TITLE PAGE

This publication summarizes the abstract texts of talks given at the "2nd Workshop on Sound Change" held 2nd to 4th May 2012 in Kloster Seeon, Germany.

Edited by Dr. Mary Stevens.

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Abstracts of the 2nd Workshop on Sound Change 2012

1 Preface

Welcome to Kloster Seeon and to the *2nd Workshop on Sound Change*. This workshop follows the *Workshop on Sound Change*, held in Barcelona in October 2010, and we are grateful to Maria Josep Solé for help in the initial planning stages. Thank you to Andrea Ertl at Kloster Seeon and our colleagues at the IPS including especially Florian Schiel, Felicitas Kleber, Ulrike Vallender-Kalus and Fabian Bross for their time. The 2nd Workshop on Sound Change is supported financially by the *Deutsche Forschungsgemeinschaft*, the Bavarian Archive for Speech Signals and the Ludwig Maximilians Universität through the *Empirical Speech and Language Processing* PhD programme and the *LMU-UCB Research in the Humanities* programme.

We thank you for coming and look forward to an enjoyable and stimulating meeting.

Jonathan Harrington and Mary Stevens

2 What you need to know during your stay at Kloster Seeon

Meals

All meals are buffet style and vegetarian options are available. Unlimited mineral water is available; other drinks including wine and beer are available for purchase. At dinner on May 1 and May 3 one glass of wine is provided for each guest (dinner on May 2 follows the welcome drinks which are fully catered). During the coffee breaks hot and cold drinks are available along with snacks.

Internet/Telephone/Television

Free Internet is available in all bedrooms and cables are provided. There is a television and a telephone in each room (call costs will be added to your bill; the country code for Germany is +49). There is also a communal TV room near the games area downstairs.

Activities outside of workshop hours

A 'Bier Stüberl' (Bavarian style pub) is open downstairs until 1am with drinks including local beer on tap for purchase. There is also bowling alley, games area and TV room in the Kloster. A short walk of about 10 minutes takes you into Seeon village, which is worth a look around and has amenities e. g. bank. See the map in this booklet (page 4) or ask Kloster Seeon Reception who are happy to assist you with any questions about the Kloster and surrounding area.

Leaving Kloster Seeon

At the close of the workshop buses are arranged to take you to Bad Endorf train station in time to meet the 5:15pm train back to Munich. If you wish to leave the Kloster at other times, you can book a taxi at Reception. Please check out of your room by 10am on the day of departure. You can leave luggage with Reception and lockers are also available.

Payment

You will be asked to pay your room costs on departure. If you require a special address on your invoice, please speak with Kloster Seeon Reception ahead of time so that this can be prepared before check-out.

Questions?

Please speak with the workshop secretary in front of the Lambertisaal during workshop hours. You can also speak with any of the workshop participants from the IPS-Munich or with the Kloster Seeon Reception.

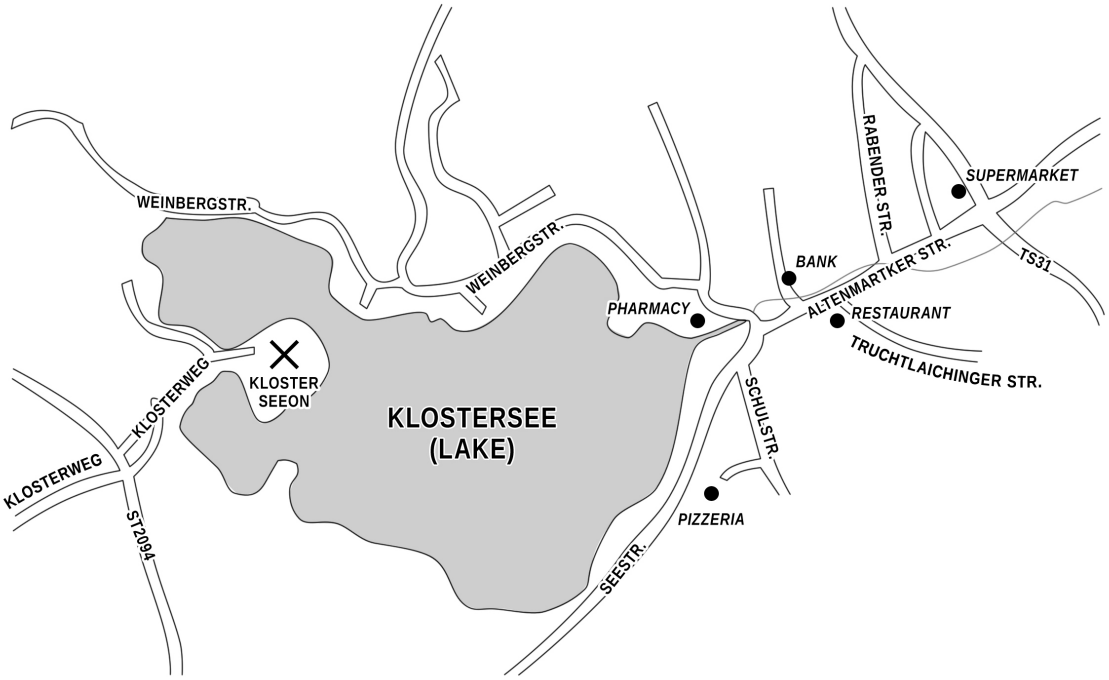

Figure 1: The surrounding area

3 Program

1st of May

From 15:00	Arrival and registration
19:00	Dinner

2nd of May

7:00-8:30	**Breakfast**
8:45-9:00	**Welcome**
	Session 1: Coarticulation, the listener, & sound change (Chair: Andy Butcher, from page 9)
9:00-9:45	John Ohala: *What sound change, phonotactics and aglossic speech reveal about the essence of speech communication*
9:45-10:30	Jonathan Harrington, Felicitas Kleber, Ulrich Reubold & Jessica Siddins: *The relationship between coarticulation, prosodic weakening, and sound change*
	Coffee break
11:00-11:45	Maria-Josep Solé: *The perception of voice-initiating gestures*
11:45-12:30	Katerina Chládková, Silke Hamann & Daniel Williams: *The possible role of alternative perceptual cues in sound change: Diphthongization in Standard Southern British English /u/-fronting*
	Lunch

Session 2: Computational models of sound change
(Chair: Khalil Iskarous, from page 16)

14:00-14:45 Morgan Sonderegger: *Combining longitudinal data and mathematical models of sound change*

14:45-15:30 James Kirby: *Sound change in Khmer: Acoustic and perceptual studies*

15:30-16:15 Paul Boersma: *Velar fronting in Russian emerges from a bidirectional phonology-phonetics interface*

Coffee break

16:45-18:15 **Poster session 1**, page 45

18:30 **Welcome drinks**

20:00 **Dinner**

3rd of May

7:00-8:30 **Breakfast**

Session 3: Speech Production, Imitation, Entrainment & Sound Change
(Chair: Janet Fletcher, from page 20)

8:45-9:30 Khalil Iskarous & Louis Goldstein: *Discreteness and continuity in language design and sound change*

9:30-10.15 Grant McGuire & Molly Babel: *Imitation as a mechanism for the spread of sound change*

10:15-11:00 Eric Vatikiotis-Bateson: *Imitation, entrainment, and sound change*

Coffee break

Session 4: First language acquisition & sound change
(Chair: Eric Vatikiotis-Bateson, from page 25)

11:30-12:15 Mary Beckman: *Aligning the timelines of phonological acquisition and change*

12:15-13:00 Alex Cristia, Amanda Seidl, Jeff Mielke, Robert Daland & Sharon Peperkamp: *Infants' contribution to the stability of patterns involving natural sound classes*

Lunch

Session 5: Social/dialect factors & sound change
(Chair: Jane Stuart-Smith, from page 31)

14:30-15:15 Cynthia Clopper: *Sound change in the individual: Effects of exposure on cross-dialect speech processing*

15:15-16:00 William Labov: *Linear incrementation and curvilinear reversal: 100 years of sound change in Philadelphia*

16:00-16:45 Stefanie Jannedy, Melanie Weirich & Jana Brunner: *Category Instability of the Palatal Fricative in Berlin German*

Coffee break

17:15-18:45 **Poster session 2**, page 68

20:00 **Dinner**

4th of May

7:00-8:30	**Breakfast**
	Session 6: Sound change and evolution (Chair: Lasse Bombien, from page 37)
8:45-9:30	Juliette Blevins: *The Life Cycle of Voiceless Sonorants*
9:30-10.15	Didier Demolin: *Sound change as epigenetic regulations*
10:15-11:00	Dan Dediu: *Genetic biases: the neglected factor in sound change*
	Coffee break
	Session 7: Relationships between continuous and categorical change (Chair: Mary Stevens, from page 41)
11:30-12:15	María Riera & Joaquín Romero: *A coarticulatory account of historical r-vocalization in English*
12:15-13:00	Paul Kiparsky: *A Stratal OT Perspective on Sound Change*
	Lunch
14:30-16:00	Closing remarks

4 Oral presentations

Session 1:
Coarticulation, the listener, & sound change

2nd May, 8:45-12:30
Chair: Andy Butcher

What sound change, phonotactics and aglossic speech reveal about the essence of speech communication

John J. Ohala (UC Berkeley, USA)

Speech communication involves an exchange of elements between speaker and hearer. I argue that those elements—the 'coin' as it were—are acoustic modulations of the carrier signal. In support of this view I examine three domains. First, sound change should be examined for what does *not* change. For example, the reflexes of PIE *ekwos, "horse": Latin *equus*, Greek *hippos* give evidence that what did not change in the medial stop was transitions having low F1 and F2. Second, common cross-language phonotactics show that robust acoustic modulations are characteristic of those sequences that are common and persist (e.g., ta, twa, sta, etc.) whereas weak modulation are characteristic of those that are absent or rare (e. g., wu, ji, bw-, etc.). Third, studies going back to 1630 of aglossic speech (speech without a tongue) testify that speech produced without this organ is quite intelligible. Although the articulations in such cases may not resemble those in intact speakers, the sounds produced are similar enough to be recognizable. The listener is an equal partner in the exchange of these basic elements of speech and attends particularly to moments in the speech signal where there are rapid modulations in any of several acoustic parameters: voicing, amplitude, periodicity, spectrum.

The relationship between coarticulation, prosodic weakening, and sound change

Jonathan Harrington , Felicitas Kleber, Ulrich Reubold & Jessica Siddins (IPS Munich, Germany)

The paper is concerned with the influence of the stress hierarchy on the relationship between the production and perception of coarticulation. The longer-term aim is to consider whether a perceptual under-compensation for coarticulation contributes to the prevalence of historical sound change in prosodically weak constituents (Beckman et al, 1992, Language & Speech, 35, 45-58). Three types of studies form the background to those presented here: the demonstration that there is usually parity between the production and perception of coarticulation (Fowler, 2005, *J. Phonetics*, 33, 199-213); the evidence of greater coarticulation in the production of unstressed vs. stressed syllables (Mooshammer & Geng, 2008, *J. Int. Phonetic Assoc.*, 38, 117-136); and the association between sound change and perceptual under-compensation for coarticulation (Ohala & Feder, 1994, *Phonetica*, 51, 111-118).

The first experiment was concerned with the influence of sentence-level deaccentuation on coarticulation. Fifteen L1 speakers of German produced symmetrical non-word CVC syllables for V = /ʏ, ʊ/ and C = /p, t/ in the carrier phrase 'Maria hat CVC gesagt' ('Maria said CVC') under two conditions:

for the first, the nuclear accent fell on CVC; for the second, Maria was nuclear-accented and the following CVC was deaccented. The dependent variable was the second formant frequency (F2) at the acoustic vowel target which is higher for front /ʏ/ than for back /ʊ/. The measurement of coarticulation was based on the F2-lowering influence of the labial locus on /ʏ/ in /pʏp/ and on the F2- raising influence of /t/ on /ʊ/ in /tʊt/. The same subjects took part in a forced-choice speech perception experiment in which they identified /ʊ/ or /ʏ/ from /pʏp-pʊp/ and /tʏt-tʊt/ continua synthesised by lowering F2 of the vowel in 11 equal steps. The tokens from the continua were embedded in a production of 'Maria hat CVC gesagt'; in addition, f0 was synthetically manipulated such that the nuclear accent was perceived to fall either on CVC (the accented condition) or on 'Maria' (the deaccented condition). For speech production, the magnitude of coarticulation was found to be greater in the deaccented than in the accented condition primarily as a result of a greater degree of F2-raising of /ʊ/ in deaccented /tʊt/. Listeners compensated perceptually for this prosodic difference: thus, the perceptual boundary between /ʏ-ʊ/ was shifted to a greater extent towards /ʊ/ in deaccented than accented /tʊt/ suggesting that listeners compensate more for the effects of coarticulation in deaccented than accented syllables. Thus this study shows that the influence of accented vs. deaccented on consonant-on-vowel coarticulation is matched in production and perception.

For the second experiment, 18 speakers produced /pV$_1$pV$_2$l/ target non-words for combinations of V$_1$ = /ʏ, ʊ/ and V$_2$ = /o, e/. This target non-word was always nuclear-accented in the carrier-phrase 'Maria hat /pV$_1$pV$_2$l/ gesagt' but produced such that lexical stress fell either on the initial or on the final syllable. The dependent measure was a shift in F2 due to trans-consonantal V$_2$-on-V$_1$ coarticulation in which F2 of /ʏ/

was expected to lower and F2 of /ʊ/ to raise under the backing and fronting influences respectively of V_2 = /o, e/. The same subjects participated in an analogous perception experiment in which the target non-word with the same two lexical stress conditions was embedded in the same carrier phrase (and with f0 synthesised such that the nuclear accent fell on the target non-word). As in the first experiment, a V_1 = /ʏ-ʊ/ continuum was created by lowering F2 in 11 equal steps. In both production and perception, the lexical stress differences had no influence on the size of trans-consonantal V_2-on-V_1 coarticulation. However, listeners were also found to compensate less for the F2-lowering influence of the consonantal /p/ context in unstressed compared with stressed syllables.

The overall conclusion from these findings is that the extent of listeners' compensation depends on the type of coarticulation and the level of the stress hierarchy: thus on the one hand, listeners are sensitive to the more extensive C-on-V coarticulation that is due to deaccentuation; but on the other, they do not compensate sufficiently for the same extensive C-on-V coarticulation at the level of rhythmically strong (primary lexical stress) vs. weak (secondary lexical stress) syllables.

The perception of voice-initiating gestures

Maria-Josep Solé (Universitat Autònoma de Barcelona, Spain)

While a large number of studies have looked at the variation in production which may give rise to sound change, fewer studies have looked at how this variation is perceived and (re)interpreted by listeners. Moreover, most studies have focused on coarticulatory, aerodynamic, inertial or rate-induced variation that, because is automatic and predictable, could lead listeners to expect the resulting effects and correct for them (or fail to do so). This talk focuses on the perception of variation resulting from implementational features, that is, features directed at achieving a certain goal; specifically, the use of nasal leak directed at achieving vocal fold vibration. Such implementational effects differ from regular phonetic variation in two important respects. First, they are features *targeted* by the speaker (rather than mechanical) as part of the 'constellation of gestures' directed to achieve a certain acoustic effect (Browman and Goldstein 1989)–in this case, voicing during a stop. Second, they are *not* fully *predictable* as they vary from speaker to speaker and segment to segment of the stop category, although they appear to be used rather consistently.

I will report the results of a perceptual study designed to examine whether English and Spanish listeners can detect the nasal leak that may accompany utterance-initial voiced stops in Spanish and French (Solé 2010, Solé and Sprouse 2010), and reinterpret it as a nasal segment. Such reinterpretation would account for a number of sound patterns, e.g. prenasalized voiced stops, emergence of non-etymological nasals adjacent to voiced but not voiceless stops, preservation of voicing exclusively after nasals (see Solé 2009 for a review).

Oral pressure, nasal airflow, oral flow and audio were recorded for utterance-initial /b/ /d/, /p/, /t/ produced by 10 Spanish speakers (five males and five females) and 5 French speakers (three females and two males) ten to thirteen times each. The perception stimuli were selected as follows. The tokens showing maximum and minimum delayed velic raising (i.e., velum leak) for each segment (/b d p t/) were selected for the high and low 'delayed velum raising' conditions. Maximum velum leak was taken to occur when delayed nasal closure exceeded 50ms, and minimum when it was below 20ms. Tokens showing a 'nasal burst' accompanying voicing initiation were also selected for the perceptual test. The tokens showing the largest and smaller (in magnitude) nasal burst for each segment were selected for the high and low 'nasal burst' condition.

The initial /C_{stop} VC/ portion was excised from the original sentences and a vowel was added at the beginning of the sequence, such that the perceptual stimuli had a /VC_{stop}VC/ structure. The initial vowel was included to place the segment of interest in intervocalic position where both /C_{stop}/ and /NC_{stop}/ may occur. In order to provide listeners with a reference token of the /NC/ identification response (and not to bias them against this response), one token each of the sequences /VmbV/, /VndV/, VmpV/, /VntV/ was added. All stimuli were normalized for intensity. The perception test consisted of 112 randomized stimuli. E-Prime was used to test 20 Spanish and 20 English listeners who were asked to identify the stimuli as /VCV/ or /VNCV/.

Preliminary results show a significantly higher number of /NC/ identification for the

maximum 'delayed velum raising' and maximum 'nasal burst' condition. The results for the English speakers are currently being analyzed, but preliminary analysis suggests that English speakers show significantly higher /NC/ identification responses that Spanish speakers, in line with their being less familiar with the occurrence of nasal leak in voiced stops, and therefore failing to correct for it. The results suggest that listeners may detect the nasal murmur and fail to relate it to the initiation of voicing, interpreting a nasal segment. Thus a gesture that was directed to facilitate voicing initiation may be interpreted as a new target goal. It is speculated that implementational features, because they are not predictable, may be more difficult to attribute to the source (the implementation of voicing) and more likely to be interpreted as a target feature in itself and reproduced as such.

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The possible role of alternative perceptual cues in sound change: Diphthongization in Standard Southern British English /u/-fronting

Katerina Chládková (University of Amsterdam, Netherlands), Silke Hamann (University of Amsterdam, Netherlands) & Daniel Williams (University of Sheffield, UK)

Fronting of the back high vowel /u/ is a diachronic process that occurred in the history of several languages, for instance French and Swedish (Meyer-Lübke 1908 and Kock 1911). Harrington et al. (2011) illustrate with data from German that a driving force behind this diachronic process is the high articulatory cost involved in the articulation of /u/ compared to /i/ and /y/. Articulatory effort,however, cannot be the only cause, otherwise we would expect far more languages to exhibit this process.

For the recent case of /u/--fronting in Standard Southern British English (SSBE; see e. g. Gimson 1966, Wells 1982, Henton 1983), Harrington et al. (2008) propose an interaction of articulatory effort with large allophonic variation of /u/ that resulted in a misperception of fronted /u/-allophones as default /u/, based on Ohala's hypocorrection account (Ohala 1981 and following).

The present study proposes an alternative perceptual cause in the process of SSBE /u/-fronting. Due to the allophonic variation exhibited by the older generation and the resulting confusability on the acoustic dimension of the second formant (F2), younger SSBE speakers are likely to have focussed on a more reliable perceptual cue. The acoustic study by Chládková & Hamann (2011) shows that the vowels /i/ and /u/ in SSBE can be reliably distinguished by their direction of diphthongization. Diphthongization therefore qualifies as distinguishing cue for the new generation. The present study presents the results of a perception experiment with two age groups of SSBE speakers which shows that the younger SSBE speakers reliably distinguish between the vowels /i/ and /u/ by employing diphthongization in cases of ambiguous F2 values, while the older speakers are less sensitive to diphthongization.

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Session 2:
Computational models of sound change

2nd May, 14:00-16:15
Chair: Khalil Iskarous

Combining longitudinal data and mathematical models of sound change

Morgan Sonderegger (University of Chicago, USA)

Understanding which forces it is that shape phonological change, and by extension the sound patterns of languages, has long been a major goal of linguistic research. Because explanations for language change generally involve learning or usage by individuals, but address population- level patterns of change, a link between the two is needed to test proposed explanations. What are the population-level consequences of different assumptions about learning by individuals? I describe a case study (joint work with Partha Niyogi) addressing this question, which combines two approaches to studying change: building detailed datasets and mathematical modeling. We use the dynamical systems framework for modeling the relationship between learning by individuals and population-level change (Niyogi & Berwick 1995; Niyogi, 2006), applying it to a case of change showing dynamics significantly more complicated than previously considered in the computational literature on language change. These complex dynamics strongly constrain the desired behavior of a model, so that the task of model bulding is not "doomed to success".

The data are the stress patterns of 150 English disyllabic noun/verb pairs (*pérmit / permít*), as recorded over the past 400 years in 76 dictionaries. The patterns of variation and change observed in these data can be used to evaluate proposed models. The psychological and linguistic literatures provide experimental findings potentially relevant to the diachronic dynamics, for example the tendency of English speakers to misperceive final-stressed nouns as initial-stressed (Kelly, 1989). Based on these we construct dynamical systems corresponding to 15 models of language learning by individuals, and evaluate the resulting population-level dynamics against those observed in the diachronic data. One significant finding is that the only successful models of learning incorporate both transmission errors between the speaker and hearer and bias making some patterns harder to learn than others ("channel bias" and "analytic bias", resp.; Moreton, 2009), two types of proposed sources of phonological change often seen as opposed. Our results suggest that both types of bias in language learning are important factors in explaining patterns of change.

Sound change in Khmer: Experimental and computational studies

James Kirby (University of Edinburgh, UK)

Introduction Unlike many languages of Southeast Asia, Khmer (Cambodian) is not a tone language. However, linguists have noted a pitch-based contrast between certain words in the colloquial speech of a number of Khmer dialects since at least the 1960s (e. g. Noss, 1966). While the emergence of lexical tone is common in languages of Southeast Asia, the manner by which it might be taking place in Khmer—as a result of loss of /r/ in initial clusters—has not been reported for any other language. This paper presents new acoustic and perceptual data on the emergence of F0-based contrast in Phnom Penh Khmer, and shows how a computational perspective can help us understand the dynamics of this type of sound change.

Background In Standard Khmer, one can find minimal triplets such as /kɑɑ/ 'neck', /kʰɑɑ/ 'donkey' and /krɑɑ/ 'poor'. In the colloquial speech of the capital Phnom Penh, /r/ is lost in /Cr/ onset clusters, but several sources (e.g. Noss, 1966; Wayland & Guion, 2005) report that forms like 'poor' are instead distinguished by other acoustic cues such as aspiration, a falling-rising pitch contour, breathy voice quality, and in some cases diphthongization, e. g. /krɑɑ/ > [kʰŏɑ] but /kruu/ 'teacher' > [kŭu]. However, the only acoustic description of this phenomenon (Wayland & Guion, 2005) is preliminary, and it is not clear which of these cues have become perceptually sufficient or salient for listeners.

Experiments 20 native speakers of Phnom Penh Khmer participated in one production and two perception tasks. In the production task, subjects read a wordlist of minimal /CV(C), CʰV(C), CrV(C)/ triplets covering a range of vowel qualities in both careful and casual conditions. Subjects also participated in two 2AFC listening experiments, designed to test the perceptual salience of the acoustic cues present in the colloquial forms. For the first task, a 7-step [kuu ∼ kŭu] continuum varying in F0 midpoint was synthesized using a Klatt synthesizer, and used as the basis for two additional continua by adding a fixed degree of aspiration [kʰuu ∼ k h ŭu] or breathy voice [kṵṵ ∼ kŭṵ]. For the second task, a 7-step [kɑɑ∼ koɑ] continuum varying in F1 height was used as the basis for three additional continua, created by adding fixed aspiration [kʰɑɑ∼ kʰoɑ], breathy voice [kɑ̤ɑ̤ ∼ kŏɑ], or a falling-rising F0 contour [kɑ̌ɑ∼ kŏɑ]. This design allowed the potentially additive effect of a variety of acoustic cues to be explored with a minimum number of trials.

Results Perceptual response data suggest that F0 has become the primary cue used by listeners to identify colloquial /CrV(C)/ forms, although other cues (notably aspiration) also play a role. Analysis of the production data shows colloquial productions of /CrV(C)/ forms are characterized by a falling-rising F0 contour and increased post-release aspiration, with a shift in F1 limited to forms containing low vowels. Crucially, careful productions of the same forms are found to contain excrescent vowels, *contra* Huffman (1972). I will suggest that the F0 contour finds its source in the higher pitch associated with the excrescent vowel, while the restricted distribution of diphthongization results from the perceptual interaction of aspiration (perceived as breathiness) with vowel height. This result is predicted from a model-based clustering approach to phonological categories (Kirby, 2010, 2011), whereby bias (here, devoicing of /r/ in onset clusters) led to probabilistic enhancement of F0.

Velar fronting in Russian emerges from a bidirectional phonology-phonetics interface

Paul Boersma (University of Amsterdam, Netherlands)

I present a detailed computational simulation along the lines of Boersma & Hamann (2008) of a well-studied known sound change, namely velar fronting in Russian. The ingredients are (1) children who acquire the phonology-phonetics interface by optimizing their perception, (2) phonological structures consisting of feature values, (3) bidirectional use of the phonology-phonetics interface (i. e. the learner uses in production the same constraints or connections that optimized her perception), and (4) an evolution of iterated learning over the generations. After the fall of the jers, the high central vowel turns out to automatically move to the front within five generations or so. The simulation confirms Padgett's (2003) point that in the Russian velar fronting case auditory dispersion plays a role, although our simulation does not require Padgett's teleological assumption or whole-language evaluation (listeners are innocent). The simulation also confirms Dresher's (2009) point that Russian velar fronting requires the underspecification of the phoneme /k/ for the feature [palatalized].

Session 3:

Speech Production, Imitation, Entrainment & Sound Change

3rd May, 8:45-9:30

Chair: Janet Fletcher

Discreteness and continuity in language design and sound change

Khalil Iskarous & Louis Goldstein
(University of Southern California & Haskins Laboratories, USA)

One of the most fundamental design characteristics of human language is that a few meaningless gestures combine to form many words. Humboldt recognized this fundamental combinatoriality as language's way of making infinite use of finite means. But later it was recognized that language is only one of several self-diversifying natural systems in which a few particles combine to yield a limitless set of entities at a higher level (Abler 1989). In these systems, the fundamental units do not average or blend, but rather they combine as wholes into many rule-governed arrangements, since averaging and blending would limit the diversity exhibited by the higher level entities. But language is special among these self-diversifying systems in that averaging or blending of gestures does also occur as coarticulation (Abler, 1989). Language therefore involves a mixture of discrete combinatoriality and inter-unit averaging. Our goal in this work is to show that basic aspects of speech production are behind the mixture of continuous and discrete in language, in particular: the nature of how the tongue hydrostat deforms, the fact that the units are arranged over time, and the necessity of tongue movements being continuous in time. The result is a fundamental asymmetry between place and manner of articulation. Moreover, we argue that several types of asymmetries in sound change, first recognized in Labov's resolution of the neogrammarian controversy (Labov, 1981) also follow from this asymmetry.

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Imitation as a mechanism for the spread of sound change

Grant McGuire (UC Santa Cruz, USA) & Molly Babel (University of British Columbia, Canada)

Strong evidence suggests that exposure to a speech stimulus causes an observer to display characteristics of the stimulus in their own productions (Babel, 2010; Babel & Bulatov, 2011; Goldinger, 1997, 1998; Goldinger & Azuma, 2004; Honorof et al. 2011; Namy et al., 2002; Nielsen, 2011; Shockley et al., 2004). This phenomenon, called imitation, has been suggested to be both the seed for sound change (Garrett & Johnson, to appear) and the mechanism by which it is spread (Delvaux & Soquet, 2007; Garrett & Johnson, to appear; Pardo, 2006; Trudgill, 2004, 2008). Under such a view, imitative behaviour spreads sound change throughout a population as listeners/talkers accommodate to each others' speech patterns and the imperfect transmission of these accommodations acts as the seeding mechanism. Moreover, the mechanisms that support imitative behaviour may be developed through socioculturally embedded sensorimotor learning in infancy (Ray & Heyes, 2011) and therefore may be quite active in shaping the acquisition process.

Of special interest then is what constrains imitation. Current work has demonstrated that imitation is moderated by social factors (Dijksterhuis & Bargh, 2001; Babel, 2010, in press), language-internal phonological factors (Nielsen, 2011), and dialect (Babel, in press), yet the picture is far from complete. Specifically, because the imitation view of sound change relies crucially on individual behaviour and does not assume that all interlocutors will equally imitate all voices, understanding the properties of a voice that lead to imitation is of great importance. For example, given that sound change is often described as being led by young females (Labov, 2001), we might expect that the voices of young females are imitated more than other voices. A competing prediction comes from Goldinger (1997), who predicted that in an episodic perceptual system, rare or atypical tokens will receive higher levels of activation. He goes on to demonstrate that in spontaneous phonetic imitation, lower frequency words with fewer echoes will exhibit stronger effects of imitation (Goldinger, 1997, 1998). Unique or atypical voices should also trigger a similar response, resulting in more imitation of atypical voice profiles. In this paper we seek to determine whether a particular voice profile is imitated more than others. To this end 30 male and 30 female native American English-speaking voices producing 15 low frequency monosyllabic words containing /i ɑu/ were presented to independent groups of California-based listeners (n=30) who rated vocal attractiveness and voice typicality for each talker. The most attractive, unattractive, typical, and atypical voices for each gender (a total of 8 voices) were selected for use as model talkers in an auditory naming task to elicit spontaneous phonetic imitation. In the auditory naming task, participants (n=16) produced baseline tokens of the 15 monosyllabic words and then shadowed the productions of the 8 model talkers. The task was blocked by model talker; the order of the model talkers was random, as was the word list. Imitation will be measured both acoustically (Babel, 2010) and perceptually through an AXB similarity task (Goldinger, 1998). Acoustic analysis of imitation is ongoing and currently 35 listeners (of a final total of 120 listeners) have completed the AXB task. In this task listeners judge whether shadowers' baseline productions or shadowed productions sound

more like the token the model talker under whose condition the shadowed token had been uttered. Each listener evaluated two shadowers' productions in response all 8 model talkers to control of listener-specific perceptual sensitivity. A repeated-measures ANOVA with Model and Vowel repeated across listeners demonstrated main effects of Model [$F(7, 238) = 2.13$, $p < 0.05$] and Vowel [$F(2, 68) = 12.68$, $p < 0.001$], as well as a significant interaction between the two [$F(14, 476) = 2.1$, $p < 0.05$]. While all Models were imitated at above chance levels, listeners perceived the most imitation in shadowed tokens of Least Typical Male model. Note, however, that among the four female model talkers, the Most Attractive female received the most imitation. These results suggest that typicality and attractiveness may play different roles in the spontaneous imitation of male and female voices. The vowel effect found that words with /u/ were imitated most, followed by words with /ɑ/. We discuss our results with respect to the role of imitation in sound change with an emphasis on preferential imitation of particular vowels and talker types.

Imitation, entrainment, and sound change

Eric Vatikiotis-Bateson (Cognitive Systems Program, University of British Columbia, Canada)

When speakers interact with one another, they inevitably coordinate their production behavior. Exactly how people do this and to what degree(s) are not well-known, but evidence of autonomous coordination, or entrainment, appears everywhere we look: in the spectral acoustics, in the rhythmic and temporal properties of speech, in word use, grammatical phrasing, and gesturing. It is also not known what role, if any, these instances of entrainment play in determining more lasting effects on aspects of speaker production (or perception).

For the purposes of this talk, I take the position that the mechanism of coordination—whatever it may be—is the continuation of what guides imitation and pattern learning during language acquisition; but only the mechanism, because the functional purpose shifts with maturation from acquiring essential patterns to flexibly adjusting acquired patterns on a small scale and usually temporarily. I argue that these continual adjustments serve various purposes, ranging from preserving pattern stability through fluctuation to adaptive entrainment of internal structures (speech and gesture,the effects of aging) and external structures such as environmental noise (Lombard effects) and entrained interlocution. Finally, I propose that these adjustments need not be small-scale and subliminal, but can also be recruited intentionally to make larger scale, systematic changes, as we do when we switch languages or take on different speaking styles.

To address these issues at least to the point of clarifying several empirical questions that can and should be asked, I demonstrate the application of a recent technique for assessing time-varying coordination using correlation mapping analysis (Barbosa et al., in press) to varied types of linguistic performance data.

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Session 4:
First language acquisition & sound change

3rd May, 11:30-13:00
Chair: Vatikiotis-Bateson

Aligning the timelines of phonological acquisition and change

Mary Beckman (Ohio State University, USA)

The original Neogrammarian distinction between regular sound change and borrowing was based on analyses of patterns of variation in the relationships between forms used by diverged speech communities in the aftermath of language change. However, the Neogrammarian understanding of regular sound change as a distinct process from borrowing, and not simply as "a heuristic technique ... for comparative research" (Hockett 1965: 188), implies also a fundamental difference in the patterns of variation within a speech community during the change. Borrowing replaces one set of forms by another, and there can be an arbitrary relationship between sounds in the replacing forms and sounds in the replaced forms. By contrast, the variation in word forms that is observed in the time course of regular sound change is a ubiquitous type of "structured heterogeneity" (Weinreich, Labov, & Herzog 1968: 101). Specifically, it is heterogeneity structured by age.

Another difference that often has been assumed involves the timelines for the two types of change. Regular sound change – i. e., "change from below"—is typically described as a continuous gradual change that is "generated by the process of INCREMENTATION, in which successive cohorts and generations of children advance the change beyond the level of their caretakers and role models, and in the same direction over many generations" (Labov 2007: 346; see also Hocket 1950, 1965). Changes continue in the same direction over successive generations when they involve "variables which have been evaluated in the same way by the speech community over a considerable period of time" (Weinreich, Labov, & Herzog 1968: 146). By contrast, phonological change through borrowing—i. e., "change from above" that involves "importation of elements from other systems" (Labov 2007: 346)—is typically ascribed to specific historical events that bring adult speakers of two divergent systems into contact. So it will not be child speakers who are at the leading edge of this kind of change and the social evaluation of phonetic variation in the aftermath of the contact "event" can be discontinuous with the social evaluation of the "same" variable prior to the change in the system.

In this chapter, I will explore this issue of potentially different timelines by describing data from the paidologos corpus (Edwards & Beckman 2008, Beckman & Edwards 2010) on productions by the youngest speakers in several sound changes in progress, as well as some data measuring community perceptions of those productions. All of the changes began in the last thirty to fifty years. Some of them are changes from below. For example, in the Seoul dialect of Korean, the "lax'" plosives in phrase-initial position have shifted from being a "mildly aspirated" series for young adults recorded in the 1970s (e.g. Han & Weitzman 1970) to having long lag voice onset time (VOT) values that are indistinguishable from those measured for the "aspirated" series (Silva 2006, Kang & Guion 2008). Women lead this change. Their productions are now differentiated primarily by the intonational cue of rising versus high phrase-initial tone, and when naïve Korean-speaking listeners are presented with woman's productions for identification out of context, they attend primarily to fundamental frequency. In our sample of 67 children aged 2 through 5 years and 20 young adults, the children's productions are more

similar to adult male productions, and naïve Korean-speaking listeners attend more to VOT when listening to them, just as they do when listening to men (Kong, Edwards, & Beckman, 2011).

Some other changes that we can examine in the paidologos corpus are changes from above. For example, in the *Dongbei* dialects of Mandarin Chinese of the 195os, the voiceless sibilants showed only a two-way contrast between [ɕ] and a more anterior sound, and the variable [s] versus [ʂ] was related to nearness to Korea versus Mongolia. With the subsequent imposition of the Putonghua standard, the [s] versus [ʂ] difference is now lexical. That is, Li (2005) shows that in the Songyuan variety, there has been a clear shift from the older system of no contrast between [s] versus [ʂ], for speakers in their 80s, to the standard 3-way lexical contrast among dental, apical postalveolar, and palatoalveolar sibilants, for speakers in their 20s and 30s. Moreover, some young women have the Beijinghua "feminine accent" variant for the palatoalveolar, pronouncing it more like [sʲ]. Li (2008) further documents that children in Songyuan master the 3-way phonemic contrast at the same age that Beijinghua-speaking children do (e.g., Zhu 2001), and productions of the alveolopalatal by the 4- and 5-year-old girls are differentiated from productions by boys in the acoustic dimensions that Li (2005) used to index the feminine accent variant. Thus, at first glance, it seems as if young girls are leading the "imported" change in the Songyuan sibilant system, whereas the child speakers described in Kong et al. (2010) are relatively conservative in the change affecting the Seoul plosive system.

However, some other differences also need to be considered before contrasting the timelines of the two changes in progress in this way. First, the two types of consonant contrast are at opposite extremes along the scale of motor difficulty. Plosive constrictions are produced by simple ballistic gestures and they are among the first consonants to be produced by infants in canonical babbling at 6-8 months. Control of fundamental frequency is younger (at 3 or 4 months) and even the most challenging property of the Korean contrast – the control of temporal coordination between oral and laryngeal gestures to produce different VOT lag values—is not as motorically challenging as the control of lingual postures to produce voiceless sibilants with contrasting spectral shapes. Where even the 2-year-olds in the Seoul Korean sample are transcribed as having about 80% accuracy rates for the phonation type contrast between lax and aspirated stops, the children in the Songyuan Mandarin sample are transcribed as having less than 30% accuracy for [s] at 3 years, and it is only in the 4- and 5-year-old groups that accuracy is better than chance. The differentiation between [ɕ] and [sʲ] in the boys' and girls' productions can only be observed in the older children, who control the lexical differentiation among [ɕ], [ʂ], and [s]. As Li et al. (2008) put it, "The emergence of gender-marking variation might be constrained by the same maturational factors that govern the mastery of the lexical phonological contrast."

This difference in age at which the children master the relevant lexical contrast interacts with a second apparent difference for which we have only qualitative observations to date. The children in the Songyuan sample were all recorded at school. In Songyuan, it seems that women work until their mid-60s and their children are placed in government-funded nursery schools by age two. By contrast, children in Seoul tend to be placed in (private) nursery schools at a later age, and to spend less time each day at school.

Although many mothers work, grandmothers often tend the children when they are not in school. We have recordings of primary caretakers interacting with very young children in both communities, and are currently in the process of analyzing those recordings, to quantify production patterns in child-directed speech. However, we unfortunately have no recorded productions by the children's teachers in either speech community. So we will not be able to compare the production patterns in the two potentially different adult models for the children at school and at home. An interim conclusion from this comparison of the youngest speakers in different changes in progress, then, is that considerably more detailed ethnographic research on childhood is needed before any generalizations can be made about differing timelines for regular sound change versus borrowing.

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Infants' contribution to the stability of patterns involving natural sound classes

Alex Cristia (Max Planck Institute for Psycholinguistics, Netherlands), Amanda Seidl (Purdue University, USA), Jeff Mielke (University of Ottawa, Canada), Robert Daland (UCLA, USA) & Sharon Peperkamp (Laboratoire de Sciences Cognitives et Psycholinguistique, Paris, France)

Sound patterns are ubiquitous in language. In every language that has been described, certain sounds and sound sequences are less frequent than others, and some altogether absent. Furthermore, sound patterns often concern natural sound classes. For example, in German and Russian, final devoicing affects both stops and fricatives, but not some subset of the two. Patterns affecting natural sound classes could be a consequence of language use, since similar sounds face similar phonetic pressures. Additionally, **there could be cognitive biases at play during language acquisition, which lead to better learning, and consequently greater stability, of sound changes resulting in patterns involving a natural class.** This paper reports on **7 artificial grammar studies, where learning biases were experimentally isolated**. Together, these studies suggest that infants could indeed provide a filter for sound patterns, as ease of learning and spontaneous generalization tendencies converge to favor patterns that involve natural sound classes.

Experiments 1-3 suggested that infant language learners favor natural sound classes as a function of experience. Training consisted of passive exposure to a sound pattern embedded in pseudowords (words that are legal but meaningless in the listeners' ambient language; henceforth items). At test, infants' interest was estimated through the time they orientated towards the source of the sound while different types of items were being played. In these and all subsequent studies, different items are used across training and test so that the task can only be solved through an abstracted pattern; and careful counterbalancing ensures that results cannot be explained by which items are used during training or test. In Experiment 1A, 7-month-olds was exposed to items beginning with 2 nasals and 2 stops, all of which can be captured within the natural class of non-continuants. At test, infants preferred items beginning with novel fricatives over items beginning with novel stops. In contrast, 7-month-olds exposed to an arbitrary grouping (nasals and fricatives) showed no preference at test (Experiment 1B), suggesting they could not as easily generalize from this set. A control study showed that this was not due to an inherent difficulty in learning patterns with fricatives (Experiment 2). In Experiment 3, 4-month-olds were equally capable of generalizing the natural class and arbitrary grouping, suggesting that the naturalness effects documented in 7-month-olds is acquired through experience, rather than via innate biases.

Experiments 4-7 documented that only infants spontaneously encode sound patterns in terms of natural classes. In Experiments 4 and 5, 6-month-olds were trained with pseudowords where the onset was restricted to a subset of obstruents sharing voicing (e.g., /p t ʃ/). Infants in Experiment 4 were subsequently tested with novel onsets of the same voicing (i.e., /k f s/) versus different voicing (i. e., /g v z/). At test, these infants showed a significant preference for the relatively more novel (/g v z/) items.

In contrast, infants tested with exposure (/p t ʃ/) versus within-class sounds (/k f s/) showed no significant preference at test (Experiment 5). Thus, infants appear to have automatically encoded the pattern in terms of the minimal natural class encompassing all training onsets. Two additional studies suggested that such strong and immediate generalization is not apparent in adults. In Experiments 6 and 7, adult participants were told that they would help us select made-up words to use in a study on children's word learning. During training, they answered how well-formed each item was, and at test, they were asked how frequently each item had been presented before (as in the infant studies, test items had not been used during training). Experiments 6 and 7 differed in the variability of training materials (e.g., number of onsets). In both studies, adults rated within-class items as having been presented significantly less frequently than exposure ones, showing that they spontaneously encoded the specific training onsets. Moreover, generalization (higher ratings for items where the onset was more versus less similar to the training onsets) could altogether disappear in low-variability conditions. Thus, class-based patterns are reinforced in infancy to a greater extent than in adulthood.

Session 5:
Social/dialect factors & sound change

3rd May, 14:30-16:45
Chair: Jane Stuart-Smith

Sound change in the individual: Effects of exposure on cross-dialect speech processing

Cynthia Clopper (Ohio State University, USA)

Synchronic variation is a hallmark characteristic of human speech, and arises from both intra-talker sources, such as speaking style and emotional state, and inter-talker sources, such as age, gender, and regional background. Although speech perception and processing are generally robust to these sources of variability in ideal listening conditions, listeners in more difficult listening conditions exhibit significant processing benefits for familiar voices and varieties relative to less familiar voices and varieties. These results are consistent with models of processing, such as exemplar theories, in which ease of processing reflects frequency of exposure. More familiar exemplars are more strongly represented in the exemplar space than less frequently encountered exemplars and are therefore easier to process.

Listeners exhibit processing benefits for their native regional dialect in a range of tasks, including sentence intelligibility (Labov & Ash, 1997; Mason, 1946), word recognition (Clopper & Tamati, 2010), lexical decision (Floccia et al., 2006; Sumner & Samuel, 2009), and word shadowing (Phillips & Clopper, 2011). Speech produced in the native variety is more intelligible in noise than speech produced in a less familiar regional dialect. Similarly, lexical decision and shadowing responses are faster for words produced in the native variety than words produced in a less familiar variety. This effect of dialect familiarity suggests a relatively strong cognitive representation of the native regional dialect, which may contribute to the maintenance of sociolinguistic variation over time within and across individuals.

Processing benefits are also observed for the "standard" variety of a language, often represented in national media, regardless of a listener's native variety. Speech produced in the standard variety is more intelligible in noise than speech produced in a non-standard variety (Clopper, in press; Clopper & Bradlow, 2008). Similarly, lexical decision (Floccia et al,, 2006; Sumner & Samuel, 2009) and speeded lexical classification (Clopper & Pate, 2008) responses are faster for words produced in the standard dialect than a non-standard dialect. Finally, repetition effects are observed in implicit recognition memory tasks for standard varieties, but not for non-standard varieties (Clopper & Tamati, 2010). These results are also consistent with a model in which frequent exposure to a particular variety, even passively through the media, can facilitate speech processing. Unlike the strong representations associated with native regional varieties, however, the strong representations associated with the standard variety may contribute to dialect leveling and the reduction of sociolinguistic variation over time.

Both processing benefits and processing costs are observed for individuals who have extensive experience with multiple dialects, such as a native regional variety and the standard variety. In lexical decision tasks, non-standard variants exhibit semantic priming effects similar to standard variants for listeners who are familiar with both variants (Sumner & Samuel, 2009; Warren & Hay, 2006). However, whereas as standard variants also exhibit form priming, non-standard variants inhibit form priming for listeners who are familiar with both variants (Clopper, 2011). Similarly, larger cross-dialect in-

terference effects are observed in speeded lexical classification tasks for listeners who are highly familiar with both the standard and a non-standard regional variety than forlisteners who are less familiar with the non-standard variety (Clopper & Pate, 2008). These interference effects for listeners with frequent exposure to multiple varieties suggest competition between linguistic and sociolinguistic representations. In an exemplar model, these competing representations would be realized as overlapping or bimodal distributions of exemplars. These kinds of distributions are inherently less stable than well-separated unimodal distributions and may therefore be more susceptible to drifting and changing over time.

Taken together, these effects of familiarity on cross-dialect speech processing suggest that long-term exposure to synchronic variation affects the representation and processing of linguistic information. The processing benefits associated with familiar varieties suggest that language users have strong cognitive representations for these varieties. However, the interference effects observed for listeners with frequent exposure to multiple dialects suggests that the maintenance of multiple competing linguistic systems negatively impacts speech processing. The competition between strong representations of a native regional variety and the standard variety may provide a locus of sound change for these individuals.

Linear incrementation and curvilinear reversal: 100 years of sound change in Philadelphia

William Labov (University of Pennsylvania, USA)

New techniques of automatic alignment and vowel measurement have made it possible to investigate the path of sound change with increasing accuracy and detail. The FAVE (Forced alignment and vowel extraction) program was applied to a very large corpus of neighborhood studies in Philadelphia, carried out yearly from 1973 to 2010, yielding over a million vowel measurements for 325 speakers with dates of birth ranging from 1890 to 1990. Several sound changes show a pattern of continued linear incrementation, tightly correlated with date of birth: the raising of /ey/ in closed syllables in *made*, *pain*, *date*, etc.; and the centralization of /ay/ before voiceless consonants in *right*, *sight*, *like* etc. However, a third change that was found to be "new and vigorous" in the 1970s now shows clear evidence of reversal for those born in 1960s and later: the raising and fronting of /aw/ in *down*, *south*, *loud*, etc. This reversal appears to be correlated with increasing social salience for /aw/, paralleled by the increasing retraction of two stereotypes of the Philadelphia dialect, the raising of tense short-a in *mad*, *man*, *last*, etc. and the raising of long open –o in *water* and *daughter*. The reversal of these sound changes is led by community members with higher education, a social dimension that has no effect upon the sound changes with linear incrementation.

Previous studies indicate that as long as sound change remains below the level of social awareness, it is promoted by the highest status speakers in the local community. If the level of social consciousness is raised high enough, this social relationship may be reversed, and eventually the sound change itself may be reversed for the community as a whole. The current findings in Philadelphia also indicate that some sound changes may go to completion without such a reversal taking place. When and where a sound change becomes salient is a matter of social history, an aspect of the actuation problem that lies outside of the study of linguistic structure .

Category Instability of the Palatal Fricative in Berlin German

Stefanie Jannedy (ZAS Berlin, Germany), Melanie Weirich
(Friedrich-Schiller-Universität Jena, Germany)
& Jana Brunner (Universität Potsdam, Germany)

From a typological point of view, /ç/ is relatively rare in the languages of the world. However, standard German contrasts the palatal fricative /ç/ as in /fɪçtə/ ('spruce') and the postalveo- palatal fricative /ʃ/ as in /fɪʃtə/ (1. and 3. P. sg. past tense 'to fish'). Nevertheless, several dialects from the central region of Germany (such as Moselle Franconian, Hessian, Thuringian, Saxonian) do not contrast these two sounds and canonical /ç/ is realized as /ʃ/.

Auer (1999) observed a synchronic alternation of /ç/ and /ʃ/ in a variety spoken by young multi-ethnic speakers in urban areas of Germany (Hamburg) where this alternation is unexpected. We have followed up on this observation and conducted production and perception studies in Berlin where we also find larger multi-ethnic neighborhoods where this alternation is quite pervasive and noticeable. It is mocked and stigmatized and there is a general awareness in the Berlin population that many young speakers from Kreuzberg, Wedding or Neukölln substitute /ç/ with /ʃ/.

A forced choice perception test was designed to test for listeners' identification of stimuli from a 13 step acoustic continuum ranging from a palatal fricative as in /fɪçtə/ to a postalveolar fricative as in /fɪʃtə/. Color pictures of a spruce and of a young man holding a fishing rod were attached to the response box. 99 male and female listeners were instructed to press the appropriate response button for each stimulus they heard. Different groups of listeners were tested under three CONDITIONS: group 1 saw the word *Kreuzberg* written on the response box, group 2 saw the word *Zehlendorf* and group 3 did not get any such information. Also, in group 1 and 2, the listener's attention was implicitly and subtly directed to his group membership by casually mentioning the CONDITION under the assumption that s/he would derive inferences from that. In total, listeners were presented with 11 Blocks (each in a different random order) of 13 stimuli. Responses from Block 1 were excluded from the analysis.

Age Group	**No. of Subjects**	**No. of Responses**
Young (mean=22.9, SD=1.9)	61	8529
Middle **Y**oung (mean=29.1, SD=1.7)	23	3205
Middle **O**ld (mean=35, SD=0.9)	6	840
Old (mean=50.1, SD=5.1)	9	1242

Table 5: Number of Subjects and Responses by Age Group.

A linear mixed effects model (lme) revealed significant results for the factors CONDITION ($p<.05$) and AGE ($p<.05$). Thus, suggesting that listeners adjust their interpretation of synthesized acoustic continua in accordance with their expectation, indicating that both perceptual cues and inferred social factors play a role in the categorization of speech stimuli. The results show that the mere suggestion of where the speaker may

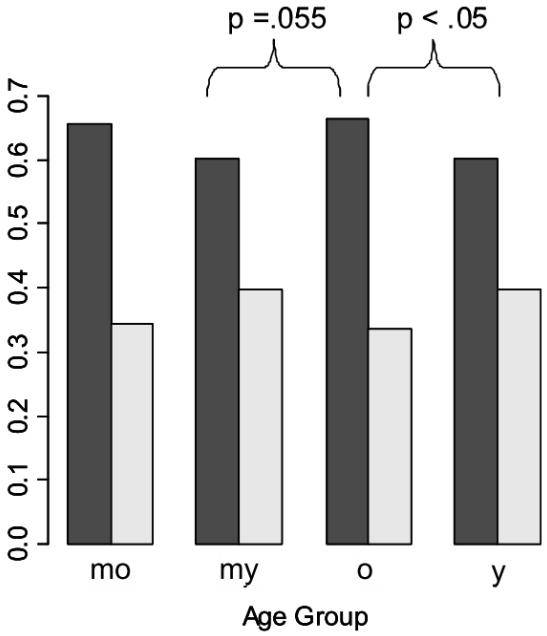

Figure 1: Distribution of responses (in %) by Age Group (black = 'Fichte', grey = 'fischte').

come from even within the confines of a city is enough to trigger such inferences. Also, younger listeners perceive more /ʃ/- variants than old listeners. Arguing in the same vain of expectation guiding perceptual categorization younger speakers hear more /ʃ/ because this variant is prevalent in their environment.

Session 6:
Sound change and evolution

4th May, 8:45-11:00
Chair: Lasse Bombien

The Life Cycle of Voiceless Sonorants

Juliette Blevins (CUNY Graduate Center, USA)

In this paper I examine the phonetic origins of voiceless sonorants cross-linguistically within the general framework of Evolutionary Phonology (Blevins 2004, 2006). One common sources of voiceless sonorants is coarticulation in {Rh,hR} and {Vh, hV} clusters. Another phonetic source of voiceless sonorants are laryngeal spreading gestures associated with prosodic domains. In this second case, voiceless sonorants can arise as allophones of their voiced counterparts. While a fair number of languages show voiceless sonorant glides, liquids and nasals phonologized as a consequence of {Rh, hR} coarticulation, very few languages show phonologization of voiceless sonorants via the second process. Still more striking is the resistance of voiceless vowels to phonologization despite their common evolution. While Gordon (1998) suggests that the distribution of voiceless sonorants follows from synchronic constraints encoding a conflict between articulatory ease and perceptual saliency, resistance to phonolo gization follows naturally within Evolutionary Phonology, where the failure to perceive voiceless vowels in, for example, word-final position, is associated with their historical loss.

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Sound change as epigenetic regulations

Didier Demolin (Gipsa-lab, Université Stendhal, France)

Phonological systems are dynamic and self-organized systems, i. e. systems in which time and the timing of elements play a crucial role. An important aspect involved with self- organization is the notion of feedback and regulations. Feedback processes are continuously used in speech, both to control production and in the correction procedure involved in speech perception. Regulations are defined are constraints that adjust the rate of production of the elements of a system to the state of the system and of relevant environmental variables. The main operators of these adjustments are feedback loops (Thomas et al. 1995). Two types of processes can be distinguished in regulatory networks, homeostatic and epigenetic. Homeostatic regulations account for the correction procedure involved to prevent sound change in speech. In nature a lot of variables are subject to homeostatic regulations (temperature of homeothermic vertebrates, chemical composition of the inside medium). Depending on the case, the variable is maintained at a desired value, or oscillates around this value. In fact, the same process is likely to happen in speech, in order to regulate the variations and the distortions of a signal sent by a speaker and perceived by a listener. Variations exist both at the articulatory (the timing and the trajectory of gestures) and at the acoustic level (the greater or shorter duration of elements, variations in amplitude...), not to mention other levels involved in speech production and perception. Despite these variations and the so-far unresolved issues of phonetic invariance and segmentation, phonological systems work efficiently as more or less stable entities in speech communities. Homeostatic regulation accounts for the stability of phonological systems but not for other fundamental issues in speech, such as phonemic coding and sound change. The mechanism at work in the two latter points is epigenetic or differentiative regulations. The fundamental difference between the two types of regulations is that homeostatic regulations stabilize a variable (with or without oscillation) between the minimum level and the maximum level; epigenetic or differentiative regulations force a variable to a stable choice, either to the minimum level or to the maximum level. Differentiation is mainly of epigenetic nature and is a biological modality of the more general phenomenon of multistationarity. Such differences are not linked to differences at the level of genetic inheritance even if in biological organisms they are transmissible through cell generations. What epigenetic differentiation brings to the study of speech is the importance of environmental factors, in this case, the role of the linguistic community. The mechanisms which shape and regulate a phonological system are homeostatic and epigenetic regulations. The first accounts for the apparent stability of the system and the second for the evolution of the system which can be observed in the study of sound change. Many instances of sound change where the amplification of a feature makes the system shift to another state can be explained in this way. This accounts for the source of sound change. At the collective level, the propagation of amplified variations can be explained in the same way. This last case is however more easily formalized by using a logistic equation in which the inhibition factor may be taken as the perceptual distinctiveness between elements of the system.

Genetic biases: the neglected factor in sound change

Dan Dediu (Max Planck Institute for psycholinguistics, Nijmegen, Netherlands)

One potential factor affecting language change and evolution is represented by *genetic biases*, which can act at various stages in the process of language transmission. When influencing speech production and perception, these biases act by affecting sound changes, making some directions of change more probable than others.

Here, I will briefly review the current state of knowledge concerning the action of genetic biases on sound change, including both empirical, computational and evolutionary investigations. Dediu & Ladd (2007) showed that the population frequency of two brain growth and development genes, *ASPM* and *Microcephalin*, are associated with the worldwide distribution of *tone languages*, and proposed that the mechanism responsible is the biasing of the acquisition, production or processing of tone by these two genes. This biasing would affect sound changes in such a way that tonogenesis or tone loss would be favored in languages spoken by populations with differing genetic structures, resulting, across generations, in the observed typological diversity.

In a similar vein, Peter Ladefoged (1984) suggested that the differences between the vowel systems of Yoruba and Italian have a biological component, whereby the structure of the speakers' upper vocal tract biases the vowel system of these languages. There are a number of other such proposals in the literature (e.g., Traunmüller, 2003; Brosnahan, 1961) but most require further investigation, being anecdotal or based on small samples.

Moreover, recent computer models (e.g., Kirby et al., 2007; Dediu, 2008) strongly suggest that plausible implementations of genetic biases affecting the transmission of abstract linguistic features do influence the direction of language change. Finally, very recent investigations inspired from evolutionary biology using Bayesian phylogenetic methods (Dediu, 2011; Dediu & Cysouw, in preparation) found that certain structural features of language tend to be stable across many language families and geographic areas, pointing towards potential genetic biases "anchoring" them. Interestingly, phonetic and phonological features tend to span the whole range from extremely stable to extremely unstable.

In conclusion, I will argue that genetic biasing might represent an active causal factor in some sound changes, and that a better understanding of the mechanisms involved and the resulting patterns, as well as the identification of such cases, are necessary for a scientifically complete description of the process of sound change.

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Session 7:

Relationships between continuous and categorical change

4th May, 12:15-13:00

Chair: Mary Stevens

A coarticulatory account of historical r-vocalization in English

María Riera & Joaquín Romero (Universitat Rovira i Virgili, Spain)

The pronunciation of coda /r/ in English is one of the main characteristics that help distinguish between dialects of the language. Traditionally these have been divided between rhotic dialects, i. e., those in which /r/ is pronounced in all positions, and non-rhotic dialects, i. e., those in which /r/ is only pronounced prevocalically. Non-rhotic dialects are characteristic of most of England and areas settled by English speakers after the 18th century. Earlier settlements, such as those in Ireland or North America, have typically maintained rhoticity, which gives us a good indication as to when /r/ loss took place in England. Historical accounts of /r/ loss place the origin of the sound change in southern England some time during the late 17th and early 18th centuries. Even though at the time /r/ dropping was considered a sign of lack of refinement and was discouraged by grammarians (Beal, 1999), by the end of the 18th century it seems to have been widespread in educated London speech.

In standard accounts of the phonetics of non-rhotic dialects, the consequences of /r/ dropping are the appearance of a set of so-called 'centring' diphthongs and triphthongs, i. e., /ɪə/, /eə/, /ʊə/, /aɪə/ and /aʊə/, from earlier /ir/, /er/, /ur/, /aɪr/ and /aʊr/, and the coalescence of former /ɑr/ and /ɔr/ with /ɑː/ and /ɔː/ resulting from vowel lengthening, which created pairs of homophones of the *fort-fought* type. The two developments appear at first sight to be unconnected. However, a closer look at the articulatory nature of vowel+/r/ sequences in rhotic dialects of English seem to suggest otherwise. In this paper we provide experimental evidence that shows how the articulatory transitions present in vowel+/r/ sequences can be seen as being responsible for the dual development observed historically in non-rhotic dialects, thus providing a plausible unified account a historical /r/ dropping that is in accordance with the dynamic nature of speech production. Specifically, we show how the development of centring diphthongs and triphthongs correlates with the presence of clearly identifiable schwa-like elements in the transitions between high front/back vowels and the following /r/ in /ir/, /ɛr/, /ʊr/, /aɪr/ and /aʊr/ sequences in American English. When the /r/ follows low back vowels, as in /ɑr/ and /ɔr/ sequences, the transitions are much less obvious and are sometimes absent altogether.

Evidence for the above findings has been obtained with an experiment that investigated the presence of a schwa-like element in the VC transitions of final V+/r/ sequences in American English as a function (i) of the phonetic/phonological nature of the preceding vowel and (ii) of speaking rate. Acoustic measurements (F1, F2, F3 and duration) were obtained for the transitional element from six speakers. The data were analyzed using factorial repeated measures ANOVAs with context and rate as independent variables and with F1, F2, F3 and duration as dependent variables. The results suggest (i) that this vocalic element is highly variable in terms of its formant and duration values depending on context and rate, and (ii) that there is a strong correlation between the type of vowel and the durational and spectral characteristics of this vocalic element, which are significally more distinct when the preceding vowel is high and front/back than when it is low and back. These findings give support to the hypothesis formulated here that the reflexes of /r/ dropping are the result of articulatory dynamics and provide a unified account of historical /r/ loss in English.

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A Stratal OT Perspective on Sound Change

Paul Kiparsky (Stanford University, USA)

The classical explanation for exceptionless neogrammarian sound change and for the phenomenon of phonologization by secondary split (the persistence of allophones when their conditioning factors change) relied on a sharp separation of phonology and phonetics. In a paradoxical marriage of synchronic structuralism to diachronic neogrammarianism, sound change was located outside of the linguistic system that it transforms.

This picture is at odds with structural explanations for sound changes. In particular, it makes inexplicable the fact that sound change never subverts phonological universals, and it does not account for the interactions of sound changes with already existing phonological processes and constraints of the language through blocking and repair. It also fails to explain why secondary split sometimes does not happen, and allophones instead just adopt to their new conditioning environment.

But the most fundamental objection to the structuralist view of sound change comes from a growing body of evidence for the independence of the structural notion of CONTRASTIVENESS (unpredictable distribution) and the perceptual notion of DISTINCTIVENESS, conflated in traditional phonemics. Phonemes are contrastive and distinctive, allophones are non-contrastive and non-distinctive, but the other two combinations exist as well. Contrastive but nondistinctive elements are documented in NEAR-MERGERS (Labov 1994), cases where speakers reliably produce a slight contrast, but cannot distinguish it, either in their own speech or in the speech of others, e.g. source and sauce in New York. Elements that are non-contrastive but distinctive—predictable but perceptually salient—are what have been called QUASI-PHONEMES (Ebeling 1960, Korhonen 1969).

	contrastive	non-contrastive
distinctive	phonemes	quasi-phonemes
non-distinctive	near-merged	allophones

Studies of ongoing sound change show that allophones become phonologized as quasi-phonems *before* they actually become contrastive, and that phonemes merge via a stage at which they are non-distinctive.

I argue that these properties of sound change can be explained and mutually reconciled in Stratal OT, a constraint-based version of Lexical Phonology. A Stratal OT phonology is a hierarchy of serially related modules, each of which is a parallel constraint system of the classical OT type. It provides a principled characterization of quasi-phonemes independently of the post hoc information that they are phonologized when another sound change occurs.

In the proposed model, phonologization occurs when a constraint ranking spreads from the postlexical phonology into the lexical phonology, driven, I conjecture, by a bias for assigning structure as early as possible. The lexical phonology assigns categorical (hence perceptually salient) feature values, operates within the word domain, and interacts with the morphology. The phonologization becomes overt—the non-contrastive quasi-phoneme turns into a contrastive phoneme—when the postlexical constraint system changes in such a way as to mask the lexical conditioning. Conversely, when conditioned allophones are created in the postlexical constraint system, they disappear when their conditioning environments are lost, and no secondary split occurs.

5 Poster presentations

Poster Session 1

2nd of May, 16:45-18:15

Neutralisation of the feature [±constricted] in the high vowels of Standard Austrian German: A Sound Change in Progress?

Julia Brandstätter & Sylvia Moosmüller
(Austrian Academy of Sciences, Acoustics Research Institute)

Introduction: It has been observed for Standard Austrian German (SAG) that speakers tend to neutralise the opposition [±constricted] of the high vowels /i/ – /ɪ/, /y/ – /ʏ/ and /u/ – /ʊ/ in favour of the [+constricted] vowels. Neutralisation was especially observed in spontaneous speech, but also in unstressed positions in the more formal task of reading sentences. The question arose whether this observation might be evaluated as a sound change in progress, caused by the interaction with the Viennese dialect (VD), a variety whose phoneme inventory lacks the [-con- stricted] high vowels /ɪ/ and /ʊ/ (the phoneme inventory of the VD lacks front rounded vowels in general) or whe- ther phonetic and phonological reasons might be responsible for these variations. In cooperation with the Institute of Phonetics and Speech Processing, Munich, articulatory, acoustic, and perceptual investigations are currently performed in order to shed light on the formation and dynamics of this process.

Method: The current presentation focuses on the acoustic analysis of the front vowels /i/ and /ɪ/ of the speaking task "reading of logatomes" of 14 speakers of SAG. All /i/ and /ɪ/ vowels (¿ 600) have been segmented manually. F1, F2, and F3 were extracted (software: ST_x, method: LPC, window length 46ms, overlap 95%). Depending on the length of the vowel, the measurement procedure described rendered 40 to 150 measurements per vowel, i. e., the formant movements over time enter the analysis. For statistical analysis, one-tailed t-tests and cluster analyses were performed.

Results: Cluster analysis revealed that some speakers, independent of age, did not clearly separate /i/ and /ɪ/. For them, a third, mixed cluster, containing both /i/ and /ɪ/, was generated. /i/-vowels of this cluster proved to be significantly shorter than the /i/-vowels pooled in cluster 1. In-depth inspection of formant movements over time revealed that the steady states of the /i/-vowels of the 3 rd cluster were shortened, whereas the duration of offset formant transitions was not affected. The acoustic pattern of /i/-vowels of SAG characteristically shows a high F3 coming close to F4 (Moosmüller 2007). Changes in articulatory settings in the transition phase of the vowel causes a monotonous and substantial drop in F3 frequency. Since formant transitions enter the analysis, this drop in F3 frequency, starting relatively early as compared to the longer vowels, might be responsible for the formation of 3rd cluster. Consequently, at least as concerns the vowels /i/, the observed 3rd cluster might be caused by both the methodological approach (vowel transitions entering the analysis) and by the acoustics which causes a monotonous and substantial drop in F3 frequency at the offset transition of the vowel (especially for subsequent bilabial and velar plosives). Therefore, the mere formation of a 3rd cluster does not necessarily point to an ongoing neutralisation of the /i/ and /ɪ/ vowels. However, articulatory analysis, acoustic analysis of spontaneous speech, and perception tests will shed more light on this phenomenon.

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Speaking and hearing Australian Aboriginal languages: could hearing impairment play a role in the evolution of a phonology?

Andy Butcher (Flinders University, Australia), Hywel Stoakes (Flinders University, Australia), Janet Fletcher (University of Melbourne, Australia) & Marija Tabain (La Trobe University, Australia)

Chronic *otitis media* with effusion (OME) causes hearing loss which affects both the low frequency end of the scale (under 500 Hz) and the upper end of the scale (above 4000 Hz). Among the specific consequences of this are difficulties in perceiving fricatives and hearing voicing distinctions among stops. OME develops in the majority of Australian Aboriginal infants within a few weeks of birth. Audiometric measurements of 37 subjects in a remote Arnhem Land community (Figure 1) confirm previous clinical data from 913 children in a desert community, which show that around 75-80% of children are left with a significant conductive hearing loss (i. e. greater than 25 dB in at least one ear).

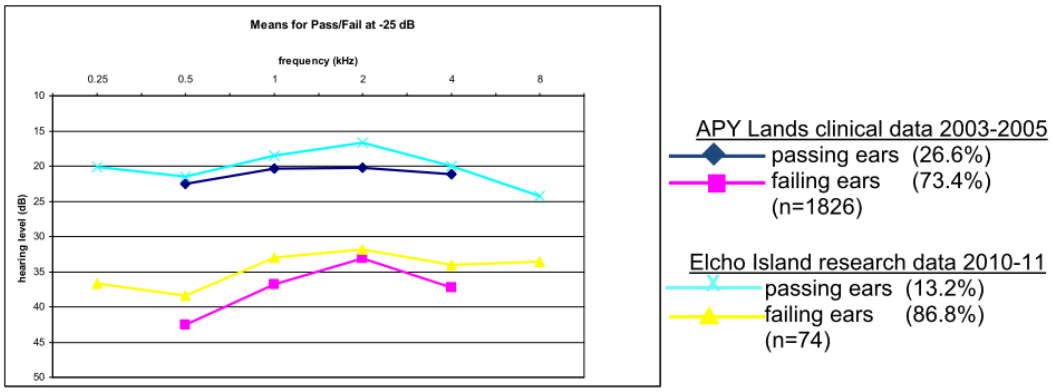

Figure 1: Results of hearing tests on 950 Aboriginal children

Acoustically the sound systems of Australian Aboriginal languages are strikingly different from the majority of the world's languages. They are lacking both in contrasts which depend on low frequency acoustic cues (high vowels, voiced obstruents) and in contrasts which depend on cues at the high frequency end of the spectrum (fricatives, aspirated stops).

Long-term average spectra of speech in two unrelated Australian languages, Yolngu Matha and Pitjantjatjara, were compared with spectra of the same 16 individuals speaking Australian Aboriginal English (AAE). There were clear quantitative spectral differences between the AAE speech and the speech in the two Aboriginal languages (see Figure 2), with the AAE having higher amplitudes at higher frequencies (4-16 kHz) when compared to the two Australian languages and the latter. In contrast, the signal between 750 Hz and 2kHz has higher amplitudes in the Australian languages. Although this is a very small difference, it holds true for all speakers regardless of sex or language group. Australian languages typically have five, six or even seven place of articulation

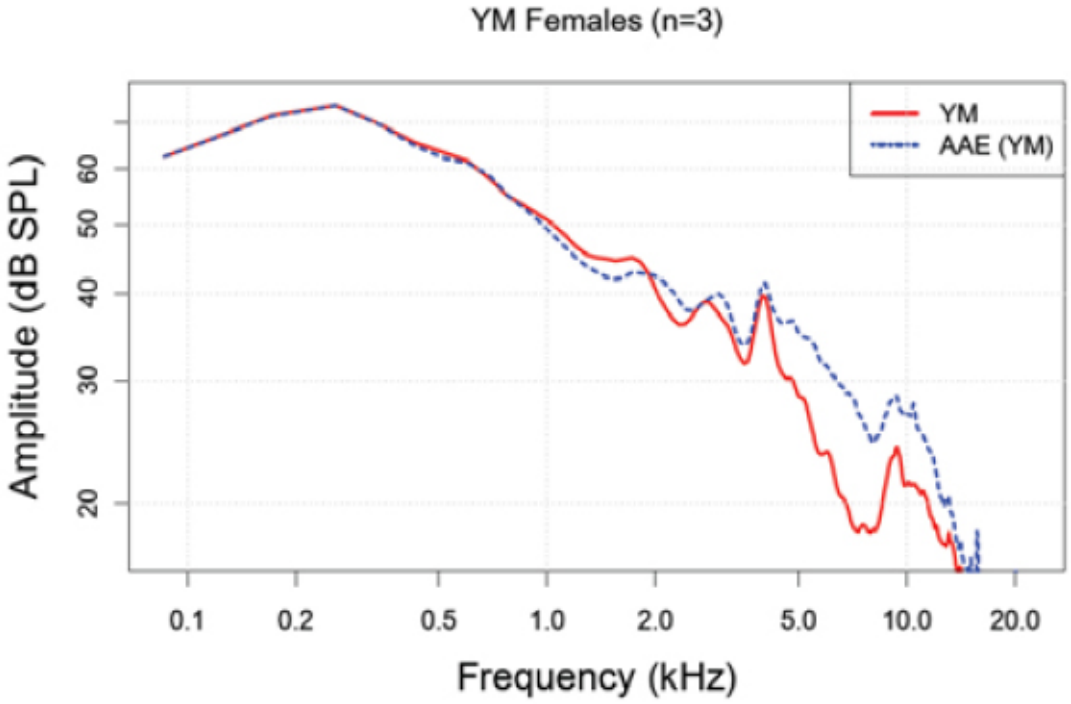

Figure 2: Average spectra of female speakers of Yolngu Matha and Australian Aboriginal English (60 s speech sample)

contrasts, which depend on rapid spectral changes in this part of the frequency range. Furthermore it seems that speakers use a number of strategies to maximise the clarity of these contrasts. Thus it appears that Aboriginal languages favour sounds whose characteristics exploit precisely that area of hearing ability which is most likely to remain intact in OME. Is this simply a coincidence or is it possible that the phonetics and phonology of Australian languages have evolved to match the auditory input experienced by the speakers?

The merger in process of [ɕ] and [ʃ] in Luxembourgish

François Conrad
(University of Luxembourg, Department for Luxembourgish Linguistics and Literature)

The young Germanic language Luxembourgish (Lux) shows some significant differences in the phonological system compared to its "big" neighbor, Standard German (StG). Some of these differences are found in the fricative system: The StG voiceless palatal fricative [ç] has its reflex in every context in the Lux voiceless alveolo-palatal fricative [ɕ] (e.g. germ. *richtig* ['Rɪçtɪç] > Lux *richteg* ['Riɕtəɕ]), the palatal variant is missing in Lux altogether. The voiceless post-alveolar fricative [ʃ] in StG and Lux is more or less the same in context and phonetic shape, with a labialized variant [ʃʷ] found in Lux in the speech of mainly elder speakers (e.g. germ. *schön* [ʃø:n] ¿ Lux *schéin* [ʃ$^{(w)}$əin] 'beautiful'). The shift from voiceless palatal to alveolo-palatal fricative is recent. Older descriptions of Lux from the 19th to the middle of the 20th century transcribe the sound with the palatal fricative. First notifications of a "mixture" or a "middle-sound" appear in the late 40s and 50s, suggesting a sound shift or merger of both fricatives to an in-between sound: [ç] > [ɕ] < [ʃ]. As for many areas of Middle German dialect regions (e.g. documented in Koblenz, Erp, Leipzig) this sound shift lead to the loss of the palatal variant and to no significant perceptual differences between the fricatives.

In the 90s, a first phonetic-acoustical investigation on a small scale was carried out[1], affirming this perceptual impression. My analyses intended to clarify the sound shift on a larger scale, including a more in-depth phonetic investigation of the spectral shape of the fricatives. To do so, the speech of 6 speakers (4 male, 2 female) from 3 different generations, all from the capital city of the Grand-Duchy of Luxembourg (seen as the center of the main dialect area, motor of the standardization process of Lux) was analyzed. The position of the first spectral peak, computed using the LPC-smoothing algorithm of the phonetic software PRAAT, proved most significant in order to distinguish the Lux fricatives. The combination of this information with the auditory transcription and the analysis of the general shape of the spectral curve lead to some interesting results, which both affirmed and nuanced some of the suppositions in the literature:

a. There is a clear difference in the fricative system of the three generations, with an opposition between a labialized post-alveolar fricative [ʃʷ] and an alveolo-palatal fricative [ɕ] for the elder generation, a less stronger opposition between an optionally labialized post-alveolar fricative [ʃ$^{(w)}$] and [ɕ] for the middle generation, and the virtual absence of opposition in the speech of the younger generation, with a clearly delabialized [ʃ] and an alveolo-palatal [ɕ] close to the latter, e.g. (the numbers indicate the range and the average frequency of the first spectral peak):
   - Male speaker, 85: [ʃʷ] = 1150-1600 / 1310 Hz. [ɕ] = 1760-2000 / 1860 Hz.
   - Male speaker, 50: [ʃ$^{(w)}$] = 1480-1850 / 1650 Hz. [ɕ] = 1850-2130 / 1970 Hz.
   - Male speaker, 27: [ʃ] = 1350-1725 / 1575 Hz. [ɕ] = 1550-1750 / 1675 Hz.

b. The inner-individual differences are systematical, i. e. every speaker shows a consistent fricative system. Inter-individual differences, on the other hand, are in some cases very strong.

c. First impressionistic examinations of the voiced variants [ʒ] and [ʑ], rather frequent in Lux, suggest a similar pattern to the one found for the voiceless fricatives.

[1] Gilles, Peter (1999): Dialektausgleich im Lëtzebuergeschen. Zur phonetisch-phonologischen Fokussierung einer Nationalsprache (= Phonai 44) (Tübingen).

The relationship between oral and nasalised vowels in Australian English /æ/ change

Felicity Cox & Sallyanne Palethorpe (Macquarie University, Australia)

In many languages /æ/ is maximally affected by nasal contexts (Beddor 1993). In low vowels (with high F1), nasalisation contributes a spectral peak below the first formant, creating a first spectral prominence with increased bandwidth leading to the percept of a higher vowel than that without nasal coupling. There is also potential coincident velum lowering and tongue body raising brought about by palatoglossal activity (DeDecker & Nycs 2006).

In Australian English (AusE), nasalisation of /æ/ and the raised quality of the nasal allophone has been the subject of comment for over 100 years. Cox et al. (2004), in an acoustic study of historical data, found nasalised /æ/ to be phonetically raised relative to oral /æ/ but did not observe excessive allophonic separation. Over the past 20 years, a change in /æ/ has seen this vowel lower to occupy the extreme open position of the inverted triangular vowel space (Cox & Palethorpe 2007). The lowering of /æ/ appears to be coincident with a newly initiated allophonic split whereby nasalised /æ/ may be raised to overlap with /e/ but oral /æ/ remains low . In this paper we explore oral and nasalised /æ/ and /e/ to investigate the strategies speakers use to ensure maintenance of this highly functional contrast.

Oral and nasal allophones of 18 vowels including /æ/ and /e/ were collected from 30 females in short phrases and isolated /CVn, CVd/ words repeated three times in random order. Cluster analysis based on F1 and F2 (Emu: `http://emu.sourceforge.net/`) confirmed the presence of two groups of speakers: those who produce an oral/nasal allophonic split for /æ/ and those who do not. Figure 1 shows the results from two speakers to illustrate these speaker differences. Mixed model analysis reveals that the important contrast between /æ/ and /e/ is maintained by duration for those speakers who exhibit allophonic split.

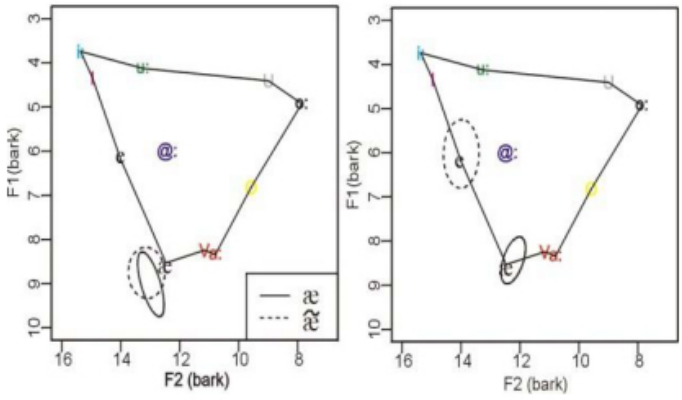

Figure 1: Oral and nasalised /æ/. Overlapping allophones (left), allophonic split (right).

Figure 2 shows the length effect for oral and nasalised vowels and indicates that two binary features (nasality and length) generate a four way contrast at the raised vowel location. A length distinction is observed between oral [e] *head* and [e:] *haired* and between nasalised [ẽ] *Ben* and [æ̃] *ban.* **References**

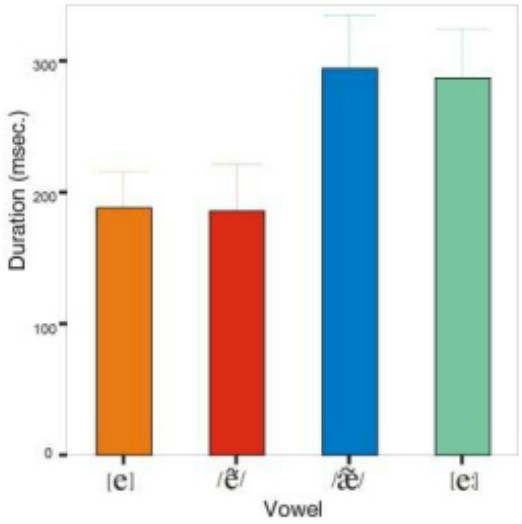

Figure 2: Duration of oral and nasalised vowels in the vicinity of /e/. Contrast is achieved by nasalisation and length

Beddor, P. (1993) The perception of nasal vowels. In Huffman, M. K., Krakow, R. A. (eds.) *Phonetics and Phonology: Nasals, Nasalisation and the Velum.* San Diego: Academic Press.
Cox, F., Palethorpe, S. & Tsukada, K. (2004) A century of accent change in Australian English, Presented at the 10th Australasian International Conference on Speech Science and Technology, Sydney.
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Evidence for a Network Model of Sound Change

Thaïs Cristófaro-Silva (Universidade Federal de Minas Gerais, Brazil), Clerton Barboza (UERN-UFC, Brazil) & Katiene Nascimento (UECE, Brazil)

This paper intends to provide evidence for a Network Model of sound change (Bybee, 1995, 2001, 2010). According to this model the categorized units of usage form a network where recurrent patterns emerge (Bybee & Hopper, 2001: 8). Linguistic patterns, which may consist of syllables, words or constructions, are thus involved in a complex web-like series of connections with each other. Abstractions emerge at various levels of the network connections. The network is dynamic, since language use adjusts the web connections to new forms that are experienced. In this paper we will be explore the notion of productivity, which consists of the likelihood of a new pattern to apply to novel items. This is primarily of concern to sound change since productivity should indicate the major routes a sound change would take. Two factors are central in determining productivity: type frequency and schema strength. Type frequency refers to the number of different lexical items to which a particular pattern or construction is applicable. A pattern with a large number of types will more readily apply to novel items than a less frequent pattern. Schema strength is also related to type frequency and refers to generalizations of similar patterns. In order to explore the role of productivity in sound changes we will examine the emergence of affricates in Brazilian Portuguese (BP). Affricates were formerly introduced in some varieties of BP when followed by a high front vowel: tia [tia] > [tʃia] 'aunt' and dia [dia] > [dʒia] 'day' (Câmara Jr., 1970). Varieties which present affricates are said to be palatalizing ones and they present affricates followed by a high front vowel: tia [tʃia] 'aunt' and dia [dʒia] 'day'. On the other hand, non-palatalizing varieties are said to present alveolar stops followed by a high front vowel: tia [tia] 'aunt' and dia [dia] 'day'. Palatalizing varieties are expanding throughout Brazil (Abaurre & Pagotto, 2002). Thus, non-palatalizing varieties face pressure from palatalizing ones which are seen more prestigious and are predominant in Brazil (Carvalho, 2004). We claim that non- palatalizing varieties are moving towards palatalizing ones by presenting affricates which emerge through productive patterns. We will show that in non-palatalizing varieties an affricate may occur in postonic position where a former alveolar stop followed a glide: pátio [patju] > [pat^{h}] > [patʃu] 'patio'. We suggest that affricates occur in postonic position as a consequence of retiming of articulatory routines where a stop followed by a glide leads to the emergence of an affricate. The (stop+glide) sequence consists of a type which strongly favors an affricate to occur. Frequency type involving this segmental sequence plays an important role in the expansion of affricates in the lexicon. There is also another instance where affricates emerge in non-palatalizing varieties of BP: when the suffix –ik occurs preceded by a sibilant. For example, in a word such as plástico [plaʃtiku] > [plaʃtʃiku] 'plastic'. In this case there is also retiming of articulatory routines involving [ʃtʃ], but this only applies to cases involving the –ik suffix, indicating the relevance of a morphological schemas. Although affricates are said not to occur in non-palatalizing varieties of BP we observe that they do occur in specific environments. We argue that affricates occur in non-palatalizing dialects as retiming of articulatory routines which are related to productive phonological and morphological

patterns. These patterns operate in a network fashion where morphological and phonological generalizations operate under frequency effects at various levels of organization. This paper provides evidence that linguistic knowledge operates in a network fashion and it also provides us with evidence for the interaction between morphology and phonology through connections that are somewhat mapped probabilistically (Pierrehumbert (2001, 2003)).

Consonant coordination and perception in Portuguese stop clusters and CVC-sequences

Conceição Cunha (IPS Munich, Germany)

The focus of this research is on consonant clusters coordination and perception in two varieties of Portuguese, Brazilian (BP) and European (EP) and more specifically on whether there are timing and overlap differences in the production of CVC-sequences and consonant clusters and how they are perceived by native speakers.

Preliminary auditory studies have suggested that there is a greater tendency in Brazilian (BP) than in European Portuguese (EP) for a vowel to intervene between two consonants of a stop cluster (Bisol, 1999; Mateus & d'Andrade 2000). Thus BP and EP differ in the production of *captar* ('to catch'), which is sometimes transcribed as /kapɪtar/ in BP but /kaptar/ in EP. EP unstressed high vowels [ɨ,u] are mostly deleted in connected speech. Consequently there are post-lexically many clusters that are similar to L clusters resulting in near homophones (e.g. PL /(t)ɐptar/, *tapetar* "to wallpaper" and L /(k)ɐptar/, *captar* "to catch"). In a nutshell, previous studies showed that BP tends to realize stop clusters and CVC- sequences with an intermediate vowel, while EP tends to realize both as a consonant cluster.

This intervening vowel in the lexical representation of the cluster (Mateus & d'Andrade 2000) is a popular explanation, but another equally plausible way of representing such differences may be in terms of timing differences in a model of articulatory phonology (Browman & Goldstein, 2002), that could be expressed by phase differences between the consonants. Thus, in BP, C_2 is timed to occur later than C_1 in a /C_1C_2/ cluster and this gives rise to the perception of an intervening short vowel without one actually being included in the word's lexical representation. If consonants of a cluster are timed to occur closer together in EP than in BP, then listeners should also be more inclined to (mis)perceive a cluster as a singleton consonant in EP. For other languages previous studies have shown that the contrast between pairs differing in the presence or absence of a pretonic unstressed vowel were not completely neutralized (e.g., beret/bray; police/please) and that the difference between the words was maintained phonetically because of the longer distance between the two consonants in the words with lexically unstressed vowels (Browman & Goldstein, 1990; 1992; Geng et al., 2010). Consequently, the aims of this study were to test, if consonants overlap more in EP than in BP, more in CVC-sequences than in cluster and whether these different lexical stimuli can be discriminated in perception.

In order to test these hypotheses, movement data were recorded using a 5D electromagnetic articulograph (Carstens AG500) from five EP first language speakers and two BP L1-speakers. The stimuli consisted of lexical words containing /pt/, /pɨt/, /put/, /kt/, /kɨt/, /kut/ in medial position. For the intergestural timing we measured a) the time interval between the end of the constriction plateau of C_1 and the beginning of the constriction plateau of C2 (Chitoran et al 2002; Kühnert et al 2006), b) the distance between both constriction plateaus, and the duration of both consonants. For the intragestural timing of tongue tip (/t/) we compute the magnitude, the time to peak velocity and the swiftness of the raising gesture (Harrington 2010:155). The results showed

more overlap in the EP than in the BP data, however, in both data sets clusters showed more overlap than the corresponding CVC- sequences. These differences were quite small but consistent over the data for the EP stimuli. The distance between plateaus and the consonant duration were also smaller for clusters than CVC-sequences. In the perception experiment twenty-one L1 EP and 19 L1 BP speakers participated with a forced choice task in which they judged whether medial /Ct/ or /CVt/ stimuli (C_1 = /p, t/) excised from real words had been produced as a CVC, a cluster or reduced to a singleton /t/. In the BP stimuli EP listeners performed the task less well but both groups were able to distinguish between CC and CVC. In the European stimuli both groups of listeners perceived clusters, independently of the word intended in the production. Overall, this study showed that consistent differences still present in the production but not in the perception of European clusters and CVC-sequences.

Implications of interarticulatory coordination for patterns of sound change

Phil Hoole & Lasse Bombien (IPS Munich, Germany)

In our previous work, data on patterns of articulatory overlap led to a plausible account of the greater susceptibility of clusters such as /kn/ to sound-change (e.g. compared to /kl/). We consistently found less overlap between the consonantal gestures in /kn/ for German, a language that unlike English has retained both clusters. This was interpreted as a strategy to avoid destroying salient properties of the plosive burst through premature lowering of the velum. Thus we assumed that the low-overlap cluster /kn/ is dispreferred because it is less suitable for fulfilling the competing constraints of parallel transmission (efficient for speaker) and good recoverability (efficient for hearer). An interesting challenge to the generality of this account has emerged from more recent analysis of plosive+r clusters. Such clusters appear to be much more common than plosive+nasal clusters. Nevertheless EMA data for German and French (all 9 speakers studied having a dorsal /r/) showed clearly less overlap for onsets with plosive+r than plosive+l.

Our first reaction to this finding was that it could provide a neat explanation for the fact that while plosive+r clusters are very common it is nonetheless the case that /r/ is frequently involved in metathesis (e.g. Germ. "Ross" vs. English rhotic dialects "horse"), thus in a sense involving instability in the position relative to the vowel. Moreover, as recently pointed out by Webb & Bradley (2009), it is possible to identify cases of metathesis involving dorsal /r/ that may not be amenable to an account based on the effect of long-range lowering of F3 put forward by Blevins & Garrett (2004). The low-overlap pattern for plosive+r clusters would lead to straightforward scenario if , in turn, this resulted in the rhotic C2 showing a particularly large degree of overlap with the following vowel (which would actually be a prediction of the c-center pattern of organization of onset clusters proposed by Browman & Goldstein). This would result then in a situation in which listeners might very easily misinterpret the position of the rhotic in the syllable given some variability in gestural timing by the speaker. Unfortunately, the articulatory data gave little evidence for such a pattern: Rather than the right- edge of the cluster-onset moving to the right over the vowel compared to a control singleton onset, there was a strong shift of the left edge of the cluster away from the vowel. To resolve this puzzle, stimuli are now being prepared using articulatory synthesis to investigate the perceptual implications of systematically varying the amount of overlap, both of the onset consonants with each other as well as the onset as a whole with the vowel. This would aim to pinpoint what aspects of plosive+/r/ clusters make them successful as onsets (i.e. presumably easily recoverable by the listener), even if this comes at the price of low overlap (inefficient for the speaker) and occasional misperceptions of temporal location by the listener.

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I'm quite (h)appy (h)ere: The curious case of /h/ in Carlisle English

Sandra Jansen (University of Duisburg-Essen, Germany)

H dropping is one of the most stigmatized and socially marked features in the dialects of English in England. Geographically speaking there are only a few pockets left in England where /h/ is retained in word initial position, e.g. in Northumberland and its urban area Tyneside (Beal 2008). However, for Carlisle English and Cumberland English, varieties which are spoken in close proximity to the north-east of England, historical sources such as Sullivan (1857), Ellis (1869) and Wright (1977) described the loss of /h/ in word-initial position and a recent BA thesis has shown that h-dropping is quite common in Workington in Westcumbria (Tall 2009).

In the case of Carlisle English, we have the interesting situation that the use of [h] in word initial position is increasing again after a period of considerable H dropping. This kind of change is quite unique in England but has been attested in New Zealand (Gordon 2010). This sound change could be an indication of /h/ diffusing to Cumbria from Northumberland/Newcastle where the use of velar fricatives is retained. Another possible but less likely explanation would be the reintroduction of this feature resulting from dialect contact with the two /h/ retaining varieties Scottish English and Irish English.

The aim of this talk is to have a look at real time changes of /h/ in this variety and give reasons why the use of [h] had again increased after a period of loss. The analysis is based on sociolinguistic interviews conducted between 2007 and 2010. To add the real time view on this data, oral history recordings conducted in the 1980s by the local museum have also been included in the analysis. The speakers in these recordings were born around the turn of the 20th century and were mainly factory workers, i.e. speakers who probably represent the Carlisle dialect in its most vernacular form.

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Variation and change in Scottish English: rhotics and rhoticity in Ayrshire

Thomas Jauriberry (University Of Strasbourg, France)

Scottish English (SE) is typically described as a rhotic variety of English, with taps [ɾ] and approximants [ɹ] as typical rhotic variants [1]. Prevocalically, phonological environment and gender have been invoked to account for the variation of /r/ [1; 2]. Non-prevocalically, recent findings, especially in the last decade, indicate not only that /r/ is extremely variable, but also that a process of derhoticisation might be ongoing in this accent leading to coda /r/ being vocalized and eventually absent [2; 3; 4; 5; 6]. This study investigates the variation and possible change of both prevocalic and non-prevocalic /r/ in SE in relation to internal and external factors in a corpus of eight Scottish speakers from Ayrshire, Scotland. The hypothesis is that apparent-time sociophonetic investigation and analyses may confirm change in general and derhoticisation more particularly for our Ayrshire speakers' /r/.

The speakers were selected from the PAC-PFC project [7] according to their age and gender: four men and four women, and within each group two young speakers (18 – 28 y.o.) and two older speakers (64 – 82 y.o.). All speakers come from a working- to lower-middle- class background. Results presented here are those for an informal style, consisting in spontaneous speech from casual conversations between native Scots. An acoustic analysis was performed to determine the type of rhotic used. The realisations of the /r/ phoneme were analysed for all possible phonological environments (both pre- and postvocalic) in connected speech, and were separated into six different categories: 'trill [r]', 'tap [ɾ]', 'approximant [ɹ]', 'fricative [h]', 'altered vowel [ɚ]'; 'zero realisation [Ø]'. The factor of syllable stress was taken into account in non-prevocalic environments, in addition to the factors of age, gender, and phonological environment analysed in both pre- and postvocalic contexts.

The acoustic analysis of eight Ayrshire speakers has revealed a great amount of variability in the realisation of /r/, in both prevocalic and non-prevocalic positions, dependent upon internal and external factors. Prevocalically, /r/ realisations are determined by the phonological environment, but also by the social factors of age and gender, young (female) speakers favouring approximant realizations.

In non-prevocalic position, the realisation of /r/ depends on the linguistic factors of syllable stress and phonological environment, as well as on the social factors of age and gender. Derhoticisation is the most frequent for young women, and the least so for old men, age being the primary significant factor, though rhoticity is significantly higher in a linking environment. This could be a change in progress which seems to be led by young women, who also change their favoured type of consonantal rhotic, from taps to approximants.

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On-going mixing of vowel categories in verbal morphology in Brazilian Portuguese: The importance of fine phonetic detail

Rafael Laboissière (CNRS, France), Leonardo S. de Almeida (Universidade Federal de Minas Gerais, Brazil), Hani C. Yehia (Universidade Federal de Minas Gerais, Brazil) & Thaïs Cristófaro-Silva (Universidade Federal de Minas Gerais, Brazil)

Introduction

Recent studies have shown the role of fine pho- netic detail in shaping representations (Johnson 1997, Pierrehumbert 2001, Foulkes & Docherty 2006), most of them involving production (Bybee, 2001, 2010; Munson et al 2010). In this paper, we examine the role of fine phonetic detail in sound change with focus on perception, in particular a case which involves the merging of vowels in verbal morphology in Brazilian Portuguese (BP). Nouns are not affected, indicating that fine phonetic detail is particular to specifc morphological categories (Losiewicz, 1992). We also examine different age groups in order to understand the behavior of the innovative merging in verbal morphology. This result indicates that fine phonetic detail in perception is relevant in ongoing sound changes.

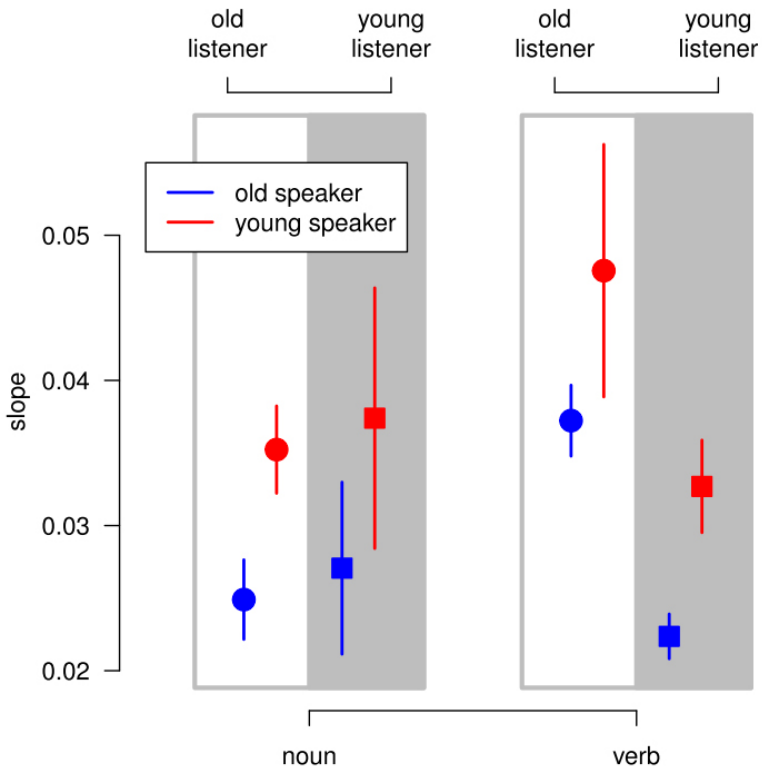
Methods & Materials

Cohort. A total of 29 subjects took part in the experiment, who were separated into two age classes: young subjects (19 to 25 years old) and old subjects (45 to 59 years old). **Stimuli**. A young (28 year old) and an older (53 years old) speaker recorded the stimuli to be tested in four sentences containing the words /ˈlavə/ vs. /ˈlɛvə/ (verbs) and /ˈsalə/ vs. /ˈsɛlə/ (nouns). In each pair of sentences the stimuli differ only by the vowels /a/ and /ɛ/. The sentences were then interpolated using an acoustic morphing algorithm (developed by the authors) that preserves the naturalness of the sentence and produces a continuum between the two vowels. **Procedure**. Identification tasks were done by the subjects. For each pair of sentences, the subjects heard 80 interpolated stimuli, covering the continuum /a/–/ɛ/, and made a forced choice between the two possible words. Psychometric curves were fitted to the responses and the slopes of the curves were taken as the independent variable of the analysis. The slope of the psychometric fitting curve can be considered as an indication of the amount of confusion between the two vowels. Small slopes would indicate a stronger vowel mixing.

Results & Discussion

A mixed-effects linear model was fitted to the data. The fixed factors were the *age group* of the subjects (young vs. old), the *identity of the speaker* (young vs. old), and the *grammatical class* (verb vs. noun). Subjects were considered as a random factor. The results are shown in the figure below. The dots denote the means and the vertical bars represent the standard errors for each case. The identity of the speaker has a significant effect on the slope, the old speaker inducing lower values ($p < 0.01$). However, there is no significant effect in the interaction between the speaker identity and the other factors. There is no global effect for the individual factors age group and grammatical class. On the other hand, we found a significant effect for the interaction factor age group vs. grammatical class ($p < 0.05$). For the noun pair there is almost no difference in slope between the two age groups. However, for the verb pair, old subjects had a higher slope

compared to those of the young subjects. This can be interpreted as a mixing of vowels that is occurring for younger speakers of BP, which is restricted to the case of verbal morphology. Our result support the importance of fine phonetic detail in perception of on-going sound change.



Stability of phonetic features in reduction processes in spontaneous Czech

Pavel Machač & Magdalena Zikova
(Institute of Phonetics, Faculty of Arts, Charles University, Czech Republic)

Spontaneous Czech—like German, English, Dutch or French—is rich in reduced word forms. However, viewing reduced forms as a mere consequence of segment elision or as a result of weakened articulation in a linear ordering of segments seems not to be satisfactory. An appropriate identification of speech units usually depends on the presence of articulatory prosodies, parallel articulation (phonetic features of two distinct sounds realized simultaneously through the whole segment) and deviations from the principles of Czech phonotactics (e.g. neighborhood of obstruents differing in voicing etc.).

Intelligibility of a particular stretch of the speech signal seems to be guaranteed as long as *a minimal phonetic information* (*phonetic essence*) is preserved (e.g. *Já nevím, jestli jsem to už nepsala* [jaːˈneviːmˈjestlɪsemtouʃˈnepsala] > [aˈə̃ɪˈes͡sə̃təuʃˈə̃psaa]). The structure of the phonetic minimum is, however, far from clear: what features are just sufficient to ensure proper understanding of a particular speech unit? Do they vary for different segments and words in a systematic manner? To what degree are they context-dependent?

In our experiment, we concentrate on pairs of highly similar reduced speech units (words or sequences of words, e.g. [ə̃ʃ] X [əʃ] = [nɛʃ] *než* 'sooner than' X [aʃ] *až* 'as soon as') which differ only in a single phonetic feature, and examine the participants' perceptual response. The participants' task is to assign an appropriate meaning to the perceived speech form. Where possible, we manipulate a resynthesized speech signal, in other cases we rely on controlled recordings of reduced speech unit pairs.

As regards reduced speech forms, it appears that a model of speech consisting of dynamic phonetic features varying in time should be preferred to a model in which speech consists of single segment sequences. As our experiment shows, in reduced word forms it is often the case that even though a segment as a whole seemingly disappears it leaves a "trait" in the neighboring segments in the form of their non-inherent phonetic features (e.g. [ə̃sʃəa] X [ə̃s̻ʃəa] = [nɛslɪəɛla] *neslyšela* 'she did not hear' X [nɛsluʃɛla] *neslušela* 'it did not suit [you]'). Through this process, interestingly, some phonetic features which are not considered phonological in standard accounts of Czech actually turn out to be distinctive in reduced variants. Indeed, the results of our experiment suggest that while processing spontaneous speech Czech listeners may rely on the distinctiveness of features such as nasality of vowels or labialization, palatalization and quantity of consonants. Thus, feature distinctiveness in reduced speech forms proves to be a marker of phonetic feature stability.

Social determinants of individual sound change in a laboratory setting

Holger Mitterer (Max Planck Institute for Psycholinguistics, Netherlands)

Sound change on an individual level has been observed on very short time frames in laboratory tasks (Babel, 2010) as well as in interactive tasks (Pardo, 2006). Together with observations of phonetic drift over long periods of time (Harrington, Palethorpe, & Watson, 2000), this seems to reflect a causal chain from individual behavior to sound change. An open question, however, remains what can influence the direction of this change. The current experiment takes as a starting point an anecdotal observation. Speakers tend to change their phonetic targets if they move to a different dialect area within their native language. In that situation, they are "surrounde" by a consistent majority of speakers using other phonetic targets. This resonates with an observation in social psychology that one tends to agree overtly with a consistent majority in a paradigm now named the Asch conformity paradigm (Bond & Smith, 1996).

To test the possibility that listeners are more likely to align with a consistent majority, participants were engaged in a "cloze task" (i.e., Stimulus: "In fantasy movies, silver bullets are used to kill ..." Response: "werewolves") with either one or four interlocutors. To control the speech style of the interlocutors, their questions and answers were pre-recorded in either a formal or a casual speech style. The stimuli's speech style was then manipulated between participants and was consistent throughout the experiment for a given participant. Surprisingly, participants aligned less with the speech style if there were multiple interlocutors. This may reflect a "diffusion of responsibility": Speakers may find it more important to align when they interact with only one person than when they interact with a larger group, because they feel more accountable when conversing with only one speaker.

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Reexamining the Less Sonorous /w/ in Early West Germanic and Positing the Language-internal Difference of the Ordering

Toshihiro Oda (Fukuoka University, Japan)

Whereas classical phonology established the universal ranking of sonority, Hankamer and Aissen (1974) posited sonority conversion according to which the ordering of the loudness differs in individual language. Suzuki (1989, 1996) argues that in Early West Germanic (EWG) /w/ is less sonorous than the rhotic and the lateral (/w/ > Rhotic > Lateral in the general ranking). The present paper posits the internal difference between English and German: in Early English (EE), Rhotic > Lateral > /w/ > Nasal and in Early German (EG), Rhotic > Lateral > Nasal > /w/.

Relevantly, the argument has been recursively made that the apparently consistent sound changes among EWG languages have the different phonological processes. Murray (1991) argues that syllable structures differ in each of them. Open Syllable Lengthening, as Dresher and Lahiri (1995) claim, take an internal process in the phonologies of EE, EG, Early Dutch. By making use of Ohala's notion on speaker and listener, EE and Early Dutch are shown to have a different process on Open Syllable Lengthening (Page 2006).

Earlier works (Hankamer and Aissen, Steriade 1982, as well as Suzuki) confined sonority conversion within /w/ and liquids. Recent works, however, show the ones between a rhotic and the lateral, nasals in American English, and between TURNED V (mid central) and high peripheral vowels in standards/variaties of English. Sonority conversion is therefore implied to have more possibility than the earlier expectation, although it occurs within the range of specific conditionings.

Looking back on the history on each language, the labio-velar semivowel underwent a different fortition process; in EG, the phoneme itself was replaced by /v/; in EE, it shifted to /b/ or /v/ in the onset of stressed syllables and, on the whole, continues to have a phonemic status. Historically, the smaller sonority scale in EG than in EE, but not vice versa, assumably occurs.

Phonetically, the articulation of /w/ is typically the closest to that of fricatives due to the double articulation. It readily gives rise to turbulent air flow, on account of which the voiceless counterpart [ʍ] is classified as a fricative (Ball and Rahilly 1999). The strong feature of the semivowel is attributed not to articulatory energy, but to the postures of the back of tongue and the lips. In relation with the assumably correct ranking on EG, the less sonorous /w/ than nasals is expected to be ordered.

The following adduce the three sorts of evidence in favor of the internal difference. The gemination (from VC.RV to VC.CRV) where C is /w/ occurs in EG, but not in EE. The Syllable Contact Law gives the general assumption in EWG that the less sonorous the candidate C, the more affective the gemination. The blocking in EE and the affection in EG regarding the geminated /w/ lead to the smaller sonority in the latter.

The case in which R is /w/ gives the same outcome. Given the Syllable Contact Law, more sonorous sonorant consonants render the germination affective. In OE, R is /j/ or /r/ for the majority of the cases. In EG, nasals more commonly induce the gemination than /w/ following /j/ and liquids. The fact in EG may give the ranking I suggest.

Among the shared onset clusters /hw-, hn-, hl-, hr-/, EG affected the deletion of /hw-/ earliest and that of others later. By contrast, EE had the deletion of /hn-, hl-, hr-/. In the underlying /hw-/ of ME, the initial may or may not be deleted and the phoneme existed continuously (Crisma 2007). Taking the sonority-based analysis into account, the lower-valued SonC is omitted. The cases lead to the least sonority scale on EG /w/.

The Articulatory Sociophonetics of Sound Change in a Bilingual Community

Lorenzo Spreafico & Alessandro Vietti (Free University of Bozen/Bolzano, Italy)

We present a sociophonetic investigation of rhotics in bilingual speakers based on articulatory data collected through the Ultrasound Tongue Imaging technique. By means of this study we want to focus attention on recurring context-independent variations in tongue position and shape that in a language contact situation might trigger the often reported front-to-back sound change in rhotics. In particular we want to draw attention to postdorsum backing, front retraction and dorsum bunching. Thus our research focuses on patterns of realization of /r/ amongst six adult simultaneous bilinguals who have been exposed to the two languages spoken in South-Tyrol, namely Italian and the Tyrolean Dialect, since their birth; and four late sequential bilinguals in the same two languages who become the control group.

We record three repetitions for each test word -namely real disyllabic words in isolation, which contain CRV sequences- an analyze them as follows: firstly the rhotic is identified on the base of the acoustics; secondly the tongue surface at the rhotic point in each token is traced and defined in terms of x-y coordinates; thirdly tongue shapes are compared and distances between tongue curves are computed.

Preliminary data show that as for late sequential bilinguals there is no strong categorical distinction between rhotics as articulated in the two languages (be it a dorsal or a coronal rhotic): tongue position and shape almost coincide and present broadly comparable root, dorsum and tip contours. Therefore sequential bilinguals behave like second language learners and transfer the articulatory gesture of their dominant language to the other language (see Fig. 1)

On the other hand simultaneous bilinguals act in a completely different manner: the amount of variations in postdorsum backing and dorsum bunching in rhotics as articulated in the two language is significant, even when acoustic outcomes are comparable as in the case of fricatives (see Fig. 2).

Preliminary articulatory data on categorical differentiation in simultaneous bilingual like these help shed light on the initiation of sound change in bilingual communities and will be discussed on the base of Flege's Speech Learning Model (1995), who claims that age-related changes might affect the way the two languages' phonetic subsystems interact so that early bilinguals are more likely to establish new phonetic categories for each sound of the two languages than late bilinguals are -at least to the extent that the bilinguals perceive the two sounds as dissimilar.

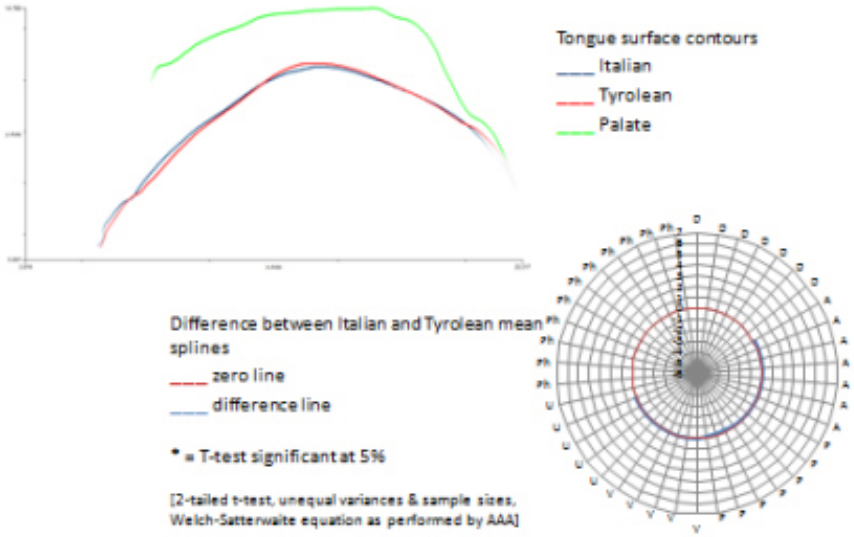

Figure 1: Sequential Italian-dominant

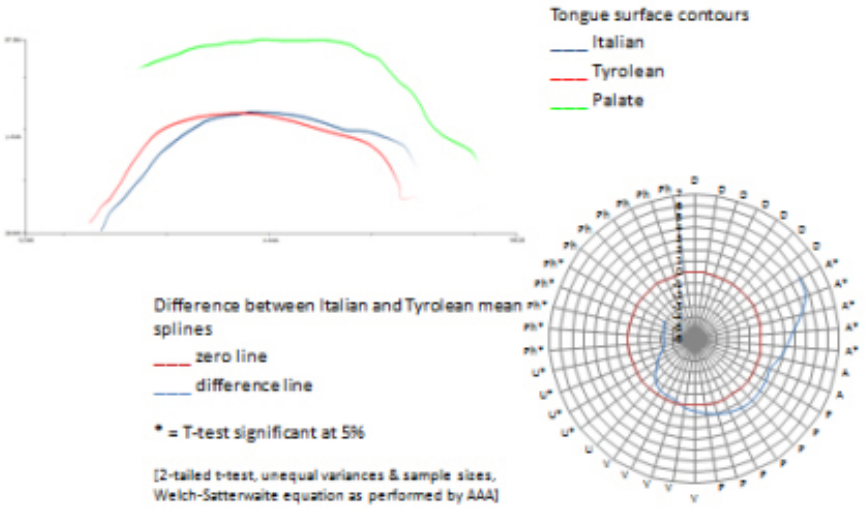

Figure 2: Simultaneous bilingual F

Best boot forward? A real-time study of Scottish English /u/ over forty years

Jane Stuart-Smith (University of Glasgow, UK), Tamara Rathcke (University of Glasgow, UK) & Claire Timmin (Queen Margaret University, UK)

Recent research has demonstrated change in progress for in the high back vowels in several varieties of English (e.g. Standard Southern British English, e.g. Harrington 2007; American English, Labov, Ash and Boberg 2006; New Zealand English, Maclagan et al 2009). The direction of the change seems to be fronting towards /i/ in the acoustic vowel space. In SSBE, the change appears to have been taking place over the last fifty years (Harrington et al 2011). The factors involved in the changes are both linguistic and extra-linguistic. Following Ohala e.g. 1981, 1993, Harrington et al 2008 provide evidence from SSBE which proposes an relationship between coarticulatory variation and perception as a mechanism for the change; there is also evidence that acoustic fronting is the result of tongue fronting (Harrington et al 2011). The situation for Scottish English seems to be different from that of other varieties of English. Particularly in the vernacular, /u/ (a single lexical set, BOOT, corresponding to English English GOOSE and FOOT), has been reported to be fronted, and/or central in the vowel space, from auditory accounts since before the Second World War (McAllister 1938, Macaulay 1977, Johnston and Speitel 1983). Contemporary acoustic and articulatory analysis of Scottish English in the Eastern Central Belt suggests that /u/ is fronted and lowered, and that the tongue position is as front as that of front vowels /i/ and /e/ (Scobbie 2011). The intriguing question is whether this may reflect a real-time process of fronting, i. e. whether there has also been any change in the acoustic realization of the Scottish English vowel over the past 40 years.

In this poster we present the first results from a new study of real-time change in Scottish English vernacular in Glasgow. The corpus for the real-time project consists of existing sociolinguistic and oral history recordings from young, middle, and old, male and female, speakers recorded over four decades, from the 1970s to the 2000s. Here we concentrate on presenting real-time data from young and middle aged speakers recorded in the 1970s and 2000s. The recordings from 2000s were made for the Glasgow Media Project (Stuart-Smith 2006), and consist of spontaneous conversations from self-selected pairs of speakers. Those from the 1970s are from sociolinguistic interviews between fieldworker and informant (Macaulay 1977). All tokens of /u/ were extracted, including both Standard Scottish English items and those belonging to the Scots variable set OUT (e.g. SSE *out*, Scots *oot*). Instances of /i/ and /a/ were counterbalanced with /u/ for phonetic context and lexical item. The acoustic analysis of the vowels was carried out in Praat and Emu, in order to allow comparison of formant measurement from different recordings.

Our results suggest that in contrast to the rather substantial changes in the quality of the high back vowels south of the Border, in Scottish vernacular only rather slight shifts in fronting and lowering have taken place over the past 40 years. The changes are discussed with respect to segmental and prosodic context and the distinctive Scots lexicon.

High vowel tensing in innovative RP: phonetics & phonology

Gabor Turcsan (Aix-Marseille Université, Laboratoire Parole et Langage (CNRS), France) & Sophie Herment (Université de Provence, France)

This paper is concerned with the ongoing change involving the neutralisation of tenseness contrasts in word-final (*happy*) and pre-vocalic (*piano*) positions in unstressed syllables in innovative RP. The process, also known as 'Happy-tensing' when it is final, was first documented by Wells (1982) and has been progressively adopted in the proposed transcriptions of pronunciation dictionaries from the 1990s on (cf. Jones, 2006 and Wells, 2008). Recent phonetic studies include Harrington (2006) and Fabricius (2002).

Emerging allophonic processes, like weak-vowel tensing in high vowels in innovative RP, are extremely helpful for our understanding of how languages work. The trigger of the process gives us evidence about the dynamics of systems while the actual phonetic changes debunk mysteries of the correct featural characterization of segments. Accordingly, this paper focusses on two aspects: i. consequences for the phonological analysis of innovative RP vowel system(s) and ii. results of acoustic measures for tenseness and length by comparing [iː] vs. [i] vs. [ɪ] in an RP-related spoken language corpus Aix-Marsec (Auran et al. 2004). This multi-layered database contains 5 hours of naturally occurring speech in various discourse situations.

As far as the trigger of the process is concerned, we have established that the modelling of prominence relations in English words is much more complicated than a simple stressed / unstressed dichotomy. Unstressed word-final (_#) and prevocalic (_V) positions seem to copy distributional properties of these same positions under stress in that they require vowels to be tense. The tendency indicates the emergence of a new semi-weak or semi-strong position in the prosodic hierarchy of words in English, a language where the licensing of segmental (featural) content depends on prosodic strength (Harris 1994) and vice versa.

By measuring length and tenseness for [iː], [ɪ] and [i] we hoped to find phonetic cues as to the correct featural characterisation of these sounds and thus contributing to the modelling of the vocalic system of RP. Our results show that length is not necessary for the characterisation of the three high front vowels and it cannot discriminate them since it is rather context than phoneme dependent. Tenseness is also context dependent but much less than length and it allows us to discriminate between high vowels. Prevocalic and final unstressed [i] are definitely more tense than [ɪ] although they are less peripheral than [iː]: our average values indicate that the allophone is situated half way between the two phonemes [ɪ] and [iː]. Thus the tense contrast is not fully neutralised.

Our results also show that the ongoing changes affecting the phonetics and the phonology of RP high vowels result in a much simpler system.

Poster Session 2

3rd of May, 17:15-18:45

Spanish fricative lenition as an example of phonemic shift

Karolina Broś (University of Warsaw, Poland)

It is a well-known fact that syllable-final *s* undergoes aspiration in several Spanish dialects. The process is typically described as positionally-conditioned segment weakening originating in southern Spanish Andalusian dialects. Typically, coda s is weakened to *h* in preconsonantal contexts and can be divided into several advancement stages, depending on the dialect, spreading from word-medial to word-final and then to phrase-final position. Thus, in the most advanced Spanish varieties, it encompasses all syllable-final environments and even extends to prevocalic contexts across a word boundary, which can be analysed as an analogical extension rather than a phonetically conditioned weakening process (e.g. Lipski 1999). This behaviour of s draws attention to the nature and limits of sound change as an ongoing process.

As argued by linguists, sound change can be analysed both in diachronic and synchronic terms and Spanish *s*-aspiration is an interesting instance of the latter approach as a clear manifestation of segment lenition conditioned by prosody. In this paper, it will be argued that the analysis of Spanish *s* lenition across word boundaries in prevocalic contexts as pure analogy or lexical diffusion (Kiparsky 1995, Bybee 2000, 2003, Hualde 2010) is flawed, which can be demonstrated with the use of Chilean Spanish data where an interaction between s debuccalisation and total segment loss refutes the paradigmatic regularity argument. Lexical frequency does not play a crucial role in this dialect, the phonological conditioning being the predominant force behind the observed lenition process. This is based on the following observations: word-final coda *s* is deleted phrase-finally in Chilean (*una vez* 'one time' and *cinco veces* 'five times' are realised as [u.na.βɛ] and [siŋ.kɔ.βɛ.sɛ], respectively). Otherwise, either deletion or debuccalisation applies, depending on what follows. *S* is lost before a consonant as in *una vez comí* 'once I ate' [u.na.βɛ.kɔ.mi], while an opacity effect may be observed before a vowel. Due to resyllabification, the coda segment of *vez* is forced into the empty onset position of the following word, but its featural specification changes. It is thus *h* that surfaces as the onset of the following word—a visible trace of *s*-aspiration with no manifest motivation on the surface (*una vez es demasiado* 'one time is too much' [u.na.βɛ.hɛ.ðɛ.ma.sja.ðɔ]).[2] In line with some of the Neogrammarian views on sound change followed by Labov (1994, 2006) and Kiparsky (1995), among others, and drawing on the precepts of Articulatory Phonology (Browmann & Goldstein 1991), it will be proposed that Spanish *s* reduction is a more in-depth and complex process of ongoing lenition spreading from the weakest to other contexts and advancing in its articulatory consequences. Weakening ceases to be solely syllable-final and Chilean *s* is slowly being pushed out of the phonological system (via deletion), which leads to a distributional shift in the Spanish phonemic inventory. Note that weakening leads to the addition of a new phoneme into the Spanish phonemic inventory (the only other non-anterior fricative prior to this change being /x/, restricted to the onset position) to occupy the coda position and then extend to the onset position (across a word boundary), the next stage, with preconsonantal *s* loss, being presumably its shift to onset position only, which complements the inventory of sounds admitted in Spanish onsets by one phoneme.

[2]The analysis of this interesting interaction with full-fledged overapplication is couched within the optimality-theoretic framework.

The effects of context and Min dialect on the realizations of /ʐ/ variants in Taiwan Mandarin

Yu-Ying Chuang (National Taiwan University, France)
& Janice Fon (National Taiwan University, Taiwan)

There are four retroflex consonants in Mandarin: three voiceless sibilants /tʂ, tʂʰ, ʂ/, and one voiced sibilant /ʐ/. In Taiwan Mandarin, however, it has been widely acknowledged that all retroflexes undergo the process of deretroflexion, in which they are replaced with non-retroflex sounds. Most researchers have attributed this process to the influence of Min (Kubler 1985), which is another language widely spoken in Taiwan. This claim, nonetheless, is constantly questioned with the abundant counter-evidence provided in later studies. For example, both Li (1995) and Chuang (2008) found the effect of speech context on the degree of deretroflexion, signifying that deretroflexion is not a completely phonologized rule in Taiwan Mandarin. Since this conclusion is derived from the examination of the three voiceless retroflex sibilants only, it remains unknown whether the voiced /ʐ/ is completely deretroflexed. In this regard, it is the goal of the present study to look into /ʐ/ dertroflexion in Taiwan Mandarin, with particular interests in investigating whether it is a fully phonologized rule, and whether variant occurrence is subject to speech context, as are the voiceless retroflex sibilants.

The other aspect of /ʐ/ deretroflexion that is worth exploration is in terms of the realization of the deretroflexed variant. Kubler (1985) proposed that /ʐ/ is replaced with /dz/, the most similar non-retroflex phoneme to /ʐ/ in Min, whereas Chan (1984) found other realizations, such as /l/. Since in some Min dialects /dz/ is replaced with /l/, it is suspected that the discrepancy between these two studies results from the fact that different Min-speaking groups had been targeted at. To verify this hypothesis, the second research goal of this study is to see whether the Min dialect that Taiwan Mandarin speakers acquire would play a role with regards to the realization of /ʐ/ variants.

A production experiment was conducted accordingly. Stimuli were five /ʐ/-initial disyllabic words. To examine the effect of speech context, two types of materials were used—a wordlist and a question-answer paradigm (QA). Subjects were eight young Mandarin-Min balanced bilinguals. They were instructed to first complete the QA session, in which they spontaneously uttered the target words with the cues that the experimenter provided. Afterwards, they went on to read the wordlist. At last, they read a Min paragraph which contained 10 Min words with the /dz/ sound. The Min production test was done to check the Min dialect of each speaker.

Results showed that /ʐ/ was variably pronounced. In addition to the /dz/ and /l/ variants that are indicated in the literature, we found that a great number of the /ʐ/ tokens were actually realized as the retroflex approximant /ɻ/ and the retroflex tap /ɽ/. The preservation of retroflexion suggested that /ʐ/ deretroflexion is not yet completely phonologized in Taiwan Mandarin. Such incompleteness possibly resulted from the fact that deretroflexion is stigmatized in Taiwan Mandarin, and young speakers try to avoid it especially in careful speech. Parallel with the voiceless retroflexes, the speech context effect was likewise observed. More retroflex realizations were found in the wordlist condition than in the QA condition.

To examine the effect of Min dialect, subjects were divided into the /dz/-group and the /l/-group, based on the result of the Min production test. It was found that the lateral deretroflexed variant /l/ only occurred in the /l/-group, but never the /dz/-group. Notably, for the /l/-group, the /l/ variant also occurred less frequently in the QA session than in the wordlist condition. Taken together, the current study uncovered that there is indeed deretroflexion of /z/ undergoing in Taiwan Mandarin, but this process has not attained completeness, possibly due to its negative sociolinguistic connotation, and it is sensitive to the formality of the speech context. Furthermore, for the occurrence of its deretroflexed variants, the Min dialect that individual speakers acquire is largely a determining factor.

An evolutionary model of phonological inventories based on synchronic data

Christophe Coupé, Egidio Marsico & François Pellegrino (Dynamique Du Langage, France)

The sound systems of the world's languages exhibit properties that fit the framework of complex adaptive systems well. Indeed, the structure of inventories is often explained in terms of constraints weighting on phonological units and on their interactions (Liljencrants & Lindblom, 1972 ; Lindblom et al., 1983 ; Lindblom & Maddieson, 1988). In this paper, we present an evolutionary model of phonological inventories based on the synchronic distribution of sounds in actual systems. More precisely, this model encapsulates phonetic and phonological constraints by considering the frequencies of occurrences of phonemes and of pairs of phonemes. We assume that these occurrences summarize, in an implicit form, a significant amount of the physical an cognitive factors bearing on real systems.

Our model relies on the UPSID database, a genetically and geographically balanced sample of 451 languages (Maddieson, 1984; Maddieson & Precoda, 1990). For each segment and each pair of segments, we count how many times it appears in the 451 languages and calculate the difference between this number and what could be expected by chance alone. For individual segment, the sign of the difference tells whether his segment is favored or disfavored in systems. For pairs of segments, it indicates whether these two elements attract or repulse each other. For both segments and pairs of segments, we assess the significance of the difference by a statistical test, which result is equated to the strength of these elements. It is hence possible for any given system to compute its "coherence" by combining the strength of the segments and pairs of segments it contains. The higher this coherence, the more responsive the system (we assume) is to general phonetic-phonological constraints.

The previous synchronic measures can be turned into an evolutionary model which primary dynamics lies in the maximization of the coherence. To this end, we compute the range of possible evolutions from a given system--differing by a few units--and evaluate their coherence. These possible evolutions are ranked according to the gain in coherence they offer. A strict maximization--i.e. following only pure phonetic-phonological constraint--would entail choosing the highest ranked output as the next step. However, in order to incorporate external evolutionary factors such as sociolinguistic constraints, we add stochasticity to the model by assigning to each potential new system a probability of being chosen positively related to its coherence.

In our presentation, we will discuss:

1. the outcomes of the model on specific vocalic and consonantal systems
2. general trends in terms of coherence and stability in the UPSID database in link with phonetic-phonological constraints
3. the differences between deterministic and stochastic dynamics
4. evolutionary paths in Bantu languages.

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Camuno Final Obstruent Devoicing

Michela Cresci (Dep. of Linguistics, CUNY)

This paper documents and analyses final obstruent devoicing in Camuno paying specific attention to factors contributing to the evolution of this sound pattern. Camuno is a language of Italy spoken in Valcamonica, in the north-east of Lombardy (Cresci 2010). The language lacks a systematic writing system and is severely endangered. It is spoken in an area of historical contact between Romance and Germanic languages, which use different acoustic correlates to cue voicing contrasts for obstruents. Camuno exhibits final obstruent devoicing in a number of morphological alternations, including: verb paradigms (e. g. [kriˈdi] 'to believe' [me ˈkrɛde] 'I believe' vs. [ly l ˈkrɛ] 'he believes'); masculine/feminine paradigms (e.g. [ˈhorga] 'mouse, f.' vs. [hoˈrɛk] 'mouse, m.'; [ˈgɛrba] 'unripe, f.' vs. [ˈgɛrp] 'unripe, m.'; [heˈrada] 'closed, f.' vs. [he ˈrat] 'closed, m.'); and in augmentative/diminutive pairs (e.g. [ˈʃot] 'nail', [ʃuˈdi] 'small nail', and [ʃuˈdu] 'big nail'). The unique status of Camuno allows us to address the following research questions: (1) What acoustic correlates cue voicing in this language, and do these correlates reflect a contact zone between Romance and Germanic languages? (2) Is final obstruent devoicing a sound pattern of the language? (3) What are the phonetic correlates of final obstruent devoicing in a spoken language uninfluenced by a written system? Does Camuno show complete or partial devoicing? (4) What is the most appropriate phonological characterization of devoicing in this Italic language? (5) How did this sound pattern emerge and develop? This is the first study that investigates the phonetic of devoicing in this region of Italy, and substantiates impressionistic observations with instrumental analysis. The data that inform this study were collected with three tasks. The Repetition Task provided samples to identify the phonetic parameters that cue voicing contrasts; the Production Task samples of final obstruents to measure; the Acceptability Judgment Task complemented and reinforced the Production Task. The data were subjected to Wilcoxon Signed Ranks Test. Camuno cues voicing contrasts for obstruents by means of acoustic correlates that are in between true 'voicing' and 'aspirating' languages, thus reflecting a contact zone between Romance and Germanic languages. Camuno voiced stops may not be fully voiced throughout the closure and they have some aspiration; voiceless stops exhibit longer aspiration duration than usually attested in voicing languages. Final obstruent devoicing is a sound pattern of the language. Phonetically, underlying voiced stops in final position are different from underlying voiced stops in initial and medial positions; they have less amount of vocal fold vibration and longer aspiration duration. Underlying voiceless stops in final position are also different from underlying voiceless stops in initial and medial positions; like underlying voiced stops they have less amount of vocal fold vibration and longer aspiration duration. They are different from either voiced or voiceless series in the language. Neutralization between word-final underlying voiced and voiceless stops is almost complete. Phonologically, the contrast in the Camuno lexicon between /p, t, k/ and /b, d, g/ should be characterized in terms of the feature [±voiced]. In word-final position a [spread glottis] feature is associated with final stops and results in delinking of [+voiced] if it is present. The emergence of the sound pattern in the language is the result of word-final vowel loss (other than

/a/), a sound change that has characterized a number of Italic languages spoken in the north-west of Italy (Giannelli & Cravens 1997). Evolutionary Phonology (Blevins 2004) provides a model that explains the emergence and development of the pattern. Within this model, the recurrent pattern and high frequency of final devoicing is attributed to multiple phonetic sources. One source is a laryngeal spreading gesture in phrase-final position. The association of laryngeal spreading gesture with vowels can yield final vowel devoicing and loss (Myers 2007); association of a glottal spreading gesture with final obstruents is expected to result in complete or partial final devoicing. Final devoicing need not result in full neutralization, nor even in a category which is identical to preexisting categories. The phonetic changes are gradient, and so there is an expected trajectory that is not predicted by a purely phonological approach. Incomplete neutralization and the emergence of a third stop category word-finally could be related to the non-literary status of Camuno. Perhaps, with no forced choice determined by spelling, non-binary contrasts in voicing categories reflect a natural stage in the evolution of final devoicing.

Corpus-based analysis of change in a dead language: the case of assimilation in Latin *con-*

András Cser (Pázmány Péter Catholic University, Hungary)

The study of dead languages presents general problems even in the case of well-documented languages with large surviving written corpora (inscriptions and manuscripts). In the case of (Classical) Latin, the bulk of the remaining corpus is not contemporary but is often several times removed from the period when the language was spoken. When studying variation phenomena that point at language change, such factors are to be taken into account. For the phonologist it is a crucial question to what extent the patterns found in the corpus reflect phonological reality and thus contribute to a realistic picture of phonological change.

Consonantal assimilations at prefix–stem boundaries have been objects of detailed scrutiny in the past (Buck 1899, Prinz 1949 and 1953, García González 1996), and while the major patterns have been made clear, these studies did not involve proper quantitative analyses. The present paper attempts to take a close look at the assimilation between the nasal of *con-* and stem-initial l (e.g. *conlatus/collatus* 'carried'; for the nature of the nasal consonant cf. de Vaan *s.v.* and Cser 2011:80–81). The actual corpus we use is vol 1 of CLCLT-5 (release 2002, cca 50 million words, we do not include medieval texts in the study). Frequency of attestation and the proportion of assimilated vs. non-assimilated forms is compared and a correlation is found, although the set of relevant forms attested at least about 300 times in the corpus is small (six words altogether; the rarest word we included is *conlabi* 'collapse' with 290 occurrences).

Prefixation led in many cases to lexicalisation, which in turn resulted in drastic phonological modifications at the prefix–stem boundary as well as within the stem. The pace and the extent of lexicalisation, however, was highly variable. Furthermore, prefixation also involved recomposition in all periods of the documented history of Latin. The varying pace of lexicalisation and the varying degree of transparency coupled with the phonological processes that took place at prefix–stem boundaries resulted in a not particularly straightforward relation between written forms and probable phonological variants. It is also clear that beginning with the 1st century AD etymologically oriented habits of spelling began to gain ground, but did not affect all words of a similar composition to the same extent.

Given these difficulties it is all the more notable that if one looks at these *conl-/coll-* words that are attested in the corpus with sufficient frequency to allow for any meaningful generalisation, there seems to be a correlation within this small set between frequency of attestation and frequency of assimilation. This may possibly point to a relatively faithful representation of phonological reality in the extant manuscript corpus.

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Word-initial and intervocalic aspiration loss in Northern Basque

Irantzu Epelde (IKER (UMR-5478), Bayonne, France)
& Oroitz Jauregi (University of the Basque Country, Spain)

This poster will report work in progress which has two main aims: (1) to identify a developing contact-induced sound change in Basque—the loss of aspiration in word-initial position and intervocalic contexts in Northern varieties—age being the independent variable in oral data collected from Basque speakers, and (2) to examine alternative patterns which may be indicative of change in the future.

Language variation can mark stable class differences or stable sex differences in communities, but it can also indicate instability and change. When it marks change, the primary social correlate is age (Chambers 2002), and the change reveals itself prototypically in a pattern whereby some minor variant in the speech of the oldest generation occurs with greater frequency in the middle generation and with still greater frequency in the youngest generation. If the incoming variant truly represents a linguistic change (Labov 1994, Trudgill 1974), as opposed to an ephemeral innovation as for some slang expressions or an age-graded change, it will be marked by increasing frequency down the age scale.

We will consider the applicability of these concepts to data emerging from *Measuring the rhythm of Basque varieties* and Norantz: *contact des langues et variation linguistique. Création d'un observatoire des nouveaux parlers basques* projects*, in which we explore with the Praat speech analizing program the aspiration of the recorded speech. We will focus on three age groups: youngs (-30), middle-aged (40-60) and octogenarians (+70) from the provinces of Lapurdi, Low Navarre and Zuberoa (France). All of the informants have the Basque language as their mother tongue and home language, but the older ones received education only in French language and use French in formal (and often informal) situations, in oral and in written communication. The data come from recorded interviews——individual as well as in-group—held in Basque, and from specific questionnaires and word lists. A sample of data is analysed in detail in light of the Natural Phonology framework (Hurch 1988), in order to determine whether or not the linguistic features favouring change can be found.

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What metathesis tells us about sound systems

Raymond Hickey (University of Duisburg and Essen, Germany)

This poster will examine the phonetic phenomenon of metathesis and consider what insights its various manifestations may have for the interpretation of the phonological system of a language. The data will be taken from Irish, from the study presented in Hickey (2011) and that in Hickey (2012) with further consideration of historical data from the history of the language. A number of remarkable facts which attend metathesis will be discussed, noticeably the fact that with consonant metathesis between the onset and coda of syllables, or across syllabes, the value for [palatal] which pre-metathesis consonants may have is retained despite the operation of metathesis. What this shows is that, because the palatal and non-palatal nature of consonantal segments in Irish is central to the morphology of the language and to the lexical structure of words, the value of [palatal] remains unaltered. There are implications here for the phonological interpretation in Irish, above all that those phonetic segments which are the realisation of systemic distinctions in the language occupy a priveleged position in the language and are not affected by such non-systemic, but highly constrained processes as metathesis.

The poster will also consider the opinions contained in the literature on metathesis (see references below) and consider a number of further examples, notably from varieties of Romance languages, to stress that metathesis is a non-systemic but rule-governed phonetic process which in some languages/varieteis licenses an unordered linearity for segments in the phonetic stream.

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Shared innovation and the variability: On the development of syllable-initial voiced obstruents and its interplay with tones in north-western Gan Chinese dialects

Fang Hu (Institute of Linguistics, Chinese Academy of Social Sciences, China)

It is generally agreed that there were four tones in Middle Chinese, namely *Ping* (´level'), *Shang* (´rising'), *Qu* (´departing'), and *Ru* (´entering'), and at the same time, there was a three-way distinction of syllable-initial obstruents into voiced, voiceless unaspirated, and voiceless aspirated (Karlgren 1915-1926). The development of syllable-initial voiced obstruents and tonal split are two major sound changes from Middle Chinese to Modern Chinese and its dialects, which actually determines the profile of modern phonologies of Chinese dialects and contributed to the diversity of tones.

Ideally, tones split according to the voicing condition of initial consonants, namely high tones, in general, are associated with voiceless initials and low tones with voiced initials. Regarding the development of obstruents, only Wu dialects and the old varieties of Xiang dialects retain the three-way distinction. In the other dialects, voiced obstruents merged with voiceless ones in various ways. For instance, voiced stops and affricates became voiceless unaspirated in Min dialects, but voiceless aspirated in Hakka and Gan dialects, in general. And in Mandarin dialects, voiced stops and affricates became voiceless aspirated in level-toned syllables and voiceless unaspirated in non-level-toned syllables. The complex interplay between the development of voiced obstruents and tones thus contributed to a highly diversified phonology of consonants and tones in modern Chinese dialects.

This paper focuses on north-western Gan dialects. As in the other Gan dialects, voiced stops and affricates merged with their voiceless aspirated counterparts in north-western Gan dialects. But unlike in the other Gan dialects where voiced stops and affricates generally become voiceless aspirated, voiceless aspirated stops and affricates merged into their voiced counterparts on the contrary. This shared innovation of historical sound change made north-western Gan dialects a unique group in Chinese dialects. However, the phonetics of this shared innovation demonstrates great variability. The merged category of historical voiced and voiceless aspirated stops and affricates may realize as voiced unaspirated in Hukou, Duchang, Xingzi and Xiushui, and realize as voiced aspirated or further realize as voiceless but with voiced aspiration in Yongxiu and De'an, as reported in the literature of Chinese dialectology (e.g.: Liu ed., 1999: 268-271). Moreover, tonal split and its interplay with obstruent development added further complexity into the current phonetics and phonology of north-western Gan dialects. Something unique to this group is that the historical voiceless aspirated syllables, which are generally associated with high tones in other Chinese dialects, has become low-toned and either merged into the corresponding voiced syllables tonally or even contributed to a distinctive tonal category. In other words, not only historical voicing but also aspiration contributed to tonal split. More intriguingly, the influence of aspiration on tones is even retained on the *Ping*-tone split in Nanchang and Xinjian where the merged voiced obstruent category has further developed into voiceless aspirated. Based on the acoustic analysis of the obstruent production from 30 speakers from 10 dialects, this paper examines the phonetic variability and its interplay with tones in North-western Gan Chinese dialects. The fine-grained phonetic details clearly demonstrated that shared innovation shares great variability as well.

The listener as a gate keeper between phonetic variation and phonological innovation

Reiko Kataoka (San Jose State University, USA)

Numerous parallels between historical sound change and phonetic contextual variations in natural speech have motivated considerable research in phonetics, phonology, sociolinguistics, and historical linguistics on issues of how these phonetic variations become phonological. A particularly heated debate in the last three decades has been on whether a main cause of sound change is in the listener, as argued for by Ohala (1981, 1989, 1993) and other researchers (e.g., Beddor 2010; Blevins 1994; Harrington et al. 2008; Yu, 2011), or in the speaker, as argued for by Lindblom and his colleagues (1995) and other researchers (Boersma 1997; Hura, et al. 1992; Steriade 2001; Garrett & Johnson 2011). The purpose of the present study is to shed some light on a division of labor between speech production and speech perception for transmission of speech sounds between a speaker and a listener as well as to study the role of cognitive factors that seem to bridge production and perception.

To ascertain the relevant factors in both speech production and speech perception that might be preconditions for coarticulation-based sound changes, I investigated how speakers of American English produce, perceive, and repeat the high back vowel /u/ in fronting and non- fronting contexts. The production study examined the extent of contextual variation of /u/ in /dud/, /bud/, and /hud/ syllables uttered at various speaking rates. I found that: (1) the relative acoustic difference between the fronted /u/ and the non-fronted /u/ persisted across the elicited ranges of vowel duration; and (2) the degree of acoustic variability was less for the fronted /u/ than for the non-fronted /u/. These results indicate that speakers have a distinct and more narrowly specified articulatory target for the fronted /u/ in the alveolar context, separately from the /u/ in non-fronting contexts. A perception study examined each subject's /i/-/u/ category boundary in a /dit/-/dut/ and a /bip/-/bup/ syllable continuum separately. That study found evidence for (1) compensation for coarticulation (i.e., phonemic category boundary shift as a function of consonantal environment), (2) systematic individual variation in perceptual category judgments, and (3) similarity between the distributional properties of /u/ observed in the production experiment and the range of perceptual responses. Taken together, these results suggest that one source of systematic variation in speech perception is individual differences in listeners' phonological grammars (the perceptual category boundaries) used in speech perception, and that this grammar emerges in response to the structure of ambient language data to which the listeners have daily exposure. Finally, a vowel repetition study examined the acoustic quality of vowels that listeners repeated after hearing each of the CVC syllables used in the perception study. I found evidence that listeners' judgments about the auditory quality of heard vowel stimuli guide how they repeat the vowels, suggesting that perceptual interpretation determines mental representation of spoken inputs.

Based on these experiments, I contend that pronunciation variation emerges through a system of multiple causal loops between and among mechanisms of speech perception and speech production, speaker knowledge of the normative pronunciations in one's speech community, and the distributional structure of ambient language data. These properties of spoken language govern the output of communicative interactions among members in a speech community, and one such output is the knowledge of sub-phonemic variations as distinct pronunciation categories that speakers have for their pronunciation repertoire. Additionally, I argue that any speech community is in a constant state of readiness to adopt an innovative pronunciation as a new community norm, because members have rich pronunciation repertoire even when there is no observable community-level sound change.

Age dependent differences in the production of the phonemic vowel length contrast in two regional varieties of German

Felicitas Kleber (IPS Munich, Germany)

Many varieties of German (e.g. Standard German, Saxon, etc.) distinguish between phonemic long and short vowels (e.g. /bɪtən/, 'to request' vs. /biːtən/ 'to offer') and the acoustic cues to this contrast are vowel duration and vowel quality. Bavarian is distinct from other German varieties as that there is a correlation between vowel quantity and the underlying voicing (which is cued, among others, by the stop duration) of the subsequent stop: underlying voiced stops—which are phonetically shorter than voiceless stops—are preceded by long vowels and vowels before voiceless stops are always short.

Lameli (2004) and Wagener (2002) present some evidence that younger speakers of German dialects produce less dialect features and tend to a more standard-like pronunciation. Incomplete neutralization of a phonemic contrast (e.g. Port & O'Dell, 1985) may be an indicator of a sound change in progress if the degree of neutralization (or maintenance) of a contrast is different for two generations of one speech community. The main purpose of this study was to investigate the extent to which the vowel length contrast is neutralized or maintained in the speech of older versus younger Bavarian speakers when they produce speech of a Standard German variety. To do this, we investigated the vowel length contrast in minimal pairs such as *bitten* (/bɪtən/) vs. *bieten* (/biːtən/) and Hölle (/hœlə/, 'hell') vs. *Höhle* (/høːlə/, 'cave') taken from a corpus that contained read speech by 40 older (i.e. older than 50 years) and younger (i.e. younger than 50 years), Bavarian and Saxon speakers. We measured the vowel and stop duration in these minimal pairs and calculated the difference between the vowel to stop duration ratios (henceforth, VC ratio) of underlying long and short vowels.

The prediction was that the vowel quantity together with the type of post-vocalic stop voicing would be different in the two varieties and the two Bavarian age groups. Commensurate with the way that the vowel quantity contrast is produced in their broad dialects, we expected Saxon speakers to maintain the length contrast (but to produce a more voiced-like obstruent irrespective of the underlying vowel length of the preceding vowel). As far as the older Bavarian speakers were concerned, there were two possible outcomes. The first was that they would neutralize the quantity contrast towards a short vowel before the voiceless stop in *bitten* vs. *bieten*. The second was that they would maintain it indirectly by producing a voiced stop in the latter thereby causing a phonetic lengthening of the preceding vowel: that is under this second scenario the contrast would be [bɪtən] vs. [biːdən] in which the lengthened [iː] is a phonetic consequence of [d]. Based on the assumption that dialectal features are less pronounced in younger speakers of German dialects (Lameli, 2004; Wagener, 2002), we predicted that younger Bavarian speakers would maintain the quantity contrast without varying the underlying voicing, i.e. the length of the subsequent stop.

Our results support the second hypothesized outcome: older Bavarian speakers maintained the vowel length contrast to a greater extent than did Saxon speakers and the mean difference between the VC ratio in words with underlying long and short vowel was significantly greater for old than young Bavarian speakers. While there were no sig-

nificant differences between young and old Saxon speakers, young Bavarian and Saxon speakers showed similar VC ratio differences between long and short vowels. Furthermore, older Bavarian speakers even lengthened sonorant consonants (/l/, /n/) after underlying short vowels to a greater extent than the other speaker groups, indicating that older Bavarian speakers applied the vowel length rule to other contexts which do not differ in underlying voicing in Standard German (they are always voiced). The results suggest that there is a sound change in progress in Bavarian: a two-contrast system in which vowel quantity and stop voicing can be freely combined evolves presumably under the Standard German influence.

Convergence and stability in speech-like communication systems with a many-to-one mapping in the production process

Christian Kroos (MARCS Auditory Laboratories, University of Western Sydney, Australia)

A comprehensive investigation of sound change in spoken language requires not only to examine the characteristics and mechanisms of change but also the conditions of stability. Without understanding stability, clarifying the underpinnings of change is in danger of remaining patch work. To use a metaphor and put it simply, with sound change, there seems to be always an elephant in the room in the form of the implicit unspoken question: Why is there not constant change?

This study investigates convergence and stability in communication systems with a many-to-one mapping between different stages in the production of communicative signals: Can such a (partially) ambiguous relationship be overcome by the self-organisation of an emerging communication system? In human speech production the articulatory-to-acoustic transformation is considered to be such a many-to-one mapping: Different (static) vocal tract shapes can produce the same acoustic output (e.g., Atal et al., 1978). There is some limited evidence that the ambiguity of the underlying vocal tract shape can be resolved by context information when looking at dynamic articulatory trajectories (e.g., Hodgen, 2007). However, for this study we assume that at least some ambiguities are left and will show that—even if they are substantial—they do not lead to problems in emerging communication systems.

We employed agent-based modelling to investigate the properties of evolving simple communication systems (see Steels, 1997, 2000, for an overview) with or without a many-to- one mapping in the production process. We limited the modelling to aspects of the lexicon omitting problems of syntax and pragmatics altogether and simplifying semantics to a small set of meanings being the same for all agents. The synthetic virtual agents had the ability to move freely on a two-dimensional plane within circular boundaries. In the simulation the agents start with an empty tiered binary 'gestural score' repertoire. When an agents happens to wander within 'perceptive proximity' of another agent, the agents interact with each other ('speak'). The active agent chooses randomly a meaning from its lexicon and retrieves the associated gestural score. If the meaning has not yet a gestural score assigned, the agent generates one randomly avoiding, however, scores it already uses. It then produces an 'acoustic' signal from the gestural score, a rational number, subject to either a one-to-one mapping (OO) or a many-to-one mapping (MO). The interlocutor agent tries to recognise the signal using a one-dimensional Gaussian Mixture Model for the backward conversion to the gestural score. If the interlocutor agent retrieves the same meaning as the one intended by the producing agent, they both register the success. Agents have a limited lifetime, thus, they will disappear sooner or later. Every time an agent ceases from existence, a new agent is added with an empty gestural score repertoire.

A trial consisted of three simulations runs of 100,000 cycles with 80 agents in each of the two mapping conditions—one-to-one mapping (OO) and many-to-one mapping (MO)—using different levels of simulated Gaussian articulatory and acoustic noise (doubled each time). The lifetime of the agents was set to vary randomly between 10,000 and 100,000 cycles, thus at the end of the simulation all agents were second generation. Ten trials were conducted.

The results show that—given the simple but general model of the communicative process applied in the study—a many-to-one mapping does not prevent convergence, though the average number of converged meanings across all agents has been found to be lower in MO than OO. This difference, however, decreases significantly at the highest noise level. The emerging systems appear to approach asymptotically a stable maximally converged state which, however, consists of several 'dialects' - variations shared by a big number of agents but not across all agents.

Understanding qualitative change in prerhotic vowels through the use of Ultrasound Tongue Imaging

Eleanor Lawson (Queen Margaret University, UK), Jane Stuart-Smith (University of Glasgow, UK) & James M. Scobbie (Queen Margaret University, UK)

Postvocalic /r/ has had a significant and varied historical impact on the development of vowels in Germanic languages, causing contradictory vowel modifications such as lowering, retraction, centralization, raising, fronting and rounding of vowels, see Campbell (1959:§139), Dobson (1957:§198-218), Marshall Denton (2001), Hiller (2012). Prerhotic vowel changes are often used as the basis for reconstruction of historical forms of /r/, e.g. Lass and Anderson (1975), Lass (1983), Marshall Denton (2001); however, researchers typically do not support their assumptions about the coarticulatory influence of /r/ with empirical articulatory evidence. We will provide evidence of the very different coarticulatory effects of covert articulatory variants of postvocalic /r/ on prerhotic vowels in a rhotic variety of contemporary English (Scottish English).

Our study focusses on the prerhotic unrounded mid vowels /ɪ/, /ɛ/, /ʌ/ in Scottish English, as postvocalic /r/ has a strong effect on the quality these vowels. We carried out an acoustic and articulatory analysis of vowel tokens in word-list speech style, taken from a socially-stratified audio∼ultrasound tongue imaging corpus (15 speakers, 8 working-class speakers and 7 middle- class speakers).

In an earlier analysis of this data, middle-class speakers were found to use bunched variants (see Delattre and Freeman 1968) of postvocalic /r/ almost without exception, while working-class speakers had a preference for /r/ variants where the tongue front or tip was raised to the (post)alveolar region (Lawson, Scobbie & Stuart-Smith 2011). We will show how the presence of these different configurational /r/ variants can explain a longstanding divergence between prerhotic /ɪ/, /ɛ/, /ʌ/ vowels in working-class and middle-class Scottish speech. Our acoustic analysis of the data confirmed that middle-class speakers in the corpus centralize and neutralize /ɪ/, /ɛ/, /ʌ/ before /r/, while the working-class speakers retract /ɛ/ to [ë] and neutralise /ɪ/ and /ʌ/ to [ʌ].

In order to identify the coarticulatory effect of /r/ on /ɪ/, /ɛ/, /ʌ/, we compared the average midsagittal tongue configuration from the onset of prerhotic /ɪ/, /ɛ/, /ʌ/ with the average midsagittal tongue configuration for postvocalic /r/ at its point of maximum constriction. Our results show that for each middle-class speaker in the study, the average tongue configurations at the onset of prerhotic /ɪ/, /ɛ/, /ʌ/ closely match the location and shape of the average tongue configurations for their bunched /r/. For the working-class speakers in the study, only the location of the tongue root of /ɪ/, /ɛ/, /ʌ/ is similar to that of the speakers' /r/s; although for some speakers the tongue root is more retracted during the vowel onset than at the point of maximum constriction for /r/. Our results suggest that bunched /r/ exerts a centralizing influence over preceding /ɪ/, /ɛ/, /ʌ/, resulting in vowel merger [ə/ɚ], while the secondary root-retraction articulation of tongue-tip/front raised /r/ results in retraction and lowering of the /ɪ/, /ɛ/, /ʌ/ vowels in working-class speech. Moreover, the stronger coarticulatory influence of middle-class bunched /r/, which has a dorso-palatal constriction, compared with that of working-class tip/front-raised /r/s is supported by the *degree of articulatory con-*

straint model of coarticulation, e.g. (see Recasens et al 1997, Recasens and Espinosa 2009) where consonants produced at the alveolopalatal or palatal zone exert a stronger coarticulatory influence over adjacent vowels than alveolars do.

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Where the bloody h[ae]l are we? Mapping the acoustics of sound change(s) in South-Eastern Australia

Debbie Loakes, Josh Clothier, John Hajek
& Janet Fletcher (University of Melbourne, Australia)

Clear phonetic isoglosses have been difficult to establish in Australia, but in south-eastern Australia, a regional sound change is clearly in progress, where /el/→[æl] has been documented for some speakers/listeners (Cox & Palethorpe 2004, Loakes, Fletcher & Hajek 2011). Another, lesser-known phenomenon also occurs, where /æl/→[el] (Loakes et al. 2011). These have been called *merger* and *transposition* respectively, but these are working definitions which may not be fully appropriate.

Merger has been described as a listener-motivated sound change, where /el/→[ɬ]→/æl/ (Loakes et al. 2010, c.f. Ohala 1981). The presence of transposition is as yet unexplained, and two hypotheses have been posited (see Loakes et al. 2011). In one, transposition is a hypercorrection and part of the same sound change, while in the other it is linked to a separate sound change (where vowels raise before nasals). In the latter case, merger and transposition are distinct, having differing directionality.

At present, neither phenomenon is understood in any detail, and their exact nature, their geographical distribution, and the sociolinguistic profiles of their users are still to be determined. Until some of these questions are answered, the relationship between the sound change(s) themselves, and the lax vowel system of Australian English, remains unknown.

We report the results of an experiment designed to answer some of these questions. Speakers were recorded in four localities in Victoria, the only Australian state for which the presence of the sound changes has been confirmed. Sites include the state capital, Melbourne, as well as three smaller regional towns located on, or close to, state borders.

In this study we focus on acoustic patterns of lax vowels in pre-lateral and pre-/d/ contexts in controlled speech, for 35 female speakers. Initial acoustic findings from two of the four sites show that speakers from Melbourne (N=11) and Albury-Wodonga (N=9) (which straddles the north-east border) have no significant differences in pre-/d/ lax vowels. However, 50% of the Melbourne speakers merge /el/-/æl/, while all the Albury-Wodonga speakers keep them distinct (to varying degrees). Initial thoughts were that speakers in Melbourne merged due to pre-lateral vowel lowering coupled with lower vowels in general (e.g. Loakes et al. 2011), but this has not been borne out in these results. It may be that the lateral has a darker quality in Melbourne, but this is awaiting independent investigation.

That Albury-Wodonga speakers keep /el/-/æl/ distinct helps us determine almost the exact boundary of an isogloss, just within the Victorian side of the border. In a previous study, Cox & Palethorpe (2004) found that merger was present in Wangaratta, 69km (43 miles) to the south of Wodonga, and the nearest town connected by a major highway. Preliminary auditory results for the north-west and south-west sites suggest that change from /el/→/æl/ may be one of geographical diffusion, with the northern sites patterning together (no merger) and southern sites patterning together (merger for some).

In this study, we present acoustic-phonetic results for all locations, and include a focus

on transposition. Lexical frequency and speaker background will also be factored in, so that we may more fully describe the sound change(s) and their distribution.

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How can a conservative language user be identified? An approach via implicit and explicit language attitude

Katalin Mády (Research Institute for Linguistics, Hungarian Academy of Sciences)

Introduction. Leading groups in sound change processes can be defined based on their age, gender, or social status [1]. Additionally, language attitude is often mentioned as a potentical factor for sound change, but this aspect has been studied to a smaller extent. One possible reason is that language attitude is dificult to measure reliably. When filling in a questionnaire, participants might try to satisfy the expectations of the researcher rather than show their real attitude. Another problem is that explicit and implicit (un- conscious) attitude [3] often diverge. At the same time, in some cases it is desirable to categorise participants as conservative and liberal language users. In sound change processes that seem to have ended before their completion, investigation of the degree of conservativism can provide information about the current state of the process. It is possible that the initial and the potentially final state of the process will coexist in the language and function as a social marker.

Such an uncompleted sound change process is the neutralisation process of vowel quantity in unstressed high vowels in Hungarian. The process might have been triggered by a weakened perception for spectral differences between long and short vowels that are most obvious for low and least for high short–long vowel pairs. [2] found that old listeners relied to spectral differences for unstressed high and mid vowels to a larger extent than young participants.

Experiment. Implicit attitude was measured based on a set of concatenated 34 spontaneous utterances. The data set contained 19 utterances with substandard linguistic forms and 7 disfluencies (funcioning as distractors). Native Hungarian participants listened to the chain of the sentences and were asked to press a button if they hear something that is incorrect. The categorisation of implicit attitude was performed based on the number of spotted stigmatised forms. For explicit attitude, a questionnaire containing 6 assump- tions such as "People used to speak more correctly in former times" was used. Degree of agreement was given on a 5 point scale.

F1 and F2 of unstressed /o/ and /u/ were manipulated from the least (= long) to the most (= short) centralised vowel quality in 9 steps, while duration was constant. Target words were embedded in carrier sentences. 13 young and 12 old listeners participated in a forced choice identification experiment in which they had to decide whether they heard the sentence with the short or the corresponding long vowel. The dependent variable was the steepness of GLMM-based logistic regression curves for each subject.

Results: A repeated measures MANOVA showed a weak effect of implicit language at- titude on vowel quantity perception based on tenseness ($p = 0.055$). Age and explicit attitude had no effect. The missing impact of age suggests that the loss of perceptual dis- tinction between long and short vowels is not an ongoing sound change process at present. However, the impact of implicite attitude on perception shows that the phenomenon does play a role as a social marker.

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On phonetic factors in lambdacisation and rhoticisation. Evidence from Greek

Daniella Müller (Universitat de Tolosa 2–Lo Miralh, France)

Lambdacisation of a rhotic, i.e. development /R/ into /l/, and the more common rhoticisation of an alveolo- dental lateral, i. e. evolution of /l/ to the rhotic tap /R/, are ubiquitous sound changes in the languages around the world and through the ages. The present study is designed to take a closer look at the phonetic factors conditioning misperceptions of /l/ as /R/ and /R/ as /l/ via a perception experiment using natural stimuli and listeners from Modern Greek.

A previous study has tried to pin down the contribution of duration to the phenomena under investi- gation (Müller 2010). It found that a temporal reduction of the lateral matching that of the rhotic tap led to a certain amount of perceptual confusion of the two sounds, i.e. to the basis for /l/-rhoticisation. On the other hand, reduced instances of rhotics, whereby the rhotic seemed to be realised rather as an alveolar approximant than as a tap, had not only significant longer durations than the taps, but also gave rise to some perceptual confusion, and hence, lambdacisation, whereas the (unreduced) taps did not. – The aim of the present experiments is to address yet unanswered questions raised by Müller 2010. In order to ensure maximal comparability, the same method as in this previous study was applied.

Experiment 1: 20 native Greek listeners were presented with stimuli of the sequences /ala/ and /aRa/, which varied systematically according to stress pattern (unstressed, iamb, trochee), length of the lateral (from 20 ms to 70 ms, by 5 ms incremental steps, obtained through manipulation of the recorded stimuli), and degree of reduction in the rhotic (unreduced, slightly reduced, strongly reduced). These stimuli were extracted from recorded sentences read by a Greek speaker.

In a forced-choice test (5 repetitions of each stimulus, presentation in random order), the listeners had to decide which type of stimulus they had heard ("ara" vs. "ala") and how they judged the quality of the sound on a five-point-goodness-scale. Such a goodness rating was not elicited in Müller 2010.

Results: Analyses are currently being carried out. A first summary of the results appears in Figures 1 and 2 in boxplot form and mosaic form, respectively. In contrast to the findings by Müller 2010, only very few instances of /l/ were heard as /R/, despite the stimuli being more natural (closer to spontaneous speech) than in the previous experiment. Among the rhotic, the strongly-reduced variants led to some confusion with the lateral. Figure 1 shows that misheard rhotics were in general judged as bad instances of laterals, whereas misperceived laterals were judged no differently than the true rhotics (although the large number of outliers calls for additional testing). Moreover, correctly perceived laterals were judged better than correctly perceived rhotics (χ^2-test: $\chi^2 = 60.2461, df = 4, p = 0.0000$), perhaps due to the reduced instances of /R/ in the set of stimuli. The correctly perceived unreduced tap and longer laterals received better goodness judgments than reduced rhotics and shortened laterals, as evident from Figure 2.

Experiment 2: A second experiment with the same setting, for which the stimuli were obtained during the same recording session by the same speaker as in Experiment 1 and focusing on substantially shortened laterals and strongly-reduced rhotics vs. laterals of normal duration and non-reduced taps in both intervocalic and pre-stop positions (as opposed to only intervocalic position in Experiment 1) will be carried out and presented and thus allow to refine the results obtained in Experiment 1.

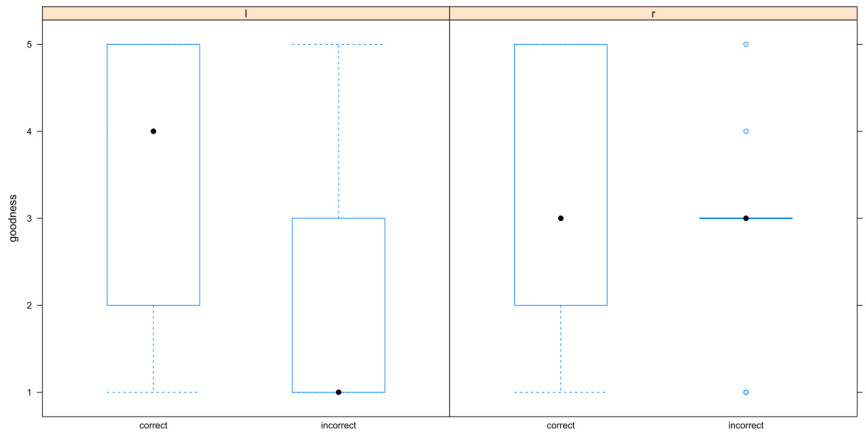

Figure 1: First results of goodness judgments according to incorrect and correct responses to the stimuli

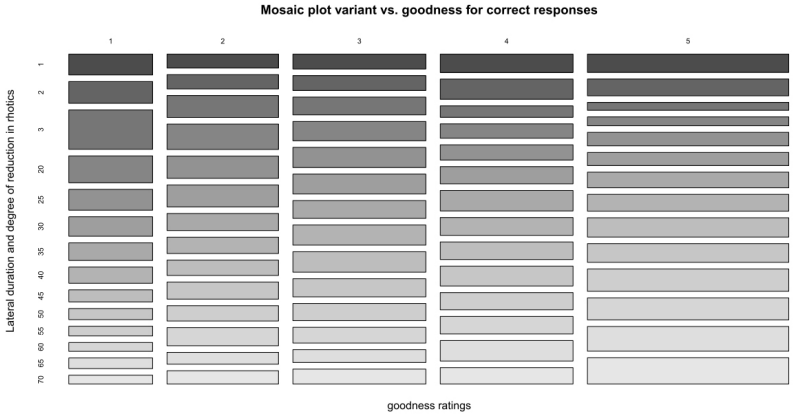

Figure 2: Mosaic plot

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/s/-aspiration and sound change in two varieties of Andalusian Spanish

Hanna Ruch & Sandra Peters (IPS Munich, Germany)

In many varieties of Spanish syllable final /s/ is usually aspirated or even deleted: e.g. *avispa* ('wasp') [aˈɛihpa]; *casas* ('houses') [ˈkasah]. /sp, st, sk/ sequences are of particular interest because of their high variability in pronunciation. Whereas traditional dialectological studies on Andalusian Spanish (e.g. Alvar, 1961-1973) used to transcribe /sp, st, sk/ as geminates or preaspirated stops, recent studies (e.g. Torreira, to appear; Parrell, 2012) have found that for Western Andalusian Spanish (WAS) postaspiration [p^h, t^h, k^h] seems to be the usual realisation of /sp, st, sk/ sequences, at least among younger speakers. For Eastern Andalusian Spanish (EAS), on the other hand, preaspirated stops (Torreira, 2007), breathy voicing (Gerfen, 2002; O'Neill, 2010) and a constrained relationship between consonant and vowel lengthening have been observed (Gerfen, 2002).

These findings raise the question of a sound change in progress from pre- to postaspiration in Andalusian Spanish. We expect this process to be in an advanced stadium in Seville (i.e. WAS) and, possibly, in an initial state in Granada (i.e. EAS), as previous informal observation suggest. Which strategies do Andalusian speakers use to distinguish between /st/ and /t/ in speech production? Applying the apparent-time method and assuming a sound change in progress [ht] → [t^h], we expect the strategies to depend on age and dialect. Our assumption is that Sevillian speakers distinguish /st/-/t/ mainly by VOT-duration, while Granadian speakers use presumably preaspiration. Furthermore, we expect differences according to age in both varieties: VOT-duration should be longer among young speakers, and preaspiration should occur more frequently among older speakers.

As a first approach to the hypothetical sound change in Andalusian Spanish we analysed four trisyllabic words with medial /st/ and two with medial /t/ (isolated and randomized; 3 repetitions) pronounced by 24 speakers from Seville and 24 speakers from Granada. Each dialect group consisted of 12 young and 12 older speakers. In all test words, /st/ or /t/ was followed by /a/, nucleus of the stressed syllable (e.g. pestaña, etapa). Breathy voicing and voiceless preaspiration were both considered as preaspiration; unaspirated tokens, which represent the Standard Spanish pronunciation (i.e. [pesˈtaɲa]), were excluded from the analysis. The analysis was done in Emu-R (Harrington, 2010), applying ANOVA on the VOT difference /st/-/t/ and general linear mixed models on the occurrence of preaspiration.

Age and dialect showed to have a highly significant effect on the VOT-difference /st/-/t/. Young Sevillians presented the highest value (mean = 38.1 ms), old Granadians the lowest (3.5 ms). The difference between old Sevillians (12.6 ms) and young Granadians (16.4 ms) was not significant. Furthermore, we found that age and dialect had a significant effect on the frequency of preaspiration; young Sevillians displayed the lowest (27%), old Granadians the highest (77%) percentage of preaspirated tokens. The difference between old and young speakers (65% of preaspirated tokens) from Granada was not significant.

Overall, our results confirmed the findings of previous studies that Eastern and Western Andalusian Spanish differ in the manner of aspiration of /sC/ sequences. VOT length was an important acoustic cue in WAS, existence of preaspiration in EAS. This difference between the two varieties, however, was much less distinctive if we took account of age as a variable. Our findings clearly suggest a sound change from pre- to postaspiration in /st/ sequences not only in Seville, but also in Granada Spanish. A perception study is currently being carried out to further analyse this phenomenon. A comparison between closely related varieties in different stadiums of a sound change in progress allows us to better understand its nature and its mechanisms.

A recipe for phonetically conditioned sound change

Bridget J. Smith (Ohio State University, USA)

Most theorists distinguish between sound changes where an association between sounds (*phonetically-conditioned sound change*) is responsible, and those arising from association between sound and another category (*analogical change*). This analysis is problematic because it treats phonetically-conditioned sound change and analogy as distinct. I argue that analogy and phonetically-conditioned sound change utilize the same mechanism: mental associations of sounds with other linguistic (e.g., sounds, words) and non-linguistic (e.g., talker characteristics) contexts. To discover the processes underlying sound change, we must first learn how associations develop between sounds in a language and other objects, both linguistic (e.g., phonetic environment, semantic relationship) and extra-linguistic (e.g., talker characteristics such as gender, dialect).

In this experiment, I use existing variation in pronunciation of the stop+approximant /tw/ cluster as a springboard to replicate sound change in the laboratory so that we may see the effect of various associations on phonetically conditioned sound change. In American English, alveolar stops may become alveo-palatal affricates before /j/. Many American English speakers also palatalize and affricate /t/ before /r/. In order to examine sound change before it is a change in progress, we should look to variation that may occur but has not yet reached a point in which the variation has been assigned to any variable. Approximants are known to increase the degree and length of aspiration in preceding stops. The lip-rounding that accompanies /w/ may spread to the preceding stop, which, by lengthening the front cavity, may create the percept of a retracted /t/. If the aspiration is strengthened, the resulting sound may be similar to an alveo-palatal affricate. However, the aspiration could be fronted, as the place of articulation transitions from the alveolar to bilabial place of articulation, developing into a more anterior frication, yielding /ts/. Both a front and a retracted variant may then arise from the coarticulation of /t+w/.

Using the perceptual learning technique as in Norris, McQueen and Cutler 2003 (i.a.), we can create a change in the perception of a phoneme under laboratory conditions. Additionally, a shadowing task, such as that employed in Goldinger 1998 (i.a.), in which participants repeat a word after they hear it, it is possible to reproduce a mini-sound change in the laboratory, in both perception and production. In this experiment, a lexical decision task reveals differences in accuracy and response times based on which variant was used in the training phase and the frequency of the word. Participants who were trained on the retracted variant show greater acceptance of and faster response times to words with the training variant, and less acceptance of and slower response times to words with the untrained variant, relative to the control group. This effect is especially robust in low-frequency words. The results of an identification task, which tests the variant /t/ pronunciation before the vowel /u/, show that the sound change can be generalized to a new phonetic environment, with the retracted variant trained group showing less acceptance of the front variant as an exemplar of /t/. One interesting aspect of these results is that the control group and front variant trained group seem to accept a greater range of variation that is centered around the traditional alveolar pronunciation, but that the retracted group shows acceptance for a narrower range of variation, with the center shifted towards a retracted pronunciation. That is, not only did the /t/ boundary move to include the retracted variant, but that it seems to have pulled the front end of the phonemic category back as well.

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The listener and preaspiration in Italian

Mary Stevens & Ulrich Reubold (IPS Munich, Germany)

Recent acoustic phonetic investigations into spoken standard Italian have shown that /pp tt kk/ are optionally produced with a portion of preaspiration e. g. *fatto* [fa^{h}tːo] 'done', post-aspiration [fatː^{h}o] or both. This conflicts with descriptive sources, which instead all agree that voiceles stops are unaspirated in Italian (e g. Bertinetto & Loporcaro 2005). Nonetheless, preaspiration of /pp tt kk/ is a shared tendency for native speakers from 15 Italian cities and occurs approximately one third of the time, depending on consonant place and other factors (e. g. Stevens 2010). In terms of the established phonetic cues to C-length in Italian (preceding V duration, overall C duration and C/V ratio, cf. especially Pickett et al. 1999), acoustic results to date suggest that /pp tt kk/ produced with preaspiration are more robust than plain [p: t: k:]— if, for these temporal measures preaspiration is included in the overall duration of the consonant. In other words preaspiration appears to be an enhancement of C-length on the part of the speaker. However, as Ohala (1981) and many others since have argued, sound change also crucially depends on the listener and there is evidence to suggest Italian listeners could perceive preaspirated stops as /VC/ rather than intended /VCː/. More specifically, preaspiration is very hard to hear (e. g. Bladon 1986) and in a desriptive typological study Silverman (2003) directly links this lack of perceptual salience to the diachronic instability of preaspiration as a contrastive feature, which tends to be replaced with cotrastive vowel length i. e /VːC/ > V^{h}C > /VːC/. This proposal is also motivated by the fact that degemination has occured almost everywhere else in Romània (although not as far as we know involving preaspiration).

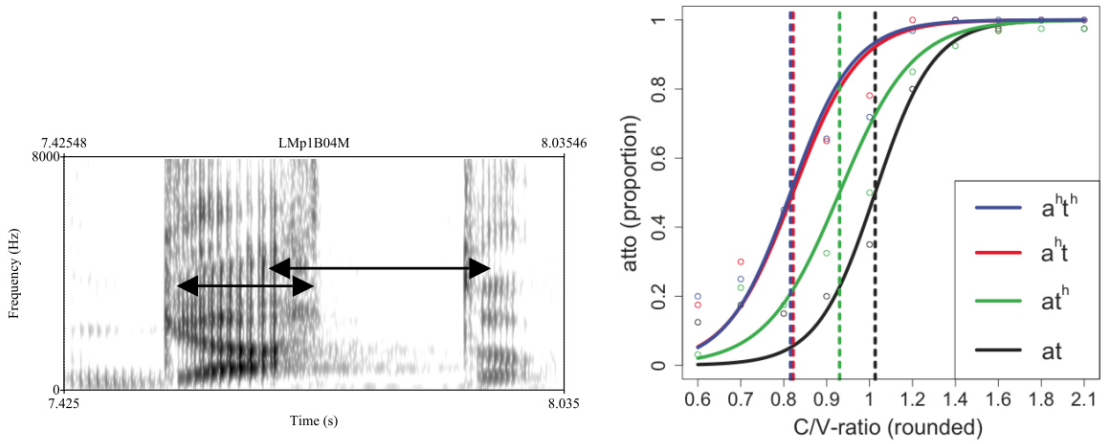

Figure 1: Left: Preaspiration in *gatto* 'cat', which could be included as part of the vowel /a/ or the consonant /tt/ as the arrows indicate. Left: Preliminary result for 5 listeners showing the proportion of "atto" responses according to C/V ratio (x-axis, cf. Pickett et al 1999) for the 4 continua

With these issues in mind this study tests the consequences of preaspiration and post-aspiration for native listeners and in particular whether they include preaspiration as part of the consonant or as part of the preceding vowel (cf. Figure 1, left) e. g. hearing *fato* rather than intended *fatto*. A forced choice preception experiment was designed involving 4 synthesized continua from [aːto] to geminate [atːo] (keeping overall duration stable) for [at], [a^{h}t], [at^{h}] and [a^{h}t^{h}]. For each stimulus listeners chose between "atto" or "ato". We predict that if listeners include

preaspiration in the consonant (i. e. maintenance) the C v. CC preceptual boundary should remain the same across the 4 continua whereas if they perceive preaspiration as part of the vowel, the boundary will shift to the right (i. e. more "ato" responses). Preliminary results (n listeners = 5) show that stops with preaspiration (cf. Figure 1, right) are perceived as "atto" earlier than thos without i. e. listeners include preaspiration as part of the C. Post-aspiration also appears to favour the perception of a geminate. These results do not support our hypothesis that a further sound change involving listener-driven degemination, via preaspiration, is likely to take place in Italian. Instead preaspiration appears to serve a a perceptual enhancement of C-length. Further work is needed to determine whether preaspiration is a phonetic cue to geminates in its own right and whether it could develop into a stable feature in standard Italian.

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Pronunciation Change of French Consonant Groups by Vietnamese Learners

Thi Thuy Hien Tran & Nathalie Vallee (GIPSA-lab, Speech & Cognition Department, France)

The pronunciation of French consonant groups by second language (L2) learners of French, especially those whose first or native languages (L1s) lack key phonetic features of French, has not received much attention in L2 research. Vietnamese, for example, an isolating CVC language, has consonant sequences only at word boundaries or syllable boundaries in compound words. This monosyllabic language thus lacks the consonant clusters allowed in French in onset and coda positions $(C_1)(C_2)(C_3)V(C_4)(C_5)(C_6)(C_7)$, studied by Rousset (2004). The L1 syllable structure must have an impact on the production of L2 complex syllable structures? In addition, the voiceless stops /p t k/, the first elements of an inter-syllable consonant sequences in Vietnamese, are generally not released in their coda position. This feature must also have consequences on realization of French clusters? The present research aims to yield more insights into the interlanguage phonology of Vietnamese learners of French in these regards.

This study provides new data regarding the production of French consonant groups in two levels of Vietnamese learners: intermediate and advanced. The participants were forty students (twenty per level), enrolled in a Hanoi university. They read a wordlist embedded in a carrier sentence which was recorded, then acoustically and statistically analyzed. The corpus contains all consonant groups present in both languages /p t k m n/ + C, included in three positions of French words #CCV, VC#CV and VCC#.

The results showed that, even after several years of practice, Vietnamese L2 learners of French have real problems pronouncing French consonant groups, even when the specific consonant combinations are found in both languages. In 2 562 observed consonant groups, 66.7% were not correctly pronounced by Vietnamese learners. Performance was worse for final consonant clusters than for those in onset or inter-syllabic positions, and stop-initial clusters were significantly worse than those beginning with a nasal. Vietnamese learners more frequently change complex codas than complex onsets. When faced with challenging consonant groups, Vietnamese learners use different strategies for simplification. Modification by non-release and deletion were found to be the most common strategies. In agreement with several previous studies, this work highlights the role of native language syllable structure in the acquisition of second language consonant clusters. Still, while Vietnamese L1 phonetic and phonological factors are involved in errors in the production of French L2 consonant clusters, we found that those factors cannot account for all the errors. Other influences, as typological universal preferences, are needed to explain the learners' difficulties which do not directly relate to the differences between L1 and L2. This work with scientific data confirms the difficulty persistence of the French consonant clusters pronunciation by Vietnamese learners, despite their level of French.

New developments in Polish sibilant system

Marzena Zygis, Czaplicki Bartek & Daniel Pape (ZAS Berlin, Germany)

Introduction

The sibilant system of Standard Polish consists of fricatives /s ɕ ʂ/ and affricates /t͡s t͡ɕ t͡ʂ / as well as their corresponding voiced counterparts. It has been claimed to be governed perceptually in terms of maintaining sufficient perceptual contrast (Padgett & Zygis 2007).

The present paper reports on a new development in sibilants observed in the pronunciation of young Polish women from central Poland who instead of an alveolo-palatal /ɕ/ produce a palatalized [sʲ].

Experimental evidence

In order to substantiate the perceptual impression we conducted an acoustic experiment in which we tested both sibilant fricatives /s ɕ ʂ/ and affricates /t͡s t͡ɕ t͡ʂ / pronounced in words embedded in (i) a carrier sentence and (ii) a coherent text. The sentences were repeated five times and the text was read twice. 6 native speakers of Standard Polish aged 20-23 took part in this experiment.

Using multitaper spectra (Thomson 2000), we investigated the following acoustic parameters: The highest peak of the complete spectrum (p_{all}), the highest spectral peak in the frequency range from 2-4kHz ($p_{2\text{-}4kHz}$), the power amplitude difference p_{all}-$p_{2\text{-}4kHz}$, the spectral moments according to both the Praat formula (v. 5.2) and Forrest et al. (1988), and the spectral slopes m1 and m2 (Jesus & Shadle 2002).

The preliminary results based on the analysis of four speakers show that the new sound [sʲ] is produced with a significantly higher peak than the alveolo-palatal sibilant [ɕ] (5125Hz vs. 4198Hz, $p<.01$). Furthermore, the highest spectral peak in the frequency range from 2-4kHz is significantly lower for [sʲ] (3288 Hz) than for [ɕ] (3733 Hz, $p<.001$) and the power amplitude difference between p_{all} and $p_{2\text{-}4kHz}$ is significantly higher for [sʲ] (8.4) than for [ɕ] (2.2, $p<.001$). The COG and SD values appear to be higher for [sʲ] (5227 Hz, 1873) than for [ɕ] (4115 Hz, 1466). Skewness and curtosis values did not show significant effects. Finally, the spectral slope m1 values are significantly higher for [sʲ] (1.9) as compared to [ɕ] (1.15, $p<.05$) and m2 values are significantly lower for [sʲ] (-4.98) than for [ɕ] (-4.22 $p<.001$).

Conclusions

In summary, the acoustic results strongly suggest the alveolo-palatal /ɕ/ is being replaced by [ʲ]. The fact that this change has been initiated by young female university students largely accord with Labov's (2001) general conclusion that women initiate language change which in turn might arise from nonconformity to the norms of society.

Following the reasoning put forward in Zygis & Padgett (2010) we hypothesize that this new development—if it proceeds and eventually leads to the restructuring of the underlying representation—will give rise to an optimization of perceptual contrast between the sibilants: /sʲ/ creates a better contrast to /ʂ/ than does /ɕ/, a point which should, however, be substantiated by perceptual evidence.

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