ make an appearance before rhoticity is completely gone? Do /r/-sandhi processes appear first after word boundaries, or word-internal morpheme boundaries?

Current New Zealand English is non-rhotic, but displays linking and intrusive /r/. However, work on the speech of first generation New Zealand English speakers has demonstrated that such speakers display a surprising degree of rhoticity (see Trudgill 1999). The availability of recorded interviews with early New Zealanders, then, makes possible a systematic study of the relationship between the decline of rhoticity and the emergence of linking and intrusive /r/ in New Zealand English (NZE).

2 Rhoticity

The English varieties spoken in the southern hemisphere are usually classified as non-rhotic (see for example, Wells 1982). In other words, /r/ is not realised in post-vocalic (or non-prevocalic positions) such as "car" [ka:] rather than [kaɹ]. However, there are a couple of exceptions to this generalization.¹

General consensus on the development of the southern hemisphere Englishes and the loss of non-prevocalic /r/ in English suggests that the absence of rhoticity in Australia, New Zealand, and (much of) South Africa can be explained by the timing of colonization in the southern hemisphere (Trudgill 1986; Lass 1987). Non-prevocalic /r/ began disappearing in English during the 17th century, at least in certain environments (Strang

¹ Parts of Otago and the Southland area of New Zealand are partially rhotic (Bartlett 1992). It has also been claimed that some varieties of South African English have variable rhoticity (Lanham 1978; Lass & Wright 1986).

1970:112), though this process was not widespread in southern England until, at the earliest, the middle of the 18th century (Wolfram & Schilling-Estes 1998:94). Thus, at the time of the spread of English into the anglophone northern hemisphere colonies, from approximately the mid 17th to the mid 18th century, non-prevocalic /r/ would have been a feature of most English dialects, and so rhoticity would have been transported with the settlers². Although it is hypothesized that /r/-loss was probably not complete in southern Britain until at least the early 19th century (Lass 1987:275; Lass 1997:289; Bailey 1996:105), it has generally been assumed that it had spread sufficiently by this time, for the majority of settlers to the southern hemisphere to have already lost /r/ before they left Britain. The fact that AusE, NZE and SAfE are non-rhotic is generally cited as support for this claim.

However, the evidence we present below shows that rhoticity levels amongst the first and second generation New Zealand-born Europeans seem rather high to support this hypothesis, even taking into account the proportion of settlers from rhotic areas. In fact, the early New Zealand data we present here suggests that in addition to the Scottish settlers, non-prevocalic /r/ is likely to have been common amongst a significant proportion of the English settlers (see also Trudgill 1999, Trudgill et al. 2000a), which would support claims, such as Lass' (1997:287), for later rather than earlier loss of rhoticity in English.

3 /r/ Sandhi

The term linking /r/ is used to refer to cases in which /r/ is orthographically present, and surfaces across a morpheme or word boundary, when followed by a vowel (e.g. "fear" [fɪə] ~ "fearing" [fɪəɪŋ]; "car" [kɑ:] ~ "car alarm" [kɑ:ələ:m]). We refer to these as word internal linking /r/ and word final linking /r/ respectively. Intrusive /r/ refers to the production of non-orthographic /r/ in the same environments (e.g. "draw" [drɔ:] ~ "drawing" [drɔɪŋ] (word internal intrusive /r/); "ma" [ma:] ~ "ma and pa" [ma:ənpa:] (word final intrusive /r/).

Most dialects which exhibit linking /r/ also exhibit intrusive /r/. However, there are some non-rhotic dialects which display neither linking nor intrusive /r/. In particular, there are some dialects in the Southern U.S. which are non-rhotic, and have little or no linking or intrusive /r/ (Wells

² Note that Lass (1987) and others (Wolfram & Schilling-Estes 1998) argue that non-rhoticity would also have been taken to the colonies.

1982:543). South African English may also fall into this category, although reports on this topic are inconsistent³.

In dialects which display /r/-sandhi, production of /r/ across word boundaries is variable (Jones 1964, Gimson 1980, Wells 1982). Linking /r/ appears to occur at higher rates than intrusive /r/, perhaps because the latter may be associated with a certain amount of stigmatisation (see, e.g. Lewis 1975, 1977; Pring 1976; Fox 1978; Brown 1988). Word-internally, linking /r/ "almost invariably occurs", while there are "occasional" instances of word-internal intrusive /r/ (Wells 1982). The existence of variability in the production of /r/-sandhi raises the question of the degree to which this variability is socially or linguistically conditioned.

Jones (1964) and Gimson (1980) claim that intrusive /r/ is more likely following schwa than other vowels. It is also claimed to be less stigmatized in this context—one explanation that has been put forward for this is that schwa is by definition unstressed, so /r/ tends to be "less noticed" in this environment (Crystal 1984:43, Brown 1988:149).

Wells (1982) suggests that the collapsing together of FORCE and THOUGHT occurred subsequent to the development of /r/-insertion, and that, as long as *sore* and *saw* were produced with distinct vowels, there was no reason for the latter to emerge with surface /r/. Once the vowels merged, and /r/-insertion occurred with words like *saw*, it became possible to state the /r/-insertion rule as following a natural class: non-high vowels. Wells claims intrusive /r/ after /ɔ/ is more stigmatized than after other vowels because it was a later innovation (1982: 225).

The stressed status of the following vowel has also been claimed to play some role in determining the likelihood of /r/-sandhi, with Jones (1964:197) claiming that "there appears to be an increasing tendency, especially among younger people, not to use linking /r/ at all, particularly when the vowel following the word ending in r is unstressed." Linking and intrusive /r/ have been claimed to occur less often when there is already an /r/ immediately preceding (Jones 1964, Wells 1982), or, more generally, nearby (Brown 1988).

Brown (1988) suggests that frequency of occurrence of the words involved may play a role, with the /r/ being more stigmatized (and so perhaps more avoided) in more frequent words, as it is more noticeable in such contexts. All of these claims about possible linguistic conditioning, however, are based on informal observation and/or instinct. None of them have been tested on a large body of data⁴.

³ See Trudgill and Hannah (1982); Wells (1982: 618) Lass (1987: 306).

⁴ An exception is the work by Foulkes (1997a, b), who examines a number of these claims in his data-set. However he finds no significant results relating to linguistic

This study aims to:

- Document the emergence of /r/-sandhi in early NZE
- Investigate possible social conditioning on the decline of rhoticity and the emergence of /r/-sandhi in the New Zealand context
- Investigate possible linguistic conditioning factors on /r/-sandhi processes
- Shed light on the diachronic relationship between rhoticity, linking /r/ and intrusive /r/

4 Methodology

The data for this analysis is taken from two corpora, the Mobile Unit (MU) and the Goodyear Corpus (GC)⁵, held by the Origins of New Zealand English Project (ONZE) at the University of Canterbury, New Zealand.

The MU corpus consists of interviews with some three hundred New Zealanders, born between 1850 and 1900, who were recorded by the NZ Broadcasting Service in the late 1940s (see Lewis 1996 for further details). Fifty-nine of these speakers have been selected for a detailed quantitative analysis of a number of diagnostic variables in NZE. Here we report just on the findings involving /r/. The GC consists of recordings of New Zealanders born between 1890 and 1930, conducted between 1989 and 1995 as part of an oral history research project (see Trudgill et al. 2000a:115). In order to extend our data-set well into a period in which NZE was characterized by relatively focused non-rhoticity, the MU data was supplemented with data from 8 GC speakers born between 1907 and 1924. The results reported here are therefore based on an analysis of 67 speakers, with birth dates spanning almost 70 years, which encompass the formative years of NZE.

Speakers were selected on the basis of clear recordings, amount of analyzable speech and the extent of background knowledge known about each speaker (such as parental origins). In addition, attempts were made to stratify speakers according to the variables of age, sex, and region (island), although limitations of the corpus placed some restrictions on the degree to which such stratification was possible.

conditioning. It is unclear whether this is because such linguistic conditioning does not exist or, more likely, because his data-set was not large enough for the patterns to emerge in a statistically significant way.

⁵ The Goodyear Corpus forms part of a larger corpus known as the Intermediate Archive (see Lewis 1996).

4.1 Analysis

This analysis is based on auditory transcription. To ensure consistency (following Woods 1997) each of the MŪ speakers was analyzed blind on two separate occasions by the same analyst.⁶ Tokens were only included if there was consensus between transcriptions. Two variants were coded—[r] and Ø. /r/-sandhi cases in which a glottal stop was inserted were coded as Ø. Different rhotic realizations were not distinguished—any rhotic segment was coded as [r], and this was most often a rhotic approximant. The aim was to use 300 tokens of non-prevocalic /r/ per speaker and all cases where /r/ sandhi could occur. To avoid lexical bias, a maximum of ten tokens per individual word were included per speaker.⁷

Several reports in the literature highlight the fact that linking and/or intrusive /r/ can arise in contexts in which the phonetic (rather than the underlying phonological) environment is appropriate. Wells (1982:226), for example, cites *the window/r/ isn't clean* and *how/r/ are you* as well-formed in dialects in which GOAT and MOUTH can be reduced to schwa. Our corpus does include occasional instances in which an /r/ surfaces when the phonetic environment (but not the underlyingly phonological) is appropriate. However these are not included in the statistics reported below, due to difficulties this would raise in determining what should count as a potential environment for the realization of /r/.

5 Results

5.1 Rhoticity

A total of 13,760 non-prevocalic /r/ tokens were analyzed. The statistics reported here are based on the rhoticity percentage recorded for each speaker.

As expected, rhoticity steadily declines with the year of birth of the speaker. Speakers who are born earlier are more likely to be rhotic. This relationship between year of birth and rhoticity is shown in Figure 1.

Year of birth is not the only predictor of rhoticity. There is a strong and significant effect of the island on which the speaker was born, and lived.

⁶ It is important to emphasize that the results presented in the paper are based on a quantified analysis of speakers from the ONZE corpora. As such the results reported here differ from patterns found in the previously reported non-quantitative analysis conducted by Peter Trudgill (Trudgill 1999a, b; Trudgill et al. 2000a, 2000b).

⁷ This did not apply to tokens of linking and intrusive /r/, where all tokens were counted, regardless of frequency.

South Island speakers are on average 12% rhotic, and North Island speakers on average only 4% rhotic. There is no effect of speaker sex.

A stepwise linear model returns both birth date and island as significant, independent predictors of rhoticity.⁸ It further divides South Island speakers according to date of birth, identifying 1876 as the most predictive year on which to split the speakers. South Islanders born before 1876 are significantly more likely to be rhotic than those born after 1876.

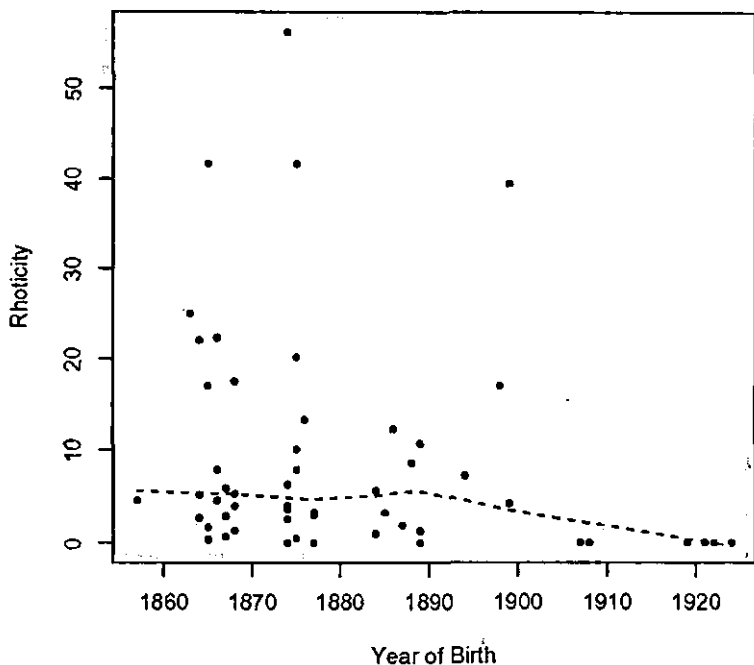


Figure 1. Relation between year of birth and rates of non-prevocalic /r/ (rhoticity). The line is a non-parametric smoother (Cleveland 1979) fit.

⁸ Since rhoticity is calculated as a ratio, the log rhoticity was modeled here, in order to closer approximate the normality assumptions of this technique. South Island: coef = .81, $p < .001$; Birth date: coef = -.03, $p < .01$. Overall model: $r^2 = .29$, $p < .001$.

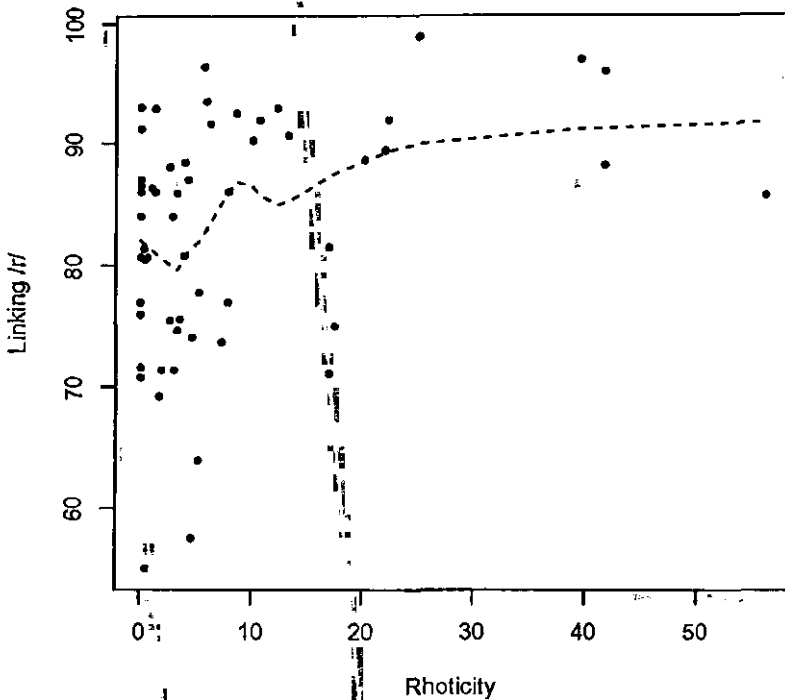


Figure 2: The relation between rhoticity and rates of word-final linking /r/. The line represents a non-parametric smoother (Cleveland 1979) fit. (Spearman's rho = 0.34, n=56, $p < .02$).

5.2 /r/-Sandhi at Word Boundaries

5.2.1 Linking /r/

In order to analyze the patterns in linking /r/ across word boundaries, two datasets were analyzed. The first is a by-speakers data-set, which includes the level of rhoticity, level of linking /r/, sex, birth-date, and island of birth for each speaker. Speakers for whom we have fewer than 20 coded linking /r/ tokens were excluded to ensure the relative robustness of the percentage values. This analysis involves 56 speakers, with 24 to 142 tokens per speaker, and 55-99% linking /r/.

The second analysis is based on a dataset including all linking /r/ tokens coded (2833). Each token is coded for a range of linguistic factors

concerning the immediately preceding and following word. We discuss the by-speakers patterns first.

As shown in Figure 2, there is a robust and significant correlation between rhoticity and /r/ in linking positions. As speakers become less rhotic, their use of /r/ at word boundary linking positions also declines. However, notice that by the time /r/ in non-boundary positions is completely absent, rates of linking /r/ are still fairly high—consistently greater than 50%. Thus, there was never a period of /r/-lessness in NZE. Rather, pronunciation of non-prevocalic /r/ in non-boundary positions decreased and eventually vanished, while its pronunciation in boundary positions decreased somewhat, but remained relatively high overall, resulting in a non-rhotic dialect with high rates of linking-/r/ at word boundaries.

Speaker sex is also an important variable, with males producing significantly more linking /r/ (mean= 85%, median= 87%) than females (mean= 78%, median= 77%). The final factor which may be a predictor of the degree to which a speaker will display linking /r/ is their island of birth. South Islanders tend to display more linking /r/ than North Islanders. A stepwise linear regression retains level of rhoticity, island of birth, and sex as significant, independent predictors of rate of linking /r/.⁹ One possible interpretation of this lies with the considerable body of sociolinguistic evidence which demonstrates that women tend to be the leaders of linguistic change (e.g. Labov 1990; Watt & Milroy 1999). Our results span a period in which /r/ in linking position is on the decrease. Thus, one explanation of the finding that women are using significantly less linking /r/ than men is that it is women who are leading this change. One problematic aspect of this interpretation is the lack of a significant difference between men and women in rates of rhoticity. Given that changes in rhoticity are essentially driving changes in /r/ at boundary positions, it is curious that we find a significant sex difference for one but not the other.

An alternative (and equally speculative) explanation for this result is that a stylistic dimension is at work. The interviewer on these recordings is always male, and is fairly formal in his delivery. We can speculate that this may have led the women to pay greater attention to their speech than the men, and make more conscious attempts to speak clearly while being recorded. This would have led to a more careful speech style, in which connected speech phenomenon (such as /r/-sandhi) occur at lower rates, and

⁹ Linking /r/, like rhoticity, is calculated as a ratio. The log was taken of both linking /r/ and rhoticity to satisfy the parametric requirements of linear regression techniques. South Island: coef = .08, p.01; Male speaker: coef= .1, p.01; Rhoticity: coef = .03, p.07. Overall model: r = .26, p.001.

also to the conscious avoidance of stigmatized phenomenon (of which /r/-sandhi may have been one). It is our informal impression of the recordings that the observed difference between male and female rates of /r/-sandhi may at least partially relate to stylistic factors. However we have not investigated this possibility systematically.

Tokens (2833 in total) were coded for the presence and absence of linking /r/, and each of the following factors:

- The grammatical status (content or function) of the preceding and following words.
- The log lexical frequency of the preceding and following words (using CELEX frequency counts; Baayen et al. 1995).
- The length, in syllables, of the preceding and following words.
- The occurrence of other /r/s in the last two syllables of the preceding word, or first two syllables of the following word.¹⁰
- Whether the preceding vowel and the following vowel were lexically strong or weak.
- The length of the preceding and following vowels.
- The backness (front, central, or back) of the nucleus of the preceding and following vowels.

We then fit a binomial stepwise generalized linear model to the data.¹¹

The following factors were retained as significant predictors of linking /r/:

- The backness of the following vowel. (front vowels disfavor: $p < .001$)
- The lexical frequency of the following word (high lexical frequency disfavors: $p < .001$)
- The occurrence of other /r/s in the following word. (disfavors: $p < .01$)
- The lexical strength of the following vowel. (lexically stressed vowel favors: $p < .01$)
- The backness of the preceding vowel. (front vowels disfavor: $p < .02$)

Thus, in addition to the level of rhoticity and the sex of the speaker, a range of linguistic factors affect the likelihood that linking /r/ will be produced. Most of these factors involve the nature of the following word,

¹⁰ We coded here for the lexical presence of /r/, rather than its phonetic instantiation. That is, this coding includes tokens like *cart*, even when the /r/ was not produced.

¹¹ Following Venables and Ripley (1994: 183-196)

rather than the preceding word, although the quality of the preceding vowel does have some effect.

We do not discuss possible explanations for these results due to limited space. Here, we just note that the majority of the above results reflect the importance of the following environment, rather than the preceding environment, in which the /r/ is orthographically contained. We view this as evidence in support of syllable-driven accounts of /r/-sandhi, in which one of the primary purposes of the /r/ is to provide an onset for the following word. In such an account, the /r/ falls into the prosodic domain of the following word, and so it is to be expected that the following word should exert a stronger influence than the preceding word.¹²

5.2.2 Intrusive /r/

Possible sites for the appearance of intrusive /r/ are relatively rare. Indeed, for 24 of 67 speakers, no potential intrusive /r/ word-boundary environments occurred during the stretch of analyzed speech. The remaining speakers each produced between 1 and 29 potential environments, for a total of 185 tokens analyzed, of which 23 were produced with an intrusive /r/.

Because of the small number of tokens per speaker, there is a limit to the by-speaker analysis. We do, however, see a significant increase in rates of intrusive /r/ as rhoticity declines. Figure 3 demonstrates this relationship, which is significant by a non-parametric correlation (Spearman's rho = -0.36, $n = 43$, $p < .02$). The less rhotic the speakers are, the more likely they are to display intrusive /r/. This correlation should be treated with appropriate caution, as in many cases the percentage values for rate of intrusive /r/ are based on a very small number of tokens. However there does appear to be a fairly clear pattern overall. Intrusive /r/ *increases* as rhoticity declines. Note, too, that a non-trivial percentage of speakers are both partially rhotic, and display some intrusive /r/.

Due to the small number of available tokens, we did not carry out a full analysis of the linguistic environments which favor intrusive /r/. We did, however, investigate the effect of the identity of the preceding and following vowels, in a binomial stepwise generalized linear model. While the identity of the following vowel had no significant effect, the identity of the preceding vowel did ($p < .02$). The highest rate of incidence of intrusive /r/ was following the vowel in START, and the lowest rate was following the

¹² For detailed discussion of each of the above factors, the reader is referred to Hay and Sudbury (forthcoming).

THOUGHT vowel. Indeed, there is good evidence that intrusive /r/ after THOUGHT was a later innovation. While intrusive /r/ occurs in our earliest-born speakers after START (1865) and SCHWA (1864), our earliest token of its occurrence after THOUGHT is produced by a speaker born in 1921.

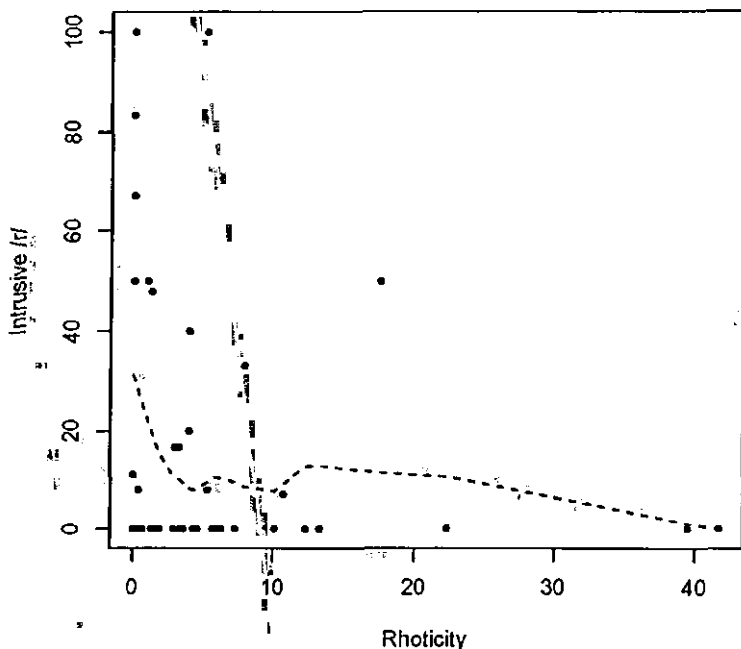


Figure 3: The relation between rhoticity and rates of word-final-intrusive /r/. The line represents a non-parametric smoother (Cleveland, 1979) fit. (Spearman's $\rho = -0.36$, $n = 43$, $p < .02$).

5.3 /r/-Sandhi at Word-internal Morpheme Boundaries

Potential environments for linking /r/ across a word-internal morpheme boundary (e.g. *fearing*) were coded (142 in total).¹³ Of these tokens, only one

¹³ This includes affixed words only. Compounded words were coded, but they numbered sufficiently few that they are not discussed here.

(the word *feverish*) was produced without an /r/. Linking /r/ across morpheme boundaries, then, appears to have remained robustly categorical throughout the transition to non-rhoticity.

Potential environments for intrusive /r/ across word-internal morpheme boundaries (e.g. *drawing*) are vanishingly small. We recorded only 18 in our entire dataset. Of these, an intrusive /r/ was produced in only one token, by a speaker born in 1921.

Due to the small number of tokens available for the study of /r/-sandhi processes at word-internal morpheme boundaries, we are not in a position to make strong claims on this topic. The one generalization that does seem fairly robust, though, is that while linking /r/ remained near-categorical across word-internal morpheme boundaries and was variable across word boundaries, intrusive /r/ was more likely to occur across word boundaries than morpheme boundaries.

6 The Fall and Rise of /r/

The results laid out above tell a fairly clear story about the relationship between the decline of rhoticity and the emergence of /r/-sandhi in early NZE. First generation NZE speakers tended to be partially rhotic, though none of them were consistently so.

As speakers' birth dates approached the end of the 19th century, their rhoticity levels decline (Figure 1). This decline came to completion around the turn of the century. All of the speakers we analyzed who were born in the 1900s were completely non-rhotic. NZE therefore emerged as a non-rhotic variety around the turn of the century, and started to become fairly focused in this respect in the last 20 years of the 19th century, the years in which the oldest 2nd generation NZE speakers would have reached adolescence (Trudgill et al. 2000b).

As rhoticity declined in non-boundary non-prevocalic positions (e.g. *cart*), /r/ production also declined at word final linking positions (e.g. *car alarm*) (Figure 2). As speakers become less rhotic, they also become less likely to produce /r/ at word-final linking positions. However, the rate of decrease in such positions is significantly smaller than the rate of decrease in other positions. Overall linking /r/ in word final positions steadily declines with the loss of rhoticity, but shows no sign of disappearing. Unlike linking /r/ in word final positions, linking /r/ in word internal positions (e.g. *fearing*) was not affected by the change in levels of rhoticity. /r/ in this position was consistently produced.

Intrusive /r/ across word boundaries (e.g. *ma and pa*) appeared well before rhoticity completely disappeared. It then steadily increased with the

loss of rhoticity—the less rhotic a speaker was, the more intrusive /r/ they displayed (Figure 3).

Intrusive /r/ appears after-schwa and /a/ amongst our oldest speakers (although not amongst our most rhotic speakers). Tokens of intrusive /r/ after /ɔ/, however, do not appear amongst any speakers born in the 19th century, and so this appears to have been a later innovation.

Finally, it is important to note that while speakers' rates of linking /r/ and intrusive /r/ correlate highly with their rate of rhoticity, they do not correlate well with their year of birth. This provides good evidence that the emergence of /r/-sandhi processes is not an independent development which just happened to coincide with the loss of rhoticity. Rather, the rate of the emergence of /r/-sandhi processes is directly and causally connected to the decline of rhoticity. The time period we have analyzed appears to record a process of convergence of word-external intrusive and linking /r/-sandhi. As rhoticity levels declined, /r/ in linking positions also declined—with rates of /r/ production remaining high, but non-categorical. And while both rhoticity and linking /r/ were on the decrease, intrusive /r/ positions began to steadily increase.

7 Conclusion

Almost no corpus work has been conducted on /r/-sandhi phenomena, and none on the relationship between rhoticity and /r/-sandhi. The availability of recordings of first generation New Zealanders, together with the finding that this first generation was partially rhotic, has enabled us to conduct a systematic study of the process through which /r/-sandhi emerges, and the linguistic factors which condition it. Our corpus contains speakers who range from 56% to 0% rhotic, with the highest rates of rhoticity concentrated amongst South Islanders, and amongst the earliest born speakers.

The analysis reveals that production of /r/ in linking positions steadily declined along with non-prevocalic /r/, but that its decline was much less dramatic. Thus, by the time speakers were completely non-rhotic in non-prevocalic positions, they were still producing linking /r/ at fairly high rates. Notably, however, linking /r/ at word-internal morpheme boundaries remained near-categorical for all speakers.

Word-final intrusive /r/ emerged early, and was present amongst partially rhotic speakers. Rates of intrusive /r/ increased as rhoticity declined. The evidence on word-internal intrusive /r/ is relatively sparse, but does suggest that this was a somewhat later innovation.

For the first time, then, we have a clear picture of the diachronic relationship between the decline of rhoticity and the emergence of /r/-sandhi

in a dialect of English. This is a significant advance on previous descriptive work on this topic and provides results which should both inform and constrain potential phonological theories of /r/-sandhi.

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Department of Linguistics
 University of Canterbury
 Private Bag 4800
 Christchurch
 New Zealand
 a.sudbury@ling.canterbury.ac.nz
 j.hay@ling.canterbury.ac.nz