HAL
open science

From Sensorimotor Experience To Speech Unit -Adaptation to altered auditory feedback in speech to assess transfer of learning in complex serial movements

Tiphaine Caudrelier, Jean-Luc Schwartz, Pascal Perrier, Christophe Savariaux, Amélie Rochet-Capellan

To cite this version:

Tiphaine Caudrelier, Jean-Luc Schwartz, Pascal Perrier, Christophe Savariaux, Amélie Rochet-Capellan. From Sensorimotor Experience To Speech Unit -Adaptation to altered auditory feedback in speech to assess transfer of learning in complex serial movements. Neuroscience 2015 - Annual meeting of the Society for Neuroscience, Oct 2015, Chicago, United States. hal-01221491

HAL Id: hal-01221491

https://hal.science/hal-01221491v1

Submitted on 28 Oct 2015

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

From Sensorimotor Experience To Speech Unit

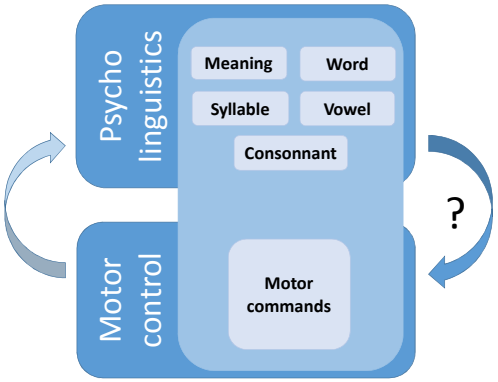
Tiphaine Caudrelier, Jean-Luc Schwartz, Pascal Perrier, Christophe Savariaux, Amélie Rochet-Capellan[a)]

gipsa-lab - Département Parole et Cognition, France [a)]

Goal: Study transfer of learning in speech production to better understand the nature of speech units

Speech is described as a sequence of units. These units could be representations of syllables stored in a mental directory (5) or mnesic traces of words.

Intro – An approach associating motor control and psycholinguistics



Which linguistics unit is connected to speech motor commands?

Word | Syllable | Vowel

If the syllable is the single unit connected to motor commands, then when the sensorimotor representation of this syllable is changed in one context, this change should transfer or generalize (4) to any other context in which this syllable is pronounced. This is what we tested by using a paradigm of transfer of auditorimotor learning (3).

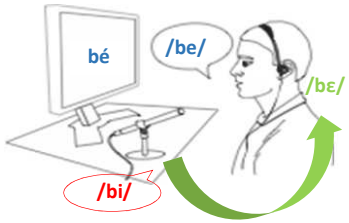
References

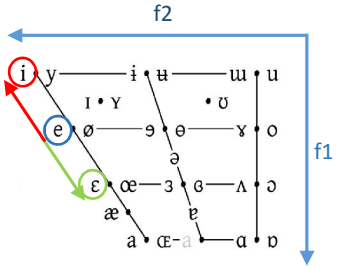
1. Cai, S., Boucek, M., Ghosh, S. S., Guenther, F. H. & Perkell, J. S. A System for Online Dynamic Perturbation of Formant Trajectories and Results from Perturbations of the Mandarin.pdf. Int. Semin. Speech Prod. 2008 65–68 (2008).
2. Hoffmann, L. a. & Sober, S. J. Vocal Generalization Depends on Gesture Identity and Sequence. J. Neurosci. 34, 5564–5574 (2014).
3. Houde, J. F. & Jordan, M. I. Sensorimotor adaptation in speech production. Science 279, 1213–1216 (1998).
4. Krakauer, J. W., Mazzoni, P., Ghazizadeh, A., Ravindran, R. & Shadmehr, R. Generalization of motor learning depends on the history of prior action. PLoS Biol. 4, 1798–1808 (2006).
5. Levelt, W. J. M. Models of word production. Trends Cogn. Sci. 3, 223–232 (1999)
6. Rochet-Capellan, a., Richer, L. & Ostry, D. J. Nonhomogeneous transfer reveals specificity in speech motor learning. J. Neurophysiol. 107, 1711–1717 (2012)

Method – Transfer of sensorimotor learning paradigm in order to study speech units

Auditory feedback alteration / Set up

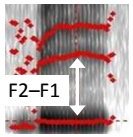
An auditory feedback perturbation from /e/ to /ɛ/ leads the speaker to compensate towards /i/.



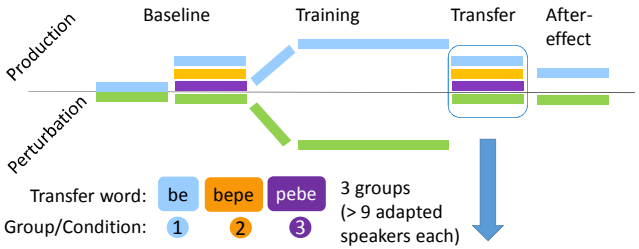


The perturbation and the compensation represented in a plan defined by the first formants (spectral maxima) F1 and F2.

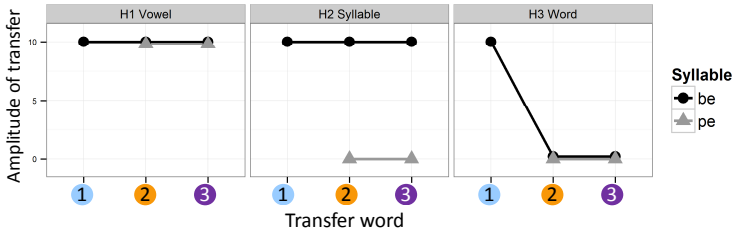
The auditory perturbation decreases F2-F1 while the speaker is expected to adapt by increasing F2-F1. As we focus on transfer, speakers who did not adapt are excluded from the results.



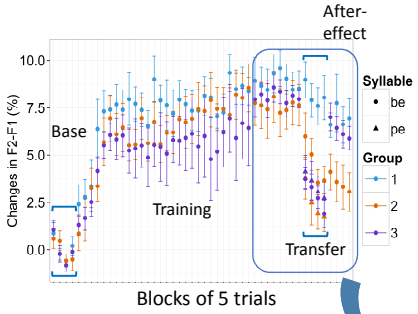
Procedure and conditions



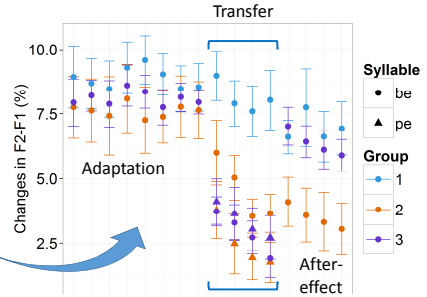
Hypotheses: Transfer profiles to reveal the speech production unit



Results – Transfer of learning and after-effect depend on the condition



Evolution of the distance between formants F2-F1 over the course of the experiment in % compared to baseline

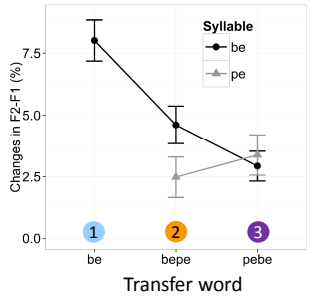


Zoom on the last 80 trials

Homogeneous adaptation among groups (ensured by selection of adapted participants only) at about 7.9% vs. baseline (~30% of the perturbation).

Transfer of learning by group and by syllable

- Transfer significantly higher in group 1 than in other groups. In group 2, producing /bepe/, transfer is higher in /be/ than in /pe/.
- Overall, these results are a mix of our hypotheses, suggesting transfer at the 3 levels: word, syllable, and vowel. They also show an effect of the position of the syllable in the word.
- Lower after-effect in group 2 (/bepe/) than in other groups also suggests a link between sequential position and motor commands, as shown recently in birds (4).



Conclusion: Links between speech units and speech articulation are at multiple levels.
The results suggest two gradients (6) of transfer by similarity: acoustical/articulatory and sequential

The research leading to these results has received funding from the European Research Council under the European Community's Seventh Framework Program (FP7/2007-2013 Grant Agreement no. 339152)