Models of Language Evolution
Session 9: The Utterance Selection Model

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2016/12/21
# Students’ Presentations

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Innovation & Propagation

- Labov and Herzog (1968) distinguish between the *emergence* of a new variant from their *spread* through the speech community.
- Both processes essentially mirror variation and selection: new variants come into use, and selectional pressures lead to their replication.
- But how does variation come about? How does linguistic innovation arise?
Innovation & Propagation

- Linguistic research has primarily addressed the spread/propagation of change rather than its innovation.
- Notable exception: Milroy & Milroy 1985; Milroy 1992 address the process of *actuation* in terms of social-network analysis.\(^1\)
- New variants may emerge for various reasons, but they only turn into a change once they come to bear on the linguistic system.
- *Actuation* is the minimal step an *innovation* needs to become a change.
- Note: it’s only the successful innovation that we register.

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\(^1\)Note that innovation and actuation are two separate processes.
Evolutionary Framework of Language Change

- language change by *replication*: linguistic structures are replicated in utterances (production)
- generation of *variation* by innovation
- diffusion is driven by *selection*
- in language change we distinguish between the *replicator* (linguistic item, lingueme, token of linguistic structure) and the *interactor* (speaker)
Exercise I: mechanisms of evolutionary framework

What are the two important distinctions of an evolutionary framework relevant to the typology of mechanisms of language change?

- Evolutionary changes involves two types of replication: i) the repeated usage of linguistic items in repeated interactions (horizontal transmission), and the transmission of a linguistic system from one generation to the next (vertical transmission)

- Evolutionary change is a two-step process: i) generation of variation, and ii) selection of some variants over others ✓

- Evolutionary change involves two roles: i) the replicator (linguistic item), and the interactor (speaker, language user) ✓

- Evolutionary change involves two different processes: i) the (biological) evolution of language faculty, and ii) the (cultural) evolution of linguistic structure

- Evolutionary change involves two different points of view: i) the individual- (or agent-) related, and the population-related view
Selection Mechanism

- Sturtevant-like: language change is attributed to ‘social’ valuation, such as positive attribution to speaker’s social status or register of variants
- Bloomfield-like: language change is attributed to the interaction structure of the community, particularly frequency effects
Exercise II: mechanisms of evolutionary framework

What are the four types of propagation mechanisms that Blythe and Croft distinguish?

- Neutral Interactor Selection ✓
- Weighted Interactor Selection ✓
- Momentum-based Replicator Selection
- Replicator Selection ✓
- Local Interactor Selection
- Neutral Evolution ✓
Selection Mechanisms in Language Change

1. Replicator Selection (RS): absence of symmetry, e.g. variants are associated with social values (Labov 2001), structural or functional biases (Haspelmath 1999, Nettle 1999), etc...
   → diffusion is mainly driven by property of variant

2. Weighted Interactor Selection (WIS): symmetrical variants, asymmetrical roles of interlocutors (Rogers 1995, Labov 2001)
   → diffusion is mainly driven by particular interlocutor roles

3. Neutral Interactor Selection (NIS): symmetrical variants, symmetrical interlocutor roles, interaction frequencies are unequal, e.g. social network structure (Milroy & Milroy 1985)
   → diffusion is mainly driven by interaction structure

4. Neutral Evolution (Drift): variants, interlocutor roles and interactions structures are symmetrical
   → change driven by rnd fluctuations in replicator frequencies
Exercise III: Roger’s Model

What are the five adopter categories of Roger’s model?

- Early majority √
- Innovators √
- Late majority
- Stabilizers
- Early adopters √
- Laggards √
- Late adopters √
- Founding fathers
Selection Mechanisms in Language Change

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<th>RS</th>
<th>WIS</th>
<th>NIS</th>
<th>Drift</th>
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<tr>
<td>replicator value</td>
<td>non-sym.</td>
<td>sym</td>
<td>sym</td>
<td>sym</td>
</tr>
<tr>
<td>interactor role</td>
<td>-</td>
<td>non-sym</td>
<td>sym</td>
<td>sym</td>
</tr>
<tr>
<td>interaction structure</td>
<td>-</td>
<td>-</td>
<td>unequal</td>
<td>equal</td>
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Table: Typology of the mechanisms of propagation of language change.
Exercise IV: types of variable changes

Variable changes may be divided into types based on origin and outcome. A new variant may introduce a new linguistic **convention**, such as a new word for a new artifact, or the **grammaticalization** of a plural marker in a language without number marking. Or a new variant may compete with an existing variant used for an established convention. ... Finally, in the case of competing variants, a new variant may end up replacing an existing variant, or reallocation may take place – that is, the two variants will become **specialized** in meaning, **register**, or both, and therefore cease to be in **competition**.
S-curves in the trajectory of language change

- replacement (of variant A by variant B) in language change is best approximated by an S-curve (cf. Greenberg 1954, Weinreich et al. 1968, Labov 1994)
- S-curve is now established as a kind of template for change (Chambers 2002)
- Blythe and Croft (2012) (B&C) present 39 documented instances of change, with 22 that fit to a full S-curve, 13 to the beginning (8) or end (5) of an S-curve, and 3 to an interrupted S-curve (page 279)
- B&C are not aware of any (nearly) completed change following a linear trajectory or an exponential curve
- S-curve shape despite variation in speakers, texts, geographical regions, or social classes over the trajectory of change
Exercise V

Which of these changes were documented as following a FULL S-curve?

- Replacement of negative na/nocht by no/not in Scots English [END of S-curve]
- Replacement of ‘Weib’ (pej. woman, wife) by ‘Frau’ (woman, wife) in German [not in list]
- System of vowels in Philadelphia English √
- Negation in French √
- Terms for ‘sofa’ in Canadian English √
S-curves in the trajectory of language change

Brazilian Portuguese ‘ir’ (go) periphrasis Future construction
In their paper “S-Curves and the Mechanisms of Propagation in Language Change” (Language, 2012) Blythe and Croft (B&C) argue that:

1. an S-curve temporal trajectory of language change is a widely observed empirical pattern
2. such a trajectory can be captured only if the propagation mechanism includes ‘replicator selection’

The provide ‘evidence’ for the second point by approaching the ‘Utterance Selection Model’ (USM).
USM: Prerequisites

- Network $\mathcal{G} := \{\mathcal{V}, \mathcal{E}\}$
- of agents $i \in \mathcal{V} = \{1, \ldots, N\}$
- and edges $e_{ij} := (i, j) \in \mathcal{E}$
- equivalent and independent variants of lingueme $v \in \{1, \ldots, V\}$
- the perceived frequency of a variant $v$ by agent $i$ is denoted by $x_v^{(i)}$ and satisfies
  \[ \sum_{v=1}^{V} x_v^{(i)}(t) = 1. \]
- the idiolect of an agent is given by the aggregated vector
  \[ \mathbf{x}^{(i)} := (x_1^{(i)}, \ldots, x_V^{(i)}) \]
USM: Utterance Selection

- choose an edge $e^{(ij)}$ of the network with probability $G^{(ij)}$
- agents $i$ and $j$ produce an utterance

$$u^{(i)} = \frac{1}{T} \text{Multi}(T, \tilde{x}^{(i)})$$

- where $T$ is the number of tokens (length) of an utterance and

$$\tilde{x}^{(i)} = M x^{(i)}$$

- where $M$ is a mutation matrix representing production errors.
USM: Update Rule

- the update rule is given by $x^{(i)}(t + \delta t) = x^{(i)}(t) + \delta x^{(i)}(t)$, whereby

$$
\delta x^{(i)} = \lambda[(1 - h)(u^{(i)} - x^{(i)}) + h(u^{(j)} - x^{(i)})]
$$

- with $\lambda$ being strength of update
- with $h$ being accommodation factor (versus self-monitoring)
the utterance selection model (USM) is an agent-based model to describe language change

the USM allows for the embedding of different selection mechanisms
Simulation Result: Neutral evolution (drift)

Result of *Neutral evolution* (drift): large fluctuations, tendency of upward/downward trend one or more times.
Simulation Result: Neutral interactor selection

Result of *Neutral interactor selection* (boost choice of high- or low-frequent variants): rapid elimination of minority variant or stable coexistence of both variant
Simulation Result: Weighted interactor selection

Result of *Weighted interactor selection* (split community into followers and leaders, the latter boost their variants by influence factor 20/50): rapid initial increase that then slows down
Simulation Result: Replicator selection

Result of *Replicator selection* (boost new variant in relation to old variant for all/most (60/70%) agents): S-shape trajectories
B&C’s Conclusion

- S-shape trajectories in language change most probably involve replicator selection
- to produce an S-shaped trajectory without replicator selection requires very specific conditions of weighted interactor selection
- these results are robust to community size and complexity (e.g. network structure)
- Where does the weighting of variants in replicator selection come from? (Exercise VI)
  - Differential weightings of the variants’ functional features, such as speaker/hearer economy or learnability.
  - Differential weightings of how well the variants fit to the whole linguistic system.
  - Differential weightings of speakers favoring one variant over the other in language use. ✓

Ergo: the weighting assigned to the interactor is transferred to the replicator (social value, such as register)
Response to B&C

- Is S-shape really a general template for trajectories of language change?
- Do particular types of language change suggest a particular selection mechanism?
- Biggest problems with B&C’s approach:
  - they test only a specific instance of a selection mechanisms
  - the do not provide a adequate statistical analysis of their simulation results: (i) no systematic evaluation of parameter combinations; (ii) no formal measure for ‘S-shapeness’
  - they do not reconsider a transfer from interactor weight to replicator weight for replicator selection
- TODO’s:
  - test more instances of selection mechanisms (model extension)
  - define formal measures that reflect ‘S-shapeness’