

Linking Phonetic Convergence and Sound Change

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Linguistic Convergence

Convergence is...

- Convergence in a range of linguistic characteristics, including:
 - vowel formants (e.g. Babel 2012)
 - pitch (e.g. Babel & Bulatov 2011)
 - intensity (e.g. Gregory & Hoyt 1982)
 - VOT (e.g. Bane et al. 2010)
 - timing of conversational turns and pauses (e.g. Street 1984)
- Also apparent in holistic impressions of speech similarity (e.g. Goldinger 1998, Pardo 2006)

Some models attribute sound change in part to speakers' tendency to sound more like their interlocutors (Yu 2013a), which is observed as *phonetic convergence* (Goldinger 1998). Not all speakers converge to the same degree, but there is limited work characterizing this variation and comparing it across measures (e.g. Pardo et al. 2015).

Questions

There are differences in the degree to which different individuals converge

- Are individual tendencies within a measure consistent across tasks and with different partners?
- Are individual tendencies consistent across measures?

Questions

- Most prior research focuses on a single measure of convergence to test particular influences on convergence (though cf. Pardo et al. 2015)
- But do different measures behave similarly across tasks and across speakers?

Hypotheses: Consistency across Measures

- Hypothesis 1: Individuals have consistent patterns of convergence across measures; a pair's convergence in one measure will be predictive of that pair's convergence in other measures and convergence in a measure in one task will be predictive of convergence in other measures in that task
- Counter-Hypothesis: Convergence in different measures is not related; convergence in one measure will not be predictive of convergence in other measures either for the same task or for the same pair

Participants

- Female native speakers of American English, ages 18-22
- 12 pairs of interlocutors: 4 RAs, each interacting with 3 different participants (different partners for each RA)

Tasks

Trivia Discussion

Speakers discussed 20 trivia questions and came up with answers together (10 minutes)

Free Discussion

Speakers were instructed to “get to know each other,” resulting in conversations about academic interests, hobbies, families (10 minutes)

Methods

- Recordings were manually labelled in Praat
- Phonological measures: F1, F2, F3
- Prosodic measures: F0, intensity, spectral tilt
- Turn-taking measures: Durations of turns and pauses
- The values in each measure were z-normalized in to allow pooling between measures

Variation across Pairs

- Convergence varies across pairs
- But there is some consistency in convergence exhibited in conversations containing the same individual
- This consistency is most apparent when compared across measures, not for each measure individually

Correlation (including all measures)

- The correlation between convergence for pairs including the same individual was significant: $r(94) = 0.33, p < .001$
- (For pairs with no individual in common, $r(94) = -0.16$)
- The difference between these correlation coefficients is significant: $Z = 3.44, p < 0.001$)

Correlation (separated by measure)

- The correlation was most apparent within vowel formants: $r(34) = 0.37$, $p = 0.017$
- The correlation within turn-taking features: $r(34) = 0.33$, $p = 0.038$
- The correlation within prosodic features: $r(34) = 0.14$, $p = 0.41$

Correlation across Tasks (including all measures)

Convergence exhibited by a pair across tasks is not apparent across all measures, because task had a large effect on some measures

- Among all measures, $r(106) = -0.0083$, $p = 0.93$

Correlation in Vowel Formants

The pattern is clearer in phonological measures

- $r(34) = 0.33, p = 0.038$

Correlation in Prosodic Measures

- $r(34) = -0.096, p = 0.58$

Correlation in Turn-Taking Measures

- $r(34) = -0.027, p = 0.88$

Convergence across Measures

There is no pattern in convergence between different measures

- Little correlation between any different measures, and no trend for correlations to be positive: using Fisher's z transformation, the mean correlation $r(32) = -0.045$, $p = 0.81$
- No individual correlations are significant, even within related measures

What is responsible for convergence?

Convergence is not simply due to the extent to which speakers' productions are unstable

- Speakers' change over time in each measure was not significantly correlated with convergence exhibited by that pair in that task
- The correlation was actually slightly negative: For all measures and pairs, $r(190) = -0.12$, $p = 0.095$
- Excluding turn-taking measures, $r(118) = 0.15$, $p = 0.098$

Time Course

Listeners are dynamic – there is a lot of variation aside from convergence, but local means demonstrate strong tracking between partners

Individual Change across Pairs

significant for f_0 ? $r(10) = 0.5$, $p =$ not close for any other measure individually

apparent consistency in change made by individuals across pairs ($r(106) = 0.21$, $p = 0.026$) was actually due to task-related differences across the measures

- The change made by each individual was correlated with the change made by that individual in a different pair:
- Mostly due to the task(s): The correlation between change made by different individuals is $r(106) = 0.15$, $p = 0.13$
- The difference between these correlations is significant: $Z = 0.49$, $p = 0.62$

Individual Change across Tasks

Consistency in individual change across tasks was only apparent for particular measures

- Including all features, $r(190) = -0.04$, $p = 0.58$
- This is largely due to task-based effects on turn-taking measures

Individual Change across Tasks (excluding turn-taking measures)

- Excluding turn durations and pause durations, $r(142) = 0.16$, $p = 0.052$
- With change in each task from a different pair, $r(142) = -0.14$, $p = 0.091$
- The difference between these correlations is significant: $Z = 2.54$, $p = 0.011$
- No correlations for individual measures reach significance

Individual Change across Measures

No pattern in change in different measures

- Little correlation in different measures and no trend for correlations to be positive
- Using Fisher's z transformation, the mean correlation $r(46) = 0.068$, $p = 0.65$

Individual Change across Measures (Individual Correlations)

Among individual measures, there are some significant correlations:

- between within-turn pause duration and turn-switching pause duration: $r(46) = 0.41$, $p = 0.0017$
- between f_0 and intensity: $r(46) = 0.35$, $p = 0.0095$
- between F_1 and within-turn pause duration: $r(46) = 0.33$, $p = 0.016$

Conclusions

- There are correlations across tasks and pairs – speakers do have some consistency within a measure, both in how much they change and in how much their pairs converge
- But there is a lack of correlation across measures

- I demonstrate that convergence and individual change vary across speakers and across measures, but do not covary, and patterns exhibited by a speaker in one measure are not predictive of her patterns in other measures.
- I argue that while convergence data may provide a source of evidence for the spread of sound changes, such change must be considered separately for different characteristics, and I suggest that at least to the extent that convergence provides a parallel for sound change, sound change is not consistently spread by particular individuals.

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Correlations across Measures

	F2	F3	Pause Dura- tion	Turn Du- ra- tion	Intensity	Spec. Tilt	F0
F1	0.1	0.33	-0.27	-0.17	0.36	-0.08	-0.05
F2		0.01	-0.1	0.17	0.36	0.13	-0.052
F3			0.02	-0.06	0.2	-0.12	-0.14
Pause Dur				0.07	-0.19	0.08	-0.003
Spec. Tilt					0.26	0.28	0.28
Intensity						-0.22	-0.005
F0							0.11

Table: Correlations for convergence