LabPhon 12

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Welcome to the 12th Conference on Laboratory Phonology

hosted by the University of New Mexico

Conference Dates: 8-10 July 2010 (three full days)

Wednesday evening, July 7
Registration will be available in the lobby of the Hotel Albuquerque from 7 - 9 PM (or later). Attendees are also encouraged to gather for an informal get-together in the Hotel's Q Bar.

Update 18 June: An outline timetable for the conference can be downloaded here. More information for presenters has been added on the For presenters page, and a new Local information page has been added.

Registration is still available. Go to the registration page.

Update 7 June: The Hotel Albuquerque is almost full.
We have set aside a block of rooms at the Best Western Rio Grande Inn, which is very close to the Hotel Albuquerque. See the Accommodations page for details.

Announcing the Association for Laboratory Phonology ...
LabPhon 12 will be the occasion of the launching of the Association for Laboratory Phonology, and the new journal *Laboratory Phonology*, published by Mouton de Gruyter. For more information about the Association, visit its website at labphon.org.

The theme of this conference is “Gesture as language, gesture and language.” This theme will be addressed from different perspectives by an exciting list of invited speakers, as well as by contributed oral presentations and posters. Non-thematic sessions (both oral and poster) will include contributions on other topics of interest to the LabPhon community.

Session themes and invited participants

- Speech as gesture
  Invited speaker: Marianne Pouplier, LMU München
  Discussant: Lucie Ménard, Université du Québec à Montréal

- Phonology of signed language
  Invited speaker: Onno Crasborn, Radboud University
  Discussant: Martha Tyrone, Haskins Laboratories

- Gesture with language
  Invited speaker: Dan Loehr, Georgetown University and MITRE
  Discussant: Sherman Wilcox, University of New Mexico

- Audiovisual aspects of speech
  Invited speaker: Marc Swerts, Tilburg University
  Discussant: Eric Vatikiotis-Bateson, University of British Columbia

- Diversity of speech gestures, focusing on Native American languages
  Invited speaker: Sharon Hargus, University of Washington
  Discussant: Heriberto Avelino, Max Planck Institute for Evolutionary Anthropology

- Modulation of speech gestures through prosody or sound change

Invited speaker: José Ignacio Hualde, University of Illinois, Urbana-Champaign
Discussant: Marie Huffman, SUNY Stony Brook

Schedule for the 12th Conference on Laboratory Phonology

8-10 July 2010

UNM Continuing Ed Conference Center (North Building), 1634 University Blvd. NE

Albuquerque, NM

Talks are in the Auditorium, Poster sessions, Coffee breaks and Lunch in Rooms B&C.

Thursday

7:30	8:00	Breakfast and registration	
8:00	8:30	Welcome	
8:30	9:15	Invited speaker	Pouplier
9:15	9:50	Contributed paper	Ridouane&Fougeron
9:50	11:20	Poster session and coffee break	
11:20	11:55	Contributed paper	Parrell
11:55	12:30	Invited commentator	Ménard
12:30	13:30	Lunch	
13:30	14:05	Contributed paper	Kochetov&Colantoni
14:05	14:40	Contributed paper	Proctor
14:40	15:15	Contributed paper	Bundgaard-Nielsen et al.
15:15	16:15	Poster session and coffee break	
16:15	17:00	Invited speaker	Hualde
17:00	17:35	Contributed paper	Tilsen
17:35	17:55	Coffee	
17:55	18:30	Contributed paper	Choe&Redford
18:30	19:05	Invited commentator	Huffman
19:05	20:30	Reception (in rooms B&C)	

Friday

8:00	8:30	Registration	
8:30	9:05	Contributed paper	Antoniou
9:05	9:40	Contributed paper	Paterson&Goldrick
9:40	10:15	Contributed paper	Cho
10:15	10:35	Coffee	
10:35	11:20	Invited speaker	Crasborn
11:20	11:55	Contributed paper	Russell, Wilkinson, Janzen
11:55	13:00	Lunch	
13:00	13:35	Contributed paper	Grosvald&Corina
13:35	14:10	Invited commentator	Tyrone
14:10	15:10	Poster session and coffee break	
15:10	15:55	Invited speaker	Loehr
15:55	16:30	Contributed paper	Roustan&Dohen
16:30	16:50	Coffee	
16:50	17:25	Contributed paper	Fais et al.
17:25	18:00	Invited commentator	Wilcox
19:00	22:00	Banquet at Hotel Albuquerque	

Saturday

8:00	8:30	Registration	
8:30	9:15	Invited speaker	Swerts
9:15	9:50	Contributed paper	Borràs-Comes&Prieto
9:50	10:50	Poster session and coffee break	
10:50	11:25	Contributed paper	Diepstra et al.
11:25	12:00	Invited commentator	Vatikiotis-Bateson
12:00	13:00	Lunch	
13:00	13:45	Invited speaker	Hargus
13:45	14:20	Contributed paper	Iskarous, McDonough, Whalen
14:20	14:40	Coffee	
14:40	15:15	Contributed paper	Demolin
15:15	15:50	Invited commentator	Avelino
15:50	16:50	Poster session and coffee break	
16:50	17:25	Contributed paper	Torreira&Ernestus
17:25	18:00	Contributed paper	Walker&Hay

LabPhon 12

Home

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Information for presenters

Poster presentations

The boards for poster display will be in landscape orientation, with a usable area of 68 inches (172 cm) wide by 44 inches (111 cm) high. Some push pins will be provided, but we encourage you to bring your own supply.

Presenters in morning poster sessions are encouraged to put their poster up before the morning's oral sessions begin. Please then remove your poster during the lunch break following your session. Presenters in afternoon sessions should put their poster up during the lunch break, and remove it after the day's sessions end in the evening.

Some useful suggestions for preparing conference posters can be found here and here.

You may wish to provide reduced-size copies of your poster as a handout. Please bring as many copies as you anticipate needing, as there are no copier facilities at the conference location. (We expect attendance of close to 200, but individual poster presenters do not need to bring 200 copies.)

Oral presentations

Speakers in oral sessions should bear in mind that your allotted time slot includes change-over from the previous speaker, your talk, and time for questions from the audience. Please plan your talk accordingly. Contributed presentations and discussants have 35 minutes, so we recommend that you plan to speak for 20-25 minutes. Invited speakers have 45 minutes, and can plan on speaking for approximately 30 minutes.

Please notify us by email (labfon12 ‘at’ unm ‘dot’ edu) if you wish to use a method of presentation other than a computer with projector.

Presenters are welcome to use their own laptops. When you arrive, please arrange with us to test your laptop with our projector before your session. This web page provides detailed instructions for preparing to use your laptop with a projector. Please practice ahead of time if you are not in the habit of doing this.

We will also provide a Macintosh and a PC (Windows XP) laptop for those who do not wish to bring their own computer. Both computers will have Microsoft Office software.

If your presentation contains any special fonts, please consider bringing your own computer or save your presentation as a PDF file if you wish to use one of ours.

If you wish to provide handouts, please bring 200 copies with you. There are no copying facilities at the conference location.

LabPhon 12

Home

Conference

Important dates
Program
Registration
For presenters
Committees
Sponsors and Logo
Previous LabPhons

Travel and Venue

Getting to Albuquerque
Accommodations
Conference venue
Local information
Getting around Albuquerque
Visiting Albuquerque

Email address:

labfon12 'at' unm 'dot' edu

Altitude

Albuquerque is a high-altitude city. The conference site is close to a mile high (almost 1600 m). The hotel is a little lower, about 4900 feet (approx. 1500 m). It is unlikely that you will notice any effects of altitude at this elevation, but it does mean that the sun is less filtered than at lower elevation. Protection from the sun is advisable if you plan to exercise or sightsee outside.

Weather

Most conference attendees will be coming from locations that are more humid than Albuquerque. The relative humidity is often below 10%. Average high temperature for July is 92° F (34° C), and the average low is 65° F (18° C). The relatively large daily variation means that mornings and evenings are almost always pleasant. You will be in the air-conditioned conference facility during the hot afternoon period.

Rain is unlikely, but storms may occur in the late afternoon. These often involve more wind, thunder and lightning than actual rain, and if rain does fall, it rarely lasts more than a few minutes.

Restaurant Hours

Restaurants in Albuquerque tend to open and close earlier than in other cities we are familiar with. It is not uncommon to see restaurants end their dinner service at 8:30 or 9 PM. However, the conference hotels are on the north edge of Old Town, which is the most heavily touristed area of the city, and where many of the restaurants will stay open till 10 PM in the summer, possibly even later. A restaurant list will be distributed at conference registration.

Taxes and Tipping

We remind attendees coming from other countries that in the US, the price you see does not include sales tax, which is now 7% in Albuquerque. This is added to restaurant meals and all purchases except basic food items bought in a store. An additional lodging tax is added to hotel room rates.

If someone serves you in a restaurant, they will expect you to leave a tip, normally 15-18%. Occasionally, if a large group eats together, a service charge is added to the bill automatically, in which case a tip is not expected. What this adds up to is that you will end up spending about 25% more than the quoted price of a restaurant meal.

Smoking

The Hotel Albuquerque, Best Western Rio Grande Inn and the Conference Center are all entirely non-smoking. Smoking is also not allowed in any restaurant in Albuquerque.

In addition, the University of New Mexico is a smoke-free campus, which means that smoking outdoors is only permitted in designated smoking areas. For the Conference Center, this is at the north end of the building. Smoking is not allowed in the parking lots in front of or behind the building.

Where to find breakfast and coffee

We will provide a light continental breakfast before the conference begins at 8 AM on Thursday morning.

Cafe Plazuela, the coffee shop in the Hotel Albuquerque, opens at 6 AM. There is also a Starbucks Coffee on the west side of Rio Grande Boulevard, just north of the Hotel Albuquerque and south of the Best Western Rio Grande Inn. Their hours are

5 AM – 9 PM (shorter hours on Sunday).

We particularly recommend the Flying Star Cafe and Satellite Coffee, which are local eateries (run by the same company) known for quality coffee and good food. Satellite Coffee has a location just over one-half mile (1 km) south of the conference location, at 1131 University Boulevard NE, on the west side of the street. They are open 6 AM – 8 PM during the week, 8 AM – 6 PM on weekends.

LabPhon 12

Home

Conference

Important dates
Program
Registration
For presenters
Committees
Sponsors and Logo
Previous LabPhons

Travel and Venue

Getting to Albuquerque
Accommodations
Conference venue
Local information
Getting around Albuquerque
Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Registration

The on-line registration site is now open (link below). Payment is by MasterCard or VISA.

The early registration deadline has passed. Please note that we can no longer honor any requests for refunds.

Late registration with payment after June 5:

- Regular rate: $260
- Student rate: $130

Participants registering at the student rate must also supply the name and email of a professor or supervisor who can certify student status. Only currently-enrolled students are eligible for the student rate. Post-docs must register at the regular rate.

Registration includes one ticket to the conference banquet. Additional banquet tickets may be purchased for $50 each. (This is a separate option in the registration site.)

Please note that you can only complete registration for one person at a time. The site asks you to enter the quantity of registrations desired, but the only acceptable response is 1.

Also, for those outside the US and Canada, in the menu selection for "State or Province", please scroll to the bottom and select "N/A" (Not Applicable).

To register and pay, click here.

Your confirmation email will come from the address "bursar@unm.edu".

LabPhon 12

Home

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Accommodations

Update 3 June: The Hotel Albuquerque is almost full. The few remaining regular rooms cannot be booked online. Please call 800-237-2133 or email lyoungblood@hhandr.com, and identify yourself as being with the 12th Conference on Laboratory Phonology. There are still a few suites available at $116/night, which can be booked online (see below).

If you are not able to get a room at the Hotel Albuquerque, we have a block of rooms available at the Best Western Rio Grande Inn, for the same $81 rate as our discounted rate at the Hotel Albuquerque. The Rio Grande Inn is just 0.2 miles north of the Hotel Albuquerque. It is also 100% non-smoking, and offers complimentary internet access.

If you wish to reserve at the Rio Grande Inn, within the US please call 800-959-4726, or from outside the US email dos@riograndeinn.com, and identify yourself as being with the LabPhon 12 group.
Note that if you are a AAA or AARP member, you can reserve at a lower rate through the web reservations page.

The Rio Grande Inn provides shuttle service from the airport from 7:00 AM to 10:00 PM. See their Shuttle Service Instructions if you wish to use this service.

A few roooms are still available for booking at Hotel Albuquerque in historic Old Town. Hotel Albuquerque has many great features, including: great rooms, free Wifi, and a daily shuttle to and from the conference. Located just steps from Old Town, you will also have the chance to explore the oldest and most unique part of Albuquerque. This includes a wide range of fantastic restaurants, outstanding museums, the beautiful Plaza with lots of Southwest and Native American shopping, and the San Felipe Church, built in 1703. Staying at Hotel Albuquerque offers something for everyone, and any accompanying friends or family that will not be attending the conference will have no shortage of things to do and places to explore in and around Old Town!

Those staying at Hotel Albuquerque will also have the benefit of:

- On-site registration for the conference on Wednesday evening, along with an informal reception (cash bar).
- Complimentary shuttle bus in the morning and evening between the hotel and the conference site.
- Free hotel parking.

Conference attendees receive a highly discounted nightly rate of $81 plus tax. This is nearly 50% off the regular rate, and it is good for up to three days before and after the conference dates. Note: This price is before the application of local sales tax.

To get this rate, you have 2 options:

- Book Online at the hotel reservation site.
  You should see PHONOLOGY in the Group Code box, and on the next screen it should display "12th Conf. Lab Phonology".
- Call 505-843-6300 or toll free 800-237-2133, and ask to be connected to reservations.
  Be sure to mention that you are with the UNM 12th Conference on Laboratory Phonology.

Please be aware that Hotel Albuquerque is entirely non-smoking.

Transportation options to Hotel Albuquerque from the airport:

By city bus: Route 50 to Downtown (Alvarado Transit Center), then Route 36 to Rio Grande Blvd and Mountain Road (Hotel Albuquerque) (can transfer a little earlier at 2nd Street and Marquette Avenue). Fare $1, or 35 cents aged 62 or more. Please note that the bus service on these routes ends shortly after 6 PM, and therefore you need to leave the airport by about 5 PM in order to use the bus to get to the hotel.

By Sunport Shuttle, approximately $15 one-way, extra passengers $5. The Sunport Shuttle desk at the airport is near the bagage claim area. Sunport Shuttle service ends at 10 PM.

By taxi, approximately $25. Less per person if shared.

We encourage as many people as possible to stay at the Hotel Albuquerque in order to benefit from the informal contacts that enrich attending any conference. However, there are a variety of other accommodation possibilities.

The nearest hotel to the conference, but right by the freeways, is Motel 6 at Midtown (1701 University Boulevard Northeast, Albuquerque, NM 87102). The Motel 6 offers a choice of non-smoking and smoking rooms.

A number of hotels and motels are located near the intersection of the I-40 and I-25 freeways. This is three-quarters of a mile (or more) from the site of the conference, but the walk from these places to the conference center involves crossing busy streets with minimal pedestrian protection.

If you choose not to stay at the Hotel Albuquerque, it might be to your advantage to use HotelsCombined International Conference Support Program. For more details go to www.hotelscombined.com/Conference_Support. If you book through one of their participating websites you can claim a 10% refund to be paid to you after the conference. Participating booking sites include Booking.com, Hotels.com and Priceline.com.

LabPhon 12

Home

Conference

Important dates
Program
Registration
For presenters
Committees
Sponsors and Logo
Previous LabPhons

Travel and Venue

Getting to Albuquerque
Accommodations
Conference venue
Local information
Getting around Albuquerque
Visiting Albuquerque

Email address:

labfon12 'at' unm 'dot' edu

Important Dates

Dates of conference: 8-10 July 2010

The early registration deadline has passed.
Late registration is available from the registration page.
Please register by July 4 if you wish to attend the conference banquet.

Please note: We can no longer honor any requests for refunds of registration fees.

LabPhon 12

[Home](#)

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 'at' unm 'dot' edu

An outline timetable for the conference can be downloaded here.

The program is subject to change at any time. Last update 7 July 2010.

Please note that the poster sessions will take place in the middle of the oral sessions, not at the end as listed here.

To find what session your poster is in, locate it by EasyChair submission number in this file. The poster sessions are approximately thematic but the distribution of papers among the sessions has to take into account various factors besides content, so your poster may not be in the session you expect.

Wednesday evening, July 7, 7 - 9 PM

Registration and informal reception (cash bar) at the Hotel Albuquerque.
(Registration will also be available on other days.)

Thursday morning, July 8

Speech as gesture

Invited speaker: Marianne Pouplier, co-author Stefan Benus
On the phonetic status of syllabic consonants: Evidence from Slovak

Contributed papers:
Acoustics without articulation: A case study of Tashlhiyt schwa-like elements
– R. Ridouane, C. Fougeron
How /b, d, g/ differ from /p, t, k/ in Spanish: A dynamic account
– B. Parrell

Invited discussant: Lucie Ménard

Poster session 1: Speech as gesture (Pdf missing)

Thursday afternoon, July 8

Speech as gesture

Contributed papers:
Spanish nasal assimilation revisited: A cross-dialect electropalatographic study
– A. Kochetov, L. Colantoni
Towards a Gestural Characterization of Liquids: Evidence from Spanish and Russian

– M. Proctor
Prosodic context effects on acoustic differentiation of coronal stops in Wubuy
– R. Bundgaard-Nielsen, B. Baker, M. Harvey, C. Best, C. Kroos

Modulation of speech gestures through prosody or sound change

Invited speaker: José Ignacio Hualde, co-authors Miquel Simonet and Marianna Nadeu
Consonant lenition and phonological recategorization

Contributed papers:
The Relationship between Speech Errors and Prosodic Phrase Boundaries
– W.K. Choe, M. Redford
Metrical regularity modulates articulatory rate
– S. Tilsen

Invited discussant: Marie Huffman

Poster session 2: Modulation of speech gestures through prosody or sound change (Pdf missing)

Thursday evening, July 8

Champagne reception at the conference site
Sponsored by Mouton to celebrate the launching of the *Laboratory Phonology* journal

Friday morning, July 9

Non-thematic contributed papers

Inter-language interference in VOT production by L2-dominant bilinguals:Asymmetries in phonetic code-switching
– M. Antoniou
Cross-linguistic applications of a weighted constraint model of F0 movements
– H. Cho

Phonology of signed language

Invited speaker: Onno Crasborn
Inactive manual articulators in signed languages

Contributed paper:
ASL sign lowering as target undershoot: a corpus study
– K. Russell, E. Wilkinson, T. Janzen

Friday afternoon, July 9

Phonology of signed language

Contributed papers:
Linguistic vs. non-linguistic coarticulation: An ASL study
– M. Grosvald, D. Corina

Invited discussant: Martha Tyrone

Poster session 3 Phonology of signed language, Gesture with language, Audiovisual aspects of speech (Pdf missing)

Gesture with language

Invited speaker: Dan Loehr
Temporal, structural, and pragmatic synchrony between intonation and gesture

Contributed papers:
Speech/Hand Coordination in the Production of Prosodic Focus
– B. Roustan, M. Dohen
Gesture analysis expands the dimensionality of infant language acquisition research
– L. Fais, B. Cass, J. Leibowich, A. Barbosa, E. Vatikiotis-Bateson

Invited discussant: Sherman Wilcox

Friday evening, July 9

Conference banquet at the Hotel Albuquerque

Saturday morning, July 10

Audiovisual aspects of speech

Invited speaker: Marc Swerts
Audiovisual correlates of social awareness in growing children

Contributed papers:
'Seeing tunes'. The role of visual gestures in tune interpretation
– J. Borràs-Comes, P. Prieto
Imitation of non-speech Lip and Tongue Gestures in Infants at the Onset of Babbling

– H. Diepstra, P. van Lieshout, S. Trehub and A. Eriks-Brophy

Invited discussant: Eric Vatikiotis-Bateson

Poster session 4: Non-thematic (Pdf missing)

Saturday afternoon, July 10

Diversity of speech gestures, focusing on Native American languages

Invited speaker: Sharon Hargus
Phonetic vs. phonological rounding in Athabaskan languages

Contributed papers:
Velum gestures and nasalization phenomena in Guarani
– D. Demolin
A gestural account of velar contrast in a coronal heavy inventory: the back fricatives in Navajo
– K. Iskarous, J. McDonough, D. Whalen

Invited discussant: Heriberto Avelino

Poster session 5: Language acquisition, Diversity of speech gestures (Pdf missing)

Non-thematic contributed papers

Reducing /voiceless stop + vowel/ sequences in French and Spanish
– F. Torreira, M. Ernestus
Congruence between 'word age' and 'voice age' facilitates lexical access
– A. Walker, J. Hay

LabPhon 12

[Home]

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Organizing Committee

Co-chairs:
Caroline Smith, Dept. of Linguistics, University of New Mexico
Ian Maddieson, Dept. of Linguistics, University of New Mexico

Joan Bybee, Dept. of Linguistics, University of New Mexico

Ioana Chitoran, Program in Linguistics and Cognitive Science, Dartmouth College

Philip Dale, Chair, Dept. of Speech and Hearing Sciences, University of New Mexico

Sandra Disner, Department of Linguistics, University of Southern California

Paul Edmunds, Center for English Language and American Culture, University of New Mexico

Joyce McDonough, Departments of Linguistics and Brain and Cognitive Sciences, University of Rochester

Scott Myers, Dept. of Linguistics, University of Texas, Austin

Amy Neel, Dept. of Speech and Hearing Sciences, University of New Mexico

Brenda Nicodemus, Laboratory for Language and Cognitive Neuroscience, San Diego State University

Rebecca Scarborough, Dept. of Linguistics, University of Colorado

Sherman Wilcox, Chair, Dept. of Linguistics, University of New Mexico

Scientific Committee

Martine Adda-Decker	Jalal Al-Tamimi	Eleanora Albano	Victoria Anderson
Jean Ann	Diana Archangeli	Amalia Arvaniti	Heriberto Avelino
Cinzia Avesani	Harald Baayen	Dragana Barac	Melissa Barkat
Mary Beckman	Pier Marco Bertinetto	Cathi Best	Sonya Bird
Juliette Blevins	Anne Bradlow	Mirjam Broersma	Denis Burnham
Joan Bybee	Dani Byrd	René Carré	Ioana Chitoran
Taehong Cho	Abby Cohn	Jennifer Cole	Bruce Connell
David Corina	Felicity Cox	Onno Crasborn	Mariapaola D'Imperio
Lisa Davidson	Barbara Davis	Ken de Jong	Véronique Delvaux
Didier Demolin	Katherine Demuth	Laura Dilley	Gerry Docherty
Marion Dohen	Susan Duncan	Jacques Durand	Jan Edwards
Mohamed Embarki	Karen Emmorey	Olle Engstrand	Mirjam Ernestus
John Esling	Zsuzsanna Fagyal	Paula Fikkert	Colleen Fitzgerald
Cécile Fougeron	Paul Foulkes	Stefan Frisch	Susanne Fuchs
Adamantios Gafos	Cédric Gendrot	Chip Gerfen	Fiona Gibbon
Bryan Gick	Barbara Gili Fivela	Matt Goldrick	Louis Goldstein
Chris Golston	Matt Gordon	Martine Grice	Susan Guion
Carlos Gussenhoven	John Hajek	Pierre Hallé	Silke Hamann
Mike Hammond	Gunnar Hansson	Sharon Hargus	Jonathan Harrington
Mark Hasegawa-Johnson	Jen Hay	Bruce Hayes	Valerie Hazan
Barry Heselwood	Julia Hirschberg	Phil Hoole	Jose Hualde
Elizabeth Hume	Khalil Iskarous	Ewa Jacewicz	Terry Janzen

Keith Johnson	John Kingston	Greg Kochanski	Alexei Kochetov
Barbara Kuhnert	Bob Ladd	Erika Levy	Dan Loehr
Ian Maddieson	Egidio Marsico	Gaurav Mathur	Joyce McDonough
James McQueen	Lucie Ménard	Christine Meunier	Yohann Meynadier
Alexis Michaud	Jeff Mielke	Amanda Miller	Holger Mitterer
Timothy Montler	Christine Mooshammer	Jill Morford	Gary Morgan
Benjamin Munson	James Myers	Scott Myers	Doris Mücke
Cornelia Müller	Amy Neel	Noel Nguyen	Brenda Nicodemus
Richard Ogden	Jaye Padgett	Fey Parrill	Mary Pearce
François Pellegrino	Sharon Peperkamp	Pascal Perrier	Marianne Pouplier
Daniel Recasens	Lisa Redford	Henning Reetz	Rachid Ridouane
Anastasia Riehl	Joaquìn Romero	Sharon Rose	Yvan Rose
Larry Rosenblum	Solange Rossato	Wendy Sandler	Rebecca Scarborough
Amy Schafer	James Scobbie	Kimary Shahin	Stefanie Shattuck-Hufnagel
Pat Shaw	Linda Shockey	Ryan Shosted	Dan Silverman
Caroline Smith	Donca Steriade	Jane Stuart-Smith	Mariko Sugahara
Marc Swerts	Alice Turk	Siri Tuttle	Martha Tyrone
Nathalie Vallèe	Els van der Kooij	Eric Vatikiotis-Bateson	Mario Vayra
Marilyn Vihman	Natasha Warner	Janet Watson	Sophie Wauquier
Pauline Welby	Doug Whalen	Ronnie Wilbur	Sherman Wilcox
Colin Wilson	Richard Wright	Alan Yu	Chakir Zeroual
Jie Zhang	Lisa Zsiga	Kie Zuraw	Marzena Zygis

LabPhon 12

Home

Conference

Important dates
Program
Registration
For presenters
Committees
Sponsors and Logo
Previous LabPhons

Travel and Venue

Getting to Albuquerque
Accommodations
Conference venue
Local information
Getting around Albuquerque
Visiting Albuquerque

Email address:
labfon12 ‘at’ unm ‘dot’ edu

Sponsors

LabPhon 12 is grateful to the following sponsors for their support.

The National Science Foundation

THE UNIVERSITY of NEW MEXICO

through the Regents' Speaker Endowment,
the Faculty Development Fund of the College of Arts and Sciences,
and the Department of Linguistics.

Robert W. Bybee, with matching funds from ExxonMobil Corporation

NDI Northern Digital Inc. RESEARCH-GRADE MOTION CAPTURE

Logo

Our logo, based on the Zia sun symbol, was designed by Samantha Metheny. We are very grateful to Zia Pueblo for granting us permission to use this symbol; in consideration of their generosity a donation has been made to the Pueblo of Zia Scholarship Fund.

LabPhon 12

Home

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Previous LabPhon conferences

- LabPhon 11 – 2008 – Victoria University of Wellington
- LabPhon 10 – 2006 – Paris
- LabPhon 9 – 2004 – University of Illinois at Urbana-Champaign
- LabPhon 8 – 2002 – Yale University
- LabPhon 7 – 2000 – University of Nijmegen
- LabPhon 6 – 1998 – University of York
- LabPhon 5 – 1996 – Northwestern University
- LabPhon 4 – 1993 – Oxford University
- LabPhon 3 – 1991 – University of California, Los Angeles
- LabPhon 2 – 1989 – University of Edinburgh
- LabPhon 1 – 1987 – The Ohio State University

LabPhon 12

[Home](#)

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Getting to Albuquerque

The Albuquerque International Sunport (ABQ) is served by several major airlines.

Albuquerque is located in central New Mexico at the intersection of I-40 and I-25.

View Larger Map

Further information will be provided closer to the conference date.

LabPhon 12

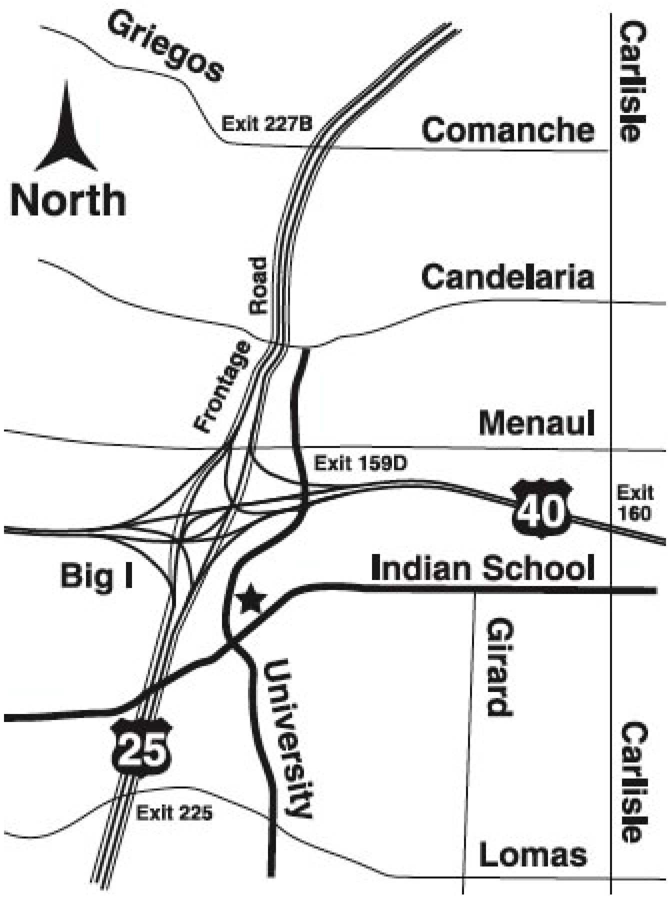
Email address:

labfon12 ‘at’ unm ‘dot’ edu

Conference venue

LabPhon 12 will take place on the campus of the University of New Mexico in Albuquerque, New Mexico. All sessions will be held at the Continuing Education Conference Center, 1634 University Boulevard NE.

Unsecured wireless access to the Internet is freely available at the conference location through the "Lobo WiFi" network. Further information can be obtained from the university's IT department.



LabPhon 12

Home

Conference

Important dates
Program
Registration
For presenters
Committees
Sponsors and Logo
Previous LabPhons

Travel and Venue

Getting to Albuquerque
Accommodations
Conference venue
Local information
Getting around Albuquerque
Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Getting around ABQ

You won't need a compass to get around Albuquerque. Just remember that the Sandia Mountains are always to the east!

For information on how to get from the airport to the Hotel Albuquerque, see here.

There are many transportation options in and around the city:

- Shuttle Bus

If you are staying at Hotel Albuquerque, the hotel will provide a free shuttle each morning and evening between the hotel and the conference.

I missed the shuttle bus, what should I do?

If you miss the shuttle, you will want to use the city bus system. There are two routings that will get you to the UNM Continuing Education Conference Center from the Hotel Albuquerque. Both routes will take about 40 minutes to an hour. For both, you need to go south down Rio Grande Boulevard until you reach Central. At Central, you need to cross the street and wait at the "Rapid Ride" east bus stop.

- Rapid Ride Blue Line 790 East

– The Rapid Ride Blue Line runs every 20 minutes during the day. Take this bus east until you reach UNM Hospital, and get off there. You are now on Lomas. Cross the street so that you are on the other side of the street, and walk west. When you reach University, go right/north. Continue for about .7 miles, cross Indian School, and the conference will be on your right.

- Rapid Ride Red Line 766 East, then bus 16/18 East

– This route involves less walking, but you have to change buses. The Rapid Ride Red Line runs every 15 minutes, the 16/18 bus about every 45 minutes (map and weekday schedule for the 16/18 here, weekend schedule here).
Take the Rapid Ride Red Line 766 to the Alvarado Transportation Center (~5 minute ride). Get off, and walk 2 blocks East on Central until you reach Broadway and Central. Wait on the Northeast corner of the intersection for bus 16/18. Take that bus until the stop "University at Indian School." The Conference Center will be at the Northeast corner of that intersection.

I don't want to wait for the evening shuttle back to the hotel, what should I do?

- Bus 16/18 East, then Rapid Ride Red Line 766

– Take bus 16/18 East from the southern side of the intersection of University and Indian School. Ride until Central, then get off and change to the Rapid Ride Redline bus 766. Get off at Oldtown (Rio Grande and Central). Walk north to the hotel.

- City Buses

This is the easiest and most economical way of getting around ABQ for a few days.

–Each trip is $1, or 35 cents for those 62 and older.

–An unlimited day-pass is $2 and is available for purchase on all buses.

–See the Albuquerque Bus Website to see maps, routes, etc. They also have a nice route planner to help get you wherever you want to go.

- Car

If you are bringing or renting a car, please know that there is plenty of free parking available at both Hotel Albuquerque and the conference center. Some other hotels in town will charge for parking.

Much of the parking at the Continuing Education Conference Center is behind the building.

- Bike

Bringing your bike? See the Albuquerque Trail Map to see the great bike trails that the city has to offer as well as which city streets have a bike lane or are widened for bikes.

- Walking

Don't forget about your own 2 feet! There are many distinct areas in Albuquerque, including UNM/Nobhill, Downtown, Oldtown. While it is not easy to walk from one district to another, once you are in any of these regions, walking is the easiest way to go.

LabPhon 12

Home

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 'at' unm 'dot' edu

Things to see and do around Albuquerque

There is so much to do in Albuquerque. Here are a few recommendations for both conference-goers as well as any friends and family that may also be coming to town.

Note: a ◆ indicates that this activity is within easy walking distance of Hotel Albuquerque.

Remember that there is lots to do in Old Town, just steps from Hotel Albuquerque.

Short on time? Check out ABQ Trolley for a trolley tour around the city.

Museums

- ◆ New Mexico Museum of Natural History
- ◆ Explora Science Center and Children's Museum
- ◆ International Rattlesnake Museum
- National Museum of Nuclear Science and History
- Tinkertown – this is on the other side of the Sandia Mountains, but well worth the drive!

Cultural Centers

- Indian Pueblo Cultural Center
- National Hispanic Cultural Center

Outdoors/hiking/etc.

- Sandia Peak Tramway
- Petroglyph National Monument
- Sandia Foothills

Zoo, Aquarium, Botanical Gardens, Tingley Beach

- ABQ Bio Park
  ◆ The botanical gardents, aquarium, and Tingley Beach are all within walking distance.

Near UNM

- Visit Nob Hill, located east of UNM on Central Avenue, for tons of great shopping and dining options.

Local information

- The City of Albuquerque's webpage for visitors has links to many sources of information.
- The Albuquerque Convention and Visitors Bureau provides tourist information.
- The UNM Computer Science department offers this webpage for their visitors.
- Some attendees may wish to visit Santa Fe before or after the LabPhon conference.You can take the Railrunner train to get there.

LabPhon 12

Conference

- Important dates
- Program
- Registration
- For presenters
- Committees
- Sponsors and Logo
- Previous LabPhons

Travel and Venue

- Getting to Albuquerque
- Accommodations
- Conference venue
- Local information
- Getting around Albuquerque
- Visiting Albuquerque

Email address:

labfon12 ‘at’ unm ‘dot’ edu

Welcome to the 12th Conference on Laboratory Phonology

hosted by the University of New Mexico

Conference Dates: 8–10 July 2010 (three full days)

Wednesday evening, July 7
Registration will be available in the lobby of the Hotel Albuquerque from 7 – 9 PM (or later). Attendees are also encouraged to gather for an informal get-together in the Hotel's Q Bar.

Update 18 June: An outline timetable for the conference can be downloaded here. More information for presenters has been added on the For presenters page, and a new Local information page has been added.

Registration is still available. Go to the registration page.

Update 7 June: The Hotel Albuquerque is almost full.
We have set aside a block of rooms at the Best Western Rio Grande Inn, which is very close to the Hotel Albuquerque. See the Accommodations page for details.

Announcing the Association for Laboratory Phonology ...
LabPhon 12 will be the occasion of the launching of the Association for Laboratory Phonology, and the new journal *Laboratory Phonology*, published by Mouton de Gruyter. For more information about the Association, visit its website at labphon.org.

The theme of this conference is “Gesture as language, gesture and language.” This theme will be addressed from different perspectives by an exciting list of invited speakers, as well as by contributed oral presentations and posters. Non-thematic sessions (both oral and poster) will include contributions on other topics of interest to the LabPhon community.

Session themes and invited participants

- Speech as gesture
  Invited speaker: Marianne Pouplier, LMU München
  Discussant: Lucie Ménard, Université du Québec à Montréal

- Phonology of signed language
  Invited speaker: Onno Crasborn, Radboud University
  Discussant: Martha Tyrone, Haskins Laboratories

- Gesture with language
  Invited speaker: Dan Loehr, Georgetown University and MITRE
  Discussant: Sherman Wilcox, University of New Mexico

- Audiovisual aspects of speech
  Invited speaker: Marc Swerts, Tilburg University
  Discussant: Eric Vatikiotis-Bateson, University of British Columbia

- Diversity of speech gestures, focusing on Native American languages
  Invited speaker: Sharon Hargus, University of Washington
  Discussant: Heriberto Avelino, Max Planck Institute for Evolutionary Anthropology

- Modulation of speech gestures through prosody or sound change

Invited speaker: José Ignacio Hualde, University of Illinois, Urbana-Champaign
Discussant: Marie Huffman, SUNY Stony Brook

paper#	title	poster session
1	What are the contextual phonetic variants of /β, ð, ɣ/ in colloquial Spanish?	Sat AM
5	Tone Perception in Itunyoso Trique	Sat PM
7	Prosodic Structure in ASL Narratives: L1-Deaf, L1-Hearing, and L2-Hearing Signers	Fri PM
16	Tracking laryngeal gestures and their impact on voicing	Thurs AM
20	Breaking into sign language: The gestural and visuo-spatial properties of classifier constructions in British Sign Language aid their acquisition by adult hearing learners	Fri PM
21	Gestural coordination of word initial clusters in Italian and what it tells us about syllable structure	Thurs AM
22	On the Psychological Reality of Turkish Sezer Stress	Thurs PM
23	Reduction of unstressed vowels by English-speaking learners of Spanish	Sat PM
24	Evidence for a dynamical approach to rhotics in Brazilian Portuguese	Thurs PM
25	Articulatory data and gestural organization of back fricatives in Brazilian Portuguese	Sat AM
29	Prosody and stress clash in the speech of children with typical and atypical language development	Thurs PM
34	The syllabification of Irish: a typological exception?	Sat AM
36	Longitudinal L2 acquisition of Russian consonant cluster coordination	Sat PM
38	Articulatory comparison of tonal alignment in Italian and Catalan: Preliminary data on broad focus and narrow-contrastive focus	Thurs PM
40	Can we hear a gesture? The influence of gestures on speech.	Fri PM
41	Inter-gestural timing in Belgian French vs. Southern French nasal vowels	Thurs AM
44	Cues to Word-final Geminate Consonants in Maltese	Sat AM
46	Effects on speech parsing of vowelless words in the phonology	Thurs AM
47	Native signers utilise auditory cortex to process signs, hearing non-signers do not: An MEG investigation of sign and gesture processing in German Sign Language	Fri PM
49	Weighting audio and visual cues in the perception of /f/ and /θ/ across talkers	Fri PM
50	Individual variation in speech perception as a source of 'apparent' hypo-correction	Sat AM
53	A Gestural Coupling Model of Tone, Consonant and Vowel Alignment in Mandarin Chinese	Thurs PM
54	Compensation for coarticulation with phonetically impoverished and rich stimuli	Thurs AM
57	A model of phonetic detail and reaction times in audio and visual perceptuo-motor interactions	Fri PM

58	The Phonological Representation of the Non-Dominant Hand: Evidence from Articulatory Compensation in ASL	Fri PM
60	The role of the motor system in sign language comprehension: evidence from studies of handedness	Fri PM
62	An EPG study of contrastive focus in Arrernte palatal consonants	Sat PM
63	Guttural Co-occurrence restrictions: Articulatory Goals and Adjacency	Sat PM
64	The Perceptual Time Course of Coarticulation	Thurs AM
65	Shadowing, phonetic imitation, and the role of articulatory gestures in speech perception	Thurs AM
67	Product-oriented vs. source-oriented generalization in miniature artificial languages	Sat AM
68	Gestural accommodation in a shadowing task: evidence from EPG data	Thurs AM
69	Acoustic and gestural characteristics of a 2-year-old's American English coda consonants	Sat PM
70	Gestures in sound change: anticipatory vs. perseverative assimilation	Thurs PM
71	Segment frequency, acoustic variability and prosodic structure	Thurs PM
72	Segment and tone errors in Mandarin Chinese tongue twisters	Thurs AM
73	Early language exposure affects the development of phonological representations in sign	Fri PM
74	The integration of somatosensory and auditory information in vowel production	Fri PM
76	An articulatory account of nasal place assimilation in Italian	Thurs AM
77	Group-final lengthening in non-speech finger movements?	Fri PM
80	Towards a knowledge-based system for accent classification in the British Isles	Sat AM
83	Intersubjectivity, phonetics and gesture in the design of turns at talk	Fri PM
84	Prosodic and information structure in Italian: Is there a domain-initial strengthening up to the discourse level?	Sat AM
85	Laryngeal gestures in whispered speech: an endoscopic study of English voicing contrasts	Thurs AM
88	On the emergence of a complex syllable	Sat PM
91	Development of lingual gesture coarticulation for phonological contrasts in children	Sat PM
92	Dynamical differences between constriction location and degree: Consequences for diachrony	Thurs AM
94	A perceptual test of language-specific temporal organization: The case of vowel devoicing	Sat PM
95	Learning of novel phonetic categories after training in perception and production	Sat AM
97	Alveolopalatalization in Standard Chinese: gestural assimilation	Thurs AM

102	Using automatic speech recognition for phonological purposes: Study of Vowel Length in Punu (Bantu B40)	Sat PM
106	Compensation for local perturbation of fricative acoustic feedback	Sat AM
107	Speech/gesture relationship in deictic pointing	Fri PM
108	Temporal (in)dependence of segment-internal gestures in American English /l/	Thurs AM
109	Revisiting Consonant-Vowel Co-occurrence in Adult and Child Language	Sat PM
110	The Phonetic Realization of High Locations in American Sign Language	Fri PM
111	The role of articulatory restrictions in shaping sound structure: Evidence from SENĆOŦEN co-articulatory effects	Sat PM
112	Bilingual children's iconic gesture use in their strong and weak languages	Fri PM
113	Temporal organization of three-consonant onset clusters in American English	Sat AM
114	Phonetic cues and phonological constraints in prosodic unit definition: evidence for the intermediate phrase in French	Thurs PM
115	An Edinburgh Speech Production Facility	Sat AM
116	Learning to be a sign language user: the influence of gestures and visual iconicity on the acquisition of British Sign Language phonology in hearing adults	Fri PM
117	Incomplete Neutralization in American English Flapping	Sat AM
118	Voicing Profiles, Gestural Coordination and Phonological Licensing: Obstruent-Sonorant Clusters in Polish	Thurs AM
120	The problem of visual targets in sign language phonology	Fri PM
121	The influence of acoustic reduction on the informativeness of semantic contextual information	Sat AM
122	Covert contrast in the speech of hearing impaired children	Fri PM
123	Place of Articulation and Lingual Coarticulation of Korean Coronal Obstruents: An Electropalatographic Study	Thurs AM
124	Do Articulatory Constraints Play a Role in Speech Errors?	Thurs AM
125	Pragmatic function as a co-determiner of gradient pronunciation variation	Sat AM
126	Visual Subliminal Primes Affect Vowel Perception	Fri PM
130	The Contrast System in Tohono O'odham Stops	Sat PM
132	The time-course of competition	Thurs AM
134	Timing of tongue tip & dorsum gestures in French and Georgian /l/s	Thurs AM
135	Prosodic variation and articulatory constraints in German consonant clusters	Thurs AM

136	The relation between phonological and auditory processing: Evidence from ERPs	Sat AM
137	On the perceptual relevance of articulation without acoustics: A case study of Berber word-initial geminate voiceless stops	Fri PM
138	Is longer also stronger? The relationship between temporal and spatial expansion in domain-initial prosodic strengthening of vowels	Thurs PM
142	Epenthetic vowels: mere gestural mistiming?	Thurs AM
143	Gestural control in the English past-tense suffix: an articulatory study using real time MRI	Thurs AM
144	Automatic Classification of Tongue Gestures in Ultrasound Images	Thurs AM
147	Prosodic boundaries and what they tell us about the nature of gestural goals in production.	Thurs PM
148	Understanding the Role of Voice Quality in Burmese Lexical Tone: An Aerodynamic and EGG Study	Thurs PM
150	Interpreting pre-peak palatal glides: a phonetic approach	Sat AM
151	Evaluating markedness in the lexicon: Harmony and disharmony in English	Sat AM
152	Electrophysiological correlates of Spanish Sign Language (LSE) processing: Evidence for semantic and phonological structure.	Fri PM
153	Phonological Consistency and Phonetic Variation: Tonal Alignment in Three Neo-štokavian Dialects	Thurs PM
154	Perceiving phonetic contrasts through the lens of native phonology: Discrimination of non-native English consonant contrasts by Italian and Danish listeners	Sat PM
155	Labio-Coronal Fricatives in Sengwato: Phonetic Evidence for a Phonological Contrast	Sat PM
156	Tonal Center of Gravity: How F0 contour shape can matter without configurations	Thurs PM
157	Vowel perception and production in Turkish children acquiring L2 German	Sat PM
158	/u/-fronting in RP and the implications of perceptual integration of lip gestures for sound change processes	Fri PM
160	Gestural conflict and laryngeal height	Thurs AM
161	Context-dependent cost of articulatory gestures: insights from segmental durations	Thurs AM
163	Incomplete neutralization and prosodic conditioning of voice assimilation in Czech	Thurs PM
166	Processing of Vowel Height Relies on Abstract Representations: An MMN Study	Sat AM
167	The Minimal Speech Unit Involved in Phonological Encoding and Articulation	Thurs AM
168	Modeling perceived prosody: speaker-dependent vs. speaker-independent model	Thurs PM
171	Effects of prosodic boundary strength on inter-gestural timing in English onset laterals	Thurs PM
172	Contrastive alignment of f0 events in homorganic vowel sequences	Thurs PM

173	Applying Articulatory Phonology to Movement in American Sign Language	Fri PM
174	Gestural overlap in labial and dorsal stops in Korean: a failure of parallel transmission	Thurs AM
175	Cross-dialectal study on temporal modulation patterns in stress manifestation	Thurs PM
176	What kinds of rate-carrying information in speech permit generation of prosodic expectancies for recovery of spoken gestures?	Thurs PM
179	Mixed voicing and temporal overlap: EMA and aerodynamic observations from Moroccan Arabic	Thurs AM
182	Stiffness as an Articulatory Gesture in N|uu	Sat PM
183	What can prosodic constituency and prominence tell us about the π -gesture scope?	Thurs PM
184	Acoustic and articulatory correlates of prosodic prominence	Thurs PM
185	The temporal scope of boundaries as a function of prominence in Greek	Thurs PM
188	Inter-segmental timing of rC sequences in Norwegian	Thurs AM
189	Scottish English vowel + /r/ rimes: an ultrasound study of social variation in gestures, phonotactics, and phonological inventory	Sat AM
190	Re-linking phonetic and phonological similarity	Sat AM
191	Uvular rhotics in German/Italian bilinguals: preliminary findings from an ultrasound study	Sat PM
193	Complex pause patterns in child and adult storytelling	Sat AM
195	The phonetics and phonology of Blackfoot pre-aspiration	Sat PM
196	Defining an articulatory joint space for sign language handshapes	Fri PM
197	Temporal organization within and across syllables	Sat AM
198	Different gestures explain different acquisition patterns for Japanese and Greek voiced stops	Sat PM
201	Articulatory gestures enhance auditory contrasts: Evidence from evoked magnetic fields	Thurs AM
202	Projection of the structure of a syllable in Korean intervocalic weakening	Thurs AM
203	Pitch Range Relations in Lakota Intonation	Sat PM
206	Some effects of altered visual feedback on sign production	Fri PM
207	Lexical Frequency and Tone Sandhi in Hai'an Mandarin	Sat AM
208	Schwa deletion under varying prosodic conditions	Thurs PM
209	Do non-speech contexts mask or contrast with speech targets?	Thurs AM
210	Japanese vowel devoicing as a gestural overlap	Thurs AM

211	Analogs of Tahltan consonant harmony in English CVC syllables	Sat PM
214	Voiceless applosive finals in Taiwanese and other E & SE Asian Languages: laryngoscopic case studies	Sat PM
215	How does a language contrast four distinct coronal stop places? Differentiation of lingual gestures by speakers of Wubuy (Australia)	Thurs AM
216	Phonetic Correlates of German Weak Pronoun Cliticization	Sat AM
217	From eye to mouth: Connecting non-linguistic visual grouping and linguistic prosody	Fri PM
219	Lip gestures in Karitiana bilabial consonants	Sat PM
220	Asymmetries in Spanish-English Gestural Drift: Data and Model	Sat AM
222	How gesture shapes language	Sat PM
225	Phonation contrasts across languages	Sat PM
226	Articulatory versus Acoustic Representation of Tone	Thurs PM
229	Vowel articulation in absolute initial position of different prosodic constituents in French	Thurs PM
230	Linear separability and feature selection in the acquisition of tones	Thurs PM

On the phonetic status of syllabic consonants: Evidence from Slovak

Our paper investigates the phonetic correlates of syllable structure on the basis of Slovak syllabic consonants. While many languages allow syllabic consonants, syllables containing consonantal nuclei are usually very restricted compared to their vocalic counterparts in terms of syllable complexity, and their occurrence is largely predictable on the basis of stress and constituency structure (morpheme boundaries). Freely distributed syllabic consonants are relatively rare in the world's languages (Bell, 1970). We consider in this paper whether this cross-linguistic restriction on syllabic consonants is grounded in articulation.

Phonetic studies of syllable structure have posited that vowels provide the basis for articulatory coordination relationships within a syllable: Consonants are coordinated with respect to the vocalic syllable nucleus, and vowels provide the basis for the articulation of consonants (Browman & Goldstein, 2000; Öhman, 1966). Vowels differ articulatorily fundamentally from most consonants in that they always involve a movement of the entire tongue body, are overall relatively unconstricted compared to consonants and are relatively slow in their movement. We may therefore hypothesize that a consonantal syllable nucleus may not provide the same possibilities for articulatory coordination compared to a vocalic nucleus. A piece of evidence in support of this reasoning is the fact that typologically, syllabic consonants usually cannot take complex onsets and codas, they are much more restricted in syllable complexity compared to vocalic syllables (Bell, 1970). If they do allow for complex syllable margins, it may therefore be the case that these consonants differ in nucleus position from their onset and coda counterparts by being kinematically more 'vowel-like' in that they are slower in their movements and longer in duration.

We tested this hypothesis on the basis of Slovak, a language that allows freely distributed vowel-less syllables with /l/ and /r/ providing the syllable nucleus, whereby /r/ is an apical trill (in all syllable positions). Slovak syllables with a consonantal nucleus can have complex onsets with up to two onset consonants (e.g., *smrť*, 'death'), but only limitedly complex codas (cf. words like *sĺnc* 'sun-Gen.Pl.' and *sŕnk* 'deer-Gen.Pl.' with a homorganic coda cluster). Thereby it should be pointed out that generally complex codas are infrequent in Slovak. Phonological rules that target the syllable nucleus apply independently of whether the nucleus is occupied by a vowel or a consonant, thereby confirming that the consonants truly occupy nucleus position. For example, Slovak shows a complex set of phonemic length alternations for syllable nuclei, mainly triggered by affixation or by the rhythmic law (Kenstowicz & Rubach, 1987; Rubach, 1993). The rhythmic law states that a long nucleus becomes short if the immediately preceding syllable contains a long nucleus. Syllabic consonants participate in these length alternations just as vowels do, and serve as both triggers and targets.

Empirically, we employ two classes of measures in pursuit of our research question: In order to assess whether syllabic consonants are more 'vowel-like' in their kinematics compared to their onset and coda equivalents, we compare /l, r/ in onset, nucleus and coda position in terms of (time-to-)peak velocity, stiffness, plateau duration and maximal articulator position. Secondly, we investigate articulatory coordination in syllables with vocalic and consonantal nuclei by means of overlap measures. We compare onset-nucleus coordination in syllables with vocalic and consonantal nuclei, as well as C-C coordination in CCC, CCV and VCC syllables. EMA data for three native speakers of Slovak were recorded.

Results show that syllables with consonantal nuclei are kinematically similar to consonant clusters. First, a consonantal syllable nucleus does not show any change in its consonantal articulatory dynamics to become more vowel like. Overall, /r/ has a tendency to be faster and have a longer plateau duration in nucleus position, while /l/ has a slight tendency to be slower, with no clear pattern in plateau duration. While syllabic /l/ and /r/ differ from their counterparts in onset and coda positions, these differences in their kinematics are overall rather subtle, and can be in either direction across subjects. Particularly /r/ is, if anything, slightly 'more consonantal', as it were, in nucleus position in that it shows the shortest time to peak velocity, the highest position and stiffness values. We conclude from this part of the analysis that the phonological status as syllable nucleus does not fundamentally affect the consonantal phonetic properties of /l/ and /r/.

The most consistent differences between syllables with a vocalic vs. consonantal nucleus is evident in measures of articulatory timing. These analyses show that onset and coda timing to a consonantal nucleus is comparable to consonant cluster timing in CCV/VCC syllables rather than to CV timing. Further, onset-nucleus are significantly less overlapped when the nucleus is consonantal (e.g., ***br**m*) rather than vocalic (e.g., ***ba**m*). Comparing onset-nucleus CC sequences (***chl**p*) to the same consonant sequence as an onset cluster (e.g., ***chl**ap*), we find that onset-nucleus sequences are even less overlapped compared onset clusters of vowel-nucleus syllables. Both onset clusters or onset-nucleus consonant sequences containing /l/ and /r/ show an open transition schwa. Complex onsets do not differ in their coordination to the syllable nucleus, independent of whether that nucleus is a consonant or a vowel. This suggests that contrary to our initial hypothesis, it is not the case that complex onsets cannot be coordinated to a consonantal nucleus if that nucleus retains its consonantal kinematics. The typological possibility for syllabic consonants seems to be rather related to the consonant timing pattern of a language.

References

Bell, A. (1970). Syllabic consonants. *Working Papers on Language Universals, 4*, B1-B49.

Browman, C., & Goldstein, L. (2000). Competing constraints on intergestural coordination and self-organization of phonological structures. *Bulletin de la Communication Parlée, 5*, 25-34.

Kenstowicz, M., & Rubach, J. (1987). The phonology of syllabic nuclei in Slovak. *Language, 63*(3), 463-497.

Öhman, S. E. (1966). Coarticulation in VCV utterances: spectrographic measurements. *Journal of the Acoustical Society of America, 39*(1), 151-168.

Rubach, J. (1993). *The Lexical Phonology of Slovak*. Oxford: Clarendon Press.

Acoustics without articulation: A case study of Tashlhiyt schwa-like elements

This study reports on ongoing research on the status of schwa-like elements ([@]) that are sometimes present in the acoustic record of Tashlhiyt underlying consonantal clusters (e.g. in [t@b@d@g] "it is wet"). Where do these vocalic elements come from? Are they epenthetic vowels or mere transitional stages of no structural relevance? This is a fundamental question, especially in a language like Tashlhiyt which has particularly long consonantal clusters and consonant-only words. Indeed, if one argues, as we do, that these elements have no structural relevance, this would imply that a form like /tbdg/ has obstruent-only syllables with stops acting as nuclei. In two previous studies (Ridouane 2008, Fougeron & Ridouane 2008a), we provided various arguments showing that these vocalic elements are not manipulated by phonological grammar, do not act as syllable peaks, and do not occur within voiceless consonantal sequences. In this work, we provide additional data tending to show that there are no temporal specifications associated with them and that their distribution depends on specific adjustments between laryngeal and supralaryngeal gestures.

Does [@] have a time slot of its own?

If this vowel-like element were a segment, one would expect it to have a specific time slot, and thus adds some duration to the CC sequence where it is realized (Davidson & Roon 2008). To test this, we recorded 5 speakers while producing 23 items containing CC sequences. The target C1C2 sequences vary in terms of laryngeal specifications, mode of articulation, and order of place of articulation (see table 1). Different measurements were taken for each sequence: duration of [C1(@)C2] sequence, duration of C1, duration of C1 release (if present), duration of @ (if present), duration of C2, and duration of C2 release (if present). Results showed that C1C2 sequences have the same duration ($p=.1$) whether there is a vowel-like element within the sequence or not (see figure 1). In addition, the duration of the C1C2 sequences is not correlated with the duration of the vocalic element ($r2=.001$, $p=.6$).

Can the distribution of [@] be predicted by the phonetic properties of the CC sequences?

We examined acoustic and electropalatographic data and showed that three conditions should be met for a transitional vocoid to surface within a CC sequence. First, at least one of the two consonants of the sequence should be voiced. Vocalic elements are more frequent when C2 is voiced (figure 2). Second, C1 release and C2 constriction have to be sufficiently spaced in time. Indeed, no vocalic element is acoustically present within homorganic sequences. In items of the type [tntltnt] "she hid them", the speaker never moves the tongue away from the alveolars, a gesture necessary to produce a vocalic element (see also Fougeron & Ridouane 2008b). Third, vocal tract should be sufficiently open during the transition from C1 to C2. Vowel-like elements are more frequent in stop-stop sequences (figure 3). This is most probably related to the fact that stops have to be released for the perceptual recovery of C1 place of articulation. In addition, we show that occurrence of vowel-like elements depends on the amount of overlap between the alveolar and velar gestures. In other words, their presence is favoured when there is less overlap in linguopalatal contact between the two consonants (figure 4).

Conclusion

To sum up, in Tashlhiyt, phonetic implementation creates what looks like a schwa vowel in some consonant sequences but in fact is not, at least of the phonological sort. This element is rather a transitional stage with a vocoid configuration (i.e. voicing and formant structure) conditioned by the specific adjustments between laryngeal and oral gestures of the consonants.

Table 1. List of items produced by 5 speakers (5 to 6 repetitions) for the acoustic study. The items were embedded in the following carrier sentence [inna … bahra] "he said … a lot"

	[+vd,+vd]		[-vd,+vd]		[+vd,-vd]	
	Fr_Bk	Bk-Fr	Fr_Bk	Bk-Fr	Fr_Bk	Bk-Fr
Stop-Stop	bdiʁ	gdiʁ	tgim	kdiʁ	bqiʁ	gtinn
Stop-Fric	bziz	gziʁ	tʁiʁ	--	bsiʁ	ddfiʃ
Fric-Stop	zgiʁ	zbiʁ	sgin	ʜbiʁ	zkiʁ	ʕtiq
Fric-Fric	zʁur	ʁziʁ	sʁiʁ	χzit	ʒʜid	ʕfiʁ

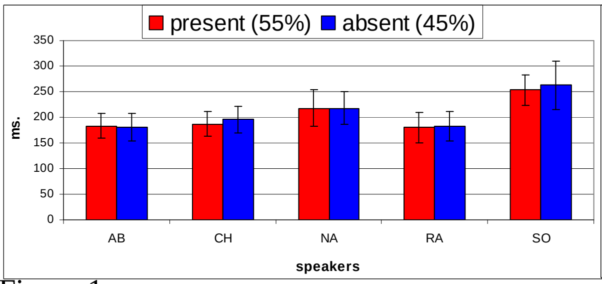


Figure 1.

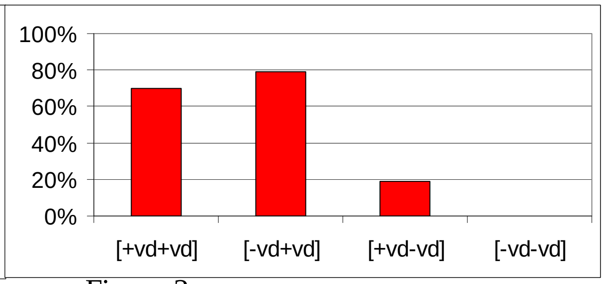


Figure 2.

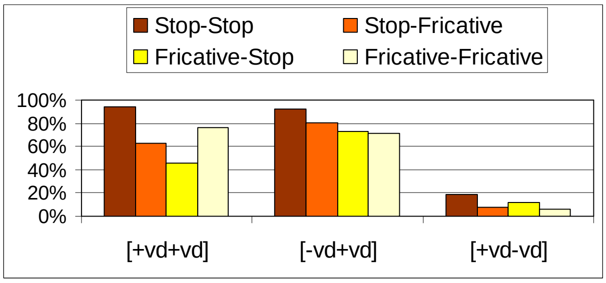


Figure 3.

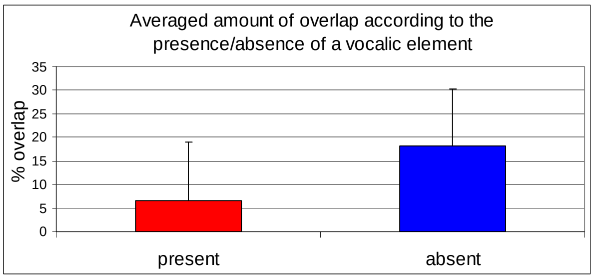


Figure 4.

Bibliography

Davidson, L. & Roon, K. (2008). Acoustic cues for differentiating consonant sequences in Russian. *Journal of the International Phonetic Association* 38 (2), 137-165.

Fougeron, C. & Ridouane, R. (2008a). On the phonetic implementation of syllabic consonants and vowel-less syllables in Tashlhiyt. *Estudios de Fonética Experimental* 18, 139-175.

Fougeron, C. & Ridouane, R. (2008b). On the nature of schwa-like vocalic elements within some Berber clusters. In *Proceedings of the eighth International Seminar on Speech Production (ISSP'08)*, 441-444.

Gafos, A. (2002). A grammar of gestural coordination. *Natural Language and Linguistic Theory* 20 (2), 269-337.

Ridouane, R. (2008). Syllables without vowels: phonetic and phonological evidence from Tashlhiyt Berber. *Phonology* 25 (2), 321–359.

How /b, d, g/ differ from /p, t, k/ in Spanish: A dynamic account

The traditional view of /b d g/ in Spanish is that these segments are underlying stops, contrasting in voicing with /p t k/, that undergo a process of spirantization except phrase initially and after a homorganic nasal or lateral (e.g. Mascaró, 1984). However, a large number of authors argue that these segments are underlying *spirants*, contrasting with /p t k/ in constriction degree, that undergo initial and post-nasal strengthening (e.g. Baković, 1995; Lavoie, 2001). Both of these theories rely on categorical productions of fully occluded versus fully spirantized stops. A large body of evidence shows that this is not the case in real speech: voiced stops in all contexts span a large area between these two extremes (Carrasco & Hualde, 2009; Cole, Hualde & Iskarous, 1999; Eddington, 2009; Ortega-Llebaria, 2004, Hualde et al., 2010). Additionally, voiceless stops can be realized both as fully voiced and spirantized (Lewis, 2001; Machuca, 1997). How, then, are /b d g/ and /p t k/ different? Some authors have proposed that duration (Hualde, 2005) or the feature [±tense] (Martínez Celdrán, 2008 and previous) distinguish /b d g/ from /p t k/.

This paper argues for a unified analysis of Spanish stop spirantization and contrast based in Articulatory Phonology (Browman & Goldstein, 1992). The shorter duration of voiced stops (e.g. Lavoie, 2001) may lead to their less constricted production (spirantization) due to increased articulatory undershoot. It is that duration difference, in addition to voicing, that distinguishes /p t k/ from /b d g/. Increased duration phrase initially and due to nasal + stop sequences lead to productions of full stops in those positions without overt allophonic control.

Methods: To test this hypothesis, a pilot study was conducted using 3D electromagnetic articulometry (EMA) with one native speaker of northern peninsular Spanish. The subject produced words in carrier phrases with /p/ and /b/ in /a(#)Ca/ context phrase initially, word initially, and word medially. The duration of the gesture from onset to constriction release was measured, along with the constriction degree (CD, distance between sensors on upper and lower lips).

Result: For total duration, there is a main effect of prosodic boundary ($p < 0.0001$) and a near-significant effect of voicing ($p = 0.08$). T-tests reveal significant differences both word-initially and medially ($p < 0.0001$, 0.03). For CD, there were main effects of both prosodic boundary ($p = 0.0002$) and voicing ($p < 0.0001$). Post hoc test reveals a significant difference between phrase medial /b/, and phrase initial /b/ and /p/ in all prosodic positions ($p < 0.0001$). Linear regressions (Figure 1) show a significant effect of duration on CD for /b/ ($p < 0.005$), though not for /p/, indicating that duration may underlie some reduction in CD. As can be seen from Figure 1, however, /b/ and /p/ with the same duration differ in CD, against our initial hypothesis. An ANOVA test reveals no difference for gestural stiffness, ruling out that parameter as the cause of this difference. However, it is known that stops have a CD target beyond the point of articulator contact (Löfqvist, 2005). Though /b/ and /p/ do differ in CD, it is proposed that /b d g/ have a *less negative* target than /p t k/ but still one that results in full occlusion. An articulatory modeling study conducted using TaDA (Saltzman, Nam, Krivokapić & Goldstein, 2008), confirms that a CD for /p t k/ of -2 mm and for /b d g/ of -0.5 mm gives the correct articulatory and acoustic output both phrase-medially and initially (duration = 80 ms, 200ms respectively) while a CD for /b d g/ of 0 mm results in incomplete closure and audible frication even at long durations (Figure 2).

In summary, these data indicate that a) voiced stops in Spanish are, in fact, stops and not spirants and b) the distinction between voiced and voiceless stops must be at least two-way, with differences in duration and constriction degree in addition to a possible voicing distinction.

Figure 1

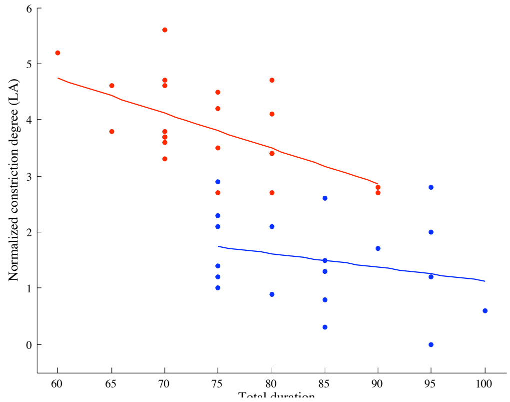
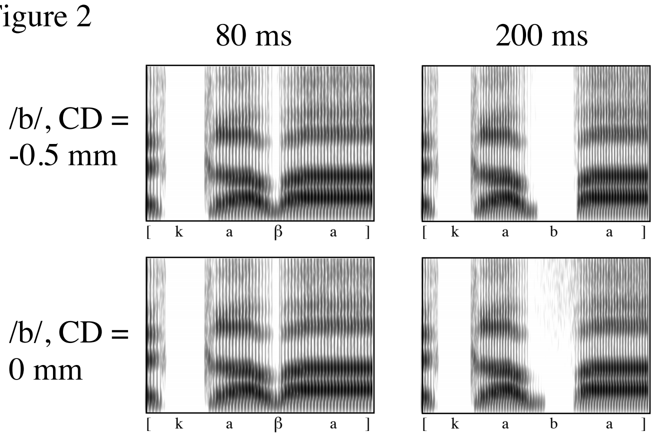


Figure 2



References:
Baković, E. (1995). Strong onsets and Spanish fortition. *MIT Working Papers in Linguistics, Proceedings of SCIL 6*, 21-39.
Browman, C. P., & Goldstein, L. (1992). Articulatory phonology: An overview. *Phonetica*, *49*(3-4), 155-80.
Carrasco, & Hualde, J. I. (2009). *Spanish voiced allophony reconsidered*. Paper presented at the Phonetics and Phonology in Iberia Conference, Las Palmas, Spain.
Cole, J., Hualde, J., & Iskarous, K. (1999). Effects of prosodic and segmental context on /g/-lenition in Spanish. In O. Fujimura, B. D. Joseph, & B. Palek (Eds.), *Proceedings of the fourth international linguistics and phonetics conference*.
Eddington, D. (2009). *What are the contextual phonetic variants of /β, ð, ɣ/ in colloquial Spanish?* Unpublished manuscript, Brigham Young University.
Hualde, J. I. (2005). *The sounds of Spanish*. Cambridge: Cambridge University Press.
Hualde, J. I., Simonet, M., Shosted, R., & Nadeu, M. (2010). Quantifying Iberian spirantization: Acoustics and articulation. Paper presented at LSRL 40, Seattle, WA.
Lavoie, L. M. (2001). *Consonant strength: Phonological patterns and phonetic manifestations*. New York: Garland.
Lewis, A. M. (2001). *Weakening of intervocalic /p, t, k/ in two Spanish dialects : Toward the quantification of lenition processes*. Ph.D. Dissertation, UI-UC.
Löfqvist, A. (2005). Lip kinematics in long and short stop and fricative consonants. *Journal of the Acoustical Society of America*, *117*(2), 858-878.
Machuca, M. J. (1997). *Las obstruyentes no continuas del español: Relación entre las categorías fonéticas y fonológicas en habla espontánea*. Ph.D. Dissertation, Universitat Autònoma de Barcelona.
Martínez Celdrán, E. (2008). Some chimeras of traditional Spanish phonetics. In L. Colantoni, & J. Steele (Eds.), *Selected proceedings of the 3rd conference on laboratory approaches to Spanish phonology*. (pp. 32-46). Somerville, MA: Cascadilla.
Mascaró, J. (1984). Continuant spreading in Basque, Catalan and Spanish. In M. Aronoff, & R. Oehrle (Eds.), *Language sound structure*. (287-98). Cambridge, MA: MIT Press.
Ortega-Llebaria, M. (2004). Interplay between phonetic and inventory constraints in the degree of spirantization of voiced stops: Comparing intervocalic /b/ and intervocalic /g/ in Spanish and English. In T. L. Face (Ed.), *LARP*. Berlin: Mouton de Gruyter.
Saltzman, E., Nam, H., Krivokapić, J., & Goldstein, L. (2008). A task-dynamic toolkit for modeling the effects of prosodic structure on articulation. *Proceedings of the Speech Prosody 2008 Conference*, 175-84.

Spanish nasal assimilation revisited: A cross-dialect electropalatographic study

Recent instrumental investigations of place assimilation in a variety of languages revealed that these processes can be implemented categorically or gradiently, depending on various general and language-specific factors (Farnetani & Busá, 1994; Ellis & Hardcastle, 2002, among others). In the only systematic articulatory study of Spanish nasal assimilation, Honorof (1999) found that the process varied between categorical and gradient as a function of the coronal/noncoronal place of articulation of the following consonant. Specifically, his EMMA data collected from 4 Peninsular Spanish speakers showed that the tongue tip gesture of the nasal /n/ seemed to assume the exact place and stricture of the following noncoronal gesture (e.g. *digan paja* → *diga*[m p]*aja*) and to blend variably with the place and stricture targets of the following coronal gesture (e.g. *digan tajo* → *diga*[^{n}n̪ t̪]*ajo*, *digan saga* → *diga*[^{n}s̃ s]*aga*). The apparent partly-categorical/partly-gradient status of the process presents a challenge for current models of assimilation which predict either discrete feature spreading or continuous gestural blending (e.g. Padgett, 1995; Browman & Goldstein, 1992), while also questioning some aspects of previous auditorily-based descriptions of Spanish (Navarro Tomás, 1970; Harris, 1969). Honorof's findings with respect to gradience, however, may not be conclusive, as the set of coronals used in the study was limited to dentals/alveolars, and the EMMA method provides a rather indirect record of stricture assimilation, particularly before coronal fricatives.

In this study we use electropalatography (EPG) to investigate Spanish nasal assimilation in two dialects that differ in the realization of syllable-final nasals – as alveolar [n] in Argentine, and as velar [ŋ] in Cuban. Across words, these nasals can occur before various consonants, including coronals that differ in place and stricture, thus allowing for a systematic investigation of assimilation patterns. Five speakers from Buenos Aires and 3 speakers from Havana were recruited for the study. The stimuli included meaningful phrases with across-word sequences of the type an#Ca, where C was noncoronal (/p f k x ∅/) or coronal (Argentine /t s ʧ ʃ/, Cuban /t s ʃ j/), and stress falling on either the preceding or following vowel. A WinEPG system with custom-made artificial palates was used to collect simultaneous articulatory and acoustic data. The analysis involved a standard set of measures of location and degree of lingual constriction (Fontdevila et al., 1994) taken at the point of maximum contact during the acoustically determined nasal interval.

The results confirmed that single word-final nasals were realized as alveolar or velar in Argentine and Cuban Spanish respectively (with some exceptions for one Cuban speaker) (Fig. 1a). When followed by a non-coronal, the nasal completely lacked the coronal constriction, presumably taking on the place and stricture of the following labial or dorsal gesture (however, less consistently for some Argentine speakers) (Fig. 1b). The realization of the nasal before coronals was most variable, yet strongly conditioned by place and stricture of the following gesture (Fig. 1c). The nasal had a more posterior constriction and higher tongue body before post-alveolars than before alveolars ($p<.001$; Fig. 2a); it also had greater constriction width (being fully or partly deocclusivized) before fricatives than before stops or affricates ($p<.001$; Fig. 2b). The differences were in general greater for Cuban than Argentine speakers, reflecting the dialect-specific realizations of coronal consonants. Overall, the patterns of nasal assimilation in both dialects showed a similar coronal/non-coronal asymmetry, despite the different place of articulation of final single nasals. As such, these patterns are inconsistent with the gestural blending analysis, particularly in the case of velar-to-alveolar shifts by Cuban speakers. The results thus suggest that in these two dialects, assimilation is mainly categorical, with gradient effects arising before certain coronal consonants.

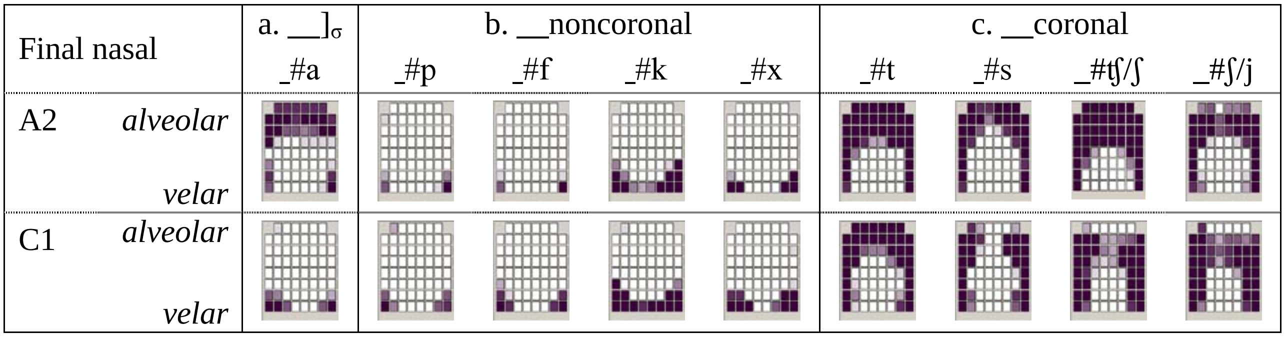
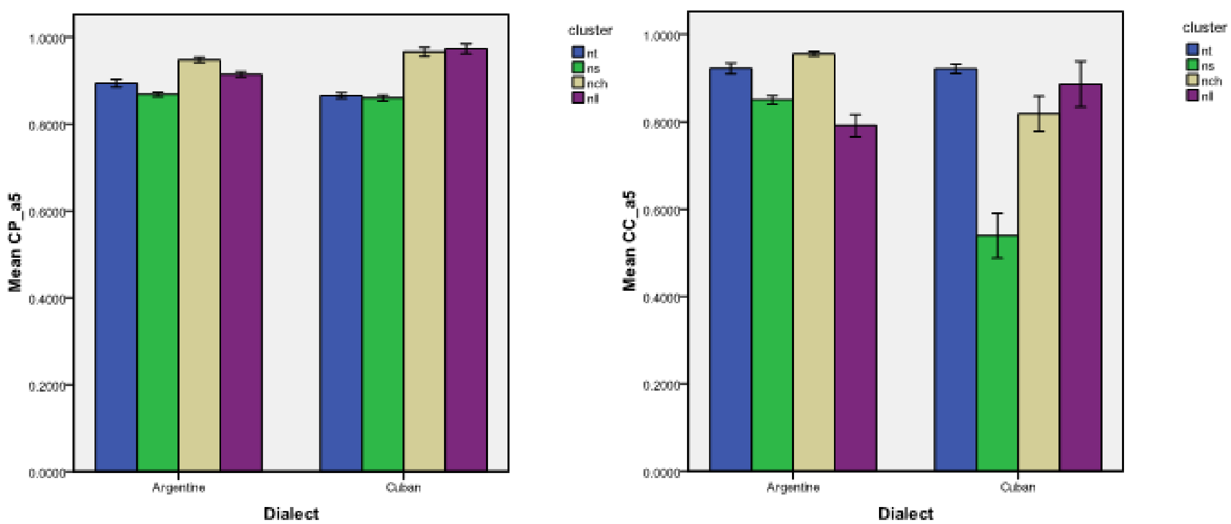


Figure 1. Mean linguopalatal contact of nasals in various across-word contexts for representative speakers of Argentine (A2) and Cuban Spanish (C1) (based on the first 6 tokens; black = 100%, white = 0% activation).



a. b.

Figure 2. Mean contact posteriority (CP) and contact centrality (CC) of the nasal before /t/, /s/, /ʧ/ or /ʃ/ (*ch*), and /ʃ/ or /j/ (*ll*) by dialect (based on the currently analyzed data from 7 speakers).

References

Browman, C. & Goldstein, L. (1992). Articulatory phonology. *Phonetica,* 49, 155–180.

Ellis, L., & Hardcastle, W. J. (2002). Categorical and gradient properties of assimilation in alveolar to velar sequences: Evidence from EPG and EMA data. *JPhon*, 30, 373–396.

Farnetani, E. & Busá, M. G. (1994). Italian clusters in continuous speech. *Proceedings of the 1994 ICSLP*, Vol. 1 (pp. 359-362).

Fontdevila, J., Pallarès, M. D., & Recasens, D. (1994). The contact index method of electropalatographic data reduction. *JPhon*, *22*, 141–154.

Harris, J. (1969). *Spanish phonology*. Cambridge: MIT Press.

Honorof, D. (1999). Articulatory gestures and Spanish nasal assimilation. Ph.D. diss., Yale.

Navarro Tomás, T. ([1918] 1970). *Manual de pronunciación española*. Madrid: CSIC.

Padgett, J. 1995. *Stricture in Feature Geometry*. Stanford, CA: CSLI Publications.

Towards a Gestural Characterization of Liquids: Evidence from Spanish and Russian

Rhotics and laterals pattern together in a variety of ways in the phonology of many languages, yet it is not well understood what the basis of this grouping might be. A variety of features have been proposed to describe the phonological behavior of liquid consonants, including [lateral], [trill] and [liquid] (Chomsky & Halle 1968, Walsh-Dickey 1997), yet none of these primitives is capable of capturing the relevant set of consonants within or across languages (Proctor 2009). It is unclear what acoustic properties members of the class might share, if any (Lindau 1985, Ladefoged & Maddieson 1996). Articulatory studies have demonstrated that, despite their variant realizations, American English laterals and rhotics are all produced with both a coronal and a dorsal/pharyngeal gesture (Delattre & Freeman 1968; Sproat & Fujimura 1993; Browman & Goldstein 1995). In light of similar evidence for coronal and dorsal gestures in Salish and Mandarin liquid production (Gick et al. 2006), this suggests that the class of liquids might be potentially well characterized in the articulatory domain. However, it remains to be seen to what extent this characterization holds true in languages that employ a greater range of liquid contrasts. Two languages of particular interest are Spanish, which uses a clear lateral, and contrasts a tapped and a trilled rhotic, and Russian, which contrasts palatalized and non-palatalized liquids. The hypothesis being examined is that the class of coronal liquids consists of segments produced via the coordination of tongue-tip and tongue-body gestures.

An ultrasound experiment was conducted to compare the dynamic production of liquid and obstruent consonants in Spanish and Russian. Five speakers of American Spanish produced each of the coronal consonants /l-ɾ-r-d/ in three different intervocalic environments /i-a-u/. Four speakers of Contemporary Standard Russian produced consonants /l-l^j-r-r^j-d-d^j/ in intervocalic environments /e-a-u/. Lingual motion was captured using high-speed optically-corrected ultrasound (Whalen et al. 2004). Tongue edges were extracted using semi-automatic tracking (Li et al. 2005). For each consonant, lingual posture was compared in intervocalic environments at three points in time: (i) the acoustic mid-point of the pre-consonantal vowel, (ii) the midpoint of consonantal production, and (iii) the acoustic mid-point of the post-consonantal vowel. Susceptibility to vocalic coarticulation was estimated by calculating dorsal displacement across consonantal tokens produced in antagonistic vocalic contexts.

Liquids in both languages were found to be united by a lower susceptibility to vocalic coarticulation than the coronal stops (Fig. 1), suggesting that articulation of the tongue dorsum is intrinsic to the liquid consonant. The tongue body gesture of the Spanish lateral resembles that of a mid-front vowel; dorsal articulation of the Spanish trill resembles that of a mid-back vowel. The tongue body gesture of the Russian non-palatalized lateral resembles that of a mid-back vowel; the Russian non-palatalized trill is produced with a dorsal gesture resembling that of a mid-central vowel.

These results are consistent with the hypothesis that coronal liquid consonants are segments corresponding to recurrent, stable constellations (Browman & Goldstein 1992) in which a consonant-like tongue-tip gesture is coordinated with a vowel-like tongue-body gesture (Gick et al. 2002). Such gestural configurations are inherently sonorous – due to the vocalic nature of the tongue body constriction and the incomplete or sporadic nature of the coronal closure – and therefore afford spontaneous voicing. Differences between clear and dark laterals are shown to result primarily from differences in dorsal target locations. Differences between rhotics are attributed to variation in the stiffness and degree of damping of tongue-tip and tongue body gestures – trills and retroflex rhotics being characterized by a more highly constrained dorsum, and taps by a more lightly damped tongue tip. Phonological processes involving interactions between liquids and nuclei – e.g. post-vocalic deletion, coloring and lengthening – are discussed as resulting from the blending of coproduced tongue body gestures.

Figures

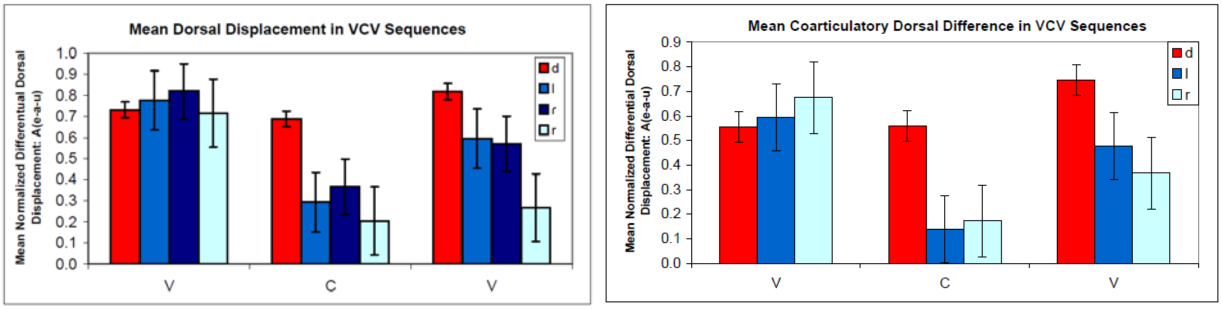


Fig. 1: Mean normalized differential dorsal displacement: coronal consonants, all subjects. Left: Spanish; Right: Russian

References

Browman, C.P. & L.M. Goldstein. 1992. *Articulatory phonology: an overview*. Phonetica 49: 155-180

Browman, Catherine P. & Louis M. Goldstein. 1995. *Gestural syllable position effects in American English*. In Fredericka Bell-Berti & Lawrence J. Raphael (eds.), Producing speech: contemporary issues (for Katherine Safford Harris), 19-34. New York: AIP Press

Chomsky, Noam & Morris Halle. 1968. The sound pattern of English. New York: Harper & Row

Delattre, Pierre & Donald C. Freeman. 1968. *A dialect study of American r's by x-ray motion picture*. Linguistics 44: 29-68

Gick, Bryan, A. Min Kang & Douglas H. Whalen. 2002. *MRI evidence for commonality in the post-oral articulations of English vowels and liquids*. Journal of Phonetics 30(3): 357-371

Gick, Bryan, Campbell, Fiona, Oh, Sunyoung and Tamburri-Watt, Linda, 2006, *Toward Universals in the Gestural Organization of Syllables: A Cross-Linguistic Study of Liquids*. JPhon. 34(1): 49-72

Ladefoged, Peter and Maddieson, Ian. 1996. The sounds of the world's languages. Oxford: Blackwell

Li, Min, Chandra Kambhamettu & Maureen Stone. 2005. *Automatic contour tracking in ultrasound images*. Clinical Linguistics & Phonetics 19(6-7): 545

Lindau, Mona. 1985. *The story of /r/*. In Victoria Fromkin (ed.), Phonetic linguistics: Essays in honor of Peter Ladefoged, 157–168. Orlando: Academic Press

Proctor, Michael. 2009. Gestural Characterization of a Phonological Class: the Liquids. PhD Dissertation, Yale University

Sproat, Richard & Osamu Fujimura. 1993. *Allophonic variation in English /l/ and its implications for phonetic implementation*. Journal of Phonetics 21(3): 291-311

Walsh-Dickey, Laura. 1997. The Phonology of Liquids. PhD Dissertation, UMass Amherst

Whalen, Doug. H., Khalil Iskarous, Mark K. Tiede, David J. Ostry, Heike Lehnert-LeHouillier, Eric Vatikiotis-Bateson & Donald S. Hailey. 2005. *The Haskins Optically Corrected Ultrasound System (HOCUS)*. Journal of Speech, Language, and Hearing Research 48(3): 543-553

Prosodic context effects on acoustic differentiation of coronal stops in Wubuy

Introduction

Articulatory phonology (AP: Browman & Goldstein, 1986; 1989; 1990) proposes that speech is composed of hierarchically organised and precisely coordinated articulatory gestures. The execution of these gestures is coordinated such that a CV coupling is tighter, i.e., more in-phase than a VC coupling, which is executed in anti-phase (Nam, Goldstein & Saltzman, 2009).

Within an AP framework, prosodic boundary strength is also posited to systematically affect the degree of gestural coordination (see Figure 1). In particular, it has been claimed that CV coupling is *strengthened* by prosodic boundaries, and as a consequence it is predicted to be tighter for word-initial but phrase medial CVs (V#CV) than word-medial VCVs, and tightest for both word and utterance-initial CVs (##CV) (Byrd & Choi, 2009; Goldstein, Byrd & Saltzman, 2006).

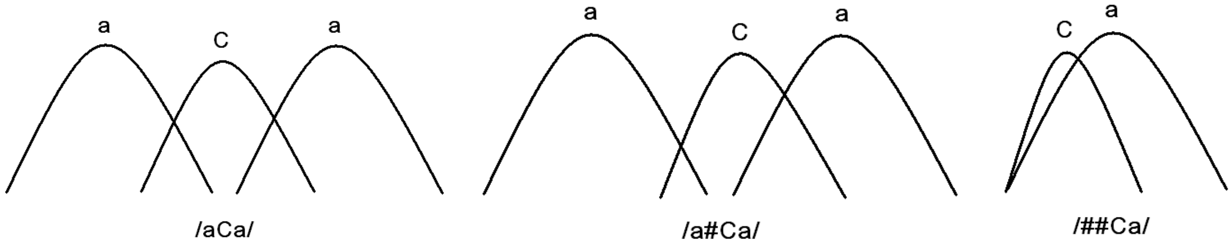


Figure 1: Schematic model of differences in gestural overlap in three different prosodic contexts: wordmedial (/aCa/), word-initial but phrase medial (/a#Ca/), and word- and phrase initial /##Ca/).

Conversely, the AP framework predicts that VC coupling is *weakened* by prosodic boundaries, thus is lesser in V#CV than VCV contexts. In this context, tighter coupling represents greater gestural overlap (in other words, the gestures are executed more in-phase), hence the acoustic effects of coordination might be thought to be greater, the tighter the coupling. However, coordination effects are also strongly moderated by the identity of the consonants and vowels involved.

Coronals have been found to display the highest resistance to coarticulation (Recasens, 1985) and, conversely, to exert the greatest effects on neighbouring vowels, among which /a/ is least resistant to coarticulation (Fowler & Saltzman, 1993). Therefore, in coronal-rich languages, where pressure to maintain coronal contrasts is high, coronal consonants should leave the clearest traces of perseverative (passive) coarticulation in the acoustics of a following /a/ in ##CV context, with the weakest traces in VCV, and intermediate effects in V#CV. However, given that anticipatory effects are greater than carryover effects, the most significant coarticulation effects should be found in *preceding* vowels, due to active anticipatory coarticulation of the C, with VCV showing greater acoustic effects than V#CV (Fowler & Saltzman, 1993).

It is typically claimed that the only robust cues for retroflexes exist in the VC transition, and not in the CV transition. Further, it has been suggested that this is the reason for the cross-linguistically common pattern of apical neutralisation in word-initial contexts (see, for instance, Steriade, 2001). Retroflex stops, such as /ʈ/, thus offer a unique testing ground for the predictions of AP that prosody affects gestural coordination and thereby coarticulatory effects leading to the preservation of contrasts. This contrasts with other frameworks, such as psycho-acoustic perspectives, which do not integrate prosody in predictions for contrast maintenance. In particular, AP predicts that CV coupling may serve to differentiate retroflexes from alveolars and dentals, just when coupling is increased by prosodic strengthening.

Method

We tested the predictions of AP using Wubuy. Wubuy (also know as Nunggubuyu, see e.g., Heath, 1984) is an endangered Australian Aboriginal language, spoken in Eastern Arnhem Land. It has a four-way coronal stop contrast /t, t̪, ʈ, c/ that is reportedly contrastive word-initially, and by implication utterance-initially. We recorded 3 female native speakers of Wubuy (ages 51-61 years), producing 5 repetitions of target Wubuy words containing the dental, alveolar and retroflex stops in a carrier phrase, in three prosodic contexts: word-medial, but syllable initial /aCa/, word-initial but utterance-medial /a#Ca/, and absolute utterance-initial /##Ca/. F1, F2, F3 values were extracted at 25%, 50%, 75% of both preceding and following vowels, as well as at consonantal closure and voicing onset as it has been claimed that information about retroflexation is carried on the preceding vowel.

The lamino-palatal series was excluded from this study for the following reasons. Researchers consistently report difficulty in distinguishing, on the one hand, apico-retroflex from apico-alveolar and, on the other, apico-alveolar from lamino-dental under certain conditions, and there is some acoustic work supporting these auditory impressions (see e.g. Hamilton, 1996). In many Australian languages, the contrast between apicals is reportedly neutralised in some environments, notably word- and morpheme-initially (see e.g. Dixon, 1980). In addition, there is some evidence for historical neutralisation of the contrast between lamino-dental and apico-alveolar in morpheme-initial positions in the genetic group which includes Wubuy (Harvey, 2003), as well as synchronically in Wubuy's neighbour and presumed congenor, Anindilyakwa (Leeding, 1989). No researchers report difficulty in distinguishing the lamino-palatal series from any other contrastive place of articulation, to our knowledge.

Results

In *preceding* vowels (/aCa/, /a#Ca/), F3 distinguishes all three stops (see Figure 2). In the /aCa/ context, the retroflex is distinct from the other two stops in terms of F3 from 25% into the preceding vowel. In the /a#Ca/ context, the retroflex is distinct from the other two stops in F3 from 50% into the preceding vowel. At the onset of consonantal closure, the VC transitions distinguish all three stops in terms of F3 in both contexts.

In the *following* vowel, however, F2 distinguishes the stops differently in each environment (again, see Figure 2). In the /aCa/ context, F2 distinguishes the dental from the alveolar and retroflex in the first 25% of the vowel. In the /##Ca/ context, the retroflex is distinct from the dental in F2 throughout the vowel, and also from the alveolar at 25% and 50% of the vowel. In the intermediate /a#Ca/ context, F2 distinguishes all three stops at 50% of the vowel, while the retroflex is distinguished from the dental in F2 throughout the vowel.

Discussion

These patterns are consistent with AP predictions. The alveolar versus retroflex stops are clearly distinguished in the preceding vowel of /a(#)Ca/, but in the crucial /##Ca/ context, where prosodic strengthening is maximal, F2 distinguishes the retroflex from the two other stops throughout the first 50% of the *following* vowel.

We suggest that this is because of the greater gestural overlap associated with a tighter coupling of the consonant and vowel gestures in the utterance initial context. F2 does not distinguish the retroflex and alveolar in the CV transition of the /aCa/ context, where the preceding vowel transitions clearly distinguish all three stops. As predicted, /a#Ca/ shows intermediate characteristics. While the preceding vowel's F3 distinguishes among the three stops, distinctions also appear in the following F2, suggesting a greater degree of gestural overlap, though not as strong as in utterance initial context. All in all, the findings support the posited convergence of prosodic strengthening and gestural coupling on coronal stop distinctions.

While formant trajectories differentiate the stops to some extent in the preceding and the following vowel, we suspect that measures of closure duration, VOT, as well as the spectral properties of the burst, may also contribute to the maintenance of contrasts. In addition, though we have established that there are measurable differences in the vowel transitions for coronal stops, perceptual studies are an important direction for future research.

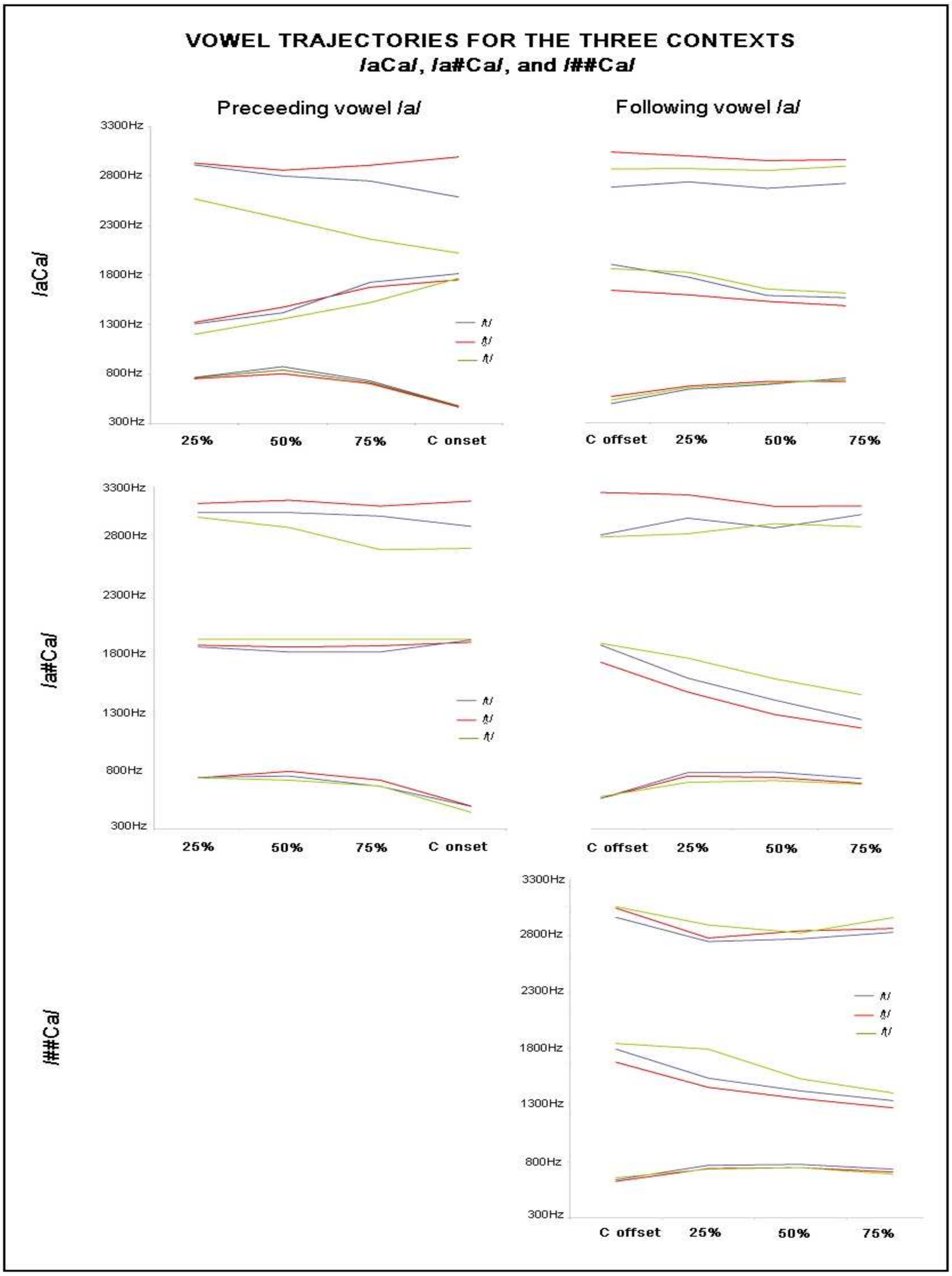


Figure 2: Averaged vowel trajectories for the vowels in /aCa/, /a#Ca/, and /##Ca/.

References

Browman, C. P., & Goldstein, L. (1986). Towards an articulatory phonology, *Phonology Yearbook*, 3, 219–252.

Browman, C. P., & Goldstein, L. (1989). Articulatory gestures as phonological units. *Phonology,* 6, 201-251.

Browman, C. P., & Goldstein, L. (1990). Representation and reality: physical systems and phonological structure. *Journal of Phonetics*, 18, 411-424.

Byrd, D. & Choi, S. (2009). At the juncture of prosody, phonology, and phonetics — The interaction of phrasal and syllable structure in shaping the timing of consonant gestures. In F.Pellegrino, E. Marsico, I. Chitoran, C. Coupé (Eds.), *Approaches to Phonological Complexity*. Mouton de Gruyter: New York

Dixon, R.M.W. 1980. The languages of Australia. Cambridge: CUP.

Goldstein, L., Byrd, D., & Saltzman, E. (2006). The role of vocal tract gestural action units in understanding the evolution of phonology. In M. Arbib (Ed.), *Action to Language via the Mirror Neuron System*. Cambridge: Cambridge University Press (pp 215-249).

Fowler, C. A. & Saltzman, E. (1993). Coordination and coarticulation in speech production. *Language & Speech*, 36, 171-195.

Hamilton, P. (1996). *Phonetic constraints and markedness in the phonotactics of Australian Aboriginal languages*. Unpublished PhD dissertation, University of Toronto.

Harvey, M. (2003). An initial reconstruction of Proto Gunwinyguan phonology. In N. Evans (Ed.), *The non-Pama-Nyungan languages of northern Australia: comparative studies of the continent's most linguistically complex region.* Canberra: Pacific Linguistics (pp 205-268).

Heath, J. (1984). *Functional grammar of Nunggubuyu*. Canberra: AIAS.

Leeding, V. (1989). *Anindilyakwa phonology and morphology*. Unpublished PhD dissertation, University of Sydney.

Nam, H., Goldstein, L., & Saltzman, E. (2009). Self-organization of Syllable Structure: A Coupled Oscillator Model.. In F.Pellegrino, E. Marsico, I. Chitoran, C. Coupé (Eds.), *Approaches to Phonological Complexity*..Mouton de Gruyter: New York.

Recasens, D. (1985). Coarticulatory patterns and degrees of coarticulatory resistance in Catalan CV sequences. *Language and Speech*, 28, 97–114.

Steriade, D. (2001). Directional asymmetries in place assimilation: a perceptual account. In E. Hume and K. Johnson (Eds.), *The role of speech perception in phonology*, San Diego: Academic Press (pp 219-250).

Consonant lenition and phonological recategorization

Even though Linguistics became a scientific discipline through the study of sound change, we still cannot say that we understand the phenomenon of sound change completely. In this paper we focus on a common reductive process, the lenition of intervocalic stops as found, for instance, in Western Romance. Even in the case of such frequent historical changes there are a number of unresolved questions:

1. How does phonological recategorization take place?
2. Is lenition restricted to word-internal contexts at the initial stages of the process?
3. Is there evidence for lexical diffusion or does lenition apply uniformly to all items with the relevant phonetic context?

To try to shed some light on these issues, in this paper we consider the incipient voicing of intervocalic stops that we find in some contemporary Spanish varieties. This is based on the hypothesis that the prelude to sound change can be found in synchronic variation and that the analysis of variation in speech may illuminate aspects of older, accomplished sound changes.

As our source of Spanish data we have used a corpus of high-quality recordings of both unscripted and scripted speech from the same 20 native speakers of Spanish from Spain. We have also analyzed unscripted speech from 12 speakers of High Navarrese Basque, a Basque variety where intervocalic /ptk/ are frequently voiced. Notice that, since intervocalic /bdg/ are approximants in Spanish (and Basque), the voiced realization of /ptk/ does not necessarily imply phonological merger. We then carry out an acoustic analysis intended to determine degree of weakening, especially among voiced tokens of /ptk/, and the degree of overlap of voiced realizations of /ptk/ with phonemic /bdg/ in different contexts. For this, we consider two acoustic correlates of degree of constriction, intensity difference in CV and maximum rising velocity in the intensity trajectory (measurement adapted from Kingston 2008, with some modifications), in addition to consonant duration. Figure 1 shows the results from one of our analyses.

Our results show that even though intervocalic /ptk/ are voiced with some frequency in unscripted Spanish speech, we cannot speak of generalized merger with /bdg/ in this language, since the two phonological series differ in constriction degree and duration even when /ptk/ are fully voiced. The smallest difference was found in the case of the velars. This was replicated for Basque.

Regarding the question of whether, at this early stage in the change, the voicing of stops is restricted to the word-internal context. The answer is negative: Voicing takes places equally inside words and across word-boundaries, as long as the target segment is in the intervocalic context. We thus find support for Weinrich's (1958) suggestion that the blocking of the sound change across word boundaries that we find in Western Romance voicing (e.g. LUPU > *lobo* vs. ILLA PORTA > *la puerta*, not ***la buerta*) must be a secondary development, linked to rephonologization, after a first stage where phonetic voicing applied without regard to word boundaries.

We believe we have evidence for a model of sound change where the online variable reduction and overlap of articulatory gestures in casual speech (see Browman and Goldstein 1991) is at some point conventionalized as a specific process of phonetic reduction. This conventionalization takes place as the Neogrammarians postulated: phonemes are affected in specific contexts. The conventionalization of the phonetics may later be followed by phonemic recategorization. This recategorization, on the other hand, operates on specific lexical units, not on phonemes across-the-board.

The claim is thus that conventionalization is Neogrammarian, i.e., phonemes are affected; but recategorization is lexically gradual, i.e., words change. Conventionalized lenition processes apply across the board in a first stage. Lexical effects and word-boundary effects are produced by the recategorization of the most extreme variants generated by the lenition process.

References

Browman, Catherine and Louis Goldstein. 1991. “Gestural structures: distinctiveness, phonological processes and historical change”. In: I. Mattingly & M. Studdert-Kennedy, eds., *Modularity and the Motor Theory of Speech Perception*, pp. 313-338.

Kingston, John. 2008. “Lenition.” *Selected Proceedings of the 3rd Conference on Laboratory Approaches to Spanish Phonology*, ed. by Laura Colantoni and Jeffrey Steele, 1-31. Somerville, Mass.:Cascadilla Proceedings Project.

Weinrich, Harald. 1958. *Phonologische Studien zur Romanischen Sprachgeschichte*. Münster: Aschendorff.

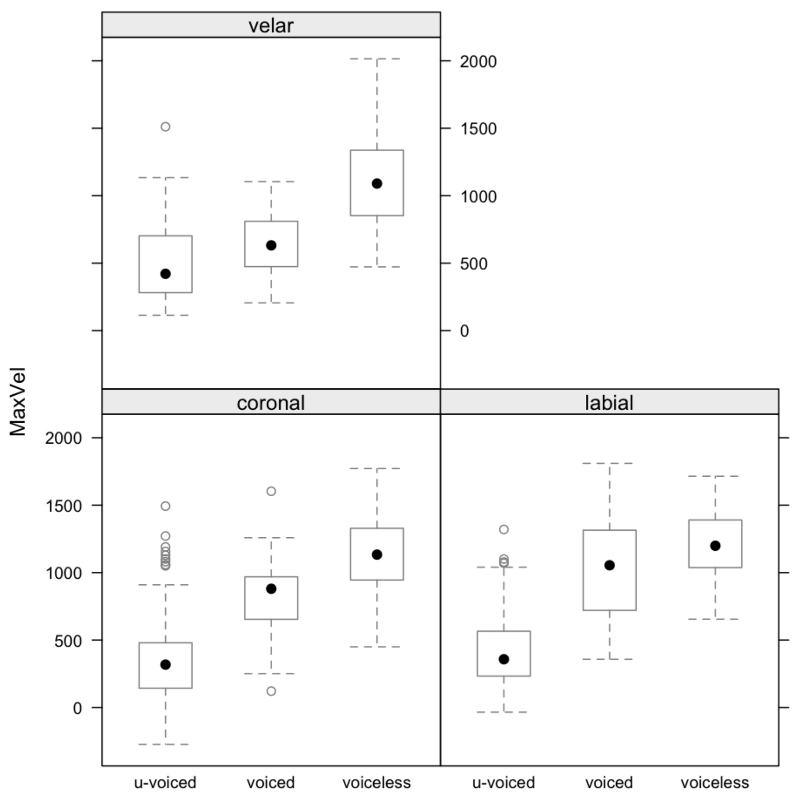


Figure 1. Spanish spontaneous speech. Boxplots of maximum rising velocity (MaxVel) in the intensity trajectory between the consonantal minimum and the vocalic maximum of /ptk/ (realized as voiceless or voiced allophones) and /bdg/ (u-voiced) as a function of place of articulation (velar /kg/, coronal /td/, bilabial /pb/).

The Relationship between Speech Errors and Prosodic Phrase Boundaries

Speech errors occur when the activation of preceding or subsequent linguistic elements interferes with the activation of a current element (Dell, 1986; Roelofs, 2002). Speech errors have been used to inform models of language production (Dell, 1986; Levelt, 1989; Roelofs, 2002) and theories of phonological structure, typically at the level of the word (Fromkin, 1971;Shattuck-Hufnagel, 1979; Mowrey & Mackay, 1990; Goldstein, et al. 2007). Our goal was to use these errors to understand something about the structure of larger, supralexical units in the speech plan. Accordingly, we investigated the relationship between speech errors and prosodic phrase boundaries. This investigation showed clearly that errors and prosodic boundaries interact.

In order to independently assess errors and prosodic phrasing and then determine how the two might relate, we asked 40 native English-speaking undergraduate students to produce 60 sentences 5 times in random order. The sentences varied in length and in the extent to which certain phonological features were repeated (tongue twisters or not). Participants were instructed to prepare their utterances in advance and then not to hesitate or stop once they started speaking. The goals of the instruction were (1) to ensure the production of well-structured utterances, and (2) to maximize the number of errors a participant might produce, while minimizing the effects that excessive self-correction might have on prosodic structure. The first author and a research assistant then listened to the entire corpus of 12,000 sentences and independently identified the errors, which occurred in about 10% of the sentences. Next, the two authors separately categorized the errors as being ones of anticipation, preservation, lexical substitution, and so on. Errors of anticipation and preservation were identified if the error repeated an element that couldbe found within the phrase. The source of the error was always assumed to be the repeatedelement that was closest to the error. For example, if the speaker produced "*The blig black bugbit the big black bear…*" the error *blig* for *big* was identified as one of anticipation with thesource being the first instance of the word *black*. Finally, the authors listened to the sentencesthat contained errors of anticipation and preservation and prosodically-transcribed strong and weak prosodic boundaries by attending to intonational and durational cues. We will refer to the units defined by these boundaries as intonational units (IU).

The 40 speakers produced a total of 1,634 speech errors, 76.93% of which were errors of anticipation and perseveration. The analyses focused on the distribution of the anticipatory and perseveratory errors within an IU and on the relationship between error position and source position. Although an error and its source were rarely matched with respect to IU position, the distribution of errors provided evidence that the IU is a coherent planning unit (see **Figure 1**). In particular, the number of errors varied as a function of position within a unit such that the fewest errors were found in IU-initial position, more occurred in early-mid position, and even more occurred in late-mid position. We refer to this result as the cumulative error effect. We also noted an IU-final position effect that varied with the position of the IU within a phrase. If the IU occurred in phrase-initial or phrase-internal position, then a disproportionate number of errors occurred in IU-final position. If the IU occurred in phrase-final position, then the number of errors associated with IU-final position was somewhat reduced relative to the number of errors found in late-mid position. The fact that the final position effect varied in this way with the position in a stimulus phrase suggests that the cumulative error effect and final effect were distinct.

The cumulative and final error effects are interpreted as evidence for the IU as the principal planning unit in a hierarchically structured speech plan. Specifically, we propose that the low error rate on initial words within an IU reflects a state of high IU activation, whereas thehigher error rate on subsequently occurring words within the IU reflects a comparably lower state of overall activation. Like the cumulative error effect, the final position effect also provides evidence for the IU as a planning unit. Whereas the cumulative error effect may reflect decaying activation in the IU that is currently being executed, the final error effect likely reflects the activation of a subsequent IU. Specifically, we suggest that the process of inhibiting the past, activating the present, and planning the future—to paraphrase Dell et al.'s (1997) formulation of serial language production—occurs at the level of the IU and that the cumulative and IU-final effects emerge because of this. Final words in phrase-internal IUs are especially error prone because their activation is confounded by the low level of activation within the IU and by the concurrent activation of a subsequent IU that is close to threshold for execution.

ACKNOWLEDGEMENTS

We are grateful to Rachel Crist for helping to identify speech errors in these recordings. This work was supported in part by NIH grant 1R01HD061458-01.

REFERENCES

Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review, 93,* 283-321.

Dell, G.S., Burger, L.K., Svec, W.R. (1997). Language production and serial order: a functional analysis and a model. *Psychological Review*, 104, 123-147.

Fromkin, V. A. (1971). The nonanomalous nature of anomalous utterances. *Language*, 47, 27-52.

Goldstein, L., Pouplier, M., Chen, L., Saltzman, E., & Byrd, D. (2007). Dynamic action units slip in speech production errors. *Cognition, 103*, 389-412.

Levelt, W. J. M. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press

Mowrey, R. A., & Mackay, I. R. (1990). Phonological primitives: electromyographic speech error evidence. *Journal of the Acoustic Society of America, 88*, 1299-1312.

Roelofs, A. (2002). Spoken language planning and the initiation of articulation. *The Quarterly Journal of Experimental Psychology*, *55A*, 465-483.

Shattuck-Hufnagel, S. (1979). Speech errors as evidence for a serial-ordering mechanism in sentence production. In W. E. Cooper & E. C. T. Walker (Eds.), *Sentence processing: Psycholinguistic studies presented to Merrill Garrett* (pp. 295-342). Hillsdale, NJ: Erlbaum.

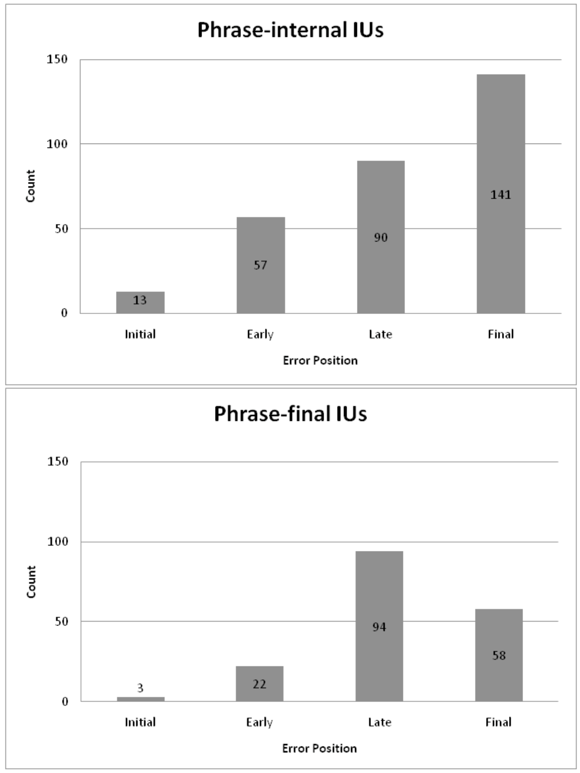


Figure 1. The number of speech errors in medium and long IUs (4+ words) is shown as a function of the position of the words containing speech errors (error position). The top panel shows error counts for phrase-internal IUs and the bottom panel shows those for phrase-final IUs. The error data was collapsed across IUs defined by weak and strong boundaries because the pattern of results was the same for both types of IUs.

Metrical regularity modulates articulatory rate

Prosodic structure is known to influence utterance production in numerous ways, but the specific influence of repetition of metrical pattern on utterance production has never been investigated. This study compared productions of sequences of four trisyllabic nonwords in two conditions: a metrically regular condition with a repeating strong-weak-weak [sww] pattern, and a metrically irregular condition that lacked a repeating pattern. Speakers produced the utterance more slowly in the irregular condition and made more production errors. These findings are important because they are not readily accommodated by current models of speech production. It is argued that the effects of metrical regularity arise from interference between different prosodic structures, which is due to dynamical constraints on how prosodic structure is represented in the working memory of an utterance plan.

There are many factors that have been shown to influence speech articulation rate, such as position relative to prosodic boundaries, lexical frequency and familiarity, phonological neighborhood density, information status, and sociolinguistic context. This study explores the influence of a previously overlooked factor: metrical pattern regularity, which is the degree of consistency in the alternation of stressed and unstressed syllables in an utterance. For example, the utterance “Sally is hoping to travel to Canada” is more metrically regular than “Sally is avoiding a trip to Canada”. Both utterances contain the same number of stressed and unstressed syllables; however, the former exhibits a repeating trisyllabic pattern of stressed-unstressed-unstressed [sww] feet, while the latter exhibits a less regular pattern consisting of [swww], [sww], [sw], and [sww]. This paper describes two novel approaches to quantifying metrical regularity. One is based upon viewing the pattern of syllables as a Markov process and computing the 2nd-order entropy rate, with the result that regularity is associated with lower entropy, i.e. a greater degree of certainty in the stress of an upcoming syllable. The other approach views the utterance pattern as a collection of syllable oscillators coupled to foot oscillators in n:1 harmonic frequency-locking ratios, and derives a regularity metric from the order of *n* and its running variance.

It was hypothesized that when a sequence of words is planned in parallel, dissimilarity in their metrical structure would effect a form of interference in the preparation and execution of articulatory plans, which would be manifested in a slowing of articulatory rate and higher error rates in sequence production. A prepared speech task (Sternberg et al., 1978, 1988; Wheeldon & Lahiri, 1997, 2002) was used to test this hypothesis. On each trial, speakers were visually presented with a sequence of four nonsense words for 3 seconds, then they subvocally rehearsed those words for another 3 seconds, and when cued with a go-signal, they produced the target sequence as quickly and accurately as possible. The words varied in only two respects: initial consonant, C{m, n, p, k, s}; and stress pattern, [sww]—/'Citədə/ or [wsw]—/Cə'tidə/. The utterance-initial consonant of the sequence was always /m/ or /n/, while initial consonants of subsequent words were random permutations of /p/, /k/, and /s/. There were two metrical pattern conditions: regular (sww-sww-sww-sww) and irregular (sww-wsw-wsw-sww). 15% of trials were catch trials with no go-signal. 8 subjects participated, each performed approximately 150 trials in both conditions. Dependent variables analyzed were reaction time, utterance duration, word durations, and error/hesitation rates.

Metrically irregular patterns were associated with significantly higher error and hesitation rates than regular patterns, suggesting that metrically irregular sequences are maintained and/or retrieved from working memory with more difficultly. After removal of errorful and hesitatory trials, statistical analyses revealed that utterances were significantly slower in the irregular condition, which supports the interference hypothesis. These results show that a previously unidentified factor—metrical regularity—influences speech articulation rate. This finding is significant because most current models of speech production predict no such effect. A dynamical model is presented in which interference between metrical patterns in the parallel planning of multisyllabic words effects a slowing of speech rate in execution.

References

Sternberg, S., Knoll, R. Monsell, S. & Wright, C. (1988). Motor programs and hierarchical organization in the control of rapid speech. *Phonetica,* 45, 175-197.

Sternberg, S., Monsell, S, Knoll, R., & Wright, C. (1978). The latency and duration of rapid movement sequences: Comparisons of speech and typing. In G. E. Stelmach (Ed.) *Information Processing in Motor Control and Learning.* New York: Academic Press. 117-152.

Wheeldon, L. & Lahiri, A. (1997). Prosodic units in speech production. *Journal of Memory and Language*, 37, 356–381.

Wheeldon, L. & Lahiri, A. (2002). The minimal unit of prosodic encoding: prosodic or lexical word. *Cognition*, 85(2): B31-B41.

Inter-language interference in VOT production by L2-dominant bilinguals: Asymmetries in phonetic code-switching

Interlanguage effects in bilingual code-switching have been noted at higher levels of language use such as time-cost in language comprehension, word recognition, and reading speed, but have not been adequately investigated at the level of phonetic realisation. While contextual changes in bilinguals' language usage, such as prolonged stays overseas, are known to result in first language (L1) and second language (L2) phonetic shifts (Sancier & Fowler, 1997), code-switching provides a unique opportunity for observing the immediate phonetic effects of interlanguage interaction. We applied a code-switching manipulation as a novel and sensitive test that differentiates among four competing hypotheses of L1-L2 phonetic interaction: 1) that there is no L1-L2 interaction, as bilinguals switch languages completely, free of interlanguage phonetic interference (Grosjean & Miller, 1994); 2) Bidirectional L1-L2 interaction will result in productions whose phonetic details differ from those of unilingual mode (in which only one language is used) for both the L1 and L2, compatible with the notion of a common L1-L2 acoustic-phonetic space (SLM: Flege, 1995; gestural drift: Fowler, Sramko, Ostry, Rowland, & Hallé, 2008; Sancier & Fowler, 1997); 3) The L1 will exert persistent unidirectional interference on productions in the L2 (Caramazza, Yeni-Komshian, Zurif, & Carbone, 1973), despite many years of usage of, and even dominance in, the L2; and 4) Dominance in the L2 will exert a unidirectional influence on the L1, as the influence of the L1 on the L2 will be suppressed, but the dominant L2 will influence the code-switched productions in the nondominant L1 (see Flege, Mackay, & Piske, 2002).

We selected voice onset time (VOT) as our measure of phonetic interference, as it is the measure that has been reported in the great majority of past research on this topic, and allows for direct within-subjects comparison with our own work (Antoniou, Best, Tyler, & Kroos, under review), and cross-subject comparisons with other directly relevant research. In addition, our target languages, Greek and English, differ in the phonetic settings of their stop-voicing distinctions: Greek contrasts stops with voicing lead versus short-lag VOT (Botinis, Fourakis, & Prinou, 2000), whereas English has a short-lag unaspirated versus long-lag aspirated VOT distinction. Importantly for the current experiment, Greek and English differ not only in their phonetic settings for stop-voicing distinctions, but in their orthographies as well. This difference in orthography should indicate unequivocally to the speakers exactly where a code-switch is to occur in visually-presented stimulus sentences, thus serving as a constant reminder of the switch in language for the target item.

We measured the VOTs of early, L2-dominant Greek–English bilinguals' productions of the bilabial and coronal stops /b, d, p, t/ in initial position. In the first session, targets were produced in a unilingual Greek (L1) or English (L2) mode (separate groups, n = 8 in each group), and in a later session, the same L1 or L2 targets were produced by the same speaker in a carrier sentence from the other language (i.e., as a code-switch) using orthography to signal the target language change. Mean VOTs and standard deviations are presented in Table 1.

Table 1. *Bilinguals' mean VOTs (M) and standard deviations (SD) of Greek and English stops in unilingual mode and when code-switching from the base language.*

Language Mode	ba		da		pa		ta	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Greek targets group								
Unilingual mode	**-117.9**	27.1	**-122.1**	30.3	**12.4**	2.4	**15.3**	6.5
Code-switch	**-111.4**	52.7	**-108.7**	46.0	**23.7**	33.6	**25.0**	16.1
English targets group								
Unilingual mode	**-8.4**	23.6	**9.0**	21.1	**76.1**	19.3	**91.9**	19.9
Code-switch	**-37.8**	52.6	**-55.0**	45.5	**68.6**	24.4	**81.8**	15.9

We conducted a 2 × (2 × 2 × 2) analysis of variance with the between-subjects factor of target language (Greek vs. English), and within-subjects factors of recording session (unilingual mode vs. code-switch), target voicing (voiced vs. voiceless), and place (bilabial vs. coronal). A significant main effect of target language, $F(1, 14) = 77.6$, $p < .001$, $\eta_p^2 = .847$, confirmed the expected language-specific VOT differences between Greek (negative mean VOT due to long lead of voiced stops) and English (positive mean VOT due to long lag of voiceless stops) ($M_{\text{GREEK}} = -48.0$ ms; $M_{\text{ENGLISH}} = 28.3$ ms). A significant main effect of voicing, $F(1, 14) = 548.2$, $p < .001$, $\eta_p^2 = .975$, and Target Language × Voicing interaction, $F(1, 14) = 9.7$, $p = .008$, $\eta_p^2 = .408$, showed that the overall VOT difference between voiced and voiceless stops was greater in Greek than in English (Greek: $M_{\text{VOICED}} = -115.0$ ms, $M_{\text{VOICELESS}} = 19.1$ ms; English: $M_{\text{VOICED}} = -18.6$ ms, $M_{\text{VOICELESS}} = 79.6$ ms).

Importantly, a significant Target Language × Recording Session interaction, $F(1, 14) = 10.8$, $p = .005$, $\eta_p^2 = .436$, revealed that the mean VOT shift between the unilingual mode and code-switched recordings, collapsed across voicing, was greater for the English targets than the Greek targets ($Mdiff_{\text{GREEK}} = -10.2$ ms; $Mdiff_{\text{ENGLISH}} = 27.8$ ms). Simple effects tests on this interaction showed that English VOTs became more Greek-like (i.e., voiced stops had more lead VOT, and voiceless stops had shorter lag) in the code-switch recordings, $F(1, 14) = 11.6$, $p = .004$, whereas Greek VOTs were unaffected by recording session, *ns*.

In unilingual mode, bilinguals produced monolingual-like VOTs both in Greek and English (Antoniou et al., under review). However, when asked to produce the identical targets via a code-switch, English stops produced via a code-switch from Greek had significantly shorter (more Greek-like) VOTs than those in unilingual English mode (see Figure 1) (inconsistent with hypothesis 1). In contrast, code-switched Greek targets from within English mode failed to show a reliable shift toward English VOTs (thus, hypothesis 2 is not well supported). It appears that L2 dominance does not guard against an L1 influence on production of the L2 (refuting hypothesis 4). In fact, the asymmetrical effect we observed suggests a pervasive L1 influence even in L2-dominant bilinguals (consistent with hypothesis 3), and this is observed most clearly under the specifically inter-language condition of code-switching.

These findings demonstrate that the L1 interferes with the L2 in production, even following years of L2-dominant experience in an L2-immersion environment. An important and novel contribution of our study is that this L1-interference was induced by our deliberate code-switching manipulation. We have demonstrated that code-switching may result in unidirectional L1-interference on production of L2 segments. This L1-interference was observed despite many years of L2 immersion and dominance since early childhood, consistent with the persistent L1-effects on L2-perception reported by Sebastián-Gallés and colleagues (e.g., Pallier, Colome, & Sebastian-Galles, 2001; Sebastian-Galles, Echeverria, & Bosch, 2005; Sebastian-Galles & Soto-Faraco, 1999).

The results of this study provide the first clear evidence that code-switching can have an effect on the phonetic realisation of bilinguals' production of speech. This is consistent with past research on higher levels of language use, which has found that code-switching shows a base language effect, or processing cost (Altarriba, Kroll, Sholl, & Rayner, 1996; Grosjean, 1988; Kolers, 1966; Li, 1996; Macnamara & Kushnir, 1971). Code-switching shows an analogous base language (L1) effect at the phonetic level in speech production as well, and thus is a sensitive test of L1-L2 phonetic interference as well as asymmetries in direction.

Our findings suggest that future research should attend more to order of acquisition asymmetries. For instance, if L2-dominant bilinguals show L1 effects on their L2, we would expect L1-dominant bilinguals to show even stronger L1-interference when code-switching. We also recommend examining voiced stops in gestural drift studies, in addition to voiceless stops, as L1-interference was more prevalent in the longer lead VOTs of the English (L2) voiced stops than in voiceless stops.

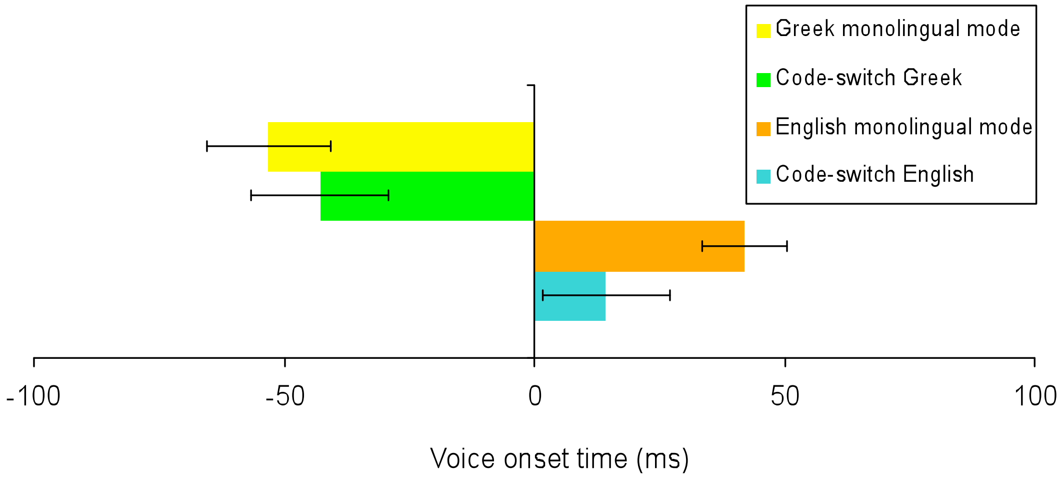


Figure 1. Bilinguals' mean VOTs in Greek and English initial-position stops across voiced and voiceless targets produced in unilingual modes and from code-switches.

References

Altarriba, J., Kroll, J. F., Sholl, A., & Rayner, K. (1996). The influence of lexical and conceptual constraints on reading mixed-language sentences: Evidence from eye fixations and naming times. *Memory & Cognition*, *24*(4), 477-492.

Antoniou, M., Best, C. T., Tyler, M. D., & Kroos, C. (under review). Language context elicits native-like stop voicing in early bilinguals' productions in both L1 and L2. *Journal of Phonetics*.

Botinis, A., Fourakis, M., & Prinou, I. (2000). Acoustic structure of the Greek stop consonants. *Glossologia*, *11-12*, 167-200.

Caramazza, A., Yeni-Komshian, G. H., Zurif, E. B., & Carbone, E. (1973). The acquisition of a new phonological contrast: The case of stop consonants in

French-English bilinguals. *Journal of the Acoustical Society of America*, *54*(2), 421-428.

Flege, J. E. (1995). Second language speech learning: Theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 233-277). Baltimore: York Press.

Flege, J. E., Mackay, I. R. A., & Piske, T. (2002). Assessing bilingual dominance. *Applied Psycholinguistics*, *23*(04), 567-598.

Fowler, C. A., Sramko, V., Ostry, D. J., Rowland, S. A., & Hallé, P. A. (2008). Cross language phonetic influences on the speech of French-English bilinguals. *Journal of Phonetics*, *36*(4), 649-663.

Grosjean, F. (1988). Exploring the recognition of guest words in bilingual speech. *Language and Cognitive Processes*, *3*(3), 233 - 274.

Grosjean, F., & Miller, J. L. (1994). Going in and out of languages: An example of bilingual flexibility. *Psychological Science*, *5*(4), 201–209.

Kolers, P. A. (1966). Interlingual facilitation of short-term memory. *Journal of Verbal Learning and Verbal Behavior*, *5*, 314-319.

Li, P. (1996). Spoken word recognition of code-switched words by Chinese–English bilinguals. *Journal of Memory and Language*, *35*(6), 757-774.

Macnamara, J., & Kushnir, S. L. (1971). Linguistic independence of bilinguals: The input switch. *Journal of Verbal Learning and Verbal Behavior*, *10*(5), 480-487.

Pallier, C., Colome, A., & Sebastian-Galles, N. (2001). The influence of native-language phonology on lexical access: Exemplar-based versus abstract lexical entries. *Psychological Science*, *12*(6), 445-449.

Sancier, M. L., & Fowler, C. A. (1997). Gestural Drift in a Bilingual Speaker of Brazilian Portuguese and English. *Journal of Phonetics*, *25*, 421-436.

Sebastian-Galles, N., Echeverria, S., & Bosch, L. (2005). The influence of initial exposure on lexical representation: Comparing early and simultaneous bilinguals. *Journal of Memory and Language*, *52*(2), 240-255.

Sebastian-Galles, N., & Soto-Faraco, S. (1999). Online processing of native and non-native phonemic contrasts in early bilinguals. *Cognition*, *72*(2), 111-123.

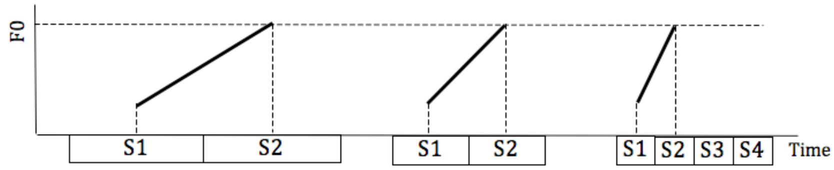
Cross-linguistic applications of a weighted constraint model of F0 movements

This paper investigates the question of what determines F0 movements: pitch targets, or shape of a rise or fall, or some combinations of these. In the level-target approaches, the F0 movements are described with level targets such as L and H (e.g. Pierrehumbert and Beckman 1988). Under this view, shapes of F0 movements (i.e. slope, duration, excursion size) are the results of interpolating between these level targets. The targets are aligned with segmental landmarks ("the anchors"), and the alignment is stable and not affected by speech rate or syllable structure ("Segmental Anchoring Hypothesis (SAH)", Arvaniti et al. 1998, Ladd et al. 1999). On the other hand, F0 movements have also been described in terms of their shape. If shape is the primary determinant of intonation, shape must be relatively stable under changes in other conditions ("Constant Shape Hypothesis (CSH)"). The two views seem inconsistent, because under changes in speech conditions such as speech rate, if segmental alignment is to be kept, the shape will change (Fg.1); as speech rate increases, rise time decreases and slope gets steeper. If shape is to be kept, the alignment will be violated (Fg.2); the peaks are found later relative to the anchor at a fast rate, and earlier than the anchor at a slow rate.

In Cho (2007), we tested the two hypotheses with Seoul Korean. Seoul Korean is a good language to test conflicting hypotheses that make contradictory predictions on F0 peak alignment patterns because it does not have lexical tones, and thus peak alignment is relatively flexible. We found both effects of the SAH and CSH on the timing of the initial rise peak in the Seoul Korean LHLH intonation pattern. Timing of peaks ("H") was linearly correlated with timing of segmental anchors ("A"), which is the effect of the SAH (Fg.3). There was also evidence for the existence of a target *rise time* ("R", the time that it takes to complete a rise from L to H). That is, when speech rate was fast, the peaks were found later than the anchor; when speech rate was slow, the peaks were found earlier than the anchor (Fg.4), as the CSH predicts. Since effects of both the SAH and the CSH are observed, the proposed model of peak timing takes these two factors as interactive terms. Instead of treating the two hypotheses as inviolable principles, we treat the two factors as interacting terms in the proposed model of F0 peak timing, by using weighted constraints (Flemming 2001) ([1]). Conflicting constraints require that the H peak be aligned to the anchor (H=A), and that the rise from L to H occupy a target duration (H=R). The actual H peak timing is the time that minimizes the summed cost of violations of the alignment target and the rise time target. In the current study, we also include the alignment constraint on L in the model.

Building on this finding, we test the hypothesis that both alignment constraint and shape constraint exist in a language and cross-linguistic differences can be captured by relative weights on the alignment and shape constraints. We conducted experimental studies of Mandarin (lexical tone language), Tokyo Japanese (pitch accent language), English (lexical stress language), in addition to Seoul Korean (phrasal tone only). In all these languages, the timing of the word-initial rise peak with regard to a segmental position was examined. We observed a cross-linguistic tendency that H peaks occurred relatively later at faster rates than at slower rates, which supports the existence of both shape and alignment constraints. However, the amount of variations in peak timing varied in different languages, e.g. Mandarin showed a more consistent alignment pattern than Korean. Such cross-linguistic differences can be explicable in terms of the weights of the alignment constraint across languages.

Figure 1. The prediction of the SAH (Segmental Anchoring Hypothesis)
(a) Slow (b) Normal (c) Fast



*The anchor is assumed to be in the middle of the associated syllables.

Figure 2. The prediction of the CSH (Constant Shape Hypothesis)
(a) Slow (b) Normal (c) Fast

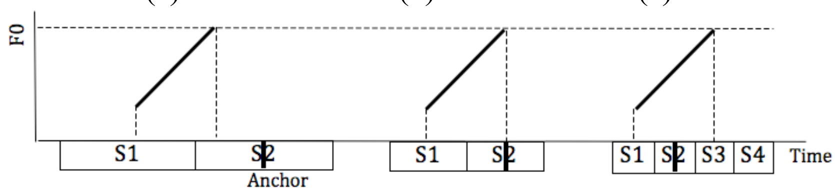


Figure 3. The effect of the SAH

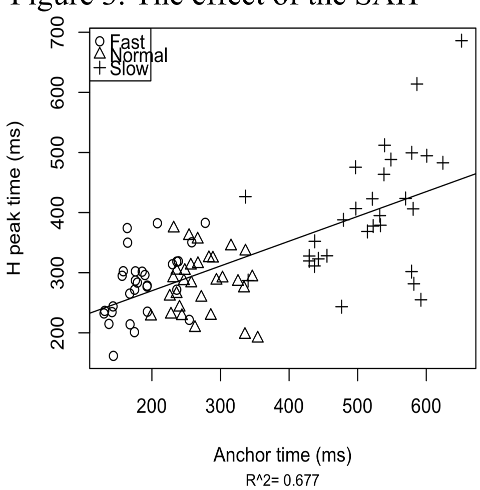
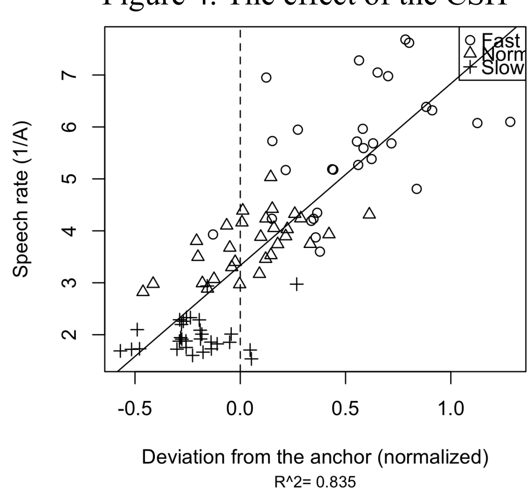


Figure 4. The effect of the CSH



(1) $H_0=\text{ArgMin}[w_A(H-A)^2+w_R(H-R)^2, H]$

H_0: actual timing of H, given A and R
A: the anchor, alignment target
R: the rise time target
w_A,w_R: positive weights

H: timing of H
H-A: Deviation from A
H-R: Deviation from R

Selected References

Arvaniti, A., R. Ladd, and I. Mennen (1998) Stability of tonal alignment: the case of Greek prenuclear accents. *Journal of Phonetics*, 26, 3-25.

Ladd, D.R., D. Faulkner, H. Faulkner, and A. Schepman (1999) Constant “segmental anchoring” of F0 movements under changes in speech rate. *Journal of Acoustical Society of America*, 106 (3), 1543-1554.

Flemming, Edward (2001) Scalar and categorical phenomena in a unified model of phonetics and phonology. *Phonology*, 18(1), 7-44.

Inactive manual articulators in signed languages

This paper will address a notable modality difference in the perception of phonetic articulations in sign vs. speech: the fact that we can see the manual articulators (almost) all of the time in signed languages, whereas in spoken languages we cannot directly see all of the vocal articulators all of the time. Indeed, it is often claimed that only about 25% of the phonemic distinctions in languages like English and Dutch can be perceived visually, even though it is known that the distinctions that are visible can influence speech perception (McGurk & MacDonald 1976). The consequence is that we can also perceive the sign articulators in their rest state, or more precisely, when they are not active in the articulation of phonologically specified material. The central question that this paper aims to address is what types of information can be derived from these rest states. This is an important question because this information is also available to the sign perceiver, and could thus contribute to the perception and recognition processes in signed languages. This study aims to provide a first look at the issues involved, and will not present any perceptual evidence for the actual use of information about inactive articulators.

Most if not all non-manual articulators have standard rest positions that can in principle be maintained during many manual signs: it is the absence of visible muscle tension in the face other than that to keep the eye lids up and the lower jaw closed; the head and upper body are upright in their default position. This is quite different for the manual articulators. In a fully relaxed state and standing upright, the fingers, hands and arms would be hanging beside the upper body, the fingers slightly curved, the forearm half pronated. When seated, the hands often rest on the lap of signers. These 'full-rest' positions and other states of the articulators have been investigated in the study of turn-taking in American Sign Language (Baker 1977) and in deaf-blind interaction in Finland (Mesch 2001), but not as an observable phenomenon in *any* sign language utterance.

Two different articulators will be investigated in some detail here: unselected fingers in handshapes and the non-dominant hand. In many signs, the handshape has a subset of fingers that are relevant or 'selected': they can be in a certain configuration (such as extended or curved), they can contact the location, and they can move. The other fingers are 'unselected': they are not phonologically specified according to most phonological models. Their phonetic configuration is however always visible, and therefore the question arises what their state is in actual realisations of signs in context. Secondly, there are many signs in which only one hand is lexically specified; the other hand is thus likely to be inactive during the realisation of these signs (but see below on other linguistic activities of the non-dominant hand).

It is demonstrated that these articulators do not automatically assume a default position and argued that we can observe the spreading of phonological features in such cases. These cases of feature spreading can potentially inform us about the size of phonological domains such as the prosodic word and the phonological phrase, just as the prolonged presence of all of the final state of the non-dominant hand can be used as evidence for prosodic structure in sign language (Sandler 1999abc).

The special affordances of the visual modality in combination with the complex manual articulators do not necessarily lead to a different view on signed than on spoken languages, but they do call for a consideration of the ways in which the ‘non-articulations’ discussed here may be informative for our understanding of prosody and language processing of signed languages. This requires studies at the interface of phonetics and phonology that can build on the Laboratory Phonology tradition for spoken language research.

References

Baker, C. 1977. Regulators and turn-taking in American Sign Language discourse. In *On the other hand. New perspectives on American Sign Language*, edited by L. Friedman. New York: Academic Press.

McGurk, H., and J. MacDonald. 1976. Hearing lips and seeing voices. *Nature* 264:746-748.

Mesch, J. 2001. *Tactile sign language: turn-taking and questions in conversations of deaf-blind people in sign language*. Hamburg: Signum.

Sandler, W. 1999a. Cliticization and prosodic words in a sign language. In *Studies on the phonological word*, edited by T. A. Hall and U. Kleinhenz. Amsterdam/Philadelphia: John Benjamins.

———. 1999b. The medium and the message: the prosodic interpretation of linguistic content in Israeli Sign Language. *Sign Language & Linguistics* 2 (2):187-215.

———. 1999c. Prosody in two natural language modalities. *Language and Speech* 42 (2-3):127-142.

ASL sign lowering as target undershoot: a corpus study

Many ASL signs that are made on the face or head in citation form are often made with a lower location in connected signing (Figure 1). One obvious analysis is that signers are undershooting the targets of the gestures, just as speakers often do in spoken language (e.g., Lindblom 1963, Browman and Goldstein 1992, Kirchner 1997). Indeed, laboratory studies using optical tracking have shown that undershoot is happening in at least some ASL signs made on the face or head (Mauk et al., 2004; Mauk and Tyrone 2007). At the same time, sociolinguistic studies in the variationist tradition have found many social and linguistic influences on such sign lowering (Lucas et al., 2002; Schembri et al., 2009). Unfortunately, neither approach alone can establish undershoot as a general explanation for sign lowering. It is uncertain whether findings from the artificial tasks and narrow linguistic contexts used in the laboratory will generalize to natural discourse. The variationist studies do not make fine-grained enough measurements to establish that what they're counting are even cases of undershoot. A fuller picture requires combining the natural discourse and wide variety of contexts of the variationist studies with the precise and continuous (not artificially dichotomized) measurements of the laboratory studies.

The corpus for this research consisted of one hour each from ten native ASL signers engaged in free conversation and telling personal narratives. Within this corpus, all tokens of signs with canonical positions on the face or head were identified. For each token, the video frame where the selected fingers came the closest to the canonical location (the attainment point) was identified, and the vertical displacement and the euclidean distance (in pixels) between the canonical position and the attainment point was measured – this is considerably less exact than infrared tracking, but likely at least as precise as using acoustic measurements to infer the position of vocal articulators.

Mixed-effects regression modelling is used to account for the amount of reduction as a function of a number of linguistic predictors. Sign frequency is estimated from a panel of native signers' subjective frequency ratings (which have been shown to correlate strongly with log-frequency in spoken languages). Other potential predictors included are lexical category of the sign (noun, verb, etc.); the previous and next locations that the contacting hand is required to be at in the present sign and (if different) the preceding/following sign; whether the sign occurs before/after a pause; the number of previous uses of that sign in the discourse and the time since the most recent use; and whether the sign co-occurs with non-manual topic marking.

Preliminary results based on a portion of the corpus suggest a strong effect of frequency on reduction for verbs (in particular those high-frequency verbs with grammatical/discourse-marking functions, such as KNOW, SEE, THINK, SUPPOSE), but a much smaller effect of frequency for nouns; a strong effect of non-manual topic marking encouraging reduction; and the expected effect of a lower location in the preceding/following sign encouraging reduction.

While there is clearly plenty of undershoot, as in the Mauk studies, some patterns are more difficult to square with the idea that articulatory undershoot is the only factor that underlies sign lowering. Very many lowered signs continue to contact the face – which would suggest that in those tokens the hand is successfully reaching a lower target rather than undershooting a higher target. Some of the more frequently lowered signs have clear secondary clusters of attainment points (e.g., a cluster of tokens with contact at the cheek in addition to a cluster at the canonical position of the forehead). This would suggest that signs' lexical entries contain more than a monolithic phonological representation – e.g., multiple abstract representations (cf. Connine 2004), exemplars, or non-Gaussian distributions of contact locations.

Figure 1:
The highest point reached by the signer's hand during token of the sign TEACHER, the canonical location of which is on the forehead.

References

Browman, Catherine P., and Louis Goldstein (1992); Articulatory Phonology: An overview; *Phonetica* 49: 155-180.

Connine, Cynthia M. (2004); It's not what you hear but how often you hear it: on the neglected role of phonological variant frequency in auditory word recognition; *Psychonomic Bulletin & Review* 11: 1084-1089.

Kirchner, Robert (1997); *An effort-based approach to consonant lenition.* PhD thesis, University of California, Los Angeles.

Lindblom, Björn (1963); Spectrographic study of vowel reduction; *Journal of the Acoustical Society of America* 35, 1773-1791

Lucas, Ceil, Robert Bayley, Mary Rose, Alyssa Wulf (2002); Location variation in American Sign Language; *Sign Language Studies* 2: 407-440

Mauk, Claude E., Björn Lindblom, and Richard P. Meier (2004); Undershoot of ASL locations in fast signing; *Theoretical Issues in Sign Language Research*.

Mauk, Claude E., and Martha E. Tyrone (2008); Sign lowering as phonetic reduction in American Sign Language; *Proceedings of the 8th International Symposium on Speech Production;* 185-188.

Schembri, Adam, David McKee, Rachel McKee, Sara Pivac, Trevor Johnston, and Della Goswell (2009); Phonological variation and change in Australian and New Zealand Sign Languages: The location variable; *Language Variation and Change* 21: 193-231.

Linguistic vs. non-linguistic coarticulation: An ASL study

While long-distance coarticulation has been studied in spoken languages (e.g. Grosvald, 2009; Magen, 1997; West, 1999), this phenomenon appears to be largely unexplored in sign language research to date (but see Bayley, Lucas & Rose, 2000; Cheek, 2001; Mauk, 2003; for related work). In this paper, we discuss results from a study of long-distance coarticulation in American Sign Language. Phonologically, signs may be characterized in terms of four basic parameters: Handshape, Location, Movement and Orientation. Here, we investigate anticipatory sign-to-sign coarticulatory influence on the Location parameter. This sign production experiment also included a “non-linguistic” condition so that we could assess the degree to which the effects seen for signs may be considered language-specific or characteristic of human actions in general.

Five signers were filmed while signing ASL sentences and additionally, were outfitted with motion-capture sensors via which the three-dimensional coordinates of key points of the signer’s body (e.g. the wrists, the back of each hand) could be recorded during the course of the signing of each sentence. The coarticulatory effects of later signs on earlier signs with respect to Location were then investigated, focusing particularly on the vertical dimension. It was expected, for example, that the signs preceding a context sign articulated at the forehead (e.g. HAT) would tend to have a higher z-coordinate (altitude) than when the same signs preceded a context sign articulated at a lower part of the signer’s body like the waist (e.g. PANTS). In the non-linguistic condition, the sentence-final “high”- and “low”-positioned context items were also positioned at the height of the signer’s forehead or waist, but required the signer to flip an appropriately-located switch instead of articulating a sign.

Evidence of coarticulatory effects of one sign on another were found across up to three intervening signs, though they were generally weaker than effects found in analogous spoken-language studies (Grosvald, 2009; Magen, 1997). This difference appears to be due in part to the greater variability among these signers in their articulatory behavior, relative to that of users of spoken language. Results for the non-linguistic condition were substantially the same as those for the linguistic (sign) condition. Therefore, to the extent that location-based effects occurred, it appears that they cannot be deemed specifically linguistic in nature. Even so, the existence of long-distance coarticulation like that found here has implications for models of sign language production and therefore for language production in general.

Temporal, structural, and pragmatic synchrony between intonation and gesture

This paper explores the interaction between intonation and gesture, noting temporal, structural, and pragmatic synchrony. Videotapes of subjects conversing freely were annotated for intonation according to ToBI (Beckman and Elam, 1997), and for gesture according to Kendon (1972, 1980) and McNeill (1992). The 7,500 time-stamped annotations were analyzed statistically, as well as visually in the Anvil tool (Kipp, 2001), which allows time-aligned viewing of video with their annotations. Alignments were investigated between three levels of intonational units, and four levels of gestural units. The intonational units were, from smallest to largest, pitch accents, intermediate phrases, and intonational phrases. The gestural units, again from smallest to largest, were apices of strokes, gestural phases, gestural phrases, and gestural units. Of these possible combinations, two pairs aligned. Apices clearly aligned with pitch accents, and gestural phrases tended to align with intermediate phrases. The existence of intermediate phrases in English has been the subject of some debate (Ladd 2008), and this paper suggests that a probable gestural correlate to intermediate phrases provides independent evidence for their existence. In addition, intonation and gesture were found to perform simultaneous complementary pragmatic functions. This temporal, structural, and pragmatic synchrony between the two modalities reinforces the idea of a single ‘idea unit’ (Kendon 1972, 1980), or ‘growth point’ (McNeill 1992, 2005), emerging in parallel in the two modalities.

References

Beckman, M., & Elam, G. A. (1997). *Guidelines for ToBI labeling, version 3*. Retrieved November 10, 2003 from http://www.ling.ohio-state.edu/research/phonetics/E_ToBI/

Kendon, A. (1972). Some relationships between body motion and speech: An analysis of an example. In A. Siegman & B. Pope (Eds.), *Studies in dyadic communication*. New York: Pergamon Press.

Kendon, A. (1980). Gesticulation and speech: Two aspects of the process of utterance. In Mary Ritchie Key (Ed.), *The Relationship of Verbal and Nonverbal Communication* (207-227). The Hague: Mouton.

Kipp, M. (2001). Anvil—a generic annotation tool for multimodal dialogue. *Proceedings of the 7th European conference on speech communication and technology (Eurospeech)* (1367-1370), Aalborg, Denmark.

Ladd, D. R. (2008). *Intonational phonology*, 2nd ed. Cambridge University Press.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. University of Chicago Press.

McNeill, D. (2005). *Gesture and thought*. University of Chicago Press.

Speech / Hand Coordination in the Production of Prosodic Focus

Manual gestures are naturally produced in spoken communication (see *e.g.* Mcneill, 1992; Kendon, 1997). The links between hand gestures and speech were mainly analyzed qualitatively and most studies showed that brachio-manual gestures and speech are tightly bound. In particular, it appears that gestures can be linked to prosody (e.g. Mcclave, 1998). Some studies have tried to shed light on the coordination of speech and manual gestures using motion capture. Levelt *et al.* (1985) studied the coordination of speech (noun phrase) and pointing gestures and found that speech seems to adapt its timeline to that of the gesture. de Ruiter (1998) found that speech/pointing coordination (speech: noun phrase or single word) was influenced by contrastive but not lexical stress. Rochet-Capellan *et al.* (2008) found that the stressed syllable (within a two-syllable non-word) is always included in the part of the pointing gesture that shows (index finger extended and pointed at target).

The aim of this study is to analyze the coordination between speech and manual gestures in the production of prosodic contrastive focus. Focus consists in putting forward (*i.e.* designating and thus, in a sense, pointing at; see Lœvenbruck *et al.*, 2009 for discussion on this issue) a word or a group of words within an utterance (ex: THOMAS$_f$ ate the candy). It is thus related to manual pointing. This study addresses several key questions: ① How does the position of focus in the utterance influence gesture/speech coordination ? ② Is this coordination dependent on the relationship between gesture and speech *i.e.* on the type of gesture?

Methodology – We compared two prosodic focus conditions: subject focus (SF) *vs.* object focus (OF); and four gesture conditions: no gesture (speech only) *vs.* index-finger pointing (deictic communicative) *vs.* beat gesture (non-deictic communicative) *vs.* control gesture (button press; non-deictic non-communicative). We used a correction task to elicit the production of focus.

The participants sat in a chair facing a translucid screen on which visual targets appeared. The motion of their mouth and right hand were tracked using a motion capture device (Optotrak). The vocal productions were recorded using a microphone. Four points of interest were annotated for gestures (beginning, apex, return, end). Articulatory lip targets (protrusion and aperture peaks) and acoustic cues (fundamental frequency and intensity peaks, boundaries of syllable production) were also annotated. Ten adults (8F, 2M) participated in the experiment. All were right-handed and native speakers of French.

Results – Focus condition (SF *vs.* OF) has a significant effect on the timing of gesture production (for all four points of interest: $F(1,9) > 52$, $p < 10^{-4}$). The position of the gesture is thus influenced by the position of focus. Gesture condition has a significant effect on the timing of gesture apices and ends for all gesture types ($F(1,9) > 9, p < 10^{-2}$).The timing of the acoustic cues of focus are not influenced by the production of a gesture nor by gesture type, except for intensity ($F(1,9) < 3.1$, n.s. for all acoustic cues, except intensity).

The positions of the gestures' points of interest were compared to those of the articulatory targets and acoustic cues. The pointing gesture is more strictly coordinated with focus than the other gestures. In particular, the pointing gesture apex is tightly aligned with articulatory lip targets corresponding to vocalic gestures. Control and beat gestures appear to be either more difficult to elicit or less precise. Speech/gesture coordination is clearly influenced by the type of gesture. Moreover the data show that speech onset is influenced by the production of a gesture but that the utterance's internal organization is not influenced. Gesture onset is always influenced by the focus condition. However, the gesture's internal organization is influenced by the focus condition only for pointing.

Conclusion – This study allows for a more precise characterization of speech/gesture coordination in spoken communication (entire sentences and dialog context). It also shows that speech/gesture coordination is dependent on the functional relationship between gesture and speech.

References

Kendon, A. (1997). Gesture. *Annual Review of Anthropology*, *26*(1), 109–128.

Levelt, W., Richardson, G., & La Heij, W. (1985). Pointing and voicing in deictic expressions. *Journal of Memory and Language*, *24*(2), 133–164.

Lœvenbruck, H., Dohen, M., & Vilain, C. (2009). Pointing is special. In S. Fuchs, P. Perrier, & H. Lœvenbruck (Eds.), *Some aspects of speech and the brain* (p. 211-258). Peter Lang Verlag.

Mcclave, E. (1998). Pitch and manual gestures. *Journal of Psycholinguistic Research*, *27*(1), 69–89.

Mcneill, D. (1992). *Hand and mind: What gestures reveal about thought*. University Of Chicago Press.

Rochet-Capellan, A., Laboissière, R., Galvan, A., & Schwartz, J.-L. (2008). The speech focus position effect on jaw-finger coordination in a pointing task. *Journal of Speech, Language, and Hearing Research*, *51*, 1507–1521.

Ruiter, J. P. de. (1998). *Gesture and speech production*. Unpublished doctoral dissertation, Catholic University of Nijmegen, The Netherlands.

Gesture analysis expands the dimensionality of infant language acquisition research

For at least the last 25 years, looking time measures have provided the vast bulk of the insights we have into the linguistic abilities of infants between 4 and 24 months of age. In this work we propose a new metric to supplement and cross-validate looking time: measures of the motion resulting from infant gesture. We report two studies using two different methodologies that, first, confirm the usefulness of gestural movement as a dependent variable, and, second, demonstrate a correlation between results concerning word/object association made using movement measures and those made using looking time measures. We suggest that, like infant looking, infant movement is not random; it is integrally linked to cognitive functioning in these language tasks, and we demonstrate that examining infant movement can yield insights into language acquisition that were previously unavailable.

Study 1: Gestural responses of 6-month-old infants to language and music stimuli. We coded the voluntary motor behavior of 20 6-month-old infants listening to language (n = 10) or music (n = 10) stimuli, using Anvil, a tool for annotating digital video on user-defined, temporally ordered hierarchical tiers, with the capability of tagging marked intervals with attribute labels. Using a detailed coding system, we labeled the presence, nature and timing of infant responses in four major areas: head, arm, and torso movement, hand and finger gesture, vocalization, and eye gaze. Results revealed meaningful significant differences in infant movement in the two conditions, including torso movement, gaze direction, and nature and timing of vocalizations. These results confirm the viability of measures of infant movement for revealing important differences in infant language and music perception.

Study 2: Movement patterns of 14-month-old infants in a word-object association task. Recent work using looking time in a habituation/dishabituation paradigm shows that 14-month-old infants can associate two nonsense, minimally differing word forms with two novel objects under very specific conditions: if the auditory stimuli are delivered by an Experimenter present in the testing room and if they share gaze with the Experimenter to a significant extent. We used this result as a benchmark against which to validate the use of infant motion as a dependent measure in language acquisition studies. We analyzed the videos taken of each of the infants as they participated in this study, using an algorithm that processes optical flow information to yield a matrix of velocity values (horizontal, vertical, Euclidean motion) for each transition from pixel to pixel in the two-dimensional video. The results for magnitude of motion exactly replicated the very specific looking time results obtained in the original study, strong evidence sanctioning the use of movement measures to investigate infant language acquisition. Further, results for movement along the x-and y-axes also yielded significant differences, providing *new* insights into infant behavior in this setting by allowing a more detailed examination of orientation toward the speaker (x-axis motion) and of postural response (y-axis motion), research parameters that are inaccessible to looking time measures.

These studies showcase the successful application of two different and revealing methods for analyzing infant gestural movement: one, a detailed coding system allowing precise qualitative characterization and measurement of infant movement, the other a non-invasive, simple-to-use video-based algorithmic analysis yielding measures of magnitude and direction of global infant movement. Taken together, the studies demonstrate that infant movement is not random, but does, in fact, vary systematically with the infant’s exposure to different stimuli, and further, that measures of infant motion not only support looking time measures, but also yield fresh insights into the cognitive processing of infants involved in language learning tasks. The examination of infant gestural motion opens up access to questions that looking time measures cannot address, and expands and enriches the dimensionality of our understanding of infant language acquisition.

Audiovisual correlates of social awareness in growing children

When children grow older, they become more proficient in their ability to communicate with other people[1] . As part of this development, they not only increase their knowledge of the words, the pronunciation and grammar of a specific language, but also acquire better skills to use and interpret prosodic structures. Prosody can roughly be defined as the set of features that do not so much determine what people say, but rather how they say it. Traditionally, the use of the term prosody was restricted to purely auditory cues, i.e., features that can in principle be measured in the acoustic signal, such as intonation (or speech melody), pauses, rhythm, tempo, loudness and voice characteristics. More recently, the term has been widened to also include a range of visually perceptible forms of body language, such as hand and arm gestures, posture, and facial expressions (Krahmer & Swerts 2009). In a typical conversation, dialogue partners can hear and see each other, so that they naturally pay attention to both auditory and visual features. Consequently, as audiovisual prosody is omnipresent in most interactions, it represents an important communicative device that children need to acquire.

Various studies have shown that the acquisition of prosody starts very early in a person's lifetime. For instance, while still in the womb, babies develop a memory for the mother's voice (DeCasper & Fifer 1980), and become sensitive to the rhythmic and intonational patterns of their native language (Mehler et al. 1987; Camras et al. 1992, 1998). They also appear to be genetically predisposed to visual input from a human body, as for instance babies from 1 hour to 3 days can imitate gestures like tongue protrusion and mouth opening after watching [1]an adult producing the same gestures (Meltzoff & Moore 1983). Given that infants are seldomly exposed to events in a single modality at a time, they also learn quickly to unify information coming from different modalities (Spelke 1976). Various people have suggested that biological or physiological factors are very important to understand the prosodic features of young infants. But as a child grows older, the impact of biological or physiological factors on variations in audiovisual

[1] The research presented in this articled was conducted as part of the VIDI-project "Functions of Audiovisual Prosody (FOAP)", sponsored by the Netherlands Organisation for Scientific Research (NWO), see foap.uvt.nl. Many thanks to Emiel Krahmer, Suleman Shahid, Lennard van de Laar, Judith Schrier, Jorien Scholze, Kim Smulders, Nicole Hobbelen, Sjoukje Houbers and Manon van Dijk, for various kinds of collaborations which have led to the three studies of this article.

prosody diminishes, as children learn that the features can also be exploited for various communicative purposes.

The central working hypothesis of the current article, is that -with age- the audiovisual prosody of typically developing children becomes more functional and more “other-directed”. This expectation is in line with many theories of cognitive and social development, especially those inspired by Piaget (Goswami 2008), that state that children between ages four and twelve become more socially aware as they grow older. Growing children get exposed to increasingly more varied environments (family, playground, school), and they find that parents and other people approach them differently when they get older (Swerts & Krahmer 2010). In this paper, we investigate the impact of a social awareness on audiovisual prosody in 3 different studies, dealing with expressions of uncertainty (study 1), of emotion (study 2), and of deception (study 3).

The three studies all use a similar 2-step procedure: we first record audiovisual expressions of children in various communicative contexts, and then evaluate these expressions in subsequent perception tests. An important aspect of the first step of this approach, i.e., the elicitation of expressions, is that we use a procedure which guarantees that the recorded materials are representative of the way children express themselves in natural interactions. In that respect, our approach differs from the one used in quite a large number of previous studies. These tended to analyse data with limited ecological validity, being based on portrayed expressions or read-aloud isolated utterances. Characteristics of such data are markedly different from the spontaneous expressions people display in interactions outside the lab. Moreover, production and comprehension tasks that involve portrayal or self-reflection are unsuitable for children, as they require good meta-linguistic and acting skills. Therefore, our paradigm makes use of games, as these have properties highly suitable for studying the audiovisual prosody of children. First, games represent artificial, small universes with their own rules, so that participants can be put in different situational contexts. Second, when people participate in a game, they are interactive, dynamic and engaging; this creates a natural ambiance for spontaneous expressive behaviour (Kaiser & Wehrle 1996; Salen & Zimmerman, 2003). And, since games are fun and players tend to enjoy them, there is less risk that they will induce stressful situations.

This approach has given us some insight into the development of audiovisual prosody in children, finding evidence to support our central hypothesis prosody shows correlates of a child’s social awareness, which is likely to become more developed with age. We indeed found from analyses of expressions of uncertainty (study 1), of emotion (study 2) and of deception (study 3) that social awareness may explain developmental patterns in audiovisual behaviour. Children do not show their confidence level as clearly as adults do, supposedly because they still need to learn that showing one’s uncertainty is a handy face-saving strategy, and is communicatively relevant for an addressee. In addition, older children are less expressive than younger ones about positive or negative emotions, maybe because such emotional cues are more internalised in the older kids, and used more as signals that can to some extent be manipulated for social purposes. And finally, older kids have a harder time to hide their lies, which could be due to the fact that they are more socially aware of the addressee whom they try to deceive, which makes them more conscious about their lies.

References

L.A. Camras, H. Oster J. Campos, K. Miyake, and D. Bradshaw (1992) Japanese and American infants' responses to arm restraint. Developmental psychology 28, 578-583.

L.A. Camras, H. Oster J. Campos, R. Campos, T. Ujiie, K. Miyake, L. Wang and Z. Meng (1998) Production of emotional facial expressions in European American, Japanese, and Chinese infants. Developmental psychology 34 (4), 616-628.

A.J. DeCasper and W.P. Fifer (1980) On human bonding: newborns prefer their mother's voices. Science 208, 1174-1176.

U. Goswami (2008) Cognitive development. The learning brain. Hove, New York: Psychology press.

S. Kaiser and T. Wehrle (1996) Situated emotional problem solving in interactive computer games. In: N. H. Frijda (ed): Proc. of the IXth conference of the international society for research on emotions, Toronto (Canada), pp. 276-280.

E. Krahmer and M. Swerts (Eds.) (2009) Special double issue on audiovisual prosody. Language and Speech 52(2-3), 129-386

J. Mehler, G. Lambertz, P.W. Jusczyk and C. Amiel-Tison (1986). Discrimination de la langue maternelle par le nouveau-né. Comptes rendus de l'Académie des Sciences de Paris 303, série III, 637-640.

A.N. Meltzoff and M.K. Moore (1983) Newborn Infants Imitate Adult Facial Gestures, Child Development 54, 702-709.

K. Salen and E. Zimmerman (2003) Rules of play. Game design fundamentals. Cambridge: MIT press.

E.S. Spelke (1976) Infants' intermodal perception of events. Cognitive psychology 8, 553-560.

M. Swerts and E. Krahmer (2010) Visual prosody of newsreaders: effects of information structure, emotional content and intended audience on facial expressions. Journal of Phonetics 38, 197-206.

‘Seeing tunes’. The role of visual gestures in tune interpretation

Since the report of the McGurk’s effect (McGurk & MacDonald, 1976), the strong influence of vision upon speech perception in normal verbal communication has increasingly been recognized and replicated. Recent studies on audiovisual speech have revealed that the visual component indeed has a clear role for the perception of various aspects of communication that were typically associated with verbal prosody. Various researchers have shown that the visual correlates of prominence and focus (movements such as eyebrow flashes, head nods and beat gestures) boost the perception of focus and prominence (Cavé et al., 1996; Hadar et al., 1983; Krahmer & Swerts, 2007; Swerts & Krahmer, 2008; Dohen & Lœvenbruck, 2009). Similarly, audiovisual cues for prosodic functions such as face-to-face grounding (e.g., Nakano et al., 2003), and question intonation (Srinivasan & Massaro, 2003) have been successfully been investigated, as have the audiovisual expressions of affective meanings such as uncertainty (Krahmer & Swerts, 2005) and frustration (Barkhuysen et al., 2005). The majority of these studies have described a *correlated mode* of processing, whereby vision partially duplicates information about dynamic articulatory patterning. Yet a *complementary mode* of processing, whereby vision provides information more efficiently than hearing for some underspecified parts of the speech stream, is also possible. For example, some studies that have focused on the role of facial expressions as indicators of the individual’s emotional state (such as incredulity or surprise, degree of knowing, uncertainty, etc.) have found that visual information is far more influential than acoustic information (Dijkstra, Krahmer, & Swerts 2006, Swerts & Krahmer 2005, and Mehrabian & Ferris 1967).

The main goal of this study is to investigate the contribution of visual cues and pitch accent cues in conveying a phonological distinction between contrastive focus and echo questions in Catalan. In this language, statements (both broad and contrastive focus statements) and echo questions are characterized by a rising-falling nuclear configuration. Borràs-Comes, Vanrell, & Prieto (2010) showed that pitch range differences are responsible for this pragmatic meaning difference in this language, thus proposing a phonological contrast between a L+H* L% nuclear configuration for the expression of contrastive focus and a L+¡H* L% nuclear configuration for the expression of an echo question (see the Cat_ToBI proposal in Prieto, in press, and Aguilar et al., 2009). This paper will address two related questions regarding the perceptual processing of audiovisual markers of echo question vs. contrastive focus meanings in Catalan. First, how important are facial gestural correlates to this distinction with respect to pitch accent cues? and (2) are there differences in the relative weight of the acoustic information when facial cues are less prominent and thus more ambiguous?

Twenty native speakers of Central Catalan participated in two identification tasks in which they had to decide between a focus or a question interpretation. Experiment 1 tackled the relative contribution of visual and auditory information to the target prosodic contrast by means of an identification experiment. For this task, subjects were presented with two videotapes of a Catalan short sentence (e.g. *Petita?* 'small') with the two target pragmatic meanings in combination with an acoustic continuum of varying degrees of pitch range of the rising-falling pitch configuration (the main acoustic cue to the distinction), thus either presenting congruent or incongruent audiovisual target stimuli. Experiment 2 investigated the role of auditory and visual information with the same stimuli but making the facial cues less prominent through the use of a morph technique. The task of the participants was again to identify for each stimulus what was the interpretation of the utterance (focus or echo question).

The **auditory stimuli** for the two experiments (Fig. 2) consisted of a continuum that was created by modifying the F0 height of the peak in 11 steps (distance between each one = 0.6 semitones) of the noun phrase *petita* [pə.ˈti.tə] ('little'-fem). The **visual stimuli** consisted of two videotaped sequences representing the typical facial gestures used when producing the two utterance types (Fig. 3). An important difference between these two gestures is eyebrow configuration.

The identification results for Experiment 1 (Fig. 4) highlighted the crucial role of the visual information in disambiguating both meanings (F (1, 2171) = 1325.292, p < .001) and also showed an effect of the auditory stimuli used (F (10, 2162) = 30.535, p < .001), facilitating the echo question interpretation when pitch height increased. However, the interaction between the two factors was not significant (F (10, 2151) = 1.256, p = .250).

This effect of the auditory information over the listeners' decisions was also reflected in reaction time measures (Fig. 5). Though RTs did not differ significantly across auditory steps (F (10, 2173) = .671, p = .752), both auditory and visual information interacted significantly (F (10, 2173) = 2.815, p = .002): shorter RTs were observed when matching audiovisual stimuli were available. A clear effect of the visual factor was again revealed for RTs (F (1, 2173) = 6.362, p = .012).

These results were corroborated in Experiment 2 using the same auditory continuum co-occurring with another continuum for facial gestures obtained through a morph technique. Once more, a clear preference was observed for visual cues (F (5, 3564) = 300.924, p < .001), and there was also a clear effect of the auditory information (F (5, 3564) = 153.439, p < .001) which was crucially more detectable when visual stimuli were more ambiguous. The analysis of the RTs provided parallel results to the previous experiment.

In sum, results from the two experiments reveal a clear preference for visual cues in the listener's main decisions, but also a crucial effect of the auditory stimuli. We argue that a complementary mode of processing whereby vision provides information more efficiently than hearing is possible. We argue that even though the facial gestures are the most influential elements that Catalan listeners use to decide between the contrastive focus and echo question interpretation, bimodal integration with the acoustic cues is necessary for perceptual processing to be accurate and fast. We finally discuss the implications of these results for models of audiovisual processing.

Figures

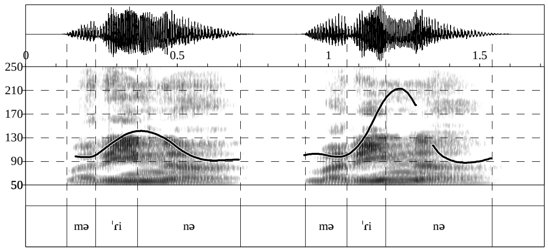


Figure 1. F0 contour of the utterance 'La petita' produced with the two meanings: contrastive focus and echo question.

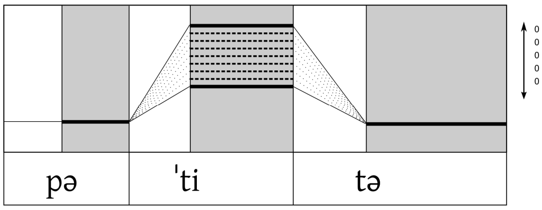


Figure 2. Schematic diagram with the pitch target manipulation.

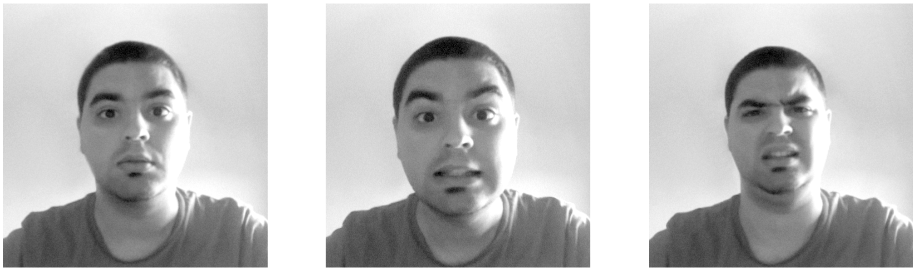


Figure 3. Stills of the neutral facial expression (left), the contrastive focus gesture (mid) and the incredulity echo question gesture (right).

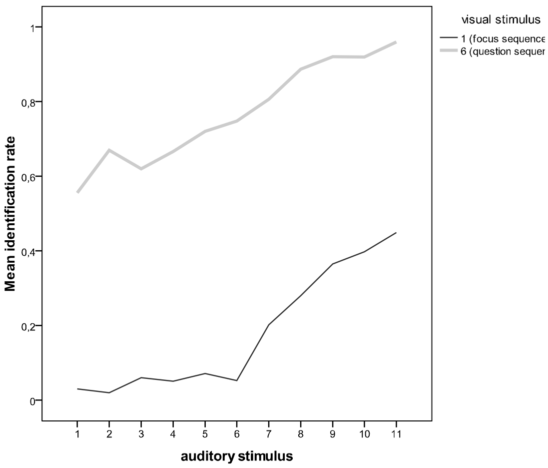


Figure 4. Results Experiment 1: Identification rate as focus or echo.

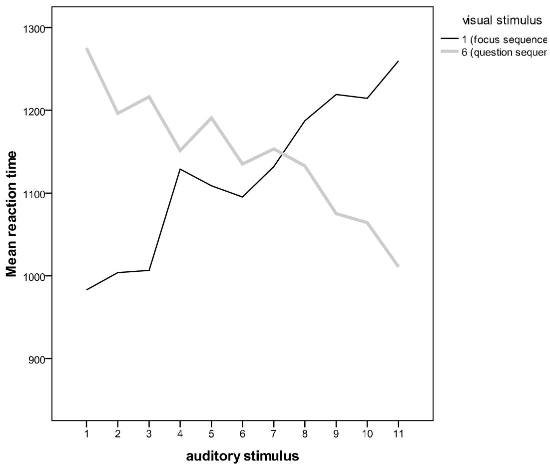


Figure 5. Results Experiment 1: RT measures depending on the stimulus.

References

Aguilar, L., De-la-Mota, C., & Prieto, P. (coords.) (2009). *Cat_ToBI Training Materials*. On line <http://prosodia.upf.edu/cat_tobi/>

Borràs-Comes, J., Vanrell, M. M., & Prieto, P. (2010). The role of pitch range in establishing intonational contrasts in Catalan. *Proceedings of Speech Prosody 2010*, Chicago. On line < http://speechprosody2010.illinois.edu/papers/100103.pdf >.

Cavé, C., Guaïtella, I., Bertrand, R., Santi, S., Harlay, F., & Espesser, R. (1996). About the relationship between eyebrow movements and F0 variations. *Proceedings of the ICSLP*, 2175-2179.

Dijkstra, C., Krahmer, E., & Swerts, M. (2006). Manipulating Uncertainty: The contribution of different audiovisual prosodic cues to the perception of confidence. *Proceedings of Speech Prosody*, Dresden.

Dohen, M., & Lœvenbruck, H. (2009). Interaction of audition and vision for the perception of prosodic contrastive focus. *Language and Speech*, **52**(2-3), 177-206.

Hadar, U., Steiner, T., Grant, E., & Rose, F. (1983). Head movement correlates to juncture and stress at sentence level. *Language and Speech*, **26**, 117-129.

Krahmer, E. J., & Swerts, M. (2007). The effects of visual beats on prosodic prominence: Acoustic analyses, auditory perception and visual perception. *Journal of Memory and Language*, **57**(3), 396-414.

McGurk, H., & MacDonald, J. (1976). Hearing lips and seeing speech. *Nature*, **264**, 746-748.

Mehrabian, A., & Ferris, S. R. (1967). Inference of attitudes from nonverbal communication in two channels. *Journal of Consulting Psychology*, **31**, 248-252.

Nakano, Y., Reinstein, G., Stocky, T., & Cassell, J. (2003). Towards a model of face-to-face grounding. *Proceedings of Association for Computational Linguistics*, 553-561.

Prieto, P. (in press). The intonational phonology of Catalan. In Sun-Ah Jun (ed.), *Prosodic Typology 2. The Phonology of Intonation and Phrasing*. Oxford: Oxford University Press.

Savino, M., & Grice, M. (2007). The role of pitch range in realising pragmatic contrasts – The case of two question types in Italian. *Proceeding of ICPhS XVI*.

Srinivasan, R. J., & Massaro, D. W. (2003). Perceiving prosody from the face and voice: distinguishing statements from echoic questions in English. *Language and Speech*, **46**(1), 1-22.

Swerts, M., & Krahmer, E. (2005). Audiovisual prosody and feeling of knowing. *Journal of Memory and Language*, **53**(1), 81-94.

Swerts, M., Krahmer, & E. J. (2008). Facial expressions and prosodic prominence: Comparing modalities and facial areas. *Journal of Phonetics*, **36**(2), 219-238.

Imitation of non-speech Lip and Tongue Gestures in Infants at the Onset of Babbling

Background and Aims: According to the theory of Articulatory Phonology, the most primitive units of phonology are speech *gestures* or actions of vocal tract constriction (Browman & Goldstein, 1992). For gestures to function as basic phonological units, they need to be discrete. One source of discreteness is the independent constriction of different articulatory organs in the vocal tract (e.g., lips versus tongue tip). Articulatory Phonology hypothesizes that when an infant is able to identify his/her own organs with the organs of a model, vocal tract constrictions of different articulatory organs may be employed for the onset of speech development (Studdert-Kennedy, 2000). Specifically, Articulatory Phonology predicts that infants will show imitative responses with the correct articulatory organs (lips or tongue) when presented with non-speech oral gestures such as lip smacks or tongue smacks. It is suggested that infants are able to do so because their auditory-visual system and their perceptual-motor system make use of the same common metric, the gesture. If this theory holds, infants will show a similar response pattern to an audio-visually as well as to an auditory-only presentation of non-speech gestures (Goldstein, 2003). However, no empirical evidence of such imitation of non-speech oral gestures has been reported to date. The present study aims to fill this gap by investigating infants' oral responses to non-speech oral gestures at the onset of babbling.

Methods: Fifteen 8-month-old and fifteen 6-month-old infants received AV presentations of a female face on a video monitor producing either bilabial smacks or tongue-tip smacks. All infants were tested separately for lip smacks (LIP condition) and tongue smacks (TONGUE condition), with the two experimental sessions scheduled one week apart and presentation conditions counterbalanced. Six sets of repetitions of three gestures were presented in trials of 50 seconds, including a 20-second response period at the end of each trial. Trials were repeated until the infant's attention waned. Prior to the gesture presentation, infants were familiarized with the model's smiling face and presented with a control trial to test for arousal responses. Another group of 8-month-old infants (N=15) received an auditory-only presentation of lip and tongue smacks, in which the model blocks her mouth with her hand (A-only presentation).
Infrared video recordings of infants' responses were annotated (ANVIL software) for attention to the monitor, exclusion elements, and oral gestures. The frequency of infants' lip gestures and tongue gestures was measured for both LIP and TONGUE conditions.

Results: Data reduction and analysis are still in progress. However, preliminary Chi-square analysis from the data of eight 8-month-old infants revealed a significant association between type of stimulus and response in the AV-condition, $\chi^2\,(1, N = 353) = 108.5, p < .001$. Specifically, infants responded to LIP presentations with significantly more lip gestures (88.4%) than tongue gestures (11.6%), and they responded to TONGUE presentations with significantly more tongue gestures (64.8%) than lip gestures (35.2%). On first inspection of the raw videos, 6-month-old infants show less or no imitative responses compared to the 8-month-old infants.

Conclusion: These preliminary results suggest differential responding to AV presentation of lip and tongue gestures by 8-month-old infants, which is in line with predictions from Articulatory Phonology. Stronger evidence for the organ hypothesis may be found in the auditory-only condition. Data for the two different age groups may provide insight into developmental aspects of a gestural perceptual-motor link in infants.

Reference List

Browman, C. P. & Goldstein, L. (1992). Articulatory phonology: an overview. *Phonetica, 49,* 155-180.

Goldstein, L. (2003). Emergence of discrete gestures. In *Proceedings of the 15th International Congress of Phonetic Sciences.* (pp. 85-88). Barcelona, Spain.

Studdert-Kennedy, M. (2000). Imitation and the emergence of segments. *Phonetica, 57,* 275-283.

Phonetic vs. phonological rounding in Athabaskan languages

Athabaskan languages differ in the timing of the lip rounding gesture of round vowel phonemes with respect to neighboring consonants.

Deg Xinag, an Athabaskan language spoken in western Alaska, has a phonological phenomenon of Rounding Assimilation, whereby the contrast between two reduced vowels, /ə/ and /ʊ/, is neutralized as /ʊ/ before a round vowel when a single uvular or laryngeal consonant intervenes. Rounding Assimilation has not been noted by previous Deg Xinag field linguists.

Babine-Witsuwit’en, an Athabaskan language spoken in northern British Columbia, has consonant contrasts at uvular and laryngeal places of articulation similar to those of Deg Xinag. Babine-Witsuwit’en has a single reduced vowel phoneme /ə/ (lacking /ʊ/) but has rounding contrasts among dorsal consonants. Babine-Witsuwit’en does not exhibit any assimilation in rounding across uvulars, nor is there rounding assimilation before inter-vocalic labio-velar stops. However, for syllable-final labio-velars preceded by reduced vowel, the rounding of the consonant is realized on the preceding vowel: /ək^w/ = [ɔ̆k^w].

Quantitative acoustic data is presented to substantiate these claims. Qualitative video evidence is also presented showing that in Deg Xinag there is anticipatory rounding in the syllable preceding round vowels /o ʊ/ (across single uvular or laryngeal consonants), whereas in Babine-Witsuwit’en the rounding gesture is strictly timed with the vowel phonemes (/o u/) from which it originates.

This diversity in the timing of the rounding gesture in the languages of the family is related to how rounding contrasts have changed over time among the Athabaskan languages. In Proto-Athabaskan (PA), there is some uncertainty over whether rounding is to be reconstructed as part of the consonant system or the reduced vowel system. PA is reconstructed with a contrast between *ə and *ʊ, but at a remoter phonological level PA *Qʊ is equivalent to *Q^{w}ə and PA *ʊQ is equivalent to *əQ^w, the latter much like synchronic Babine-Witsuwit’en. A scenario for historical change is posited, whereby PA *Qʊ > *ʊQʊ > ʊQ{ʊ,o}. [work supported by NSF]

Velum gestures and nasalization phenomena in Guarani

Guarani, a Tupi-Guarani language spoken in Paraguay, shows many interesting phenomena related to nasalization. The phonological complexity of nasal harmony has been described in various papers. However, very little has been done to understand the phonetics of nasal harmony and the consequences of nasal spreading on various classes of segments such as voiced and voiceless fricatives. This paper discusses results of aerodynamic and acoustic measurements obtained from native speakers of Paraguayan Guarani. The first part of the paper focuses on the phonetic description of acoustic and aerodynamic parameters (nasal and oral airflow and intra-oral pressure) involved in the production of nasal harmonies and nasalized segments. The second part of the paper discusses the phonological interpretation of velum gestures observed in the phonetic data. Patterns emerging from Guarani nasal phenomena and their consequences for phonological theory are then discussed. The final part of the presentation is devoted to the discussion of perceptual experiments designed to check the validity of some hypotheses made from data obtained in speech production.

In order to describe velum movements and various parameters involved in the production of nasal phenomena in Guarani, a set of words and sentences was chosen from Suarez & Suarez (1961). Six speakers (2 women and 4 men) participated to the experiments. They were asked to pronounce and repeat 5 times each of the words both in isolation and in carrying sentences. A simultaneous recording of the oral and nasal airflows was synchronized with a recording of the acoustic signal. For some speakers intraoral pressure (Po) was also recorded. Recordings were made according to the rules of the ethical committee of the Université Libre de Bruxelles concerning the participation of human subjects. Po was measured by a small plastic tube (ID 2mm) that was inserted through the nasal cavity into the oropharynx. The tube was connected to an EVA2 portable workstation consisting in a PC computer and an acquisition system equipped with various transducers and the signal editing and processing software phonedit. Oral airflow (Oaf) was measured with a rubber mask connected to the acquisition device of the workstation; nasal airflow (Naf) by two plastic tubes connected to each nostril by a small silicon olive. The acoustic signal was recorded with a directional microphone connected to the EVA 2 portable workstation. The microphone was at a constant distance from the rubber mask. The signal was sampled at 16000 kHz and processed with the software *phonedit* and *signal explorer*. In order to obtain a smooth line, plots were low pass filtered at 70 Hz.

The interest of the synchronized acoustic and aerodynamic measures is that they allow making some inferences about the coordination between the velum and the other articulator's movements. This also allows observing the opening and closure gestures of the velum in time and to some extent the degree of nasalization of the segments.

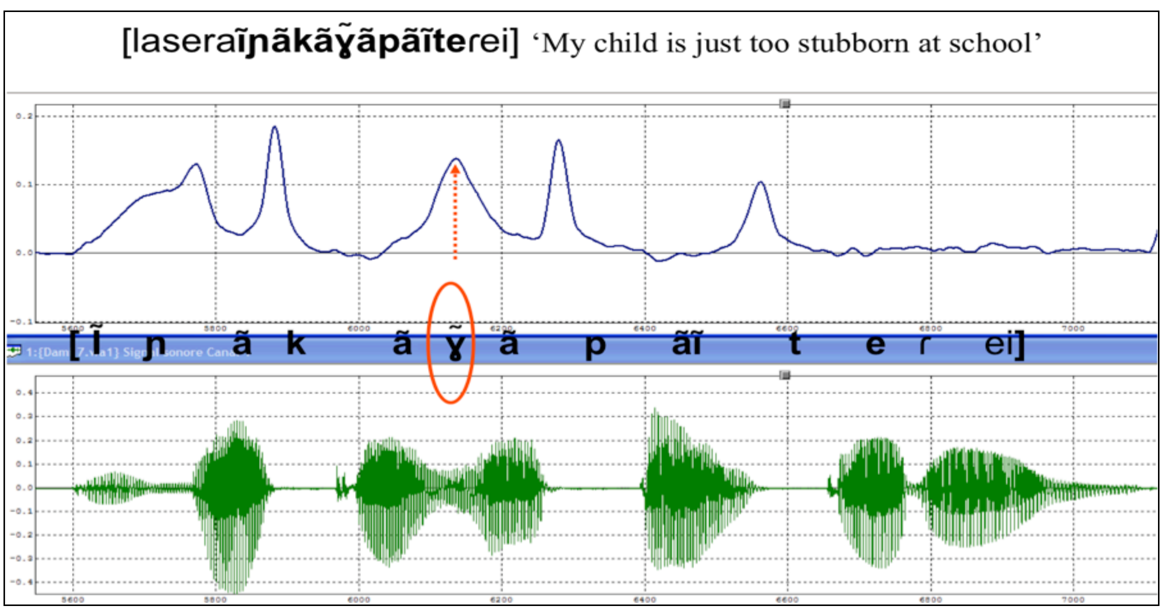
Results show a number of striking phenomena. The first is that the velum is much more active than expected in fully nasalized words or sentences. Data suggest that the velum does not remain open during whole words but that there are opening and closing gestures marking the separation between nasalized vowels and consonants. In fully nasalized words the only segments that are not nasalized are the voiceless stops. When a nasal precedes a voiceless stop there is a substantial amount of nasal airflow remaining during the first part of the stop, sometimes with a weak voicing. There is also a sharp peak of nasal airflow at the end of the preceding vowel but the closing gesture only happens after the vowel during the consonant that remains voiceless in any case. This peak of nasal airflow at the end of the vowel suggests that there is a complete closure of the oral tract at the end of the vowel, leaving all the airflow going through the nasal cavities. The observation of the nasal airflow patterns seem to confirm claims made by Suarez & Suarez (1961) who state that the amount of nasalization is not the same everywhere even in fully nasalized sequences. The consequence of this being that next to a 2-way phonemic contrast in nasalization, there are at least three degrees of nasalization phonetically. This has still to be established quantitatively but this is under way. The Guarani data also show that Ohala & Ohala (1993) and Shosted's (2006) claims about nasalized fricatives are not as opposed as might seem at first sight. Some of the incompatibilities predicted by Ohala & Ohala are observed and some predictions made by Shosted too. When nasalized [x] also assimilates in voicing to become [ɦ̃]. Therefore as claimed by Shosted (2006), the spectrum is affected, changing from high frequency energy to more flat. This makes the voiceless velar fricative become a laryngeal fricative but also voiced. The latter point goes along claims made by Ohala & Ohala (1993) who say that the nasalization of fricatives is more likely for voiced fricatives when it happens. Data presented on the Figure (presenting nasal airflow in hPa and audio waveform), show that the velum is very active during long nasalized sequences in sentences. These sequences are often described as the consequence of a nasal harmony process. Nasal airflow data from Guarani suggest that rather than having a single [+ nasal] feature, there is a complex pattern of closing and opening velum gestures that account for such sequences.

References

Gregores, E. & J. A. Suarez. 1967. *A description of colloquial Guarani*. Mouton. The Hague.

Ohala, J.J. & M. Ohala. 1993. The phonetics of nasal phonology: theorems and data. In M. K. Huffman & R. A. Krakow (Eds.) *Nasals, nasalization and the velum*. San Diego, Academic Press. 225-249.

Shosted, R. 2006. *The aeroacoustics of nasalized fricatives*. PhD Dissertation. University of California Berkeley.



A gestural account of velar contrast in a coronal heavy inventory: the back fricatives in Navajo

The sensitivity of velar consonants to vowel context is well-known (Houde, 1967; Dembowski et al., 1998). One phonetic account proposed for English is articulatory: the tongue gesture for the consonant blends with the vowel's gestures, resulting in variation associated to vowel context (Saltzman and Munhall, 1989). An interesting somewhat different case of velar-vowel contextual effects is presented by Navajo (Athabaskan), whose consonantal contrasts are both primarily coronal (26/34) and heavily obstruent (around 92%) (Young & Morgan, 1987; Ladefoged and Maddieson, 1996) and limited to stem initial position. In this position, Navajo velar fricatives are strongly conditioned by the following vowel (McDonough, 2003) (Figure 1). However, several views (Steriade, 2001) predict that this type system would protect velar contrasts from variability in 'strong positions' in the lexicon, i.e. stem initial position. In this study we present an alternate analysis, the Navajo velar contrast is best accounted for as a contrast between front versus back tongue gestures. In this sense we are arguing for articulatory gestures as primes in coding phonemic contrast (Browman & Goldstein, 1991).

To determine the extent of contextual variation in velar or back fricatives in Navajo, ultrasound imaging was used to track tongue movement for two female native speakers as they produced 50 words with the back fricative in three vowel contexts: /xɪ/, /xo/, and /xɑ/. Tongue edges were extracted using Edgetrak (Li et al., 2005). The smoothing spline ANOVA method (SSANOVA) (Davidson, 2006) was used to quantitatively study the differences in tongue shape of back fricatives, at fricative midpoint, in the three contexts, using Bayesian confidence intervals (CI). The CI for multiple repetitions within each subject show little to no overlap of shapes from the palatal to upper pharyngeal regions. But the fricatives in the back vowel context had greater CI overlap than with the palatal. Therefore, there was significant variation in the articulation of the velar contrast conditioned by the following vowel. To examine whether this data can be accounted for using the same account used for English, TADA (Task Dynamics Application) toolkit was used to simulate two hypotheses ($\mathbf{H}_1$ and $\mathbf{H}_2$) about the gestural organization of the Navajo back fricative contrast. The articulatory tongue shapes output from the model simulations were quantified using SSANOVA, and compared to ultrasound edges. In $\mathbf{H}_1$, the fricative and vowel each have Tongue Body *Constriction Degree* and *Location* gestures that overlap, with different gestural specifications and different blending strengths, similar to Saltzman and Munhall (1989)'s account for English. In $\mathbf{H}_2$, Navajo back fricatives only had CL, they lacked a *Constriction Degree* gesture; i.e., the contrastive gestural units between English and Navajo are different. Our results: CI show considerable overlap for tongue shapes in the simulations of $\mathbf{H}_1$ (low level of gradience, the English case). However, in simulations of $\mathbf{H}_2$, we found the same pattern for tongue shapes that exist in our Navajo data (lesser overlap, high level of gradience). Therefore $\mathbf{H}_2$ is a better fit for the Navajo data. In Articulatory Phonology, since gestures are simultaneously units of contrast and coordinative structures of articulators, it is possible for high levels of gradience to be encompassed within a categorical contrast, as empirically attested. That is, by virtue of the lack of a CD gesture, more gradience is found in Navajo, because the actual tongue position may change with context within the CL without affecting the underlying contrast. This result differs from that predicted by theories positing less gradience for phonemes in 'strong positions' of contrast.

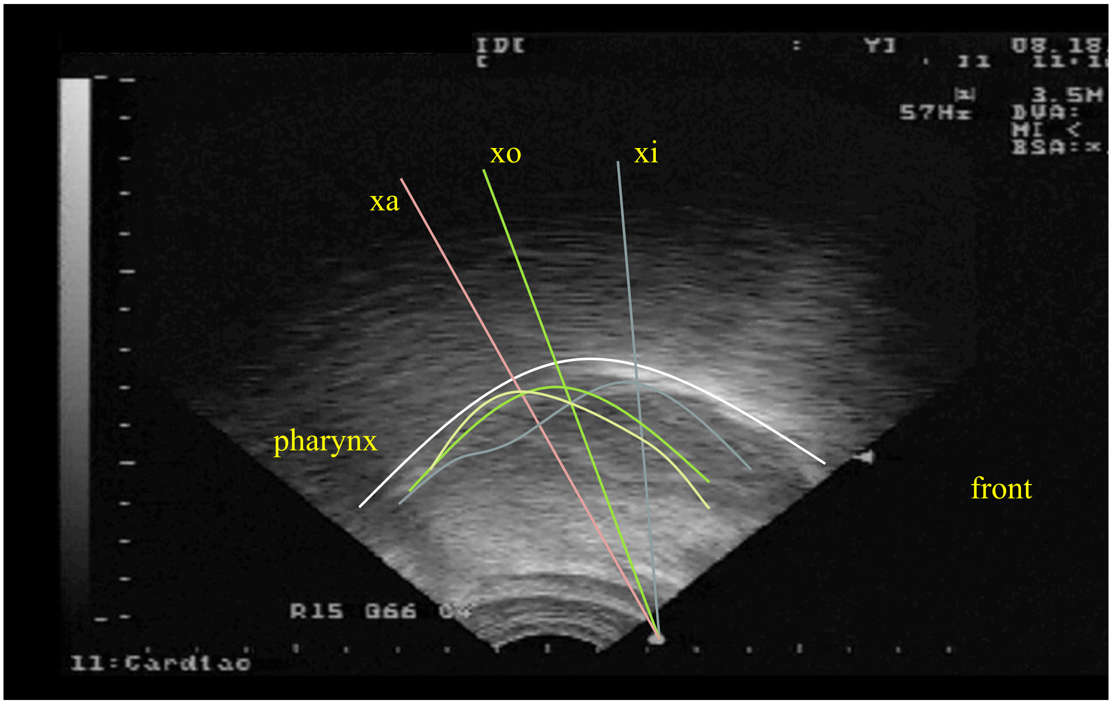


Figure 1: Ultrasound image (with fixed structure trace in white) at maximal constriction during the articulation of the velar fricative before three vowels: high *i*, low *a* and round *o*, demonstrating variation and coarticulation.

References

Browman, C. and Goldstein, L. (1989). Articulatory gestures as phonological units. *Phonology*, 6, 151-206.

Davidson, L. (2006). Comparing tongue shapes from ultrasound imaging using smoothing spline analysis of variance, *JASA*, 120, 407-16.

Dembowski, J., Lindstrom, M., & Westbury, J. (1998). Articulator point variability in the production of stop consonants. In M. P. Cannito, K. M. Yorkston, & D. R. Beukelman (Eds.), *Neuromotor speech disorders* (pp. 27–46). Baltimore: Paul H. Brookes Publishing Co.

Houde, R. (1967). *A study of tongue body motion during selected speech sounds*. University of Michigan PhD Dissertation.

Ladefoged, P. and I. Maddieson (1996). *Sound's of the World's Languages*, Blackwell.

Li, M., Khambhamettu, X, and Stone, M. (2005). Automatic contour tracking in ultrasound images, *Clinical Linguistics and Phonetics*, vol. 6, no. 19, 545-554.

McDonough, J. (2003). *The Navajo Sound System*. Dordrecht ; Boston, Kluwer Academic Publishers.

Saltzman, E. and Munhall, K. (1989). A dynamical approach to gestural patterning in speech production. *Ecological Psychology*. 1, 333–382.

Steriade, D. (2001). The Phonology of Perceptibility Effects: the P-map and its consequences for constraint organization. UCLA ms.

Young, R. and W. Morgan (1987). *The Navajo Language*. Albuquerque, University of New Mexico Press.

Reducing /voiceless stop + vowel/ sequences in French and Spanish

Speech reduction is often regarded as a universal phenomenon arising from articulatory and perceptual mechanisms. Recurrent paths of diachronic lenition phenomena support this view. However, speech reduction is also language-specific to a considerable extent. For instance, intervocalic voiceless consonants in Spanish are frequently realized as voiced approximants [1], but no such tendency has been reported for French. On the other hand, unaccented French vowels may become extremely short and completely devoiced [2], but frequent vowel devoicing has not been reported for Spanish. These observations suggest that even between related languages CV sequences may differ significantly in how they are reduced.

The present work directly compares the realization of /voiceless stop + vowel/ sequences in Spanish and French in order to determine common and differing reduction patterns. Given the literature, we expect these CV sequences to exhibit more consonantal reduction in Spanish, and more vocalic reduction in French. Importantly, our data come from corpora of highly spontaneous speech, the Nijmegen Corpus of Casual French [3] and The Nijmegen Corpus of Casual Spanish [4], recorded using a similar procedure and equipment.

V1.C1V2.C2 sequences in which C1 was a voiceless stop and V2 an accented or unaccented /aeiou/ vowel were extracted from the Spanish ($n = 1298$) and the French ($n = 856$) corpora. Duration measurements included the stop closure and the vocalic part of C1V2 syllables. The occurrence of incomplete stop closures was also annotated. Voicing was detected automatically. F1 and F2 were measured at the point of maximum F1 in V2.

Our results support the hypothesis that voiceless stops undergo significantly more reduction in Spanish than in French. The percentage of incomplete closures in Spanish was 25.5%, versus only 5.4% for French. Moreover, all incomplete closures were voiced in Spanish, but in French most of them (55%) exhibited a voiceless portion. For stops with a complete closure, durations were shorter, and voicing was longer in Spanish than in French ($p < .0001$ in both cases). Accent had similar effects in both languages, making incomplete closures less likely and closure durations longer ($p < .0001$ in both cases).

Vowels yielded more mixed results. As expected, a considerable proportion vowels (25.8% of unaccented high vowels) in French were completely devoiced, but only a few cases of vowel devoicing were observed in Spanish. On the other hand, contrary to our expectations, vowels in French were generally longer than in Spanish, including high vowels ($p < .0001$). Regarding formant values, we found that the vowel space tended to be higher in French than in Spanish ($p < .001$ for all the vowel categories examined), suggesting that French vowels are generally produced with a more constricted vocal tract than Spanish vowels. As for F2, we found that back vowels tend to be more centralized in French than in Spanish. Accent had similar effects for both languages, making F1 values higher and F2 values more peripheral. These results indicate that French vowels show more reduction than Spanish vowels in the realization of voicing and in sonority (lower F1), but not necessarily in terms of duration.

Taken together, our results reveal strong language-specific patterns of reduction, even for phonologically similar sound sequences in two related languages (e.g. voicelessness in stops is realized much more faithfully in French than in Spanish, even at the expense of the voicing of following high vowels). In our presentation, we will discuss some possible origins of these differences (e.g. specification and organization of phonetic categories within each language, different articulatory bases). Our data also remind us that reduction does not necessarily affect all characteristics of segments, and that, for this reason, the study of speech reduction should always consider multiple phonetic parameters independently.

References

[1] Lewis, A. (2001). *Weakening of Intervocalic /p, t, k/ in Two Spanish Dialects: Toward the Quantification of Lenition Processes*. PhD thesis, University of Illinois at Urbana-Champaign.

[2] Meunier, C., Meynadier, Y., and Espesser, R. (2008). Voyelles brèves en parole conversationnelle. In *Actes, Journées d'Etude sur la Parole 2008*, pages 97–100.

[3] Torreira, F., Adda-Decker, M., and Ernestus, M. (2010). The Nijmegen Corpus of Casual French. *Speech Communication*, 52:201–121.

[4] Torreira, F. and Ernestus, M. (2010). The Nijmegen Corpus of Casual Spanish. *Proceedings of LREC 2010*.

Congruence between 'word age' and 'voice age' facilitates lexical access

This paper verifies a core prediction of Exemplar Theory (ET). In ET, a lexical representation of a word is a distribution of remembered encounters with that word [1]. These memories (or 'exemplars') are complete in phonetic detail and are tagged with social and contextual information. At the very core of the theory, then, is the prediction that individual words should have a unique phonetic distribution shaped by the environments in which they were most encountered. This hypothesis receives some support from work showing that homophones are disambiguated differently depending on tone of voice. For example, if /bɹaidəl/ is said in a happy voice, listeners are more likely to guess 'bridal' than 'bridle' [2]. Similarly, there are several documented cases of 'old-timey' words appearing to lag behind in sound changes [3, 4]. However, these studies do not eliminate the possibility that the observed differences are due to topic-based style shifting rather than being truly representational, and situated at the word level.

We pursue the hypothesis directly by exploring the prediction that words should be more easily processed when they contain characteristics that most resemble the listener's accumulated past experience with that word. More particularly, we predict that old-timey words (e.g. *frock, wireless*) should be more easily recognised when produced in an older voice (which should more closely resemble the voices from which that word has been experienced) than when produced in a younger voice.

We conducted an auditory lexical decision task using native speakers of New Zealand English (NZE). Stimulus words were sourced by comparing two corpora in the Origins of New Zealand English Project (ONZE): the Intermediate Archive, a body of interviews with speakers born 1890 and 1930 and recorded between 1989 and the late 1990s, and the Canterbury Corpus, containing speakers born between 1930 and 1984, recorded from 1994 to the present day. A list of words that were considerably overrepresented in one corpus compared to the other were automatically generated, and from these lists we selected 10 'old' and 10 'young' words for each of three vowels: /ɪ/(e.g. old: *picnic, shilling* / young: *video, chips*) /e/ (e.g. *sherry, pencils* /*restaurant, stress*) and /ai/ (e.g. *idle, kite* / *lifestyle, sky*). These vowels have undergone sound change over the last 40 years in NZE. We also included a set of neutral stimulus words for each vowel which occurred with approximately equal frequency in both corpora.

Two female speakers recorded the target stimuli, together with matched non-words. One speaker's recording was created by having her shadow randomly presented words produced by the other speaker. This was done in an attempt to match pace and intonational contours across the two speakers. The speakers were approximately matched in social class, but differed in age (22 vs 50). This age difference was auditorily perceivable, as verified by independent age ratings provided by our listeners. The auditory lexical decision experiment was conducted using Direct RT. The stimuli were blocked by speaker, and randomized within each block. All 25 participants listened to both blocks. The order of presentation of blocks was counterbalanced. Participants were asked to identify words, and responses and response times were recorded.

Accuracy rates were very high. Old words were correctly recognized as words at 96.2% in the old voice and 94.3% in the young voice. Young words were correctly recognized at 95.6% in the old voice and 96.1% in the young voice. This is a significant interaction in a binomial mixed effects model showing increased error rates when voice age and word age do not match ($p<.02$). After removing outliers, mean reaction times in the congruent conditions were 114ms (old word, old voice) and 118ms (young word, young voice). In the incongruent conditions they were significantly higher: 138ms (young word, old voice) and 127ms (old word, young voice). This interaction between word age and voice age is significant in a linear mixed effects regression model with participant and item as random effects ($p<.03$).

This provides robust evidence that words are more easily processed when they contain characteristics that most resemble the listener's accumulated past experience with that word. This provides verification of a key prediction of exemplar models of the lexicon.

References

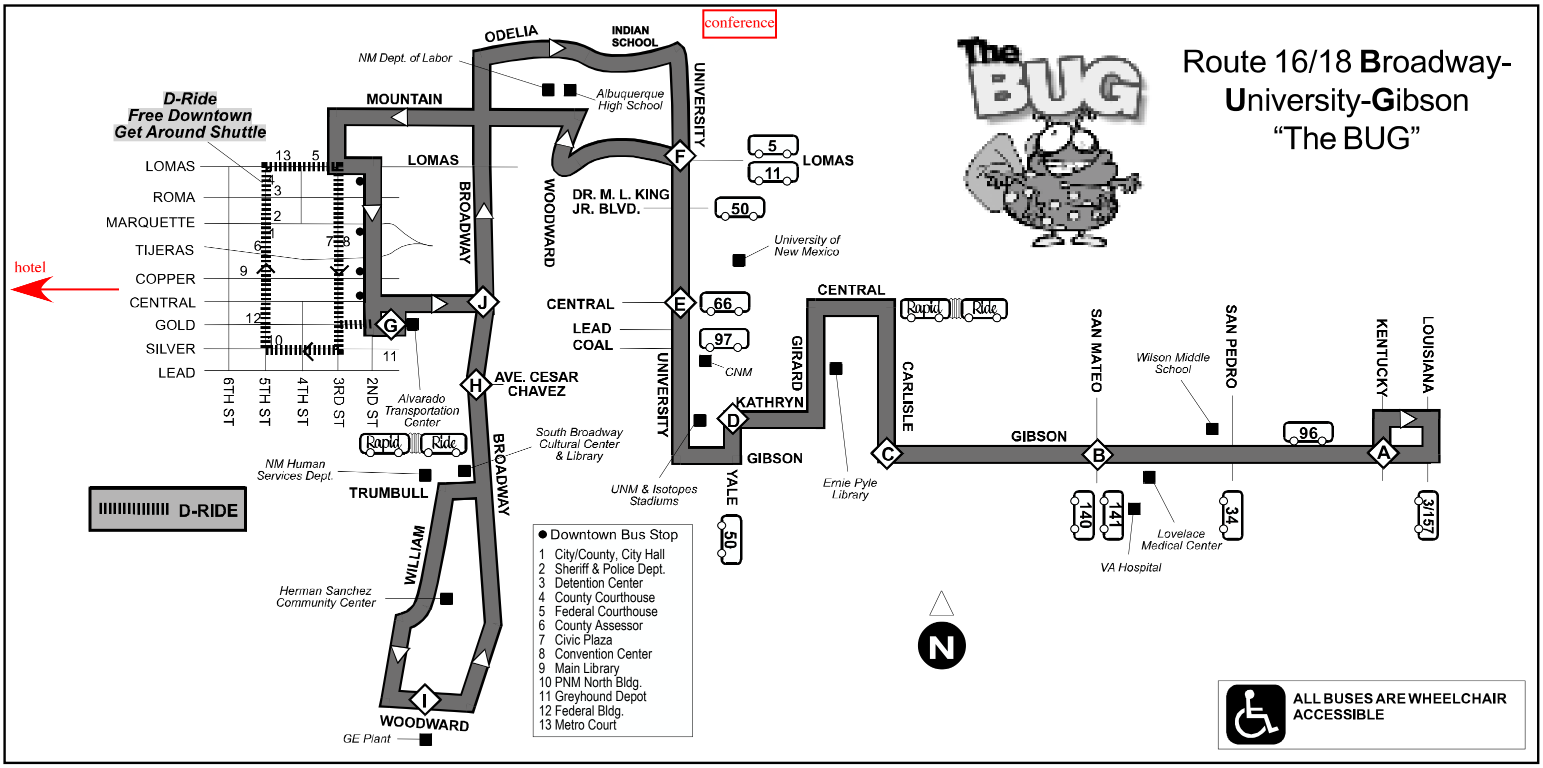
[1] Pierrehumbert, Janet (2001). Exemplar dynamics: Word frequency, lenition and contrast. In Joan Bybee and Paul Hopper (eds.), *Frequency and the Emergence of Linguistic Structure*, pp. 137-157. Amsterdam: Benjamins.

[2] Nygaard, Lynne C. and Erin R. Lunders (2002). Resolution of lexical ambiguity by emotional tone of voice. Memory & Cognition 30 (4): 583-593.

[3] Gordon, E., Campbell, L., Hay, J., Maclagan, M., Sudbury, A., Trudgill, P. (2004) *New Zealand English: Its Origins and Evolution*. (Studies in English Language) Cambridge: Cambridge University Press.

[4] Yaeger-Droh, Malcah and William Kemp (1992). Lexical classes in Montreal French (E:). *Language and Speech* 35 (3): 251-293.

Route/Ruta 16/18-“The BUG” Effective 12/19/2009



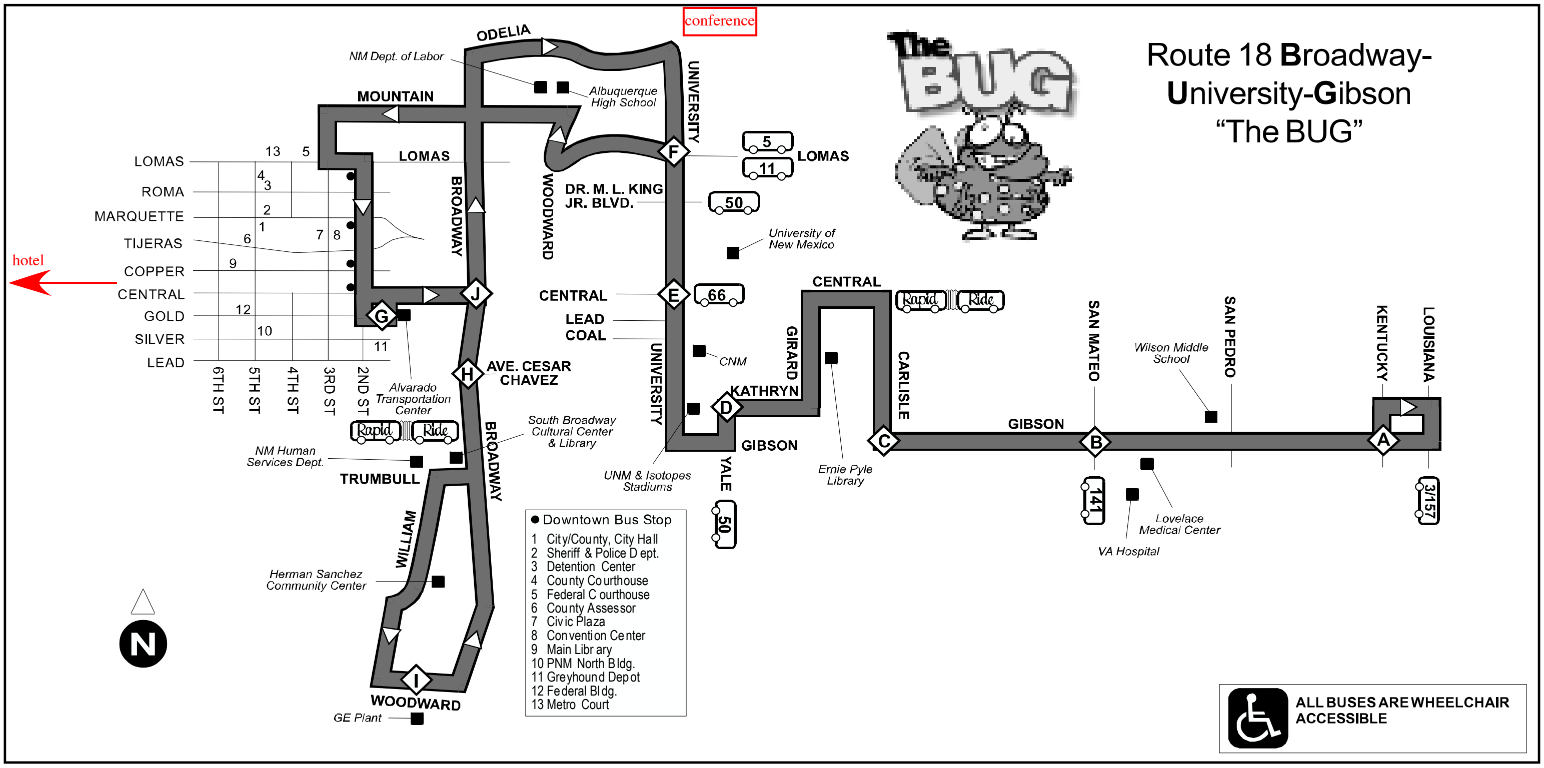
Route 16/18 - Weekday Westbound

A GIBSON & KENTUCKY	B GIBSON & SAN MATEO	C CARLISLE & GIBSON	D YALE & KATHRYN	E CENTRAL & UNIVERSITY	F UNIVERSITY & LOMAS	G ALVARADO TRANSPORTATION CENTRER	H BROADWAY & AVE. CESAR CHAVEZ	I G.E. PLANT
625a	629a	634a	648a	657a	700a	712a	721a	729a
710a	714a	719a	733a	742a	745a	757a	806a	814a
755a	759a	804a	818a	827a	830a	842a	851a	859a
840a	844a	849a	903a	912a	915a	927a	936a	944a
925a	929a	934a	948a	957a	1000a	1012a	1021a	1029a
1010a	1014a	1019a	1033a	1042a	1045a	1057a	1106a	1114a
1055a	1059a	1104a	1118a	1127a	1130a	1142a	1151a	1159a
1140a	1144a	1149a	1203p	1212p	1215p	1227p	1236p	1244p
1225p	1229p	1234p	1248p	1257p	100p	112p	121p	129p
110p	114p	119p	133p	142p	145p	157p	206p	214p
155p	159p	204p	218p	227p	230p	242p	251p	259p
240p	244p	249p	303p	312p	315p	327p	336p	344p
325p	329p	334p	348p	357p	400p	412p	421p	429p
410p	414p	419p	433p	442p	445p	457p	506p	514p
455p	459p	504p	518p	527p	530p	542p	551p	559p

Route 16/18 - Weekday Eastbound

I G.E. PLANT	H BROADWAY & AVENIDA CESAR CHAVEZ	J BROADWAY & CENTRAL	F UNIVERSITY & LOMAS	E CENTRAL & UNIVERSITY	D YALE & KATHRYN	C GIBSON & CARLISLE	B GIBSON & SAN MATEO	A GIBSON & KENTUCKY
600a	606a	610a	619a	622a	631a	644a	649a	652a
645a	651a	655a	704a	707a	716a	729a	734a	737a
735a	741a	745a	754a	757a	806a	819a	824a	827a
820a	826a	830a	839a	842a	851a	904a	909a	912a
905a	911a	915a	924a	927a	936a	949a	954a	957a
950a	956a	1000a	1009a	1012a	1021a	1034a	1039a	1042a
1035a	1041a	1045a	1054a	1057a	1106a	1119a	1124a	1127a
1120a	1126a	1130a	1139a	1142a	1151a	1204p	1209p	1212p
1205p	1211p	1215p	1224p	1227p	1236p	1249p	1254p	1257p
1250p	1256p	100p	109p	112p	121p	134p	139p	142p
135p	141p	145p	154p	157p	206p	219p	224p	227p
220p	226p	230p	239p	242p	251p	304p	309p	312p
305p	311p	315p	324p	327p	336p	349p	354p	357p
350p	356p	400p	409p	412p	421p	434p	439p	442p
435p	441p	445p	454p	457p	506p	519p	524p	527p
520p	526p	530p	539p	542p	551p	604p	609p	612p

Route 16/18-Ruta 16/18-The "BUG" Eff. 12/19/2009



Route 16/18 - Saturday Westbound

A GIBSON & KENTUCKY	B GIBSON & SAN MATEO	C CARLISLE & GIBSON	D YALE & KATHRYN	E CENTRAL & UNIVERSITY	F UNIVERSITY & LOMAS	G ALVARADO TRANSPORTATION CENTRER	H BROADWAY & AVE. CESAR CHAVEZ	I G.E. PLANT
625a	629a	634a	648a	657a	700a	712a	720a	725a
730a	734a	739a	753a	802a	805a	817a	825a	830a
835a	839a	844a	858a	907a	910a	922a	930a	935a
940a	944a	949a	1003a	1012a	1015a	1027a	1035a	1040a
1045a	1049a	1054a	1108a	1117a	1120a	1132a	1140a	1145a
1140a	1144a	1149a	1203p	1212p	1215p	1227p	1235p	1240p
1225p	1229p	1234p	1248p	1257p	100p	112p	120p	125p
110p	114p	119p	133p	142p	145p	157p	205p	210p
155p	159p	204p	218p	227p	230p	242p	250p	255p
240p	244p	249p	303p	312p	315p	327p	335p	340p
325p	329p	334p	348p	357p	400p	412p	420p	425p
410p	414p	419p	433p	442p	445p	457p	505p	510p
455p	459p	504p	518p	527p	530p	542p	550p	555p

Route 16/18 - Saturday Eastbound

I G.E. PLANT	H BROADWAY & AVENIDA CESAR CHAVEZ	J BROADWAY & CENTRAL	F UNIVERSITY & LOMAS	E CENTRAL & UNIVERSITY	D YALE & KATHRYN	C GIBSON & CARLISLE	B GIBSON & SAN MATEO	A GIBSON & KENTUCKY
620a	626a	630a	639a	642a	651a	704a	709a	712a
730a	736a	740a	749a	752a	801a	814a	819a	822a
835a	841a	845a	854a	857a	906a	919a	924a	927a
940a	946a	950a	959a	1002a	1011a	1024a	1029a	1032a
1030a	1036a	1040a	1049a	1052a	1101a	1114a	1119a	1122a
1115a	1121a	1125a	1134a	1137a	1146a	1159a	1204p	1207p
1200p	1206p	1210p	1219p	1222p	1231p	1244p	1249p	1252p
1245p	1251p	1255p	104p	107p	116p	129p	134p	137p
130p	136p	140p	149p	152p	201p	214p	219p	222p
215p	221p	225p	234p	237p	246p	259p	304p	307p
300p	306p	310p	319p	322p	331p	344p	349p	352p
345p	351p	355p	404p	407p	416p	429p	434p	437p
430p	436p	440p	449p	452p	501p	514p	519p	522p
515p	521p	525p	534p	537p	546p	559p	604p	607p

Route 16/18 - Sunday Westbound

900a	904a	909a	923a	932a	935a	947a	955a	1000a
1005a	1009a	1014a	1028a	1037a	1040a	1052a	1100a	1105a
1110a	1114a	1119a	1133a	1142a	1145a	1157a	1205p	1210p
1215p	1219p	1224p	1238p	1247p	1250p	102p	110p	115p
120p	124p	129p	143p	152p	155p	207p	215p	220p
225p	229p	234p	248p	257p	300p	312p	320p	325p
330p	334p	339p	353p	402p	405p	417p	425p	430p

Route 16/18 - Sunday Eastbound

900a	906a	910a	919a	922a	931a	944a	949a	952a
1005a	1011a	1015a	1024a	1027a	1036a	1049a	1054a	1057a
1110a	1116a	1120a	1129a	1132a	1141a	1154a	1159a	1202p
1215p	1221p	1225p	1234p	1237p	1246p	1259p	104p	107p
120p	126p	130p	139p	142p	151p	204p	209p	212p
225p	231p	235p	244p	247p	256p	309p	314p	317p
330p	336p	340p	349p	352p	401p	414p	419p	422p