Rosa's roses: reduced vowels in American English

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Beginning phonetics students are taught that some varieties of American English have two contrasting reduced vowels, transcribed as [ə] and [ɨ], illustrated by the unstressed vowels in the minimal pair *Rosa's* vs. *roses* (e.g. Ladefoged 2001, 2005). However, little seems to be known about the precise nature or distribution of these vowels. This study explores these questions through acoustic analysis of reduced vowels in the speech of nine American English speakers. The results show that there is a fundamental distinction between the mid central [ə] vowel that can occur in unstressed word-final position (e.g. in *Rosa*), and high reduced vowels that occur in most other unstressed positions, and might be transcribed as [ɨ]. The contrast between pairs like *Rosa's* and *roses* derives from this difference because the word-final [ə] is preserved when an inflectional suffix is added, so the schwa of *Rosa's* is similar to the final vowel of *Rosa*, whereas the unstressed vowel of *roses* is the high [ɨ] reduced vowel quality found elsewhere. So the standard transcription of the reduced vowel contrast is justified, but the widespread use of [ə] to transcribe word-internal reduced vowels is misleading – mid reduced vowels are generally only found in stem-final position.

1 Introduction

It is well established that English exhibits a pattern of vowel reduction whereby vowel quality distinctions are neutralized in completely unstressed syllables. Some descriptions, e.g. Chomsky & Halle (1968: 110ff.), imply that a single vowel quality is permitted in these positions, usually transcribed as schwa [ə]. Thus, for example, the first vowel of *begin* [bəˈgɪn] and the final vowel of *comma* [ˈkɑmə] are both typically transcribed as [ə]. However, it is commonly observed in introductory phonetics courses that some accents of American English have two contrasting reduced vowels, usually illustrated by the minimal pair *roses* [ˈɹoʊzɨz] vs. *Rosa's* [ˈɹoʊzəz].[1]

This minimal pair was noted by Trager & Bloch (1941: 228), although they use [əˆ] in place of the barred-i, [ɨ]. In the development of Trager & Bloch's analysis in Trager & Smith (1951), this transcription is replaced by the now-familiar barred-i (p. 40). These transcriptions imply that both reduced vowels are central, but are distinguished by height. However we are not

[1] The geographical distribution of the *Rosa's–roses* distinction is unclear since few dialect descriptions discuss unstressed vowels. We have met speakers from across the US who make the distinction, but it is reported that the distinction is not made in Seattle, WA (Richard Wright, p.c.), nor in some Ohio accents (Linda Shockey, p.c.), although it seems to be common among current students at Ohio State University (David Odden, p.c.).

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aware of any previous instrumental work that verifies these characterizations. There are also few clear generalizations about the distribution of these two reduced vowels, although Trager & Bloch (1941), Trager & Smith (1951) and Bronstein (1960: 182) offer some observations. Many subsequent descriptions of English refer to a phonetic distinction between [ə] and [ɨ] (e.g. Kenstowicz 1994: 26, Ladefoged 2001: 79f.) and/or the contrast between *Rosa's* and *roses* (e.g. Harris 1994: 110, Kreidler 2004: 83, Ladefoged 2005: 29), but it remains unclear whether the distinction between barred-i and schwa is a basic phonemic distinction in the relevant accents of English, or whether it is limited to a restricted environment exemplified by pairs like *roses–Rosa's*. This experimental study aims to clarify the realization of these two reduced vowels, and to shed some light on their relative distributions.

Besides the general desire to supplement auditory observations with instrumental data, there is some reason to be sceptical about the standard characterization of the reduced vowels. Instrumental studies of schwa in British English (Kondo 1994, Bates 1995) and Dutch (van Bergem 1994) have found that these vowels are generally high, although their precise quality is subject to considerable contextual variation. If English schwa is a high vowel, then how does it differ from the vowels that have been transcribed as barred-i?

We will see that the traditional characterization of the distinction between pairs like *roses* vs. *Rosa's* is reasonable: the unstressed vowel of *roses* is higher than the unstressed vowel of *Rosa's*, and both are central. However, the unstressed vowel of *Rosa's* differs from most word-internal unstressed vowels, such as the first vowel in *begin* [bəˈɡɪn], so it is misleading to transcribe both with the same symbol [ə]. The basic distinction is in fact between word-final schwa vowels, such as the final vowel in *Rosa*, and unstressed vowels in other positions: the word-final schwa vowels are lower than most non-final unstressed vowels. The distinction between schwa and barred-i is derived from this difference because the word-final schwa quality is approximately preserved when certain suffixes, including the possessive /-z/, are added. In other words, the unstressed vowel of *Rosa's* differs from the unstressed vowel of *roses* because the former is similar to a word-final schwa, whereas the latter has the usual non-final unstressed vowel quality. Accordingly, if a distinction is made between American English reduced vowels in transcription, it would be more appropriate to transcribe most non-final unstressed vowels with barred-i [ɨ], and reserve schwa [ə] for word-final position.

The use of the schwa symbol to transcribe both the high reduced vowels in English (and other languages) and mid central vowels in languages like Bulgarian (Lehiste & Popov 1970) obscures an important distinction, and has led to misconceptions about the nature and typology of reduced vowels, as discussed in the conclusion.[2]

2 Procedure

2.1 Materials

To clarify the nature of the *roses–Rosa's* contrast, we recorded several minimal and near-minimal pairs of this form, listed in (1). The minimal pairs are constructed from pairs of words where one word ends with a sibilant fricative or affricate, sibilant [s, z, ʃ, ʒ, tʃ, dʒ], as in *rose* [ˈɹoʊz], and the other word differs only by adding a final schwa, as in *Rosa* [ˈɹoʊzə]. Then the barred-i word is the plural of the sibilant-final word, e.g. *roses*, and the minimally-distinct schwa word is the possessive of the schwa-final word, i.e. *Rosa's*. The first word must end in a sibilant because the allomorph of the plural suffix that contains the barred-i only appears following a consonant.

[2] A similar contrast between pairs like *Rosa's* and *roses* is observed in English Received Pronunciation (RP), and other English accents, but the unstressed vowel of words like *roses* is traditionally transcribed as [ɪ] identifying it with the vowel of *pin*. It remains to be seen whether this is primarily a difference of convention, or if it reflects a significant phonetic difference.

Pairs of this type are very rare in American English because familiar words that end with schwa are uncommon,[3] and ones that are minimally-distinct from sibilant-final words are even scarcer. Accordingly, two of the pairs are not fully minimal: *ages–Asia's* and *hinges–ninja's*.

(1)

BARRED-I		SCHWA	
roses	ˈɹoʊzɨz	Rosa's	ˈɹoʊzəz
leases	ˈlisɨz	Lisa's	ˈlisəz
rushes	ˈɹʌʃɨz	Russia's	ˈɹʌʃəz
ages	ˈeɪdʒɨz	Asia's	ˈeɪʒəz
hinges	ˈhɪndʒɨz	ninja's	ˈnɪndʒəz

To obtain a broader sample of barred-i's and schwas in the same context, preceding word-final [z], we recorded five additional barred-i plurals, listed in (2), and five plurals of schwa-final words, listed in (3).

(2)	(3)
mazes	sofas
boxes	vodkas
judges	sodas
bushes	alphas
causes	umbrellas

Additional words were recorded to illustrate the quality of reduced vowels in word-final and word-medial positions for comparison with the prototypical examples of contrastive schwa and barred-i. Word-final schwa was exemplified by the stems of the possessives and plurals in (1) and (3):

(4)

Rosa	sofa
Lisa	vodka
Russia	soda
Asia	alpha
ninja	umbrella

Ten further words exemplified non-final reduced vowels (5). The first five, in (5a), contain reduced vowels between coronals (alveolars and palato-alveolars) – i.e. in segmental contexts similar to the reduced vowels in the minimal pairs – while the remaining five words, in (5b), contain reduced vowels adjacent to non-coronal consonants.

(5)

a.	b.
rhapsody	begin
suggest	report
suspend	compare
prejudice	probable
today	suffocate

[3] Schwa-final words are plentiful in non-rhotic accents, such as English Received Pronunciation, because they have developed from words with unstressed final rhotic vowels. All of our subjects spoke rhotic varieties.

Finally, we recorded a set of monosyllabic words, given in (6), containing a variety of full vowels in order to obtain a sense of the vowel spaces of the speakers.

(6) heed [i]
hid [ɪ]
head [ɛ]
had [æ]
odd [ɑ]
hood [ʊ]
who [u]

The words were read in the sentence frame 'Say ___ to me'. The sentences were arranged in pseudo-random order, subject to the constraint that the two members of a minimal pair had to occur in different halves of the list. Filler items were added at the beginning and end of each page of the list. Each subject read each word twice. Subjects were recorded onto DAT tape in a sound attenuated room. The recordings were then downsampled to a sampling rate of 11025 Hz and transferred to a computer for acoustic analysis.

Subjects were Stanford students. All were native speakers of English with no reported speech or hearing problems. Nine were female, and three were male. The subjects spoke a variety of US dialects, mainly Western (in the sense of Labov, Ash & Boberg 2006), but all distinguished the minimal pairs in the judgement of the experimenters. These judgements were supported by the acoustic analysis and perceptual test reported below.

2.2 Analysis

The frequencies of the first two formants of the reduced vowels were measured at the mid-point of the vowel using the formant analysis algorithm in the Praat acoustic analysis program, corrected by reference to FFT spectra where necessary. The word 'compare' frequently lacked any voiced vowel in the first syllable due to aspiration of the initial stop, so it was impossible to measure the first formant frequency, and these words were discarded from the analysis. Three further utterances had to be excluded because subjects mis-read the target word.

Full vowels were measured using the same procedure, except that formant frequencies were measured where the formants remained level, or at extreme values (maxima or minima) of the formants.

3 Results

3.1 Barred-i vs. schwa: minimal pairs

In the analysis we will only present data on the nine female speakers to minimize variation between speakers in overall formant ranges, but the results for the three male speakers are qualitatively similar.

A scatter plot of the first two formant frequencies of vowels from the minimal pairs for all female speakers are shown in figure 1, with the mean formant frequencies of the full vowels plotted to provide a frame of reference. The mean formant frequencies of barred-i, schwa, and the full vowels are also listed in tables 1 and 2.

Schwa has a higher mean F1 than barred-i (table 1), indicating that the schwa vowels are lower than the barred-i's, as implied by the standard transcriptions. The mean F1 of barred-i is similar to that of the lax high vowels [ɪ] and [ʊ], while the mean F1 of schwa is somewhat higher, with substantial variation ranging into mid-vowel territory. The mean F2 of schwa is slightly lower than the mean F2 of barred-i, so barred-i's tend to be more fronted. However,

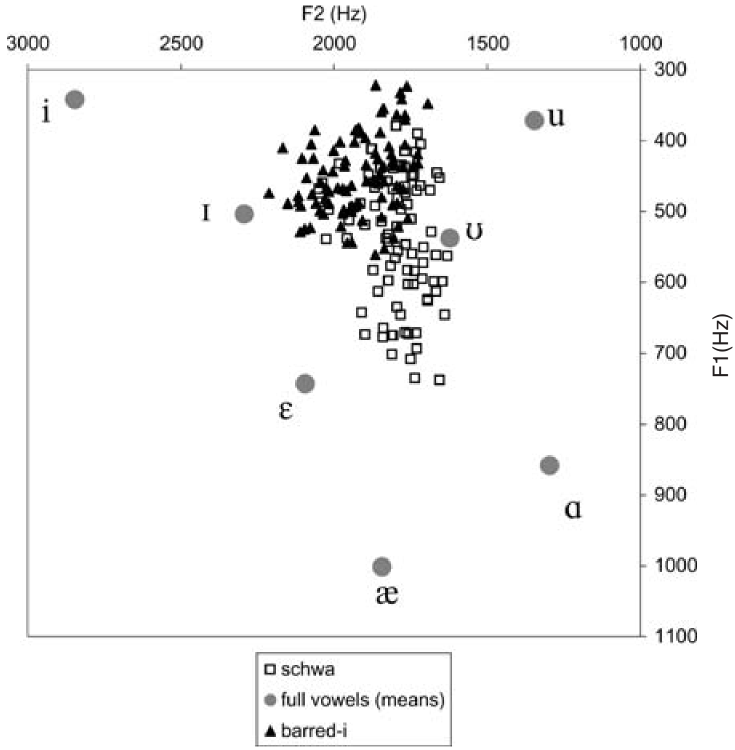

Figure 1 Formant frequencies of all tokens of barred-i (filled triangles) and schwa (open squares) from the minimal pairs, and the mean formant frequencies of the full vowels (gray circles).

Table 1 Mean formant frequencies and standard deviations (Hz) of barred-i and schwa vowels from the minimal pairs read by nine female speakers.

	F1	(SD)	F2	(SD)
barred-i	449	(56)	1922	(121)
schwa	539	(90)	1797	(97)

Table 2 Mean formant frequencies and standard deviations (Hz) of the full vowels, read by nine female speakers.

	F1	(SD)	F2	(SD)
heed	342	(36)	2846	(103)
hid	503	(66)	2293	(94)
head	743	(75)	2094	(88)
had	1002	(95)	1843	(98)
odd	858	(80)	1296	(94)
hood	538	(66)	1623	(216)
who	372	(37)	1345	(274)

mean F2 of barred-i is still considerably lower than mean F2 of lax front [ɪ] in *hid* (2293 Hz), so it is reasonable to describe most barred-i's as central vowels.

The significance of the differences in mean formant frequencies of barred-i and schwa was tested using ANOVA with effects VOWEL ('barred-i' or 'schwa'), PAIR, and SUBJECT (treated

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Table 3 Summary of ANOVA results for F1 (N = 90). *significant at $p < 0.05$, ** significant at $p < 0.01$.

Factor	df	F	p < F
VOWEL	1	53.70	0.0001**
SUBJECT	8	13.80	0.006**
PAIR	4	9.24	0.00**
SUBJECT × VOWEL	8	2.55	0.03*
SUBJECT × PAIR	32	0.48	0.98
VOWEL × PAIR	4	2	0.12
error	32		

Table 4 Summary of ANOVA results for F2 (N = 90). * significant at $p < 0.05$, ** significant at $p < 0.01$.

Factor	df	F	p < F
VOWEL	1	33.90	0.0004**
SUBJECT	8	6.94	0.003**
PAIR	4	8.04	0.0001**
SUBJECT × VOWEL	8	5.34	0.0003**
SUBJECT × PAIR	32	1.68	0.07
VOWEL × PAIR	4	0.42	0.80
error	32		

as a random effect).[4] PAIR identifies the minimal pair that a word belongs to. It is not possible to distinguish the three-way interaction from the error term in a model of this kind, so the significance of this interaction cannot be tested (Raaijmakers, Schrijnemakers & Gremmen 1999). The formant frequencies of the two repetitions of each word by a given speaker were averaged together for the analysis, yielding 90 observations altogether (9 speakers × 10 words).

The results of the ANOVAs for F1 and F2 are summarized in tables 3 and 4. The difference in F1 between barred-i and schwa is significant ($p < 0.01$). There is also a significant interaction between VOWEL and SUBJECT, showing that the magnitude of the difference between barred-i and schwa varies across subjects, but mean F1 of barred-i is higher than mean F1 of schwa for all nine speakers.

The difference in F2 between schwa and barred-i is also significant (table 4). The interaction between VOWEL and SUBJECT is again significant – the difference in F2 is small for some speakers, although it is never reversed.

In summary, the traditional characterization of the distinction between barred-i and schwa in pairs like *roses-Rosa's* is reasonable: barred-i in these words is high, schwa is generally lower, and both are central.

The minimal pairs are generally easy to distinguish, although there is variation between speakers. The overlap apparent in figure 1 is due in part to the fact that data from all speakers and segmental contexts are plotted together. The perceptibility of the difference was verified in a small listening test. Six subjects were presented with a sequence of 25 minimal pairs (*roses–Rosa's*, *leases–Lisa's*, *rushes–Russia's*), each produced by a single speaker, and asked

[4] It is not necessary to treat PAIR as a random effect, since the members of each pair are matched with respect to properties that are likely to affect formants of the target vowels since they are near-minimal pairs (Raaijmakers, Schrijnemakers & Gremmen 1999).

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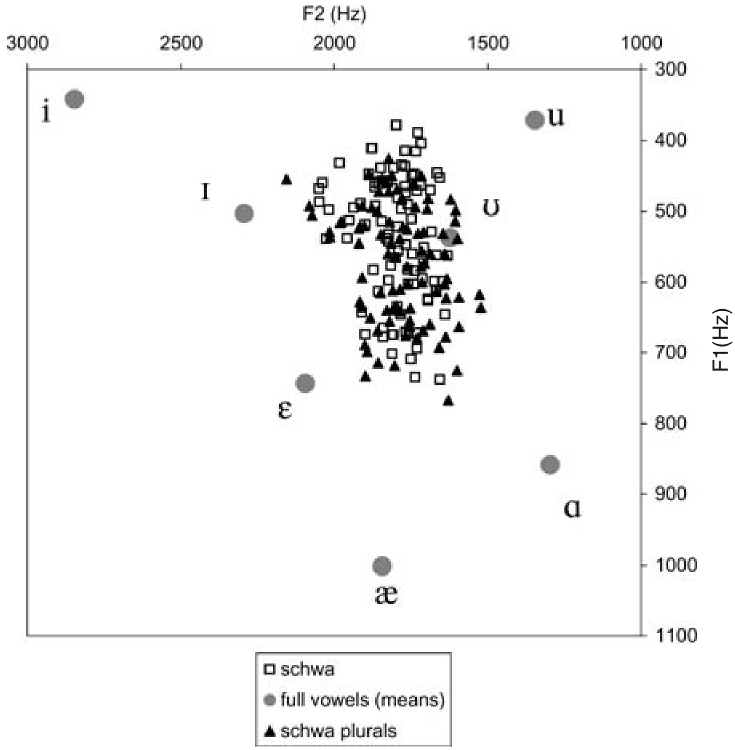

Figure 2 Formant frequencies of all tokens of schwa from the possessive forms in the minimal pairs (open squares) and the plurals of schwa-final words (filled triangles).

Table 5 Mean formant frequencies and standard deviations (Hz).

	Examples	F1	(SD)	F2	(SD)
schwa (plural/poss.)	Rosa's, sofas	556	(88)	1791	(112)
barred-i	roses	446	(54)	1912	(123)
non-final reduced vowels:					
all	begin	445	(83)	1829	(564)
coronal context	suggest	415	(52)	2042	(177)
final schwa	soda	665	(115)	1772	(138)

to identify the order in which the words were presented. On average, 88% of pairs were identified correctly, and all subjects performed at well above chance levels.

3.2 Other examples of schwa and barred-i

The reduced vowels from plurals of schwa-final words (e.g. *sofas*) have similar formant frequencies to the vowels in possessives of schwa-final words (e.g. *Rosa's*), as shown by the scatter plot in figure 2. This supports the practice of transcribing both as schwa, and suggests that the schwa vowels observed in the minimal pairs are not atypical for this segmental context. The reduced vowels in the additional plurals (2) are also very similar to the barred-i's observed in the minimal pairs (figure 3). Table 5 lists the mean formant frequencies for schwa in possessives and plurals (combined), barred-i, and non-final unstressed vowels.

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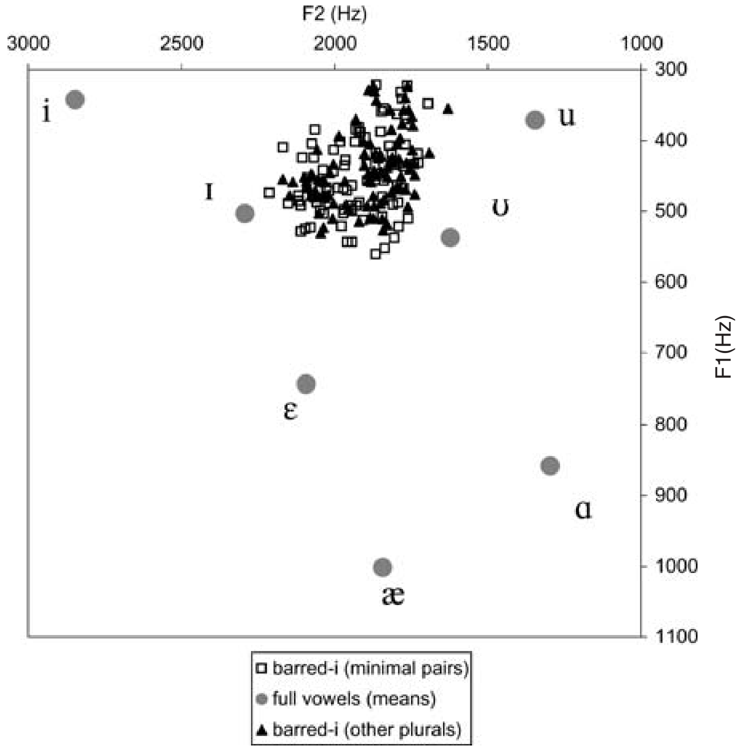

Figure 3 Formant frequencies of all tokens of schwa from the possessive forms in the minimal pairs (open squares) and the plurals of schwa-final words (filled triangles).

3.3 Non-final reduced vowels

Figure 4 shows a scatterplot of the unstressed reduced vowels from non-final positions (e.g. *begin*, *suggest*), plotted together with the barred-i's from the minimal pairs for comparison. It can be seen that the non-final reduced vowels cover a much wider range of F2 frequencies than the reference barred-i's, but in F1 they are quite comparable in mean and standard deviation, and tend to have lower F1 than schwa (table 5).

The great variation in F2 is due to the fact that F2 in reduced vowels is highly dependent on the segmental context (Kondo 1994, Bates 1995, cf. van Bergem 1994 on Dutch schwa), and the medial unstressed vowels appear in a much greater variety of contexts than the barred-i's found in plurals. Extremely low F2s are observed in the reduced vowel of *probable* (mean 1159 Hz), where the preceding vowel is back [ɑ], the following syllable contains a strongly velarized lateral, and the surrounding consonants are labials so the lips are probably never fully opened during the reduced vowel. High F2 is observed in the reduced vowel of *begin*, presumably due to the following velar which is fronted in the context of the following front vowel [i].

The barred-i's plotted in figure 4 all appear between coronal fricatives, so the most comparable medial reduced vowels are those that appear between coronal consonants. Just these medial reduced vowels are plotted in figure 5, with the barred-i's for comparison. It can be seen that the formant frequencies are very similar, although the medial reduced vowels range into higher values of F2, particularly adjacent to a palato-alveolar as in *suggest* and *prejudice*. Consequently it seems likely that the barred-i found in words like *roses* is essentially the same as other non-final reduced vowels – that is, a high vowel, with backness

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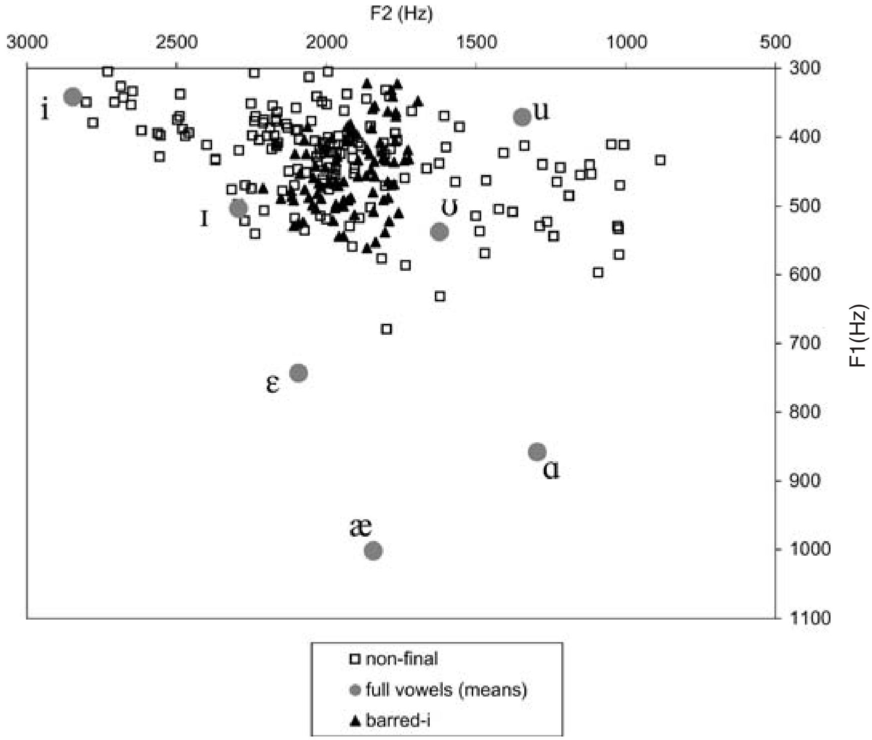

Figure 4 Formant frequencies of all tokens of non-final reduced vowels (open squares) and barred-i from minimal pairs (filled triangles).

and rounding (and hence F2) dependent on segmental context – and both are distinct from schwa as observed in words like *Rosa's*.

3.4 Final schwas

The mean F1 of unsuffixed final schwa (e.g. *Rosa̱*) is even higher than in the possessives or plurals of these words (*Rosa̱'s*, *sofa̱s*) (see table 5). Figure 6 shows that F1 of word-final schwa varies across a wide range, extending to the vicinity of low vowels, although the mean of 659 Hz indicates a mid vowel.

4 Discussion

This study of reduced vowels reveals a fundamental distinction between word-final schwa and other reduced vowels: word-final schwas center around a mid vowel quality, while reduced vowels in other positions are generally high. This suggests that the minimal contrast in pairs like *roses–Rosa's* arises because the word-final vowel quality of *Rosa* is partially preserved on the addition of an inflectional suffix such as the possessive /-z/, while the reduced vowel in *roses* is the usual high, centralized vowel quality found in non-final unstressed vowels.

The difference between final and non-final reduced vowels can be related to differences between the unstressed vowel systems in these positions. While non-final schwa is not in contrast with other unstressed vowel qualities, there are four contrasting unstressed vowel qualities in word-final position: /i, ə, oʊ/, and the rhotic vowel /ɚ/ (Hayes 1995: 14f.), as is shown in (7). The fact that all the final vowels in (7) are preceded by flaps provides evidence that they are in fact completely unstressed, because, in word-internal contexts, flapping only

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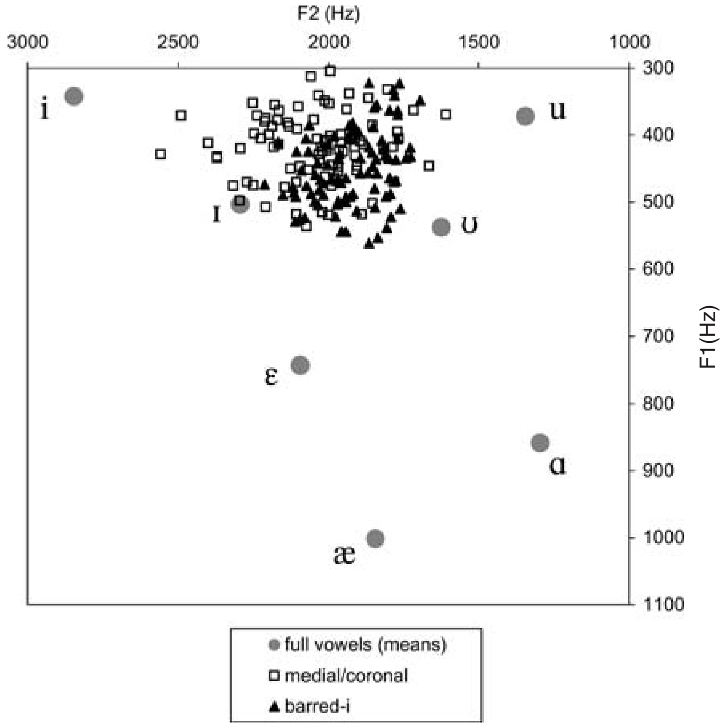

Figure 5 Formant frequencies of non-final reduced vowels from coronal contexts (open squares) and barred-i from minimal pairs (filled triangles).

applies before unstressed vowels (Kahn 1976, Zue & Laferriere 1979, Shockey 2003: 29). This diagnostic indicates that full vowels in non-final position receive at least secondary stress (with a few systematic exceptions discussed below), so forms like *[ˈpʰɹoʊɾin] (cf. *protein* [ˈpʰɹoʊˌtin]) and *[ˈmɑnəɾoʊn] (cf. *monotone* [ˈmɑnəˌtoʊn]) are ill-formed.

(7) [ˈpɹɪɾi] pretty
[ˈbeɪɾə] beta
[ˈmɑɾoʊ] motto
[ˈlɛɾɚ] letter

Given the three-way contrast between non-rhotic vowels, the fact that final schwa is non-high serves to keep it distinct from /i, oʊ/. In the absence of contrast, reduced vowels can be realized as high without endangering any contrasts. Under these circumstances, high vowels are generally preferred because they require minimal opening of the constricted vocal tract required for adjacent consonants (van Bergem 1994, Bates 1995, Flemming 2004).

Note that unstressed vowels other than those usually transcribed as schwa [ə] can appear in non-final unstressed positions but they do not minimally contrast with schwa. Hayes (1995: 14f.) observes that American dialects allow [ɪ] to appear in unstressed syllables preceding the velar nasal [ŋ], as indicated by the appearance of flaps in words like *Keating* [ˈkʰiɾɪŋ], and [i] and [oʊ] can occur unstressed before vowels (e.g. *Whittier* [ˈwɪɾiɚ], *Ottawa* [ˈɑɾoʊə]) (cf. Liberman & Prince 1977: 272f.). However, schwa does not occur in either context and so does not contrast with these other unstressed vowel qualities. The sequence [ju] or [jʊ] also appears in unstressed syllables in words like *argument* [ˈɑɹgjumənt] and *occupation*

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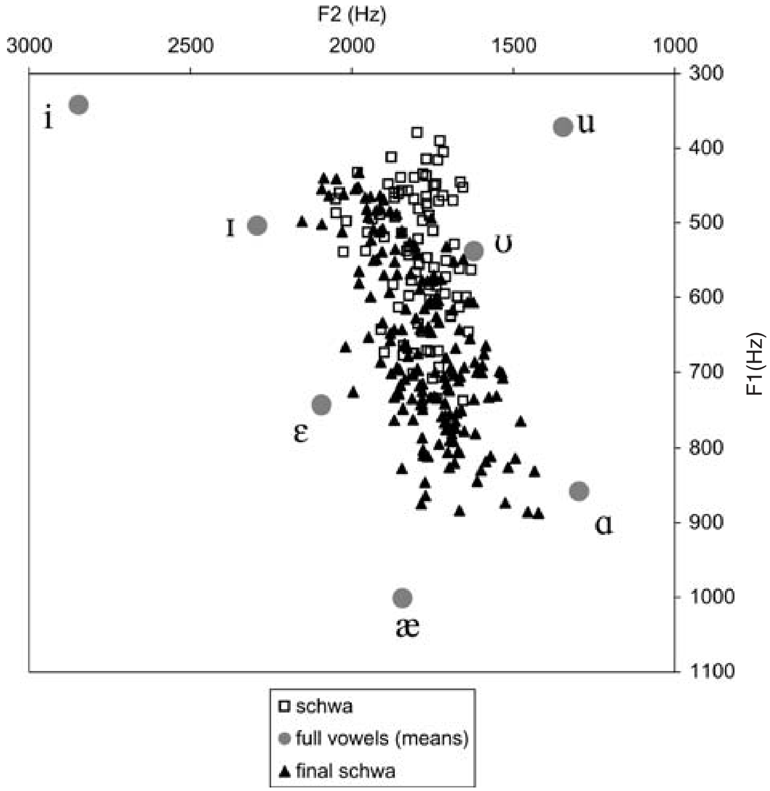

Figure 6 Formant frequencies of schwa from minimal pairs (open squares) and word-final schwa (filled triangles).

[ˌɑkjuˈpeɪʃn̩]. Flapping is not applicable as a diagnostic of lack of stress in this case since flapping does not apply before glides, but a light syllable preceding the primary stress cannot be stressed (e.g. Liberman & Prince 1977, Hayes 1981), so it is safe to say that the second syllable of *occupation* lacks stress. Again, there is no minimal contrast with schwa. In fact unstressed [ju] is in free variation with [jə] (e.g. [ˌɑkjəˈpeɪʃn̩]).[5]

These observations raise questions as to why these vowel qualities appear in these particular contexts. The feasibility of a pre-vocalic contrast between unstressed /i/ and /oʊ/ can be seen as related to the presence of intervocalic glides in these sequences. That is phonetic glides similar to [j] and [w] appear in sequences of /iV/ and /oʊV/ respectively, making it possible to realize a larger and longer difference in the formants of the two vowels than

[5] Thanks to an anonymous reviewer for bringing this case to our attention. The same reviewer suggests that [(j)u] can occur unstressed in the second syllables of *issue* and *tissue*. Impressionistic judgements of stress vary in cases like these. For example, *Merriam-Webster's Collegiate Dictionary* (11th edition) marks an optional secondary stress on the final syllables of these words whereas Kenyon & Knott (1953) does not (part of a pattern according to which very few word-final secondary stresses are marked, except in compound words). We analyze these syllables as bearing secondary stress. We do not know of any independent diagnostics of stress that are applicable to these words, but some evidence that final /u/ must bear at least secondary stress comes from an informal poll of American English speakers showing that they generally do not flap /t/ before final /u/ in Latin phrases like *in situ* and *ex mero motu*, even if they do flap /t/ before /ou/, as in the phrase *in toto* (Donca Steriade, p.c.). In any case, the key observation that there are contrasts between unstressed vowels in word-final position but not in non-final position remains unchanged whether or not [(j)u] is part of the word-final unstressed inventory.

would normally be possible in a non-final unstressed vowel. The basis for the occurrence of unstressed [ɪ] in [ɪŋ] is less clear. In the study of non-final schwas we observed that F2 of these vowels is strongly dependent on segmental context, so it is possible that the observed [ɪ] results from assimilation to the following velar nasal.

The same correlation between quality of reduced vowels and the system of vowel contrasts that is observed within English is also observed across languages. That is, a contextually-variable vowel, high in most consonantal contexts, (which we will refer to as [ɨ] for brevity) only seems to be found where all vowel quality contrasts have been neutralized, as in English non-final unstressed positions. For example, Bergem (1994) shows that vowel reduction in Dutch yields a vowel that shows a very similar pattern of variation to English [ɨ]. On the other hand, mid central [ə] is only found in contrast with higher vowels, as in word-final unstressed position in English. For example reduced vowel inventories of the general form [i, ə, u] occur in unstressed syllables in Russian[6] (Padgett & Tabain 2005), Bulgarian (Lehiste & Popov 1970), and in final unstressed syllables in Brazilian Portuguese (Mattoso Camara 1972). We do not find reduced inventories of the form [i, ɨ, u].

In Flemming (2004) this typology is analyzed in terms of a conflict between a preference to minimize effort and a preference for perceptually distinct contrasts (cf. Lindblom 1990). In the absence of vowel quality contrasts, effort minimization dominates and the result is a vowel that is strongly assimilated to its context – i.e. what we are labeling as [ɨ]. Where vowel contrasts are maintained, distinctiveness is better served by an inventory of the form [i, ə, u] (or variants such as English word-final [i, ə, oʊ]) where mid [ə] provides a better contrast with the higher vowels than [ɨ] would. The analysis implies that a language with both contrastive and non-contrastive reduced vowels could have both [ə] and [ɨ] in the respective contexts – English confirms that prediction.

The typological generalization about the distribution of [ɨ] and [ə] is obscured by the common practice of transcribing both types of vowel as [ə]. For example, the Dutch reduced vowel is conventionally transcribed as [ə] although it is high in most contexts. Transcription practices in American English are further confused by the fact that [ɨ] is distinguished from [ə], but [ə] is used to transcribe most medial and final unstressed vowels while [ɨ] is mainly used in transcribing certain suffixes. We have seen that the actual basic distinction is between word-final reduced vowels and all other reduced vowels, including the vowel of the plural suffix, so it would be more accurate to transcribe all vowels in the latter class as [ɨ] while reserving [ə] for stem-final reduced vowels as in *Rosa* and *Rosa's*.

The preservation of word-final schwa quality in suffixed words like *Rosa's* and *sofas* is part of a more general pattern: all word-final unstressed vowel qualities are preserved under affixation of the plural or possessive suffix, so [ˈsɪɾiz] *cities* preserves the unstressed tense [i] that otherwise only appears in word-final position, and the same applies to the [oʊ] of [ˈmɑɾoʊz] *mottoes*. So the minimal contrast between barred-i and schwa in pairs like *roses–Rosa's* can only arise because of the difference in morphological structure between the two words: in *roses* the stem boundary precedes the reduced vowel, [[ɹoʊz]ɨz], while in *Rosa's* it follows it, [[ɹoʊzə]z]. This contrast does not arise in other contexts, such as within monomorphemic words.

It would be interesting to investigate the same issues in English Received Pronunciation (RP) because impressionistic descriptions of this accent suggest that it may differ from the American English accents described here. First, the distinction between pairs like *Rosa's* and *roses* is usually transcribed in terms of a difference between [ə] and [ɪ] – that is, the vowel of the unstressed syllable of *roses* is identified with the stressed vowel quality found in words like *kit*. Second, a similar distinction is claimed to be possible in non-final unstressed syllables.

[6] According to standard descriptions, the system is [i, ɐ, u] in the syllable immediately preceding stress – i.e. the 'schwa' vowel is lower-mid in this position. Padgett & Tabain (2005) find some evidence in support of this claim in their acoustic study.

Wells (1982: 167f.) argues that RP and other English dialects distinguish unstressed [ɪ] and [ə] in pairs such as *Lenin* [lɛnɪn] vs. *Lennon* [lɛnən], and *rabbit* [ɹæbɪt] vs. *abbot* [æbət] (Wells's transcriptions). This distinction is not made in the American accents that we are familiar with, so *Lenin* and *Lennon* are homophonous, for example.

Our impression is that RP has a difference in height between word-final and non-final unstressed vowels, and that the unstressed vowel in words like *Rosa's* approximates the word-final schwa quality as in American English. Experimental investigation is required to determine if the unstressed vowel of words like *roses* is in fact comparable to stressed [ɪ] and thus a more fronted vowel than in American English. As for the existence of a word-internal contrast between unstressed [ɪ] and [ə], it is difficult to be certain whether the second syllables of *Lenin* and *rabbit* are really unstressed or actually bear secondary stress since secondary stress is possible in a final closed syllable, as in words like *gymnast* [ˈdʒɪmˌnæst] and *proton* [ˈpʰɹəʊˌtɒn] (Ross 1972, Hayes 1981). One possible indication that [ɪ] bears some stress in *Lenin* is the fact /ɪn/ in comparable contexts cannot be realized as a syllabic nasal, whereas /ən/ is often realized as a syllabic nasal – compare *Latin* [ˈlætɪn] and *satin* [ˈsætɪn] to *button* [ˈbʌtn̩] and *cotton* [ˈkʰɒtn̩]. In any case, preliminary investigation of two speakers who make this distinction suggests that the contrast is primarily in F2 – *Lenin* has a front vowel while *Lennon* has a central vowel, but both vowels are relatively high, so the contrast would be better transcribed as [ˈlɛnɪn] vs. [ˈlɛnɨn]. So this contrast probably differs from that found in *roses* vs. *Rosa's*, but experimental investigation is warranted.

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