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Segmental and prosodic issues in Romance phonology

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INTRODUCTION

The second *Phonetics and Phonology in Iberia* (PaPI) conference, hosted by the Universitat Autònoma de Barcelona in June 2005, proved a great success in bringing together scholars from around the world, all of them involved in researching contemporary issues in phonetics, phonology, and related areas, including language acquisition, language variation and change, and speech technology.

This volume provides a selection of the papers presented at that conference. Most of them are concerned with the relationship between phonetics and phonology, and most of them also use a methodological approach that has come to be known as 'laboratory phonology'. This approach, whose foundations were first laid about twenty years ago, sets out to answer a wide array of research questions through the use of experimental methods. In other words, experimental methodology previously associated with phonetic studies is applied to the realm of phonology with the goal of exploring the crucial correspondence between empirical data and theoretical claims. Over these last two decades, this experiment-based approach has proved extremely fruitful in its ability to test controversial claims in phonological theory, resolve phonological issues, and discover the principles guiding linguistic mechanisms (for a good overview, see articles by Pierrehumbert et al. 2001 and D'Imperio 2005).

The specific focus of the papers in the present collection is descriptive and theoretical issues in the phonology of Romance languages. These papers provide new empirical data on a number of phonetic and phonological phenomena in a variety of Romance languages and their dialectal varieties, including Catalan (Eastern and Western Catalan, Valencian and Majorcan), French (European and Quebec), Italian (Neapolitan), Portuguese (Standard European and Northern European) and Spanish (Andalusian, Argentinian, Central Peninsular and Chilean). Importantly, most of the contributions take a crosslinguistic or crossdialectal perspective, paving the way to a better understanding of linguistic differences in typologically close language varieties. This focus on Romance languages is motivated by our belief that there is a need for multilanguage data to test current theoretical claims and models, which often lack precisely this sort of broad crosslinguistic basis. The virtue of crosslinguistic research is that it constitutes a valuable tool to explore similarities and differences between languages and thus allows us to construct general linguistic theories, while at the same time ensuring that the peculiaritites of individual languages can be characterized within the theory.

An important goal of this volume is to bridge the gap between traditional Romance linguistics—already with a long and rich tradition in data collection, cross-language comparison, and phonetic variation—and laboratory phonology. In our view, subjecting the theoretical claims and data from traditional Romance linguistics to the scrutiny of experimental techniques in the laboratory can only strengthen the scientific basis of this discipline and better integrate its findings in current phonetic and phonological theory. Though in recent years laboratory phonology has proved to be a broad and fertile interdisciplinary approach in Romance linguistics and has grown in popularity among researchers, it is still not a well-known and established approach among Romance scholars. The body of experimental work devoted to Romance languages is still far smaller than the work that has examined, for example, Germanic languages. This volume is thus an attempt to help redress that imbalance: as the reader will see, the studies collected herein present cutting-edge laboratory phonology research as applied to Romance languages.

The volume has been organized into three main topic areas, which reflect the main themes of the conference. The first is concerned with segmental processes (coarticulation and assimilation processes, sandhi processes, feature cooccurrence and sequential restrictions), the second with prosodic structure (prosodic characterization of parentheticals, syllable structure, prosodic phrasing, stress and pitch accent prominence), and the third with the acquisition of segmental and prosodic features (the acquisition of vowel reduction, L1 and L2 vowel perception, initial word segmentation, and L2 rhythmic patterns). Thus we begin with the smaller segmental units, move on to larger phonological constituents, and conclude with a look at acquisition on both levels.

Section 1, *Segments and processes*, comprises four papers which address the phonetic properties of segments, their mutual influence, and phonological processes across words. Three of these papers focus on the interaction of production and perception in phonological structure and sound change, mostly within the framework of gestural phonology (Browman & Goldstein 1986), which allows modelling of the biomechanical and aerodynamic constraints of speech gestures in a way that accounts for the actual observed patterns. These papers also serve to illustrate the notion that sound change can be partly explained by universal phonetic factors and has its origins in synchronic variation (Ohala 1989, 1991).

Daniel Recasens examines the coarticulation patterns found in different types of VCV sequences in Catalan and Spanish and how they provide support for the 'Degree of Articulatory Constraint' (DAC) model of coarticulation. In particular, he argues that the workings of the speech production mechanism, and in particular the DAC model, can explain the directionality and extent of coarticulation found in VCV sequences. Acoustic data on the size of anticipatory and carryover effects between vowels [a] and [i] and a set of consonants clearly show that: (a) some VCV sequences with salient consonant anticipatory effects—like sequences with dark [l]—exhibit more vowel-to-

consonant anticipation effects than carryover effects, while sequences involving the alveolopalatals [ɲ] and [ʎ] show the reverse pattern; (b) vowel anticipation does not exhibit a comparable size for all consonants but is greater for unconstrained consonants than for more constrained ones. As predicted by the model, the direction and extent of vowel coarticulation varies inversely with the degree of constraint of the intervocalic consonant. Importantly, Recasens provides evidence in support of a close match between the predictions of the model and a number of observed sound changes and assimilatory processes in various Catalan dialects.

Maria-Josep Solé argues that the articulatory-acoustic stability of phonological features may be affected not only by concurrent features, but also by features in adjacent segments when they coincide in time due to coarticulatory overlap. Specifically, she addresses the question of whether aerodynamic factors are at the origin of the incompatibility between nasality and frication. She presents the results of a series of experiments designed to explore the effects of velopharyngeal opening (or degrees of nasality) on the stability of segments requiring a high pressure build-up in the oral cavity, such as fricatives. Acoustic and aerodynamic evidence shows that in fricative + nasal sequences anticipatory velum lowering during the acoustic duration of the fricative reduces or even extinguishes the pressure difference required for frication. This is clear evidence that frication is unstable when it comes in contact with nasalization in adjacent segments. She presents important additional evidence that this instability is at the origin of a number of phonological patterns found historically and synchronically in Romance languages by which fricatives tend to lose their friction when they precede nasal consonants. In addition, she argues that the same aerodynamic and acoustic factors responsible for the combination of features within a segment can be used to explain how features interact in contiguous segments.

Francisco Torreira deals with the well-known phonological process of /s/ aspiration in coda position present in a large number of Spanish dialects. The author furnishes instrumental data showing that in Andalusian Spanish, a southern variety of Peninsular Spanish, /s/ aspiration before voiceless stops is accompanied by consistent postaspiration of the stop consonant. His analysis of spontaneous speech clearly shows that /s/ preceding a stop, though usually realized as a period of aspiration or breathy voice, may be absent in a considerable number of cases. Crucially, voiceless stops following /s/ show a consistent pattern of postaspiration. This asymmetry suggests that the conditioning factor for postaspiration in Andalusian voiceless stops may be the presence of a preceding underlying laryngeal gesture that is not strictly timed with the supralaryngeal gestures. Torreira argues that a gestural analysis (Browman & Goldstein 1986) offers a plausible account for a phenomenon that is especially difficult to explain in terms of segments. Within this framework, the timing of the starting point of the glottal opening gesture with respect to the supraglottal closure may not be very accurately specified, while the timing of the ending point with respect to the end of the stop closure is more precise.

Finally, Torreira reviews diachronic and synchronic examples from other languages which illustrate various paths of change for the same type of sound sequence. He suggests that this pattern in Andalusian Spanish, showing unstable preaspiration and more consistent postaspiration, might eventually lead towards a new category of aspirated voiceless stops, as has occurred in other languages.

Noël Nguyen and colleagues address the well-known sandhi phenomenon of French liaison and the question of how liaison consonants are processed in speech perception. Specifically, the study analyses whether during speech comprehension liaison consonants are processed and represented differently from word-initial and word-final consonants. With this object, the authors undertook a series of perception experiments that examined potential differences in the detection rate of liaison consonants vs fixed consonants and attempted to determine whether these differences might be attributable to the phonetic properties of the consonants involved. The results provide evidence that liaison consonants are more difficult to detect than word-initial consonants (detection scores were lower and response times tended to be slower for the former than for the latter) and that these differences are not attributable to potential phonetic differences between the two. Nguyen and colleagues argue that the difficulty in processing liaison consonants seems to provide partial support for the autosegmental representation of liaison consonants as floating segments. Yet as detection accuracy also seemed to vary depending on the degree of lexicalisation of the carrier word sequence, the authors point out that more research is needed to evaluate the potential effects of probability of occurrence and thereby properly evaluate the predictions of exemplar-based models in the perception of liaison consonants.

Prosodic structure and intonational phonology have been recurring themes in laboratory phonology work, partly because of the unreliability of introspective work on these issues. The four papers in Section 2, *Prosodic structure*, address important issues in this area of study, taking advantage of the benefits offered by using a common crosslinguistic experimental approach.

Lluïsa Astruc-Aguilera and Francis Nolan examine the prosodic characteristics of extra-sentential elements (dislocated phrases, vocatives, adverbials, etc.) in Catalan and English. The authors present the results of three experiments set up to study phrasing and accentuation patterns in these constructions. Though phonological studies have traditionally considered that extra-sentential elements form prosodically independent units and are unaccented, results from these experiments show that they do not always form independent tonal units, nor are they always deaccented. Rather, they show variation in their phrasing and intonation, revealing a trade-off between prosodic independence and tonal subordination: deaccentuation only seems to be compulsory in those cases in which the extrasentential elements and the main phrase belong to the same prosodic domain. Also, the experiments reveal that accentual cues seem to be stronger and more consistent cues than phrasing cues and the degree of inter-speaker variation is lower in the former than in the

latter. In their third experiment, using both a database in which three levels of stress were specified and a masking noise technique for recording, the authors found that right-dislocated phrases were totally deaccented. Astruc and Nolan conclude that prosody signals the pheripheral status of extrasentential elements by general deaccentuation or compression of the pitch range, independent phrasing being a more optional cue.

Laura Colantoni and Jeffrey Steele provide a detailed account of the behavior of stop-liquid clusters in two varieties of Spanish (Chilean and Argentinian) and two varieties of French (Quebec and European). They show that choice of cluster simplification, whether by assimilation or dissimilation, is correlated with the voicing properties of the stop and the manner properties of the liquid (tap, fricative, approximant). The results of the production experiment in the four varieties under investigation show that: a) similarity in manner and voicing between the two members of the cluster determines the degree of cluster simplification; b) in the case of stop-rhotic clusters, the phonetic characteristics of the rhotic determines the strategy used; in the case of Spanish, with the tap being highly similar to the stop, dissimilation via vowel epenthesis is the preferred outcome; and c) stop voicing plays a role in determining the degree of assimilation and dissimilation: given that voiceless stops are longer than their voiced counterparts, a compensatory lengthening effect is observed, and thus shorter epenthetic vowels are found. The effects that trigger synchronic variation can also account for the evolution of stop-liquid clusters from Latin to Romance. Finally, the authors provide an optimality theory-based analysis of their experimental results.

The chapter by Sónia Frota and colleagues explores the phonetic realization of intonational phrasing in five Romance language varieties: Catalan, two varieties of European Portuguese, Neapolitan Italian, and Spanish. Data from a common experimental database (the 'Romance Languages Database') is used to analyze the phonetic realization of phrasing in the five varieties under examination. First, the authors provide a typology of combinations of nuclear pitch accents plus boundary tones used across languages, as well as their relative frequency. The dominant boundary tone used in the five varieties is the high (H) boundary tone, in the form of either a continuation rise or sustained pitch. Second, they offer a detailed analysis of the phonetics of the H boundary tone across languages. Specifically, the data reveal that nuclear pitch accent choice affects the scaling of the H boundary tone in a similar and consistent way, namely, the tone is higher after High nuclear accents than after Low nuclear accents. They interpret this as resulting from the upstep of the H boundary tone after an accentual H. Also, the data reveal mixed effects of constituent length on the scaling of H boundary tones, with the languages observed clustering in two main groups: the Catalan-Spanish group (with almost no length effects) and the Italian-European Portuguese group (with clear length effects).

Marta Ortega-Llebaria and Pilar Prieto's paper examines the acoustic correlates of stress prominence in Spanish in both accented and unaccented

environments (e.g. parentheticals). Traditional studies typically describe the correlates of stress in accented environments, thus suffering from covariation between stress and accent. This paper goes beyond traditional accounts in that the pitch accent factor is controlled for. The results of the production experiments described reveal that the stress contrast is maintained in deaccented contexts and that syllable duration and spectral tilt (intensity at high frequencies of the spectrum) are reliable acoustic correlates of this contrast in Spanish. These results contribute to the discussion about the nature of stress across languages, advocating for the view that stress prominence has its own phonetic cues, and against other views which claim that stress cues are parasitic on vowel reduction cues. Thus while American English, Dutch and Spanish differ in the degree of vowel reduction involved in marking stressed positions, they do not differ greatly in the way they use other acoustic correlates (i.e. duration and intensity) to signal the presence of stress.

Section 3, *Acquisition of segmental and prosodic structure*, comprises four papers which address the acquisition of segmental and prosodic contrasts by infants and second language learners. The papers in this section illustrate how laboratory phonology is in fact starting to bridge the gap between psycholinguistics and phonology.

Maria João Freitas focuses on the early production of vowels in unstressed position by European Portuguese-speaking children, and specifically, on how these children start acquiring two specific phonological processes of vowel reduction, namely, that of /ɛ, e/ turning into [i̞] and that of /a/ turning into [ɐ] in unstressed positions. Since the acquisition of vowel reduction processes has not received much attention in the acquisition literature, this paper provides new empirical data from European Portuguese, a Romance variety which presents a number of reduced vowels in unstressed position deriving from the productivity of the vowel reduction process. On the basis of longitudinal data collected for four children aged 0;10 to 2;8, it is observed that Portuguese children acquire vowel reduction relatively early in the path of development, and that syllable deletion is one of the common strategies found in children. Freitas claims that the complexity of the target vowel system increases children's early sensitivity to vowel differences and promotes the speed of phonological development. Interestingly, the results show that vowel reduction emerges either simultaneously in word-medial and word-final position or possibly earlier word-finally. Freitas suggests that the presence of morphological content in the word-final vowel might be promoting phonological development in this position.

Geoffrey Stewart Morrison introduces logistic regression analysis as applied to L1 and L2 speech perception data involving Spanish vowels. The chapter is intended as a tutorial for L2-speech-perception students and researchers who are not familiar with the technique. Using data taken from previous identification experiments on L1 Spanish vowel perception and on L1 and L2 English vowel perception, the author applies logistic regression model fitting techniques to determine which acoustic cues are attended to by listeners

when identifying stimuli. He shows that logistic regression coefficients can be successfully used to produce intuitive representations and quantify how listeners use those acoustic cues, as well as to model sequential stages in L2 learners' perception. At the same time, these statistics can also be used to determine whether there are significant differences in the perception of stimuli by L1 vs L2 groups of listeners. In sum, Morrison shows how the logistic-regression technique can be successfully used in L2 speech perception research.

Ferran Pons and Laura Bosch focus on how infants under one year of age deal with word segmentation and which prosodic features they pay attention to in order to perform this task. Sensitivity to prosodic information has been observed very early in development in studies with English and Dutch children. For example, at nine months, American English infants show a trochaic bias, meaning that they prefer to listen to lists of strong-weak disyllabic words (trochaic), as opposed to lists of weak-strong disyllabic words (iambic), a stress pattern which is atypical of English. Using a slightly modified version of the Head-Turn Preference Procedure, a paradigm that has been used successfully in infant speech perception research over the past twenty years, Pons and Bosch set out to explore the metrical preferences of six-month-old Spanish- and Catalan-learning infants. The data revealed no pattern of preference for trochees. An additional experiment with nine-month-old infants revealed that, unexpectedly, even at this age they do not show a pattern of preference for trochaic or iambic stress. The authors partly attribute this crosslinguistic difference to a weaker predominance of the bisyllabic trochaic pattern in Catalan and Spanish relative to English. Yet the results cast some doubt on the usefulness of this prosodic cue (i.e. stress pattern) alone to help early word segmentation of fluent speech. The authors suggest that phonotactic information—the fact that heavy CVC syllables appear generally in stressed positions—might be combined with stress cues at a very early age in order to predict the patterns of preference.

Finally, Laurence White and Sven Mattys set out to test the discriminative performance of different metrics of rhythmic distinctions across languages. One of the novelties of this article is that it collects data from second language rhythm, in the hope that the metrics will prove useful as a tool to identify the rhythmic differences between native English speakers, for example, and Spanish speakers of L2 English. The authors' first production experiment is designed to test how well different metrics support the distinction between the rhythm of 'syllable-timed' French and Spanish and that of 'stress-timed' Dutch and English, with the effect of L1 on L2 rhythm also considered. The results show that rate-normalised metrics of variation in vocalic interval duration clearly and effectively (a) discriminate between the classic distinction between stress-timed and syllable-timed languages; and (b) are informative about the adaptation of speakers to rhythmically-similar (Dutch and English) or rhythmically-distinct (Spanish and English) second languages. Their second production experiment examines the rhythmic contrasts between

different accents of British English, with results showing evidence of rhythmic gradience between them. Finally, results from a perceptual test find a normalised metric of vocalic interval variation to be the strongest predictor of the rating of the second language speaker's accent as native or non-native.

As a final word, we would like to thank the scholars who agreed to review the contributions included in this volume. We are greatly indebted to the anonymous reviewers at the John Benjamins office as well as the external reviewers who have participated in the assessment of articles: Laura Colantoni, Néstor Cuartero, Eva Estebas, Paula Fikkert, Chip Gerfen, Barbara Gili-Fivela, José Ignacio Hualde, Conxita Lleó, Francis Nolan, Hugo Quené, Daniel Recasens, Marija Tabain, and Laurence White.

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We believe this volume will constitute a very useful companion for phoneticians, phonologists, and researchers investigating sound structure in Romance languages. It is our desire that it will spark further interest in laboratory phonology and will contribute to enlarging the body of research focusing on these languages.

Barcelona, November 2006

Pilar Prieto
Joan Mascaró
Maria-Josep Solé

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PART 1

SEGMENTS AND PROCESSES

DETECTION OF LIAISON CONSONANTS IN SPEECH PROCESSING IN FRENCH

EXPERIMENTAL DATA AND THEORETICAL IMPLICATIONS*

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Abstract

The goal of the present study is to better understand the mechanisms involved in the processing of liaison consonants by listeners in French. Previous work (Wauquier-Gravelines 1996) showed that liaison consonants are more difficult to detect than word-initial consonants in a phoneme-detection task. We examined to what extent such differences are attributable to the consonants' phonetic properties, and we also compared the perception of liaison consonants with that of fixed word-final and word-medial consonants, as well as word-initial ones. The results suggest that liaison consonants have a specific perceptual status. Implications for both autosegmental and exemplar-based theories of liaison are discussed.

1. *Introduction*

French liaison is a well-known phenomenon of external sandhi that refers to the appearance of a consonant at the juncture of two words, when the second word begins with a vowel, e.g. *un* [œ̃] + *enfant* [ɑ̃fɑ̃] → [œ̃nɑ̃fɑ̃] "a child", *petit* [pəti] + *ami* [ami] → [pətitami] "little friend". Liaison consonants are usually *enchaînées*, i.e. realized as syllable-onset consonants, although they can also appear in coda position, compare [pə.ti.ta.mi] (with *enchaînement*) and [pə.tit.a.mi] (without *enchaînement*, Encrevé 1988). In the following, the two words at the juncture of which liaison consonants appear will be referred to as Word 1 and Word 2, respectively.

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