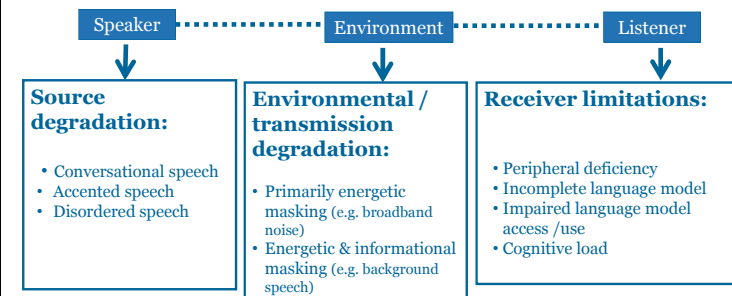


Bi-directional talker-listener adaptation across a language barrier

Ann Bradlow
 Department of Linguistics
 Northwestern University

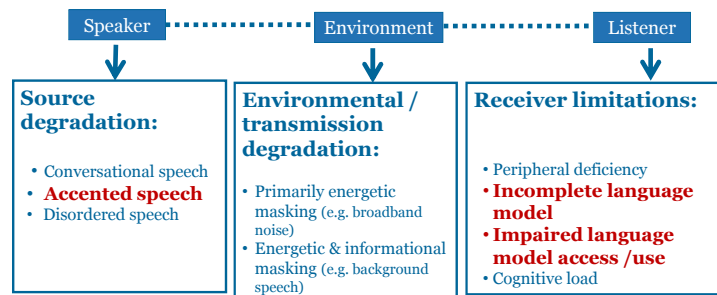
Speech communication in real-world settings typically involves several sources of adverse conditions



Speech communication across a language barrier

(Mattys, Davis, Bradlow and Scott, *Language & Cognitive Processing*, SI on Speech Recognition in Adverse conditions, 2012.)

Speech communication in real-world settings typically involves several sources of adverse conditions



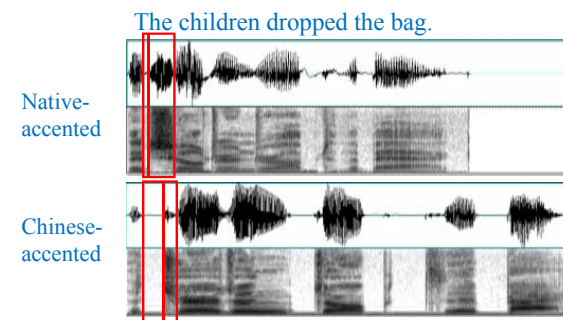
Speech communication across a language barrier

- a challenge
- an opportunity for innovation

(Mattys, Davis, Bradlow and Scott, *Language & Cognitive Processing*, SI on Speech Recognition in Adverse conditions, 2012.)

Why is foreign-accented speech hard to understand?

Deviation of the signal from the native talker norm/target

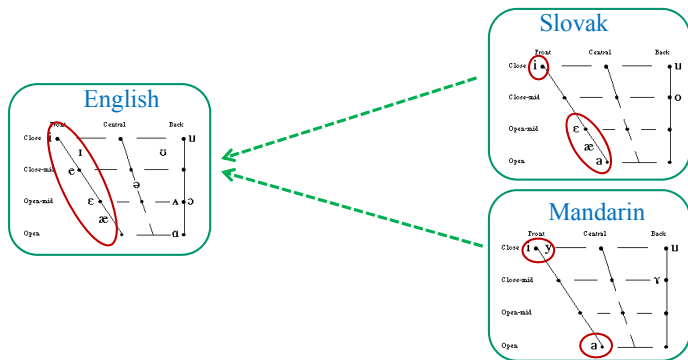


The foreign-accented sentence:

- is ~30% longer overall (lots of pauses, less fluent)
- exhibits different segmental/sub-segmental timing relations
- etc.

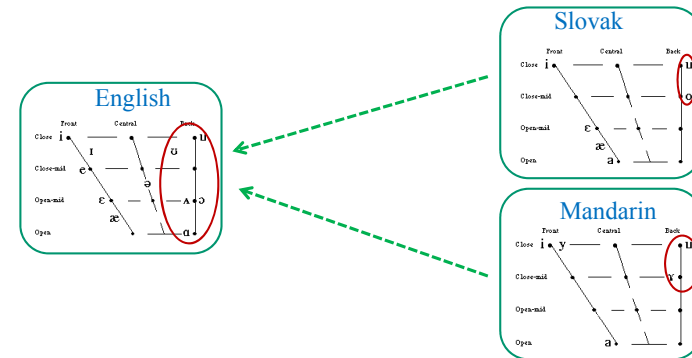
Systematicity of foreign-accented speech “deviations”

(1) L1-L2 interactions



Systematicity of foreign-accented speech “deviations”

(2) L2 typological peculiarities



Adaptation to foreign-accented speech

Study 1: Adaptation to systematic deviations of foreign-accented speech following exposure to stimuli that vary along the to-be-learned dimension

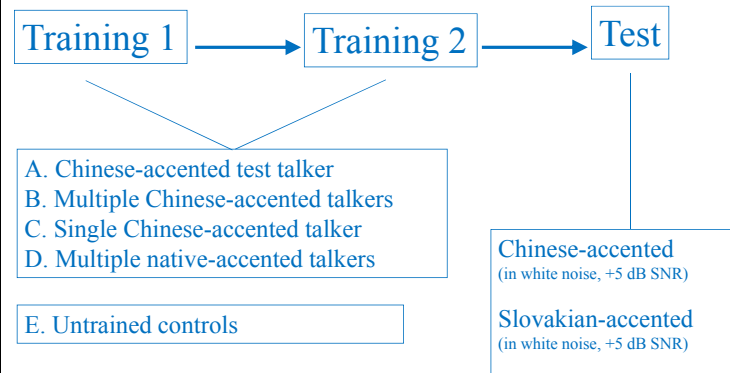
- Talker-independent adaptation
Adaptation to an accent as it extends across a group of foreign-accented talkers from the same native language background
- Accent-independent adaptation
Adaptation to foreign-accented speech by talkers from a variety of native language backgrounds

Study 2: Adaptation to foreign-accented speech in response to variation in the training task

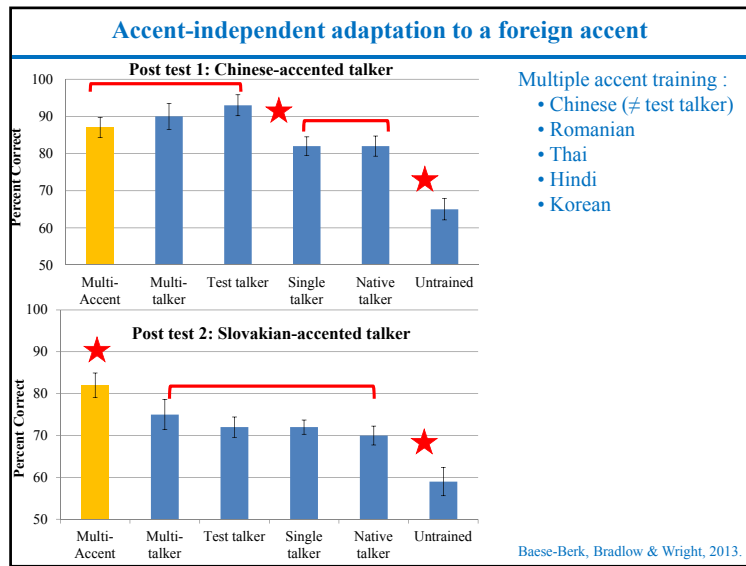
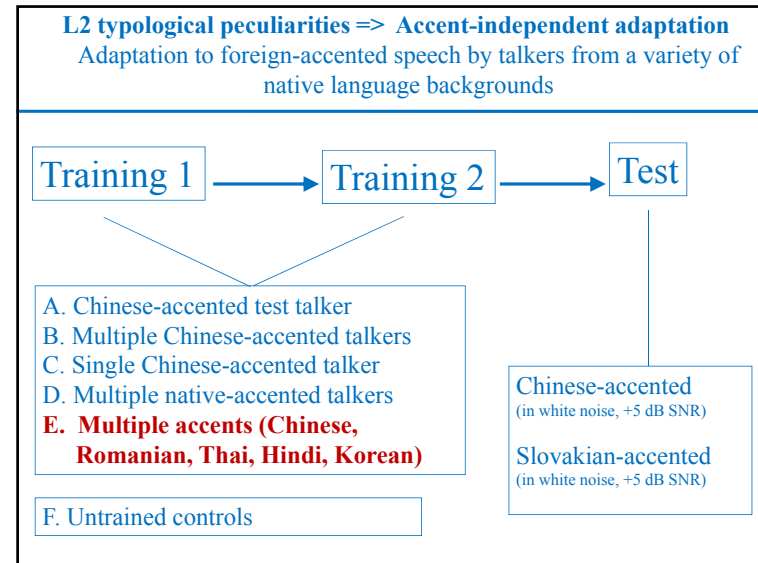
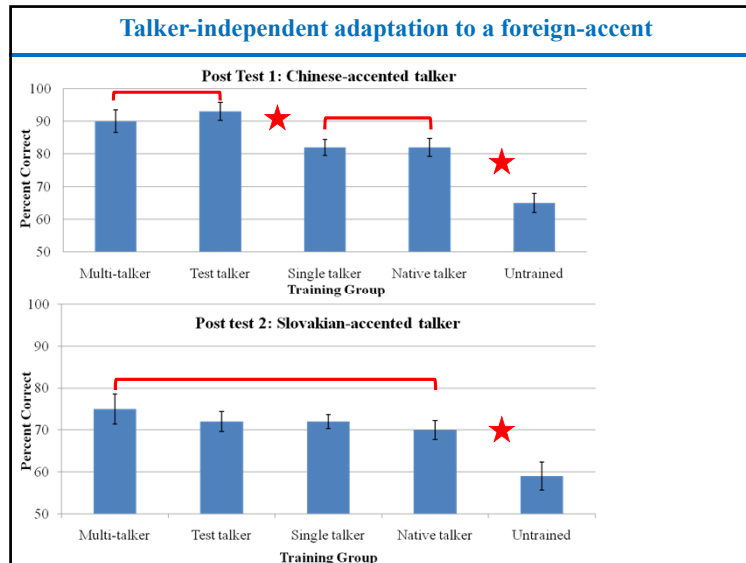
- Does perceptual learning for foreign-accented speech require active performance of a sentence recognition task?

L1-L2 interactions => Talker-independent adaptation

Adaptation to an accent as it extends across a group of foreign-accented talkers from the same native language background



Bradlow and Bent, 2008. See also Clarke & Garrett, 2004; Sidaras, Alexander & Nygaard, 2009.



Adaptation to foreign-accented speech

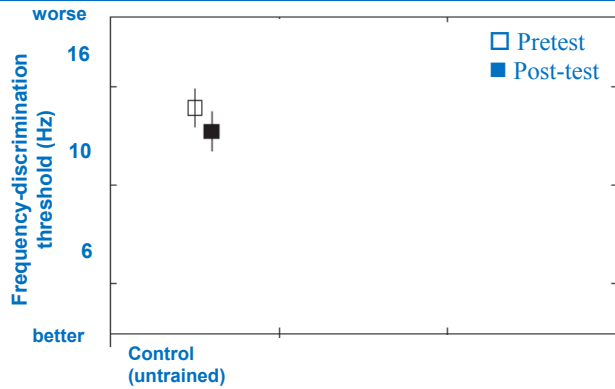
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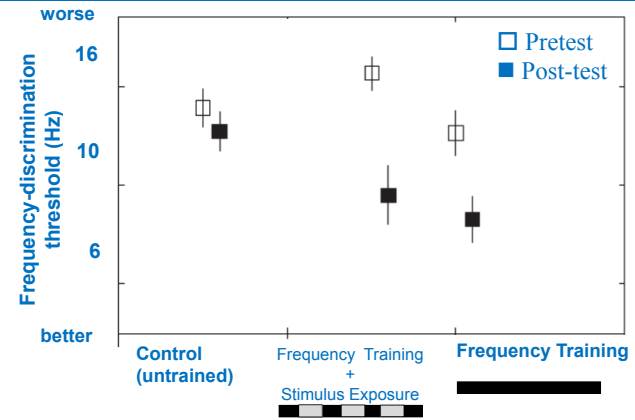
- Does perceptual learning for foreign-accented speech require active performance of a sentence recognition task?

Auditory perceptual learning with a combination of active task performance and passive stimulus exposure



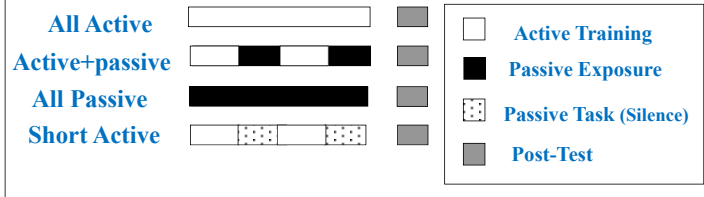
Wright, B.A., Sabin, A.T., Zhang, Y., Marrone, N., & Fitzgerald, M.B. (2010), *J. Neuroscience*.

Auditory perceptual learning with a combination of active task performance and passive stimulus exposure



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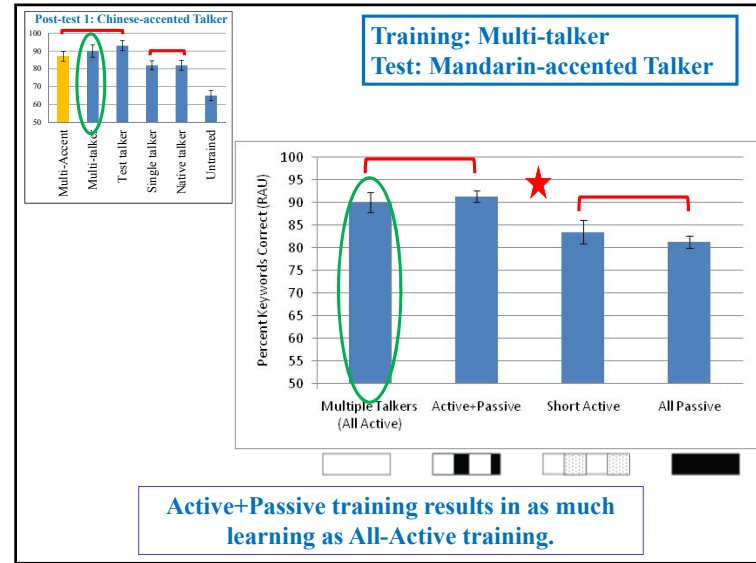
Adaptation to foreign-accented speech with a combination of active task performance and passive stimulus exposure



“Passive” task:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Translate the following symbols using the key (above).



Adaptation to foreign-accented speech

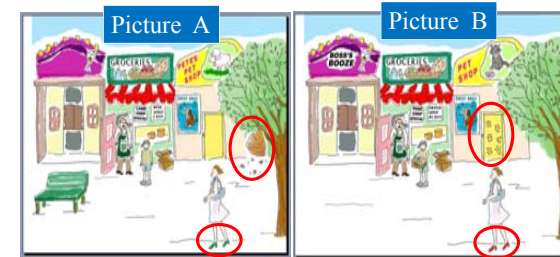
- Systematic deviations of foreign-accented speech allow highly generalized perceptual learning with exposure to appropriately variable training stimuli.
 - Adaptation to foreign accents can occur in response to a combination of active performance of a sentence recognition task and passive listening situations.
 - Perceptual flexibility underlying perceptual adaptation to foreign-accented speech may eventually lead to parallel adaptations in speech production.
- ⇒ A link between individual-level adaptation to variable speech input and population-level, contact-induced sound change.

Talker-listener interaction:

Spontaneous conversational patterns across a language barrier

The Diapix task (dialogue-based picture matching)

- A “spot-the-difference” game with 2 pictures and 2 participants.
- Without seeing each other’s picture, participants work together to find differences.
- Elicits a wide range of utterance types (questions, declaratives, exclamations etc.).
- Elicits connected speech from both participants without predetermined roles.



Communicative efficiency, phonetic convergence, and language distance

Communicative efficiency

- Task completion time
- Type-to-token ratio

Phonetic convergence

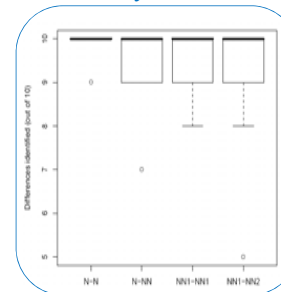
- Talker similarity judgments at the beginning versus at the end of a conversation

Language distance

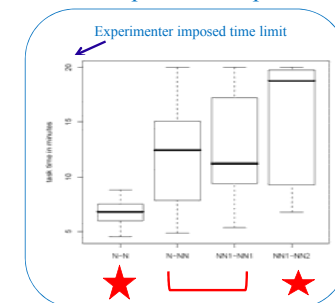


Communicative efficiency and language distance

Task accuracy



Time to complete the diapix task



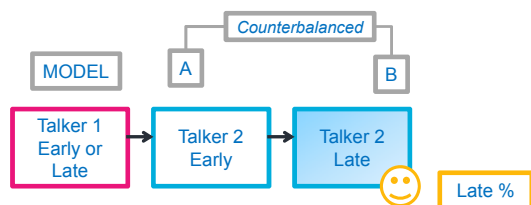
Efficiency decreases with increasing language distance.

Van Engen, Baese-Berk, Baker, Choi, Kim & Bradlow, 2010. See also Baker & Hazan, 2011; Hazan and Baker, 2011.

Phonetic convergence and language distance



Which is more similar to the MODEL, A or B?



% of trials on which the late snippet (A or B) is selected

Kim, Horton & Bradlow, 2011. See also Pardo, 2006; Babel, 2010, 2012.

Phonetic convergence in relation to language alignment

Greater phonetic convergence for pairs with relative close language distance (relatively well-matched linguistic knowledge)

- Phonetic convergence is limited to parameters and categories that are already well-established within the talkers' linguistic sound systems.

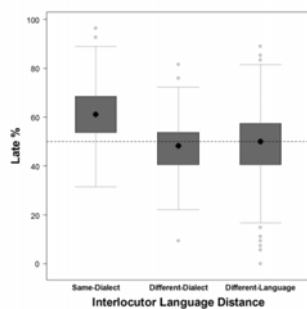
Variability across well-matched talkers is more likely to be within their existing phonetic repertoires (e.g. Babel, 2009).

Greater phonetic convergence for pairs with relative far language distance (relatively mis-matched linguistic knowledge)

- There is more room for adjustment.
- Production targets are highly flexible, just like perceptual flexibility (as reviewed by Samuel and Kraljic, 2009).

(Kim, Horton & Bradlow, 2011, *Journal of Laboratory Phonology*)

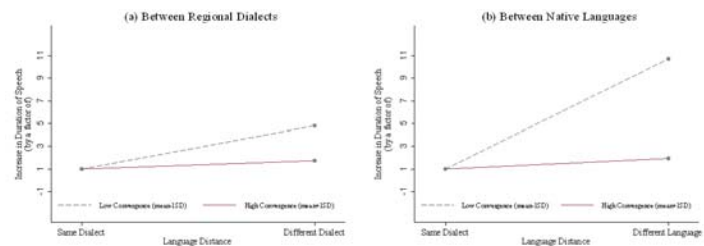
Phonetic convergence and language distance



Convergence decreases with increasing language distance.

Phonetic convergence, communicative efficiency, and language distance

Statistical modeling of the moderating effect of convergence on the relationship between language distance and task completion time (accelerated failure time regressions).



Phonetic convergence mitigates the negative influence of the language distance on communicative efficiency.

Statistical modeling by Minyoung Kim (U. Kansas).

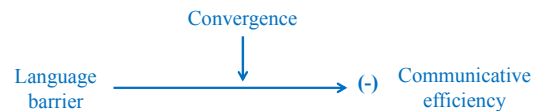
Talker-listener adaptation across a language barrier

Listener adaptation to foreign-accented speech

- Increasingly generalized adaptation with exposure to increasingly expansive dimensions of systematic variation.
- In combination with explicit training, immersion conditions can promote highly efficient adaptation to foreign accented speech.

Communicative efficiency, phonetic convergence and language distance

- Phonetic convergence mitigates the negative influence of the language distance on communicative efficiency.



How can we promote convergence?

Bi-directional talker-listener adaptation across a language barrier

Speech communication across a language barrier

- a challenge
- an opportunity for innovation

Perceptual learning and phonetic convergence

- short-term, individual-level mechanisms
- lay the foundation for longer-term, population-level speech and language change

Acknowledgments

All of this work was carried out with:

- constant and deep collaboration with past and present postdocs and students in the Speech Communication Research Group

Melissa Baese-Berk

Tessa Bent

Rachel Baker

Arim Choi

Midam Kim

Kelsey Mok

Page Piccinini

Kristin Van Engen

- cooperation of the participants and director of the Northwestern University International Summer Institute
- technical assistance from **Chun Liang Chan**
- original diapix idea **Valerie Hazan** (UCL)
- statistical modeling by **Minyoung Kim** (U. Kansas)
- **Beverly Wright** (CSD) and **Sid Horton** (Psychology) at Northwestern
- stimulating discussions from the Northwestern University "Phonatics" group
- Grant support: R01-DC005794 from NIH-NIDCD