From *uo* to *ue* in Spanish and from *uo* to *o* in Sicilian: Same Problem, Different Solutions

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1. Introduction

In sound variation and change, past and present are closely linked in that a synchronically-observed variation or change in progress can be seen as a modern-day reflex of a related diachronic sound change (Ohala 1989). This implies that patterns found in synchronic data may help us understand the factors that motivated a diachronic change. In this paper, the link between past and present is explored with data from a change in progress observed in the diphthongs of Sicilian, a language of Southern Italy, and a related change which occurred in the corresponding diphthongs in the historical development of Spanish. In both languages, the change targets back diphthongs asymmetrically. It will be argued that, although they occur several centuries apart and give different surface results, the changes in the back diphthongs of these two languages share a single motivating factor, namely the resolution of a perceptually non-optimal sequence of segments.

1.1. Background

In the transition from Latin to Romance the short low-mid vowels /ɛ/ and /ɔ/ (Latin Ĕ and Ŏ) diphthongized in stressed syllables (Grandgent 1907). In Spanish, /ɛ/ and /ɔ/ became /je/ and /we/. For Sicilian, the situation is more complicated. This language can be divided into four major varieties in terms of the development of these diphthongs (Ruffino 2006). The results for Latin BĔLLUS ‘pretty, handsome’ and BŎNUS ‘good’ with the masculine singular (-*u*), plural (-*i*) and feminine singular (-*a*) forms serve to characterize the four varieties: (i) a non-diphthongizing variety spoken in the western-most areas of Sicily and in western Agrigento maintains the Latin simple vowels, giving *beddu*/*beddi*/*bedda* and *bonu*/*boni*/*bona*; (ii) a non-diphthongizing metaphonic[1] raising variety, spoken in parts of Caltanissetta and Enna raises the underlying mid vowel when the post-tonic vowel is [+high], resulting in *biddu*/*biddi*/*bedda* and *bunu*/*buni*/*bona*; (iii) a nonmetaphonic diphthongizing variety spoken in Palermo and surrounding areas diphthongizes all stressed vowels regardless of post-tonic vowel quality, as in *bieddu*/*bieddi*/*biedda* and *buonu*/*buoni*/*buona*; and (iv) a metaphonic diphthongizing variety spoken in eastern Agrigento, western Messina, Ragusa and parts of Caltanissetta diphthongizes only when the post-tonic vowel is [+high], giving *bieddu*/*bieddi*/*bedda* and *buonu*/*buoni*/*bona*. This last variety is the one studied in this paper. Here, Latin Ĕ and Ŏ became /jɛ/ and /wɔ/ (metaphony permitting) in stressed syllables. Table 1 compares the results for Ĕ and Ŏ for Spanish and Sicilian.

	Ĕ		Ŏ	
Latin	TĔMPUS ‘time’	PĔTRA ‘stone’	BŎNUS ‘good’	RŎTA ‘wheel’
Spanish	*tiempo* /tjem.po/	*piedra* /pje.dra/	*bueno* /bwe.no/	*rueda* /rwe.da/
Sicilian	*tiempu* /tjɛm.pu /	*petra* /pɛ.tra/	*buonu* /bwɔ.nu/	*rota* /rɔ.ta/

Table 1. Spanish and Sicilian diphthongs (examples from Sánchez Miret 1998, Boyd-Bowman 1980).

[1] *Metaphony* is a term traditionally used in Romance linguistics to describe changes in the quality of a stressed vowel that occur in the presence of certain post-tonic vowels.

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The above examples highlight a key difference between the diphthongs which developed from the front vowel /ɛ/ (Ĕ) and those which developed from the back vowel /ɔ/ (Ŏ). Namely, the shape of the front diphthong is similar in both languages, with the only difference being the height of the nuclear vowel (low-mid /ɛ/ in Sicilian and high-mid /e/ in Spanish). Other Romance languages also typically developed and maintained either /je/ or /jɛ/ from /ɛ/. For example, we observe /jɛ/ in Standard Italian as in *p*[jɛ]*de* 'foot' and in some regional languages of Italy including Friulano, *s*[jɛ]*t* 'seven', and Salentino, *t*[jɛ]*mpu* 'time' (Sánchez Miret 1998, Grimaldi 2003). In Romanian, we see /je/ as in *p*[je]*pt* 'chest' (Sánchez Miret 1998). In French, /je/ occurs in open syllables as in *p*[je]*d* 'foot' where the final orthographic *d* is not phonetically realized, and /jɛ/ in closed syllables as in *f*[jɛ]*r*, 'proud' where the final *r* is pronounced (Taddei 2000). The results for /ɔ/, on the other hand, have shown more diachronic variation. In the historical development of Spanish, for instance, the nucleus of the back diphthong underwent both raising and fronting, going from /wɔ/>/wo/>/we/ (Carreira 1991:438, Penny 2002:52). Some regional languages of Italy have undergone a similar change so that the back diphthong is now /wɛ/, yielding forms such as as *r*[wɛ]*ta* 'wheel' in Friulano (Sánchez Miret 1998) and *b*[wɛ]*nu* 'good' in Salentino (Grimaldi 2003). In French, the back diphthong underwent many modifications, eventually disappearing altogether, as in FŎCU 'fire'>*feu* [fø] (via *fúɔku>*fúɔgu> fúɔɣu>fúou̯>fúeu̯>féu̯>fǿu̯>fǿ; Taddei 2000). In Romanian, on the other hand, the back diphthong never developed at all, giving forms such as *f*[o]*c* 'fire' (Sánchez Miret 1998). Synchronically, the back diphthong also appears to exhibit more variation, since even in those languages where it is maintained as /wɔ/, it is often less stable than the front diphthong /jɛ/. In Tuscan Italian, for example, /wɔ/ is often realized as its corresponding monophthong, /ɔ/, as in *foco* 'fire' (for the expected *fuoco*), while /jɛ/ usually remains a diphthong, as in *piede* 'foot' (Rohlfs 1966). In Standard Italian, where analogical levelling has spread the diphthongs to unstressed syllables, the back diphthong is more resistant to levelling: it fails to appear in most cases (e.g. *uómo* 'man'~*ométto*[2] 'man-diminutive') or it appears only optionally in others (e.g. *fuóco* 'fire'~*f(u)ocheréllo* 'fire-diminutive'). The front diphthong, by contrast, appears in most cases of analogical levelling, as in *piéde* 'foot'~ *piedíno* "foot-diminutive' (van der Beer 2006:121).[3] In Sicilian, a similar front-back asymmetry has recently been observed in the ALS (*Atlante Linguistico della Sicilia,* 'Linguistic Atlas of Sicily'; D'Agostino & Pennisi 1995). This asymmetry is described in the next section.

1.2. Asymmetric monophthongization of /wɔ/ and /jɛ/ in Sicilian

D'Agostino & Pennisi (1995) report that both /wɔ/ and /jɛ/ are undergoing a process of monophthongization in those areas of Sicily where these metaphonically-conditioned diphthongs traditionally occur. However, they also present evidence that /wɔ/ is progressing to /ɔ/ at a faster rate than /jɛ/ to /ɛ/. These authors found the overall mean rate of diphthong retention to be 31.6% for /wɔ/ compared with an overall mean of 43.18% for /jɛ/ (D'Agostino & Pennisi 1995:173-174). In some of the localities included in these calculations, the differences are quite dramatic. In the city of Sommatino (province of Caltanissetta,), for example, /wɔ/ appeared in only 2.27% of possible contexts, compared to 34.18% for /jɛ/. This monophthongization has been attributed by D'Agostino & Pennisi (1995:188) to external, social factors such as age, level of education and degree of contact with Italian, the national language: younger, more educated people and those with greater contact with Italian diphthongize the least. Since younger people are also more educated and have more contact with Italian, the three factors can be collapsed into one factor, namely contact with Italian. However, if this were the only or primary factor responsible for monophthongization we should then expect to see one of two patterns: (i) monophthongization is not sensitive to the type of diphthong or (ii) a higher rate of monophthongization is found in those Sicilian words in which the corresponding Standard

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[2] In these examples the diacritic is used to illustrate the stress shift; it does not reflect orthographic accent.

[3] This front-back asymmetry in diphthongs has also been observed for non-Romance languages. For example, in Seoul Korean (Kang 1997), /je/ is undergoing monophthongization now, after centuries of being part of the phonological inventory of the language, while /wo/ or /wɔ/ have never been part of this inventory at all. According to this author, the fact that the language never had /wu/, /wo/ (or /wɔ/), reflects the "lack of perceptual stability or optimality" of these sequences (Kang 1997:252).

Italian word does not contain a diphthong. In the case of (i) both /jɛ/ and /wɔ/ should monophthongize at comparable rates. In the case of (ii), on the other hand, we would expect Sicilian words with /jɛ/ (e.g. *tiempu* 'time') which lack diphthongs in Standard Italian (*tempo*) to lose their diphthongs faster than Sicilian words with /wɔ/ (e.g. *buonu* 'good' or *fuocu* 'fire') which also have diphthongs in Standard Italian (*buono*, *fuoco*). However, neither of these two predictions appears to be borne out by the evidence presented by these researchers. In fact, the one trend that is consistently observed in their data is that /wɔ/ appears more susceptible to monophthongization than /jɛ/. The contact argument alone, therefore, cannot satisfactorily explain the differences found in the rates of monophthongization for /jɛ/ versus /wɔ/. More importantly, this argument cannot account for the observation that Spanish and other Romance languages have shown a similar front-back asymmetry in the development of their diphthongs from Latin Ĕ and Ŏ.

1.3. Research goals

Given that the asymmetry between front and back diphthongs in Sicilian has also been observed in the history of Spanish and other Romance languages, as shown by the examples given above, a preliminary assumption would be that this asymmetry is not an idiosyncrasy specific to a particular language. Therefore, while individual languages may employ different strategies to deal with the presence of a back diphthong in their inventory (e.g. monophthongization in the case of Sicilian or dissimilation in the case of Spanish), the motivation behind these strategies may be the same for each language. The present study, then, aims to provide evidence suggesting that the observed differences between front and back diphthongs represent a general dispreference for back diphthongs which is motivated by internal, or phonetic, rather than external, or sociolinguistic, factors. Specifically, this study proposes that the discrepancy in the rate of change between /wɔ/ and /jɛ/ in Sicilian and the change from /wɔ/>/wo/>/we/ in Spanish are both rooted in the fact that back diphthongs consisting of sequences of /w/ plus a mid back vowel may be more difficult to perceive than front diphthongs consisting of sequences of /j/ plus a mid front vowel. It is further suggested that this discrepancy in perceptual salience between front and back diphthongs makes the former more stable over time and the latter more susceptible to change. The above claims are tested here in an experiment in which Sicilian and Spanish front and back diphthongs, as produced by four native speakers of each language, are recorded, submitted to acoustic analysis and compared.

The remainder of the paper is organized as follows. Section 2 explains the theoretical assumptions underlying the research and presents the specific hypotheses being tested. Section 3 describes the experimental methodology and reports and evaluates the results. Finally, Section 4 offers some preliminary conclusions and suggests possible directions for future work on this and related topics.

2. Theoretical Assumptions

The theoretical assumptions behind the above claims are based on Ohala's (1981,1993) model of sound change as perceptually-based and listener-driven as well as on observations by Kawasaki-Fukumori (1992) and Ohala & Kawasaki-Fukumori (1992) that sound sequences which are universally dispreferred tend to be made up of segments which are acoustically very similar and to show small acoustic modulations. These assumptions are detailed below.

2.1. The role of perception and the listener in phonological variation and change

Ohala (1981,1993) proposes that most sound change has a basis in perception and that the listener plays a primary role in the initiation of such changes. He observes that human speech is characterized by an "inherent ambiguity" which stems from what he terms "the many-to-one relationship between vocal tract shape and sound shape" (Ohala 1981:178), a relationship which may result in segments which are articulatorily different but acoustically similar. In addition, the speech signal is also inherently variable, or "noisy", with "seemingly an unlimited number of measurably different phonetic variants of each word in actual speech" (Ohala 1981:179). The listener, then, faces the difficult task of factoring out the ambiguity and noise in the speech she hears, a task which is facilitated by her unconscious knowledge of the effects of certain phonetic environments on specific sounds. Thus, one of the roles of the listener in sound change is to prevent this change from occurring by normalizing the speech signal (Ohala 1981:180-182, Ohala 1993:245-246); usually the listener succeeds at this task. In some instances, however, the listener may not be able to correct the noise in the signal. This may lead to a sound change, where the phonetic variation inherent in the speech signal is adopted as part of a new “pronunciation norm” (Ohala 1993:246).[4]

A sound change may occur in the above instances either through hypocorrection or hypercorrection, both of which are the result of some kind of “perceptual confusion” (Ohala 1993:251). Hypocorrection occurs when the listener fails to make a corrective change to the speech signal. This may take place in one of two ways: (i) the listener confuses acoustically similar sounds, as in the confusion between English /f/ and /θ/, where the former replaces the latter (Ohala 1989:180-182, 1993:258); or (ii) the listener’s ability to perceive the conditioning environment which led to the phonetic variation is compromised, as when this conditioning environment is lost. The development of nasal vowels in French (VN>Ṽ) is an example of this second type of hypocorrection (Ohala 1993:246-247). According to Ohala, this change occurred when the previously phonetic nasalization of vowels in a /VN/ sequence (i.e. [ṼN]) became difficult to attribute to an increasingly weak N. With time, the listener came to assume that the nasalization came from the vowel itself, resulting in phonemically nasal vowels (/Ṽ/). Hypercorrection, on the other hand, occurs when the listener applies a corrective rule where none is required. The resulting effect is one of dissimilation, which Ohala defines as “the loss or change of one or more features, including whole segments, when the same feature is distinctive at another site within a word” (Ohala 1993:249). One of the functions of dissimilation may be “as a constraint against the co-occurrence of similar segments”[5] (Ohala 1993:249).

Of particular relevance to the present research is Ohala’s claim that dissimilation may be restricted to “features which manifest themselves over fairly long temporal intervals [and which] can encroach on adjacent segments and thus create an ambiguity as to where the feature is distinctive or fortuitous” (Ohala 1993:251). An example is [labial], a feature of the labiovelar glide [w] and of its related back vowel [u]. Ohala illustrates dissimilation involving labialization with an example from Latin, where /kwiŋkwē/>/kiŋkwē/ ‘five’ lost the lip rounding on the first segment (Ohala 1993:251). The change, according to Ohala, occurred when listeners assumed that the labialization at the beginning of the word was non-distinctive (i.e. it was attributed to the presence of a labialized consonant in the second syllable) and eliminated it. On the other hand, Ohala (1981:193) also identifies [palatal], a feature of /j/, as a feature which is likely to undergo dissimilation. Therefore, in the case of the diphthongs that are the focus of this study, we might expect changes to affect /w/ and /j/ diphthongs equally. However, as shown in Section 1, this clearly is not the case for Sicilian and was not the case for Spanish. I will return to this problem in Section 2.3. First, however, I will briefly summarize evidence by Kawasaki-Fukumori (1992) and Ohala & Kawasaki-Fukumori (1992) which supports the above theoretical model and which suggests that sound sequences made up of acoustically similar segments are less perceptually salient. As a result of decreased salience, such sequences are predicted to be less likely to occur cross-linguistically and to be more susceptible to change when they do occur.

2.2. The phonetic nature of dispreferred sequences

Kawasaki-Fukumori (1992) and Ohala & Kawasaki-Fukumori (1992) identify certain patterns involving phonotactic constraints on CV sequences which seem to hold universally. Of relevance to the present study is the apparent universal tendency to avoid sequences of /w/ and labialized consonants before back, rounded vowels or /j/ and palatalized consonants before front vowels (Kawasaki-Fukumori 1992:75-76; Ohala & Kawasaki-Fukumori 1992:346). These authors propose that these constraints are largely “acoustically and perceptually based” (Kawasaki-Fukumori 1992:76)

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[4] Of course, most of the time a sound change does not occur since the listener has repeated opportunities to hear the misperceived word and probably will not mishear it in every context. Moreover, it is not likely that a major sound change will be initiated by a whole community imitating a single speaker (Ohala 1993:244).

[5] In phonological analyses, this observation may be formalized via the Obligatory Contour Principle (OCP; e.g. McCarthy 1986).

and that they are not determined by a single parameter, such as sonority (Ohala & Kawasaki-Fukumori 1992:349). Kawasaki-Fukumori (1992), for example, suggests that there are two major factors motivating these constraints. The first factor involves *salience* and is determined by "the magnitude of acoustic modulation in a given phoneme sequence", where acoustic modulation refers to "changes over time in some acoustic parameters" (Kawasaki- Fukumori 1992:76), including "amplitude, periodicity, spectral shape, and fundamental frequency (F0)" (Ohala & Kawasaki-Fukumori 1992:349). The second factor involves *dissimilarity*, defined by Kawasaki-Fukumori (1992:76) as the degree of acoustic difference between phoneme sequences, where the greater the difference between two sequences, the less likely they are to be confused with each other.

To test the first factor, Kawasaki-Fukumori (1992) tracked and measured the magnitude of acoustic modulations, as defined by the trajectories of the first three formants, of certain C_1+(C_2)+V sequences (where C_1 was a voiced stop, /b d g/, C_2 was a glide or liquid, /l r w j/,[6] and V was /i e ɑ u/). It was expected that "the magnitude in the trajectory in the F1xF2xF3 space would correlate with the degree to which the sequence was universally preferred in languages" (Ohala & Kawasaki-Fukumori 1992:351). In other words, the smaller the F1xF2xF3 trajectory, the less salient the sequence would be. The results most significant for the present study are those which showed that the trajectories between /j/ and /i/ and between /w/ and /u/ are shortest, making these the least salient diphthongs. This coincides with observations that these two sequences are not commonly found cross-linguistically (Ohala & Kawasaki-Fukumori 1992:346-347). Kawasaki-Fukumori (1992) also found that /ja/ and /ju/ are better than /ji/ and that /wa/, /wi/ and /we/ are better than /wu/. Based on these findings, then we should also expect /je/ to be preferable to /ji/, and /wo/ to be preferable to /wu/.

Kawasaki-Fukumori's findings support Weeda's (1983:149) perceptual constraint on diphthongs, according to which "diphthongs should utilize the articulatory extremes of the vowel space based on maximum differentiation of endpoints" in order to maximize their perceptual salience. Ohala & Kawasaki-Fukumori's (1992) observations, in turn, are supported by Borzone de Manrique's (1979) research on Spanish diphthongs. She shows that when /e/ and /i/, or /o/ and /u/[7] occur together in diphthongs, rather than as isolated vowels, "the distance among them is reduced and there is evident overlap between the areas of /e-i/ and /o-u/, respectively" (Borzone de Manrique 1979:197). This overlap may reduce salience, as it results in the two segments becoming more acoustically similar than if they occurred in isolation. Eventually, these low-salience sequences should undergo dissimilation in the form of a change or deletion of one of their segments (Ohala & Kawasaki-Fukumori 1992:351).

Nonetheless, nothing in what the above authors say suggests that we should observe any asymmetries between sequences of /j/ plus a mid front vowel and sequences of /w/ plus a mid back vowel. In fact, both types of sequences might be expected to behave in a parallel manner and to be equal in terms of perceptual salience. That is to say, we should expect the sequences /je/ and /jɛ/ to be as problematic as the sequences /wo/ and /wɔ/ in Spanish, Sicilian and other Romance languages. What, then, tips the scales in favour of the front diphthongs in these languages, making the back diphthongs less stable? A partial answer to this question is offered in the following section where F1 and F2 values of Spanish vowels are plotted and combined with the data from Borzone de Manrique (1979). The results suggest that front and back diphthongs differ in the degree of acoustic overlap which their respective members undergo.

2.3. Perceptual asymmetry between front and back diphthongs in Spanish and Sicilian

Representative F1 and F2 values in mels of the Spanish vowels relevant to the diphthongs studied here are given in Table 2 and plotted in Figure 1.

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[6] This author uses the symbol [r] to represent an alveolar approximant, commonly represented as [ɹ].

[7] Although it has a very limited distribution and its occurrence is not related to the diphthongization of Latin /ɔ/, the diphthong /wo/ does occur in Spanish, appearing as a heteromorphemic sequence resulting from the concatenation of a stem-final /u/ with a following morpheme /-o/ (e.g. *actu-ar* /ak.twár/ 'act-infinitive'~*actu-ó* /ak.twó/ 'act-3rd person sing. past'; Carreira 1991:418). Carreira identifies these restrictions as reflecting "a general intolerance in Spanish toward the diphthong [wo]" (Carreira 1991:418).

Vowel	F1	F2
i	286	1643
e	429	1581
o	514	896
u	336	771

Table 2. F1 and F2 frequencies in mels of Spanish vowels.[8]

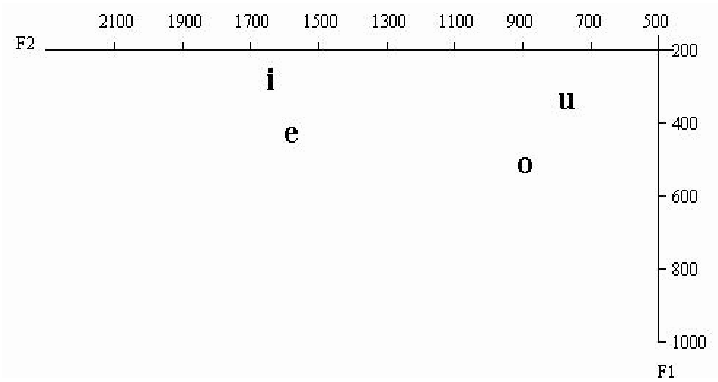

Figure 1. F1-F2 plot in mels of Spanish /i/, /e/, /o/ and /u/ as isolated vowels.

The formant plot in Figure 1 provides a visual representation of the acoustic distance between the vowels in question. If we assume that formants, especially when converted to the mel scale which is based on auditory perception, "characterize the input to speech perception" (Hayward 2000:146) and that formant charts may represent "a universal perceptual vowel space" (Hayward 2000:147), then we can propose that the linear distance in mels on the formant plot represents the perceptual distance and degree of contrast or distinctiveness between two vowels as well (e.g. Lindblom 1986). In sum, the farther apart the vowels appear on the plot, the more they may be perceived as distinct. In the above formant plot, /i/ and /e/ seem about equally distant from one another as /u/ from /o/ suggesting that, when these pairs of vowels combine in diphthongs, they should behave similarly and not asymmetrically. However, we can begin to explain the asymmetry between front and back diphthongs if we consider what happens to these individual vowels when they appear together in diphthongs. According to Borzone de Manrique (1979:198-199), the following changes in F1 and F2 values take place in these vowels when they occur together in Spanish diphthongs: the F1 of /i/ and /e/ increases by approximately 95 mels whereas their F2 decreases 250 mels; the F1and F2 of /u/ increase by 50 mels and 190 mels respectively; and, finally the F1 of /o/ decreases by 60 mels accompanied by an increase of 80 mels in its F2.

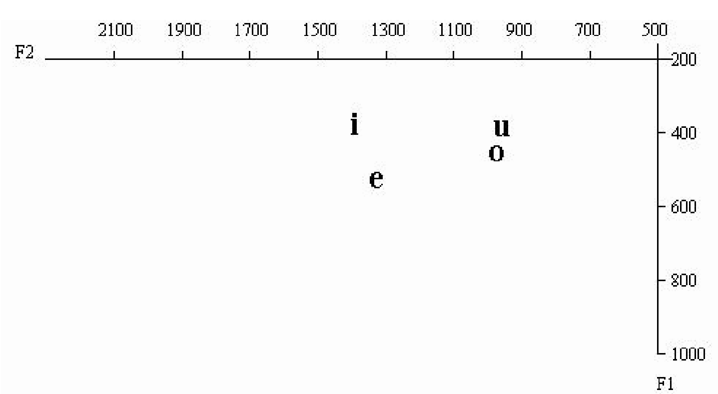

Figure 2. F1-F2 plot in mels of Spanish /i/-/e/, /u/-/o/ in diphthongs.

[8] Values are taken from Quilis (1981:157-158) and are based on stressed Spanish vowels in open syllables, situated between two labial consonants.

When these changes are applied to the vowels from Table 2 and plotted, as in Figure 2, we see that they result in a decrease in the acoustic difference between /u/ and /o/. This suggests that the potential for perceptual overlap is greater for these two segments than for /i/ and /e/. The latter segments seem to have maintained their acoustic distance despite their respective formant shifts which correspond to a lower, more posterior articulation for both. Here then we have a visual illustration that Spanish /wo/ likely starts off as perceptually less salient than its front counterpart /je/. A similar argument can subsequently be made for Sicilian /wɔ/ and /jɛ/.

In Spanish, forming a diphthong with /u/ also seems to have a greater effect on /e/ than forming a diphthong with /i/, with this effect showing itself mainly in the F2 values of /e/. For example, Borzone de Manrique (1979:199) observes that there is a greater decrease in the F2 of /e/ when it occurs in a diphthong with /u/ than with /i/. This downward shift in F2 corresponds to an even more posterior articulation for /e/ in this context, with a possible shift toward the acoustic space of /o/.

The above sections suggest that the degree of dissimilarity is greater between /j/ and the mid front vowels than between /w/ and the mid back vowels. Therefore, for Sicilian we might propose that the segments in /jɛ/ are more dissimilar than those in /wɔ/. In the case of Spanish, the segments in /je/ are assumed to be more dissimilar than those in /wo/. The smaller degree of acoustic difference between its component segments is presumably what makes back diphthongs more susceptible to perceptual confusion and change, leading to synchronic monophthongization of /wɔ/>/ɔ/ in Sicilian and diachronic dissimilation of /wɔ/>/wo/>/we/ in Spanish, with the exception of the very limited, historically unrelated cases mentioned in Footnote 6. In addition, for Spanish, it may also be the case that the degree of dissimilarity is also greater between the segments in /je/ than those in /we/ since the nuclear vowel in the latter diphthong appears to move to a more posterior articulation, possibly toward the area of /o/. This observation regarding the articulation of /e/ leads to another assumption based on the above formant plots. If we assume that vowel formants also represent “the output of speech production” (Hayward 2000:146), then the smaller differences observed between /u/ and /o/ in Figure 2 as compared to those differences in Figure 1, suggest that, when these segments appear in diphthongs, they also encroach on each other’s articulatory space. That is, the closer together they appear on the formant plot, the more articulatory properties they share. Eventually, the result may be two contiguous realizations of what is essentially the same articulatory gesture, with some differences in magnitude (Browman & Goldstein 1992). In connected speech, this may translate into a greater potential for articulatory overlap in sequences of /w/ plus mid back vowels than in sequences of /j/ plus mid front vowels. For Spanish, this greater potential for overlap may extend to /we/ since /e/ in this diphthong moves towards the articulatory space of /o/, taking on some of its articulatory properties.

To test the extent to which the proposed differences in the degree of acoustic (and possibly articulatory) dissimilarity between the above sequences affect their respective salience in terms of differences in the magnitude of acoustic modulations, the Spanish diphthongs /we/ and /je/ were recorded, analyzed and compared to the historically related Sicilian diphthongs /wɔ/ and /jɛ/. The specific hypotheses tested are outlined below in Section 2.4 while the experimental methodology and results follow in Section 3.

2.4. Hypotheses

The first hypothesis tested here is that there are differences in the magnitude of the acoustic modulations of front diphthongs in comparison to those of back diphthongs. The parameter used to calculate these differences is the F1-F2 trajectories of Spanish and Sicilian diphthongs. With respect to this parameter, the following results are expected: the F1-F2 trajectory for Sicilian /wɔ/ is smaller than that of Sicilian /jɛ/ and Spanish /je/. Among the back diphthongs, the trajectory for Spanish /we/ is expected to be larger than that for Sicilian /wɔ/. This difference between the trajectories of /we/ and /wɔ/, however, may be smaller than the difference between /wɔ/ and the front diphthongs, given what has been said about /e/ in /we/. These predictions are based on the assumptions made in Section 2.2 that less salient sequences show small acoustic modulations as well as on the observations made in Section 2.3 that there appears to be less dissimilarity between the vowels which make up the back diphthongs /wo/ (and by extension /wɔ/) than between the vowels which make up the front diphthongs /je/ (and by extension /jɛ/). An additional prediction based on the above is that the acoustic overlap already evident in the back diphthongs may be exaggerated in the context of a preceding labial consonant because of the similarities between labial consonants and the labiovelar glide /w/. Specifically, both labial consonants and /w/ lower the F2 of an adjacent vowel and both have similar CV formant transitions, increasing the possibility of perceptual ambiguity (Kent & Read 1992:136-137). That is, the listener may attribute the lowered F2 of the vowel to the presence of the labial consonant rather than to that of the glide, resulting in a hypocorrection where the CwV sequence is interpreted as CV (see Section 2.1 for Ohala's example for Latin /kwiŋkwē/ 'five'). This effect should be greater for the Sicilian diphthong /wɔ/ than for Spanish /we/ since /wɔ/ already consists of two segments which are more acoustically similar (i.e. they share backness and rounding) than the segments which make up /we/.

The second hypothesis tested is that, along with greater acoustic overlap, there is also a potential for greater articulatory overlap in sequences of /w/ plus mid back vowels than in sequences of /j/ plus mid front vowels. Following the assumption that increases in articulatory overlap may result in durational changes (Browman & Goldstein 1992), we can test whether there are durational differences between front and back diphthongs. In terms of this parameter, Sicilian /wɔ/ is expected to be shorter than its corresponding front diphthong /jɛ/. In addition, given the changes /e/ undergoes in the Spanish diphthong /we/, this diphthong is also predicted to be shorter than its corresponding front diphthong /je/. A preceding labial is predicted to exaggerate the durational differences between front and back diphthongs, making Sicilian /wɔ/ and Spanish /we/ even shorter than their front counterparts in this context.

3. Methodology

3.1. Data collection

Data were collected from recordings of eight female speakers:[9] four native speakers of Spanish living in Toronto (originally from Venezuela, Argentina, Mexico and El Salvador) and four native speakers of Sicilian living in Tusa (province of Messina). The Spanish speakers ranged in age from 35 to 51 and had achieved at least a secondary level of education in their home countries. The Sicilian speakers ranged in age from 49 to 80[10] and, with the exception of the youngest speaker who finished secondary school, all had only elementary education. These speakers could not be matched by age and education level with the Spanish speakers since younger, more educated speakers tended not to use Sicilian consistently, preferring to converse in Italian. The elicitation method used for the Spanish speakers was a reading task where the participants read a list of target words embedded in the carrier sentence *Dicen X porque quieren* 'They say X because they want to'. The speakers were instructed to speak at a normal rate of speech and to avoid hyperarticulating. The sentences were printed on index cards and read three times by each speaker with a five-minute break between readings; the cards were randomized before each reading. The target words contained either the diphthongs /we/ and /je/ or the plain vowels /o/ and /e/ in stressed syllables preceded by a stop consonant (labial, dental and velar). Since both voiced and voiceless stops were included, the carrier phrase included a nasal consonant before the target word (the <n> of *dicen*) to avoid an intervocalic environment in which the voiced stops might be realized as approximants (Martinez-Celdrán 1991). Because Sicilian is primarily used in oral communication and has no standard written form, a different elicitation method was used with these speakers. However, efforts were made to elicit words similar to those recorded for the Spanish speakers. For the Sicilian speakers, target words containing the diphthongs /wɔ/ and /jɛ/ and the plain vowels /ɔ/ and /ɛ/ in stressed syllables preceded by a stop consonant (labial, dental and velar) were elicited using a variety of oral tasks[11] including: (i) discussion of town life; (ii) picture identification;

[9] Only female speakers were used due to availability of participants.

[10] All were in good health and did not report any medical conditions which could affect their speech or hearing.

[11] Originally, a reading task was designed which included the target words embedded in a selection of proverbs, sayings and poems written in Sicilian using orthography which reflected the standard pronunciation of speakers from this town. However, this task could not be successfully implemented due to the fact that none of the speakers had experience reading Sicilian nor significant reading experience in general (for example, a test-run of this task

(iii) translation of sentences from Italian to Sicilian; and (iv) elicitation of the feminine, plural or opposite of a word. Recording was done directly to a Dell Inspiron 6400 PC with a Sony, unidirectional external microphone and the digital audio-editing program Audacity 1.2.4 at 44100Hz, 32bits. The recordings took place in a quiet meeting room for three of the Spanish speakers and in the speaker's home for the fourth Spanish speaker. All of the Sicilian speakers were recorded in their homes. The target tokens for both languages are found in the Appendix.[12]A total of 408 tokens were extracted for the Spanish speakers, of which 317 were suitable for analysis (110 for /we/; 95 for /je/; 54 for /e/; 58 for /o/). For the Sicilian speakers, only 200 of the 280 extracted tokens (53 for /wɔ/; 83 for /jɛ/; 23 for /ɔ/; 41 for /ɛ/) were deemed suitable for analysis. Tokens were deemed unsuitable if there was excessive noise in the signal which could interfere with the analysis. The data were analyzed using PRAAT 4.4.24. The details of the analysis are given in the next section.

3.2. Data analysis

The F1-F2 trajectories of the Spanish and Sicilian diphthongs were measured as follows. The F1 and F2 values used to calculate the trajectory were measured in Hertz at two separate points, near the beginning and end of the sequence, where these two formants were stable for both segments in the sequence (Kent & Read 1992:103). These values were converted to mels and the F1-F2 trajectories of the diphthongs were plotted for both groups of speakers. To evaluate whether the observed differences in the trajectories were significant, the difference in the mean change of the F1 and F2 values from the beginning to the end of the trajectories was compared for the different diphthongs

Durational measurements of the diphthongs were made using cues from both the waveforms and spectrograms. The onset of the glide portion was determined by the onset of F1 in the spectrogram and the onset of periodicity in the waveform following a stop burst. In Sicilian, where the elicitation method did not allow for a strict controlling of the pre-stimulus consonantal context, voiced stops at the beginning of the stimulus words sometimes occurred in intervocalic position where they were at times realized as approximants. In these cases the onset of the glide portion was taken to be the start of a larger period following the approximantized stop. The offset of the nuclear vowel was taken to coincide with the last period on the waveform before a stop or fricative or the end of a large period followed by a smaller period when the following consonant was a nasal, liquid or intervocalic stop. On the spectrogram, F2 offset determined the end of the vowel (Chitoran 2002:211). Similar landmarks were used for measuring the duration of plain vowels.

The relevant measurements for both parameters were entered into an Excel file and later exported to SPSS 14 for statistical testing. In all cases, t-tests were used to compare means with a significance level of .05.

3.3. Results

The results for the magnitude of the F1-F2 trajectories are presented in Table 3, which provides the mean F1 and F2 values and standard deviations for each language at the onset and offset of each diphthong in all consonantal contexts combined. As expected, the magnitudes of the trajectories of the front diphthongs (Sicilian /jɛ/ and Spanish /je/) appear larger than those for the back diphthongs (Sicilian /wɔ/ and Spanish /we/). Among the back diphthongs, the trajectory for Spanish /we/ appears larger than that for Sicilian /wɔ/, but as predicted in Section 2.4, this difference is quite small. Of the four diphthongs, Sicilian /wɔ/ appears to have the shortest trajectory. Given the observation made in Section 2.3 that there is a decrease in the acoustic distance between /u/ and mid back vowels when they occur in diphthongs with no comparable decrease in the acoustic distance between /i/ and mid front vowels, the difference in the length of the trajectories for /wɔ/ compared to /jɛ/ and /je/ is expected. In addition, the short trajectory for Spanish /we/ and the apparent proximity of its nuclear

with one speaker resulted in her becoming flustered). Since the Spanish speakers had been recorded prior to the Sicilian speakers, their task could not be changed to match those given to the Sicilian speakers.

[12] For the Sicilian speakers, efforts were made to obtain several different tokens for each consonantal context in order to increase the total number of tokens per speaker. Empty cells indicate inventory gaps or missing tokens.

vowel /e/ to the nucleus /ɔ/ is also not surprising given what was said in Section 2.3 concerning the effect of /u/ on /e/ when they occur together in a diphthong. To evaluate whether the differences in the above trajectories are significant, the mean change in F1 and F2 values from the onset to the offset of each diphthong was calculated from the values in Table 3 and compared both between and within the two languages. The within-language comparison for Sicilian shows that the difference in the F1 change between /wɔ/ versus /jɛ/ is not significant. However, the difference in the F2 change between these two diphthongs is significant ($t(3)=3.77$, $p<.05$).

		Formant			
Glide	Language	F1/F2	Onset/Offset	Mean	Standard Deviation
w	Sicilian	F1	Onset	592	18
	Spanish			593	36
	Sicilian		Offset	680	39
	Spanish			693	45
	Sicilian	F2	Onset	935	42
	Spanish			1007	26
	Sicilian		Offset	1238	81
	Spanish			1457	94
j	Sicilian	F1	Onset	553	23
	Spanish			541	45
	Sicilian		Offset	638	28
	Spanish			698	39
	Sicilian	F2	Onset	1698	54
	Spanish			1653	61
	Sicilian		Offset	1538	43
	Spanish			1442	83

Table 3. Mean F1-F2 values in mels at onset and offset of Sicilian and Spanish diphthongs (n=4 per sub-type).

The above values were used to plot the F1-F2 trajectories shown in Figure 3 below.

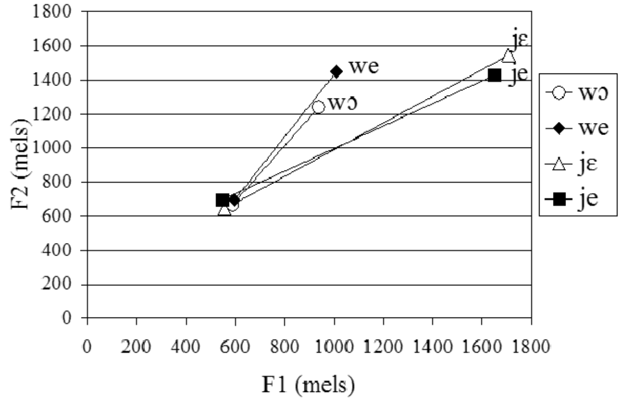

Figure 3. F1-F2 trajectories for Sicilian /wɔ/ and /jɛ/ and Spanish /we/ and /je/ in all contexts.

Representative formant movement patterns of /wɔ/ versus /jɛ/ also serve to illustrate the difference between these two Sicilian diphthongs. In terms of formant movement, the diphthong /wɔ/ does not appear to differ from its corresponding plain vowel /ɔ/, as shown in Figure 4, where the arrows indicate F1 and F2. A comparison of Sicilian /jɛ/ and /ɛ/ in Figure 5, on the other hand, shows that this diphthong and its corresponding single vowel differ in their formant movements.

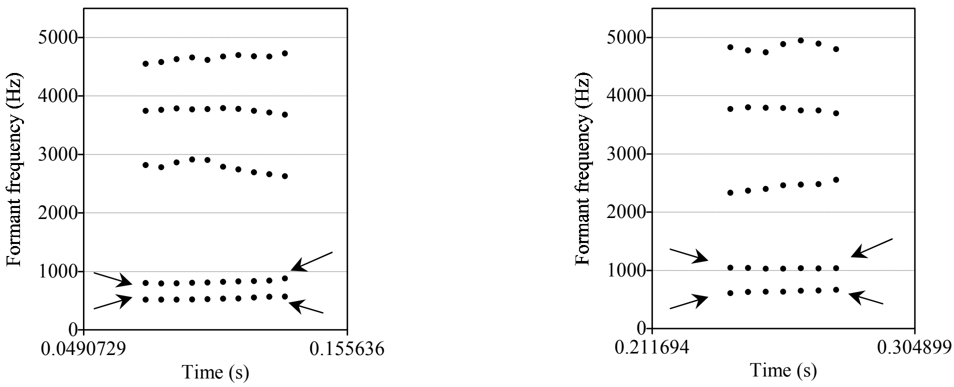

Figure 4. Formant pattern of Sicilian /wɔ/ in *buonu* ‘good-masc. sing.’(left, speaker 4) versus /ɔ/ in *bona* ‘good-fem. sing.’ (right, speaker 1).

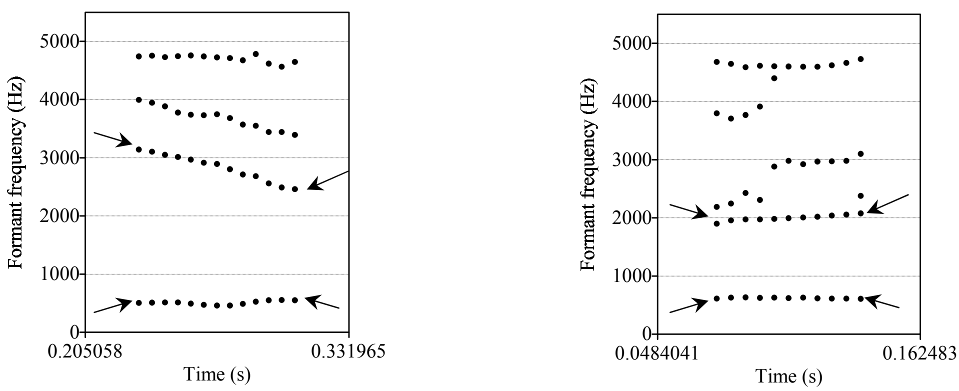

Figure 5. Formant pattern of Sicilian /jɛ/ in *bieddu* ‘good-looking-masc.sing’(left, speaker 4) versus /ɛ/ in *bedda* ‘good-looking-fem.sing.’ (right, speaker 1).

The within-language comparisons for Spanish show no significant differences in either the F1 or the F2 changes between /we/ and /je/. The between-language comparison shows no significant differences in the F2 change between Sicilian /jɛ/ and Spanish /je/. The differences in the F1 changes between these two diphthongs, however, are significant ($t(6)=2.89$, $p<.05$). This difference is reflected in the slightly steeper slope of /jɛ/ in Figure 3. For the back diphthongs (Sicilian /wɔ/ and Spanish /we/), neither the differences in the F1 changes nor in the F2 changes were significant. However, the differences in the F2 changes approached significance ($t(6)= 2.34$, $p=.058$). The differences between these two back diphthongs, nevertheless, become significant in the context of a preceding labial consonant.

		Formant			
Glide	Language	F1/F2	Onset/Offset	Mean	Standard Deviation
w	Sicilian	F1	Onset	600	17
	Spanish			602	31
	Sicilian		Offset	713	53
	Spanish			708	40
	Sicilian	F2	Onset	901	36
	Spanish			904	38
	Sicilian		Offset	1230	67
	Spanish			1454	116

Table 4. Mean F1-F2 values in mels at onset and offset of Sicilian and Spanish diphthongs following a labial consonant (n=4 per sub-type).

Table 4 lists the mean F1 and F2 values and standard deviations obtained for each language at the onset and offset of Sicilian /wɔ/ and Spanish /we/ following a labial stop. In Figure 6 the trajectories for Sicilian /wɔ/ and Spanish /we/ are compared in all consonantal contexts (left) and following a labial stop (right). In the labial context, as predicted, the difference between /we/ and /wɔ/ appears greater and this apparent difference is statistically significant, although only for the difference in F2 change (t(6)=2.64, p<.05).

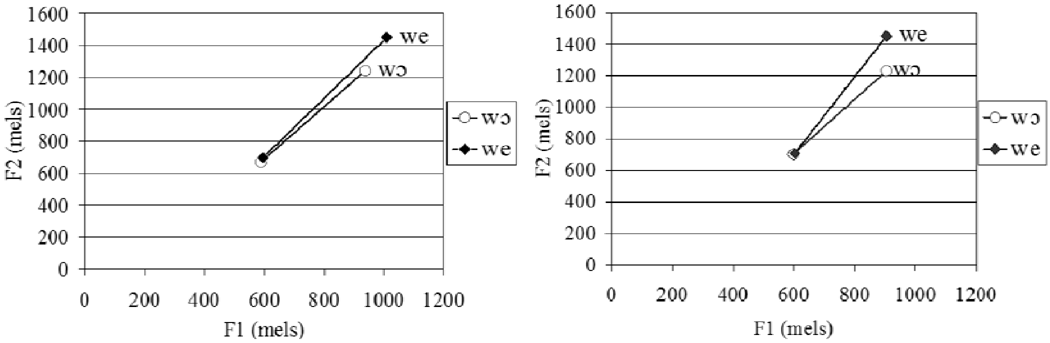

Figure 6. F1-F2 trajectories for Sicilian /wɔ/ and Spanish /we/ in all contexts (left) and following a labial (right).

The duration results are summarized in Table 5. As the different elicitation tasks used for each language may have resulted in different speech rates, only within-language comparisons are made.

Language	Sequence	Mean duration	SD
Sicilian	/ wɔ/	114	39
	/ ɔ/	112	34
	/jɛ/	117	37
	/ɛ/	106	25
Spanish	/we/	139	32
	/o/	112	20
	/je/	168	34
	/e/	102	17

Table 5. Mean duration values in milliseconds of diphthongs and their corresponding plain vowels.

As predicted, for both languages, the back diphthongs are shorter than their front counterparts. Therefore, for Spanish /we/ (139ms) is shorter than /je/ (168ms). This difference is statistically significant (t(3)=8.035, p<.01). Similarly, for Sicilian /wɔ/ (114ms) is shorter than /jɛ/ (117ms). However, this difference is not statistically significant. The difference in duration between diphthongs and plain vowels in Sicilian is also interesting. For instance, Sicilian /wɔ/ approaches the duration of /ɔ/ alone; the 2ms difference between them is not statistically significant. The difference between /jɛ/ and /ɛ/, on the other hand, is greater (11ms). However, this greater difference does not translate into statistical significance. For Spanish, the differences between diphthongs and plain vowels are larger. Even here, however, the difference between /je/ and /e/ (66ms) is greater than that between /we/ and /o/ (27ms). In this case, both differences are statistically significant although they are more highly significant for /je/ versus /e/ (t(3)=16.06, p<.01) than for /we/ versus /o/ (t(3)=3.50, p=.40).

The duration results for the diphthongs and vowels preceded by a labial stop were not as expected. Indeed, the hypothesis regarding labials was not borne out as Sicilian /wɔ/ is in fact longer (144ms, SD 41) and not shorter as expected in this restricted context than in the more general context presented in Table 5. However, this result may be due to the small number of Sicilian tokens (17) for this context. Spanish /we/ was slightly shorter following a labial (135ms, SD 23) than in the overall context (139 ms, SD 32) but this difference was not statistically significant.

3.4. Discussion

The results obtained in this study are encouraging and, although the statistical tests which evaluate them are not always significant,[13] these results reveal certain patterns which appear to support the claim that the changes taking place in Sicilian, where /wɔ/ is becoming /ɔ/, are perceptually-based. For example, Sicilian /wɔ/, compared to the other diphthongs analyzed in this study, shows a smaller degree of dissimilarity between its component segments as well as reduced salience. These characteristics of /wɔ/ are reflected in its smaller F1-F2 trajectory and its relatively flat formant pattern. In addition, with regards to duration, /wɔ/ is comparable to the simple vowel /ɔ/. If, as proposed here, these parameters[14] help determine the perceptual salience of a sequence, the combined effects of these may make /wɔ/ the least salient of the GV sequences studied in this paper. Furthermore, if the assumptions regarding universally dispreferred sequences outlined in Section 2 are correct, then /wɔ/ is predictably more susceptible to perceptual confusion and is, therefore, more likely to undergo some type of change than the other three diphthongs studied here.

4. Conclusions

This study has provided preliminary evidence which suggests that the preference for front diphthongs over back diphthongs in Sicilian is rooted in the fact that its back diphthongs are more difficult to perceive. The results presented in Section 3 for Sicilian /wɔ/ are in line with proposals by Kawasaki-Fukumori (1992) and Ohala & Kawasaki-Fukumori (1992) that universally dispreferred sequences tend to be made up of acoustically similar segments and to show small acoustic modulations. In addition, these results for /wɔ/ may be extended to the related sequence /wo/. Therefore, we can assume that the change from /wɔ/>/wo/>/we/ which occurred in Spanish also occurred for perceptual reasons. In terms of Ohala's model of sound change outlined in Section 2, the Sicilian monophthongization of /wɔ/ to /ɔ/ may be viewed as an instance of hypocorrection, resulting from the confusion of two acoustically similar segments. The Spanish change from /wo/>/we/, on the other hand, appears to fit the definition of hypercorrection, with the change perhaps triggered when listeners attributed the rounding on the /o/ to the preceding /w/ and applied a corrective rule to eliminate this rounding. This scenario seems plausible since the resulting vowel /e/ maintains the height feature of the original vowel /o/ with the rounding of the original vowel factored out. Replacing /o/ with an unrounded back mid vowel presumably would not have been an option, as such a vowel is not part of the Spanish inventory and its presence would have meant adding a new segment. This type of change, where new segments are created, is not possible in hypercorrection (Ohala 1993:261).

As concerns future research, the pattern which emerged here in regards to Spanish /we/ is of particular interest. Namely, it appears that the F1-F2 trajectory of this sequence is similar to that of Sicilian /wɔ/, mainly due to the quality of the nuclear vowel in /we/ which, as discussed in Section 2.3, approaches the acoustic space of /o/. Given this pattern, it may be worthwhile to investigate any synchronic asymmetries between /we/ and /je/ in Spanish, perhaps in cases of analogical levelling of the types cited for Italian in Section 1.1. In addition, patterns of front-back asymmetry in falling diphthongs (e.g. /ej/ and /ow/) may also be studied and compared with the patterns observed here for rising diphthongs. Falling diphthongs do not occur in the Sicilian variety studied here but they do occur in Spanish where they may be subject to similar, if not more stringent, types of constraints as those affecting rising diphthongs (Carreira 1991:419), suggesting the existence of a rising-falling asymmetry as well as a front-back asymmetry in these diphthongs. Clearly, there remains much more to be said about diphthongization, for both Spanish and other Romance varieties.

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[13] The small number of participants and the fact that the number of usable tokens was not equal for the two groups may have contributed to the high degree of variability between the speakers, as evidenced in the high standard deviation values. These factors may also explain why the results did not reach significance in some cases.

[14] A more accurate measurement of the magnitude of acoustic modulation should likely involve other parameters (e.g. amplitude, Ohala & Kawasaki-Fukumori 1992) in addition to the formant frequencies included here. Furthermore, measuring F1 and F2 at various points along the diphthong sequences, rather than only at onset and offset would likely result in a better model of the diphthong formant trajectories (Kawasaki-Fukumori 1992:77).

Appendix: Stimuli

C	(G)V	Spanish		(G)V	Sicilian			
b	/we/	*frambuesa*	'raspberry'	/wɔ/	*buonu*	'good-masc. sing'		
		bueno	'good'		*buoni*	'good-masc. plur.'		
	/o/	*bono*	'bonus'	/ɔ/	*bona*	'good-fem. sing.'		
	/e/	*venta*	'sale'	/ɛ/	*bedda*	'good-looking-fem. sing.'		
	/je/	*bien*	'good/well'	/jɛ/	*bieccu*	'ram'		
		viejo	'old'		*bieddu*	'good looking-masc.sing.'		
p	/we/	*puente*	'bridge'	/wɔ/	*cappuottu*	'coat'		
		puesto	'place'		*puostu*	'place'		
	/o/	*poste*	'pole/post'	/ɔ/	*posta*	'mail'		
	/e/	*peso*	'peso'	/ɛ/	*pedi*	'foot'		
					Peppi	'Joe'		
					pezza	'cloth'		
	/je/	*pies*	'feet'	/jɛ/	*piedi*	'feet'	*piettu*	'chest'
		pienso	'I think'		*piecura*	'sheep'	*piezzu*	'piece'
					piensu	'I think'		
d	/we/	*dueto*	'duet'	/wɔ/	*duoppu*	'after'		
		duende	'ghost'					
	/o/	*donde*	'where'	/ɔ/	-----------			
	/e/	*dentro*	'inside'	/ɛ/	*denti*	'tooth'		
	/je/	*dieta*	'diet'	/jɛ/	*dienti*	'teeth'		
		diente	'tooth'					
t	/we/	*tuétano*	'marrow'	/wɔ/	*stuortu*	'crooked-masc. sing.'		
		tuesto	'I toast'		*tuortu*	'fault'		
	/o/	*altote*	'tall-augmentative'	/ɔ/	*torta*	'cake'		
					storta	'crooked-fem. sing.'		
	/e/	*atesta*	'attests'	/ɛ/	*testa*	'head'		
					terra	'earth/dirt'		
	/je/	*tiempo*	'time'	/jɛ/	*tiempu*	'time'		
		tieso	'stiff'		*martieddu*	'hammer'		
					castieddu	'castle'		
					tiettu	'roof'		
					cutieddu	'knife'		
					vutieddu	'calf'		
g	/we/	*lengüeta*	'tongue'	/wɔ/	-----------			
		ungüento	'ointment'					
	/o/	*gota*	'drop'	/ɔ/	-----------			
	/e/	*manguera*	'hose'	/ɛ/	-----------			
	/je/	-------------		/jɛ/	-----------			
k	/we/	*pescuezo*	'neck'	/wɔ/	*cuoppu*	'package'		
		cuesta	'costs'		*dicuottu*	'brew'		
					cacuocciuli	'artichokes'		
					cuocciu	'grain'		
					cuoddu	'neck'		
	/o/	*costa*	'shoreline'	/ɔ/	*coccia*	'grains'		
					ricotta	'ricotta cheese'		
	/e/	*paquete*	'package'	/ɛ/	*schetta*	'unmarried-fem. sing.'		
	/je/	*inquieto*	'restless'	/jɛ/	*chiesa*	'church'		
		quiebra	'breaks'		*schiettu*	'unmarried-masc. sing.'		

References

Borzone de Manrique, Ana María. (1979). Acoustic analysis of the Spanish diphthongs. *Phonetica*, *36*, 194-206.

Browman, Catherine & Louis Goldstein. (1992). Articulatory phonology: An overview. *Phonetica*, *49*, 155-180.

Boyd-Bowman, Peter. (1980). *From Latin to Romance in sound charts*. Washington: Georgetown University.

Carreira, María. (1991). The alternating diphthongs of Spanish: A paradox revisited. In Héctor Campos & Fernando Martínez-Gil (Eds.), *Current Studies in Spanish Linguistics* (pp. 407-445). Washington: Georgetown University Press.

Chitoran, Ioana. (2002). A Perception-production study of Romanian diphthongs and glide-vowel sequences. *Journal of the International Phonetic Association*, *32(2)*, 203-222.

D'Agostino, Maria & Antonino Pennisi. (1995). *Per una sociolinguistica spaziale:Modelli e rappresentazioni della variabilità linguistica nell'esperienza dell'ALS*. Palermo: Centro di studi filologici e linguistici siciliani.

Grandgent, Charles. H. (1907). *An introduction to Vulgar Latin*. New York: D.C. Heath & Co.

Grimaldi, Mirko. (2003). *Nuove ricerche sul vocalismo tonico del Salento Meridionale*. Lecce: Edizioni dell'Orso.

Hayward, Katrina. (2000). *Experimental phonetics*. London: Longman.

Kang, Hyeon-Seok. (1997). *Phonological variation in glides and diphthongs of Seoul Korean: Its synchrony and diachrony*. PhD. dissertation. Ohio State University, Ohio.

Kawasaki-Fukumori, Haruko. (1992). An acoustical basis for universal phonotactic constraints. *Language and Speech*, *35*(1-2), 73-86.

Kent, Ray & Charles Read. (1992). *The acoustic analysis of speech*. Albany: Singular/Thompson.

Lindblom, Björn. (1986). Phonetic universals in sound systems. In John J. Ohala & Jeri J. Jaeger (Eds.), *Experimental phonology* (pp. 13-43). Orlando: Academic Press.

Martínez-Celdrán, Eugenio. (1991). Sobre la naturaleza fonética de los alófonos de /b,d,g/ en español y sus distintas denominaciones. *Verba*, 18, 235-253.

McCarthy, John J. (1986). OCP effects: Gemination and antigemination. *Linguistic Inquiry*, 17, 207-263.

Ohala, John J. & Haruko Kawasaki-Fukumori. (1992). Alternatives to the sonority hierarchy for explaining the shape of morphemes. In *Papers from the parasession on the syllable* (pp. 319-338). Chicago: Chicago Linguistic Society.

Ohala, John J. (1981). The listener as a source of sound change. In C.S. Masek, R.A. Hendrick & M.F. Miller (Eds.), *Papers from the parasession on language and behavior* (pp. 178-203). Chicago: Chicago Linguistic Society.

---------- (1989). Sound change is drawn from a pool of synchronic variation. In Leiv Breivik & Ernst Jahr (Eds.), *Language change: Contributions to the study and its causes* (pp. 173-198). Berlin: Mouton de Gruyter.

---------- (1993). The phonetics of sound change. In Charles Jones (Ed.), *Historical Linguistics: Problems and Perspectives* (pp. 237-278). London: Longman.

Penny, Ralph. (2002). *A history of the Spanish language*. Cambridge: Cambridge University Press.

Quilis, Antonio. (1981). *Fonética acústica de la lengua española*. Madrid: Gredos.

Rohlfs, Gerhard. (1966). *Grammatica storica della lingua italiana e dei suoi dialetti. Vol. I: Fonetica*. Translated by Salvatore Persichino. Torino: Einaudi Editori.

Ruffino, Giovanni. (2006). *Sicilia*. Roma-Bari: Editori Laterza.

Sánchez Miret, Fernando. (1998). *La diptongación en las lenguas románicas*. Newcastle: LINCOM Europa.

Taddei, Édith. (2000). *La phonétique historique*. Paris: Armand Colin.

Weeda, Don. (1983). Perceptual and articulatory constraints on diphthongs in Universal Grammar. *Texas Linguistic Forum*, *22*, 147-162.

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