Individual variation, network heterogeneity and linguistic complexity: which way does the relationship go?

Sébastien Lerique, Dan Dediu, Mátó Karsai, Jean-Philippe Magué

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Individual variation, network heterogeneity
and linguistic complexity:
which way does the relationship go?

Sébastien Lerique, Dan Dediu, Márton Karsai,
& Jean-Philippe Magué
The problem

Language must adapt to many

- landscapes
- situations
- sub-communities
- material conditions
- idiosyncracies

... in a complex network
Possible mechanisms

Lowest common denominator

“Train window” communication → rudimentary signs
Advertisements → pre-filtered interpretations
Administrative language → “syntax of abridgement”  
Marcuse 1964
Portable partial acts  
Di Paolo et al. 2018
Possible mechanisms

Super redundant-robust-complex

- Repairing breakdowns
- Articulating something
- Meaning something
- Negotiating turns & interaction

+ 

Redundancy turns into complexity when not needed
Mechanisms
dant-robust-plex
can each be done in many ways

+ complexity when not needed

### Hypothesis

Standing variation in all aspects of language \(\rightarrow\) **fuel for redundancy**

Network heterogeneity \(\rightarrow\) **pressure for adaptation**

Interactional disorder  

Di Paolo *et al.* 2018

Are core factors generating redundancy, robustness & complexity

---

Chronic *otitis media* in Australian Aboriginal populations  

Butcher 2013

More diversity than expected  

Evans

Japanese business-card exchange  

Evans
Examples

(a) !Xóõ speaker (b) Author

Vocal tract anatomy and articulation
Moisik & Dediu 2017

Chronic otitis media in Australian Aboriginal populations  Butcher 2013

More diversity than expected  Evans & Levinson 2009

Japanese business-card exchange rules  Cuffari et al. 2015
Evolutionary biology

- Niche construction → speakers construct their environment
- Developmental plasticity → learners adapt to their context
- Evolution of development → more constraints and opportunities

Adaptation to different environments is dealt with dynamic, recursive and complex processes.

Minor changes in a population

Granovetter 1978
Population structure & variation

Minor changes in a population can have macroscopic effects

Granovetter 1978   Bikhchandani et al. 1992
Inspirations

Population structure & variation

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Population structure & variation

Minor changes in a population can have macroscopic effects

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Network spreaders

Watts
Minor changes in a population can have macroscopic effects

Granovetter 1978  Bikhchandani et al. 1992
Population structure & variation

Minor changes in a population can have macroscopic effects

Granovetter 1978    Bikhchandani et al. 1992
Inspirations

Network spreading processes

Watts 2002

Structure & variation

Bikhchandani ations

n = 25
p = 0.12
\langle z \rangle = 3
Seed 0

Thresholds

Dirac Normal
loc = 0.18

Seed 0
When competing, how many nodes/edges are necessary for global adoption?

What are the effects of:
- node diversity
- network topology
- placement of seed nodes or constrained edges
Projects

Experiments

One-way communication
- Iterated Learning

Interactive communication
- Experimental Semiotics
- Minimal interactive coupling
- Perceptual crossing

Network topology
- Edge constraints
- Individual sensitivities

Possibly Twitter
- 25% GMT+0/1 tweets in French

De Jaegher et al. 2010 [CC-BY] Icons by Font Awesome [CC-BY]

How many nodes/edges of seed nodes or constrained edges?

How many nodes will provide global adoption?
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The problem

Language must adapt to many landscapes, situations, sub-communities, material conditions, idiosyncracies, ... in a complex network.

Possible mechanisms

- Lowest common denominator
- Super redundant-robust-complex
- Repairing breakdowns
- Articulating something
- Negotiating turns & interaction
can each be done in many ways

Redundancy turns into complexity when not needed

Hypothesis

Standing variation in all aspects of language → fuel for redundancy
Network heterogeneity → pressure for adaptation
Interactional disorder
Are core factors generating redundancy, robustness & complexity? Di Paolo et al. 2018

Examples

- Vocal tract anatomy and articulation
  - Chronic otitis media in Australian Aboriginal populations
  - More diversity than expected

- Japanese business-card exchange rules
  - Moisik & Dediu 2017
  - Butcher 2013
  - Evans & Levinson 2009
  - Cuffari et al. 2015

Inspirations

- Evolutionary biology
  - Population structure & variation
    - Minor changes in a population can have macroscopic effects
    - Granovetter 1978
    - Bikhchandani et al. 1992

- Network spreading processes
  - Watts 2002
  - Generate Structure
  - n = 25
  - p = 0.12
  - <z> = 3
  - Seed
  - Thresholds
  - Dirac Normal
  - loc = 0.18
  - 0
  - 0.5
  - 1
  - 0.2
  - 0.8
  - 0.7
  - 3

Projects

- Simulations
  - When competing, how many nodes/edges are necessary for global adoption?

- Experiments
  - One-way communication ~ Iterated Learning
  - Interactive communication ~ Experimental Semiotics
  - Minimal interactive coupling ~ Perceptual crossing

De Jaegher et al. 2010

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Thank you!