# Language Acquisition and a Process-Centered View of Language Change

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# Outline

- **Language Acquisition and Language Change**
- **Generalization Learning as a Specific Mechanism of Change**
- **A Process-Centered View of Language Change**

# Language Change by Language Acquisition

- First language acquisition is one of the primary drivers of language change[1]
- Plays a role in both innovation and propagation

## The general idea

- Minor "errors" in acquisition accrue over successive generations
- This eventually yields population-level change, which may be dramatic

→ **Studying acquisition is a way to get at an understanding mechanisms of change (i.e., "How and why does language change?")**

[1] Paul 1880, Sweet 1899, Halle 1962, Kiparsky 1965, Andersen 1973, Baron 1977, Lightfoot 1979 *et seq*, Labov 1989, Niyogi 1996 *et seq*, Kroch 2005, Yang 2002 *et seq*, van Gelderen 2011, Cournane 2017, Kodner 2020, *inter multa alia*

# Some Principles of Acquisition-Driven Change

## “Language Change” and “Language Acquisition”

- Both are actually collections of distinct phenomena
- Certain aspects of acquisition drive certain types of change
- Many aspects of change are not driven by acquisition

→ Every claim, implicit or explicit, in the following format is wrong:
“Pretty much all language change accounted for by [my pet research focus]”

# Some Principles of Acquisition-Driven Change

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## Individuals vs Populations

- Learning is crucially individual-level. Can be studied as cognitive science
  i.e., a study of internal mental capacities, representations, and processes
- Change is crucially population-level. Populations are subject to variation
- How do we go from individual to population and back?

# To a Very Rough Approximation…

## Processes of child language acquisition are responsible for what I call “discrete” rather than “continuous” changes

### Discrete Changes

**Centered on actuation**

- The kinds of changes generative theoreticians discuss
- Categorical properties of the grammar virtually fixed over individuals’ lifetimes[1]
- New or lost structures or constructions

### Continuous Changes

**Centered on incrementation**

- The stereotypical subjects of variationist sociolinguistics
- Positions in the vowel space, usage frequencies, optionality
- Spread through communities
- Generally variable over lifetimes
- Often known to be driven by young adults

[1] Andersson 1995, Sankoff & Blondeau 2007, Nycz 2013

# Discrete and Continuous Changes

## Actually two sides of one coin

- Once a discrete innovation enters the population, it becomes variation[1]
- Underlies the basic premise of variationist sociolinguistics:
  The study of variation is the [continuous] distribution of discrete choices[2]
- And the concept of competing grammars in historical syntax and morphology[3]

**The interesting part of the discrete aspects of language change lies closer to actuation than incrementation[4]**

[1] Kroch 2005, [2] Sankoff 1988, [3] Kroch 1994, [4] Weinrich et al 1968 for foundational discussion

# Learner Innovation ≠ Learner Error

## Innovations need not be due to “errors”

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## Errors - “Blame the Child”

- The learner does not act correctly on its input “a buggy algorithm”
- Errors presuppose appropriate evidence and an available target

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- Errors presuppose appropriate evidence and an available target

## Non-errors - “Blame the Environment”

- The learner acts correctly but is dealt a bad input sample
- Even for a good algorithm, “garbage in, garbage out”
- Change in the face of severely underspecified input or even trivial variation

→ We can study change by studying acquisition as a well-behaved system

# Acquisition in the Past

- **Children in the past must have acquired language in the same way that modern children do - this is straightforward application of uniformitarianism[1]**
- **We can reason about acquisition in the past in the same way we do now**

[1] Labov 1972 as applied to linguistics, Walkden 2019, attributed originally to Lyell (1830), but the original definition comes with other assumptions too

# Acquisition in the Past

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## But where can we get data about acquisition in the past?

- We can't run experiments on subjects who are no longer alive
  With appropriate caution, we can project experimental results back to the past
- We can't do corpus or modeling work on ancient child-directed speech (CDS)
  There is none! Overwhelmingly, modern languages don't have CDS either…

## A similar issue faced in other historical sciences…

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**Can non-child-directed speech corpora be substituted for child-directed speech to study the relevant problem?**

**Yes, for the purposes of lexical acquisition→generalization learning[2]**

Not a focus for today, but I can Talk about this in in the Q&A :-)

[1] Labov 1972 as applied to linguistics, Walkden 2019, attributed originally to Lyell (1830), but the original definition comes with other assumptions too
[2] Kodner 2019

# Outline

- Language Acquisition and Change
- **Generalization Learning as a Specific Mechanism of Change**
- A Process-Centered View of Change

# Actuation and the Paradox of Language Change[1]

*If children are so good at acquiring language,*
*how are they so bad at it?*

Helps to have a precise definition of actuation[2]…

**Actuation = Innovation + uptake into the speech community**

**(The hand-off from an individual-level process to a population-level one)**

[1] term coined by Niyogi & Berwick 1997, [2] definition paraphrased from Labov, Yager & Steiner 1972, [3] Yang 2005, 2016

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**I will focus on innovation today, but I can talk about actuation-proper in the Q&A :-)**

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**Actuation = Innovation + uptake into the speech community**

**(The hand-off from an individual-level process to a population-level one)**

…and precise models of the relevant aspects of acquisition

**Today we focus on the Tolerance Principle[3], a model of generalization learning**

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# The Tolerance Principle (Yang 2005, 2016)

- A concrete model for the acquisition of linguistic generalization
- A cognitively-motivated **evaluation metric** over linguistic hypotheses
- Separates the algorithmic aspects of acquisition from the representations over which generalizations are formed

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## Has been applied to a wide range of generalization-learning tasks

- Inflection in Arabic, Cree, English, Frisian, German, Icelandic, Polish, Spanish…
  (Yang 2005, 2016, Belth et al 2021, Björnsdóttir 2021, Munshi 2021, Merkuur 2021, Henke 2022,…)
- Dutch, English, and Latin derivational morphology (Yang 2016, van Tuijl and Coopmans 2021, Kodner 2022)
- Argument structure constraints in English, Icelandic, and Korean
  (Yang 2016, Irani 2019, Lee & Kodner 2019, Nowenstein et al 2020, Pearl & Sprouse 2021)
- 'Root infinitive' phenomenon (or lack thereof) in English, French, Hebrew and Spanish (Payne 2022)
- Phonological 'rules' in English (Sneller et al 2018, Richter 2021, Dresher and Lahiri 2022)
- Variation in Scottish *amn't* (Thoms, Adger, Heycock, Jamieson & Smith)

**and many more…**

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## And has gained backing from a range of psycholinguistic experiments

(Schuler, Newport & Yang 2017, Koulaguina & Shi 2019, Emond & Shi 2021, Li & Schuler 2023)

## And end-to-end computational learning implementations

(Belth, Payne, Beser, Kodner & Yang 2021, Payne 2022, Belth 2023, ***and we have more in prep!***)

# The Tolerance Principle (Yang 2005, 2016)

## How many exceptions is “too many” exceptions?

**Given a hypothesized generalization operating over some class, quantitatively define the number of exceptions below which the generalization is tenable**

$N$ = number of types that should obey the generalization

$e$ = number of types that do not obey the generalization

$\theta$ = max # of exceptions that can be tolerated

Exceptions are tolerable if

$$e < \theta$$

$$\theta = N / \ln N$$

# *N* and *e* Vary over Individual Development

- *N* and *e* are properties of each individual
- *N* is the number of class members a child has learned so far

→ *N* and *e* grow as the learner's vocabulary grows

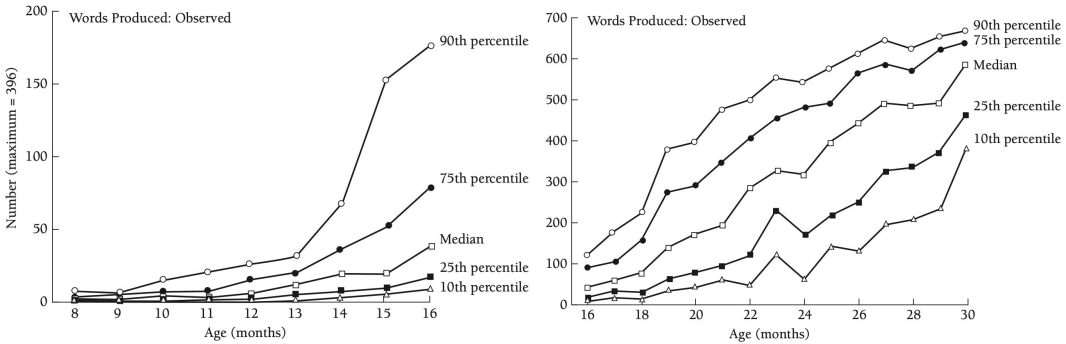
**Can learn generalizations over small *N* not possible over large *N***

**→ This predicts observed learning trajectories**

# Child Lexical Knowledge

- Learners' vocabularies grow over the course of development
- There is significant individual variation, but consistent trends[1]
- **Only on the order of $10^2$** for English and German learners by around age 3
- Observed across many languages[3]
- Children have the foundations for language-specific grammars by this point

| Language | Estimated \|Vocab\| |
|---|---|
| English 2;10-3;0[1] | 525-1,116 |
| German 2;6[4] | $\mu = 429, \sigma > 100$ |




[1] Fenson et al 1994, Hart & Risley 2003, [2] Hart & Risley 2003, [3] Bornstein et al 2004, [4] Szagun et al 2006, Plots from Fenson et al 1994

# The Tolerance Principle and Language Change

## Phonology

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- Metrical stress shift in English (Dresher & Lahiri, ‘22)
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- Secondary split in Menominee (Richter, 2021)

## Morphology

- Directionality in PGmc analogy (Kodner, 2020)
- “Dative Sickness” in Mod Icelandic (Nowenstein et al, ‘20)
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## Syntax

- Rise/Retreat of the *to*-Dative in ME (Kodner, 2020)
- Subj-exper psych verbs in ME (Trips & Rainsford, ‘22)
- DOM in Asia Minor Greek contact (Bağrıaçık & Altamaz)

## Semantics

## A shared mechanism:

**Innovations through generalization learning during language acquisition**

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Earlier Today

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## Many types of change:

Cross-cutting traditional levels of the grammar

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**Cases of secondary split**

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Cases of secondary split

Cases of analogical extension

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Cases of analogical extension

**Cases of grammaticalization, reanalysis, and bleaching…**

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Cases of secondary split
Cases of analogical extension
Cases of grammaticalization, reanalysis, and bleaching**…and more!**

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## Many types of change:

**Cases of change in a contact setting**

## A shared mechanism:

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## Semantics

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**Innovations through generalization learning during language acquisition**

## Many types of change:

Cases of change in a contact setting

**and specifically attrition-related**

# The Tolerance Principle and Language Change

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### Applications that I've worked on

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## Semantics

## Many types of change:

### A brief example for today

## A shared mechanism:

**Innovations through generalization learning during language acquisition**

# Standard Eastern vs Tehrani Armenian Paradigms

- Eastern Armenian distinguishes perfectivity in the past tense
- Two inflectional classes by theme vowel: A-Class, E-Class.
- E-Class is by far the largest

| | Form | A-Class *read* | E-Class *sing* | Irreg. *eat* |
|---|---|---|---|---|
| Standard | INF | *kardal* | *ergel* | *utel* |
| | PST.PFV.3PL | *kardac'in* | *ergec'in* | *keran* |
| | PST.IPFV.3PL | *kardain* | *ergein* | *utein* |
| Iranian | INF | *kardal* | *ergel* | *utel* |
| | PST.PFV.3PL | *kardac'in* | *ergan* | *keran* |
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## In (Conservative) Std Eastern:

- **-Vc'i-** is the default way to form perfects
- Many irregular E-Class perfects show **-a-** instead of **-ec'i-**

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## In (Innovative) Tehrani Eastern:

- Regular E-Class perfects have an ending **-a-** like conservative irregulars rather than **-ec'i-**
- **Analogical extension** from the small irregular class to the dominant one

# Two Additional Observations

## Some regular E-Class verbs already had -*a*- perfects

- **Observed in Western as well as Eastern Armenian**
- **They coexist with -*ec'i*- perfects (sometimes only in the 3rd person singular)**
- **Tend to be high-frequency verbs (‘*do*,’ ‘*bring*,’ ‘*give*,’ ‘*say*,’…)**

## Outside of Iranian Armenian, -*a*- perfects are more common in

- **Intransitive verbs[1]**
- **Verbs with monosyllabic roots**

[1] Martirosyan 2009

# There are actually two changes here…

1. **A Phonological Change**
   **Hiatus glide insertion > Deletion**
   **Conservative > Iranian**
   **/ei/ > [eji] /ei/ >[i]**

2. **A Morphological Change**
   **The analogical extension**
   **Conservative → Iranian**
   ***-ec'i-*** ***-a-***

| | Form | A-Class *read* | E-Class *sing* | Irreg. *eat* |
|---|---|---|---|---|
| Standard | INF | *kardal* | *ergel* | *utel* |
| | PST.PFV.3PL | *kardac'in* | *ergec'in* | *keran* |
| | PST.IPFV.3PL | *kard[ajin]* | *erg[ejin]* | *ut[ejin]* |
| Iranian | INF | *kardal* | *ergel* | *utel* |
| | PST.PFV.3PL | *kardac'in* | *ergan* | *keran* |
| | PST.IPFV.3PL | *kard[ajin]* | *erg[in]* | *ut[in]* |

# There are actually two changes here…

1. **A Phonological Change**
   **Hiatus glide insertion > Deletion**
   **Conservative > Iranian**
   **/ei/ > [eji] /ei/ >[i]**

2. **A Morphological Change**
   **The analogical extension**
   **Conservative → Iranian**
   ***-ec'i-* *-a-***

| | Form | A-Class *read* | E-Class *sing* | Irreg. *eat* |
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## Proposal: Indirect Causation

1. **The phono change made a novel alternative morpho generalization available to learners**
2. **A speaker adopting this novel generalization could spread *-a-* to regular E-Class verbs via over-regularization, a normal process during acquisition**

# A learner has two options after the phono change

## Conservative Generalization

- *-c'-* is the default perfect
- *-a-* vowel is listed

*-a-* remains restricted to irregulars

Predicts *ergec'in* in this case

## Innovative Generalization

- *-c'-* is a property of A-class
- *-a-* vs *-i-* marks aspect

When there is no (overt) TH,
perfect = *-a-*, imperfect = *-i-*

Predicts *ergan* in this example

Pre-Iranian

| Form | A-Class *read* | E-Class *sing* | Irreg. *eat* |
|---|---|---|---|
| INF | *kardal* | *ergel* | *utel* |
| PST.PFV.3PL | *kardac'in* | *erg-?-n* | *keran* |
| PST.IPFV.3PL | *kardain* | *ergin* | *utin* |

# Predictions

## If the phonological change set up the analogy, then

- **A-Class should retain -*ac'i*- perfects because its imperfect retains [aji]**
- **If an Armenian variety has the extension of -*a*-, it must also have /ei/>[i]**
- **If an Armenian variety has /ei/>[i], it may or may not have have the reversal**

# Predictions

## If the phonological change set up the analogy, then

- **A-Class should retain *-ac'i-* perfects because its imperfect retains [aji] ✔**
- **If an Armenian variety has the extension of *-a-*, it must also have /ei/>[i]**
- **If an Armenian variety has /ei/>[i], it may or may not have have the reversal**

Iranian

| Form | A-Class *read* | E-Class *sing* | Irreg. *eat* |
|---|---|---|---|
| INF | *kardal* | *ergel* | *utel* |
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# Predictions

## If the phonological change set up the analogy, then

- A-Class should retain *-ac'i-* perfects because its imperfect retains [aji] ✔
- **If an Armenian variety has the extension of *-a-*, it must also have /ei/>[i] ✔**
- **If an Armenian variety has /ei/>[i], it may or may not have have the reversal ✔**

| Imperfect | Perfect | # of Varieties Surveyed |
|---|---|---|
| *-ein* | *-ec'in* | (Standard Eastern) |
| *-in* | *-ec'in* | 10 |
| *-in* | *-(ec')in* | 3 |
| *-in* | *-an* | 1 (Tehrani Iranian) |
| *-ein* | *-an or -in* | unattested |

Innovation

✔ /ei/ > [eji], no reversal

✔ /ei/ > [i], no reversal

✔ /ei/ > [i], optional reversal

✔ /ei/ > [i], complete reversal

✘ /ei/ > [eji], reversal

May have reversal

Cannot have reversal

# Methodology

## Estimate learner vocabularies in increasing increments

- Verbs extracted/annotated from an Eastern Armenian frequency dictionary[1]
- Vocabularies estimated by taking the top *V* for *V*=50, 60,...,100, 200,..., 600

## Explore feasible incrementation pathways

- What novel generalizations (if any) can be tolerated at each *V* size?
- These are **feasible incrementation pathways** for the Elsewhere Reversal as new cohorts successively extend over-generalizations

[1] Ղազարյան 1982

# Data Summary (Std East)

- E-Class accounts for most verbs
- Irregular, monosyllabic, and intrans. constitute large subsets of E-Class

We take irregular E-Class verbs with *-a-* perfects in Standard as the initial state (purple column) and ignore optional *-a-* verbs (conservative assumption)

| *V* | E-Class All | Std E *-a-* | E-Class Irreg | E-Class 1σ | E-Class Intrans |
|---|---|---|---|---|---|
| 50 | 33 | 8 | 15 | 26 | 10 |
| 60 | 41 | 10 | 17 | 32 | 11 |
| 70 | 47 | 10 | 18 | 36 | 16 |
| 80 | 56 | 12 | 23 | 42 | 20 |
| 90 | 63 | 12 | 24 | 46 | 23 |
| 100 | 72 | 12 | 28 | 49 | 28 |
| 200 | 161 | 13 | 54 | 106 | 64 |
| 300 | 243 | 16 | 79 | 144 | 97 |
| 400 | 332 | 17 | 112 | 176 | 144 |
| 500 | 416 | 17 | 143 | 217 | 189 |
| 600 | 508 | 19 | 175 | 250 | 229 |

# 1. Initial Over-Generalization

## Extend -*a*- immediately to all E-Class?

***N*** **= |E-Class ⊂** ***V*****|**  ***e*** **= |⊂ E-class with -*ec'i*- perfect in Standard|**

# 1. Initial Over-Generalization

## Extend -*a*- immediately to all E-Class? Impossible.

***N*** = |E-Class ⊂ ***V***|  ***e*** = |⊂ E-class with -*ec'i*- perfect in Standard|

| ***V*** | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 |
|---|---|---|---|---|---|---|---|---|
| ***N* (*e*)** | 33 (25) | 41 (31) | 47 (37) | 56 (44) | 63 (51) | 72 (60) | 161 (146) | … |
| ***Tolerable?*** | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ |

# 1. Initial Over-Generalization

## Extend -*a*- immediately to all E-Class Intransitives? Only *V* < 70

*N* = |E-Class intrans ⊂ *V*|  *e* = |⊂ E-class intrans with -*ec'i*- perf in Std|

| *V* | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 |
|---|---|---|---|---|---|---|---|---|
| *N* (*e*) | 33 (25) | 41 (31) | 47 (37) | 56 (44) | 63 (51) | 72 (60) | 161 (146) | … |
| *Tolerable?* | ? | ✔ | ✘ | ✘ | ✘ | ✘ | ✘ | ✘ |

*?* = within 1 of *θ*

## Extend -*a*- to all Irregular E-Class Intransitives? *V* < 200

*N* = |Irreg E-Class intrans ⊂ *V*|  *e* = |⊂ Irreg E-class intrans with -*ec'i*- " " "|

| *V* | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 |
|---|---|---|---|---|---|---|---|---|
| *N* (*e*) | 15 (7) | 17 (7) | 18 (8) | 23 (11) | 24 (12) | 28 (16) | 54 (39) | … |
| *Tolerable?* | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✘ | ✘ |

# 2. If -*a*- Spread to all Irregular E-Class, then…

## Further extend -*a*- to all E-Class Monosyllables? *V* < 70

| *V* | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|---|---|---|---|
| *N* (*e*) | 26 (12) ✔ | 32 (16) *?* | 36 (20) ✘ | 42 (23) ✘ | 46 (26) ✘ | 49 (27) ✘ | 106 (64) ✘ | 144 (91) ✘ | … ✘ |

*?* = within 1 of *θ*

## Further extend -*a*- to all E-Class Intransitives? *V* < 200

| *V* | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|---|---|---|---|
| *N* (*e*) | 10 (5) ✔ | 11 (5) ✔ | 16 (9) *?* | 20 (9) ✔ | 23 (11) ✔ | 28 (14) *?* | 64 (30) ✘ | 97 (41) ✘ | … ✘ |

## Further extend -*a*- to all E-Class 1σ Intransitives? *V* < 400

| *V* | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|---|---|---|---|
| *N* (*e*) | 10 (5) ✔ | 11 (5) ✔ | 16 (9) *?* | 20 (9) ✔ | 23 (11) ✔ | 23 (11) ✔ | 28 (14) *?* | 28 (14) *?* | … ✘ |

# 3. If -*a*- Spread to all Irreg and 1σ E-Class, then…

## Further extend -*a*- to all E-Class? *V* < 400

| *V* | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|---|---|---|---|
| *N* (*e*) | 33 (6) ✔ | 41 (8) ✔ | 47 (9) ✔ | 56 (10) ✔ | 63 (13) ✔ | 72 (17) ✔ | 161(42) ✔ | 243(72) ✔ | … ✘ |

## Further extend -*a*- to all E-Class Intransitives? All *V*

| *V* | 50 | 60 | 70 | 80 | 90 | 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|---|---|---|---|
| *N* (*e*) | 10 (1) ✔ | 11 (1) ✔ | 16 (1) ✔ | 20 (1) ✔ | 23 (2) ✔ | 28 (2) ✔ | 64 (9) ✔ | 97 (15) ✔ | … ✔ |

**This process was repeated iteratively to uncover feasible incrementation pathways**

# Feasible Pathways for Analogical Extension

## If $V$=100 is used as the min $|V|$ needed for incrementation:

- Several pathways for incrementation to the analogical extension

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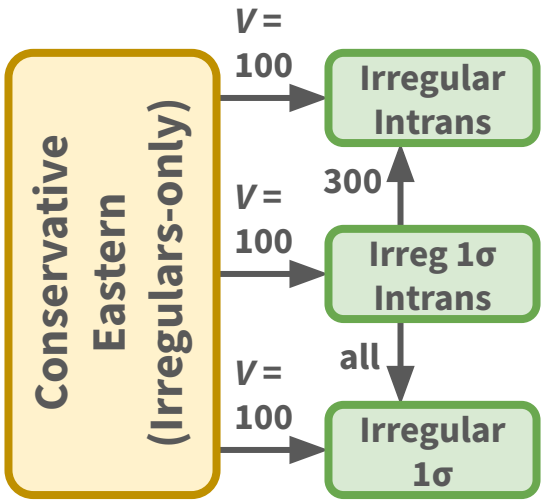


Attested Iranian (all E-Class)

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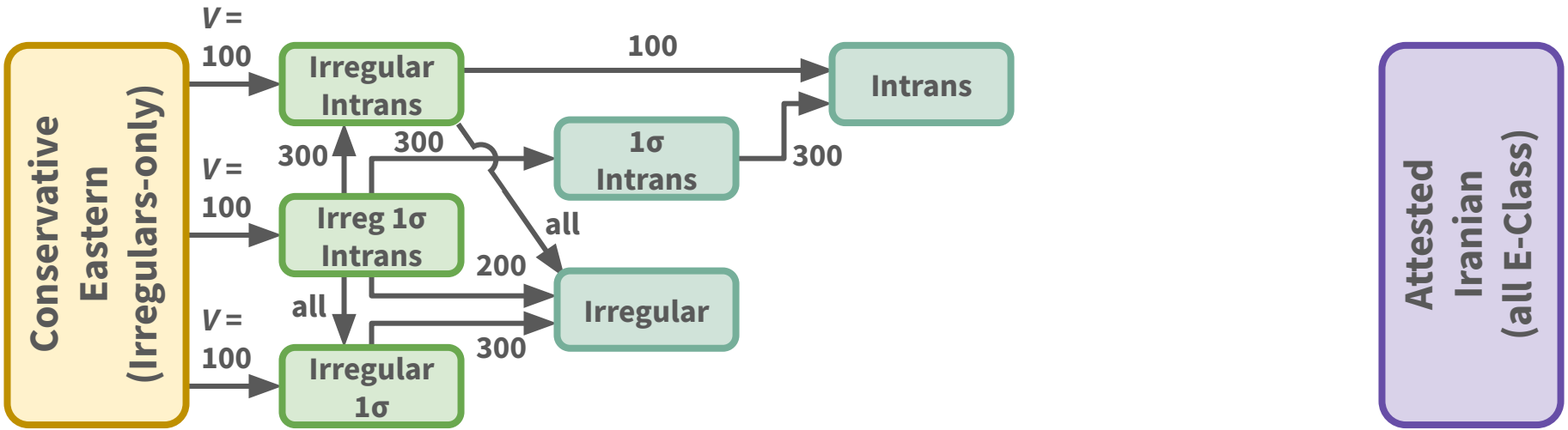

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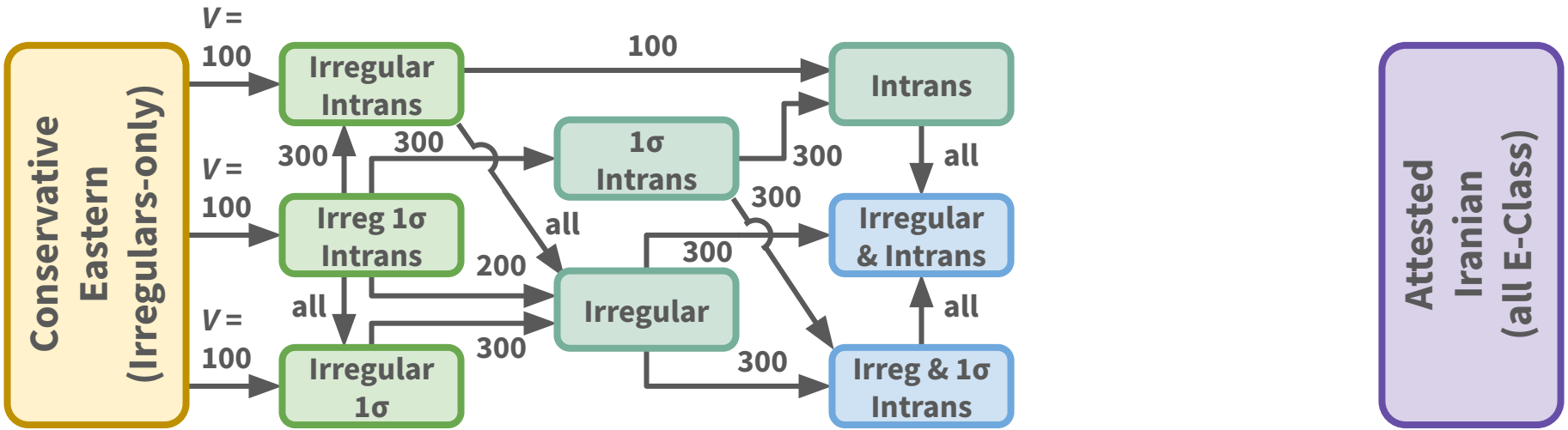

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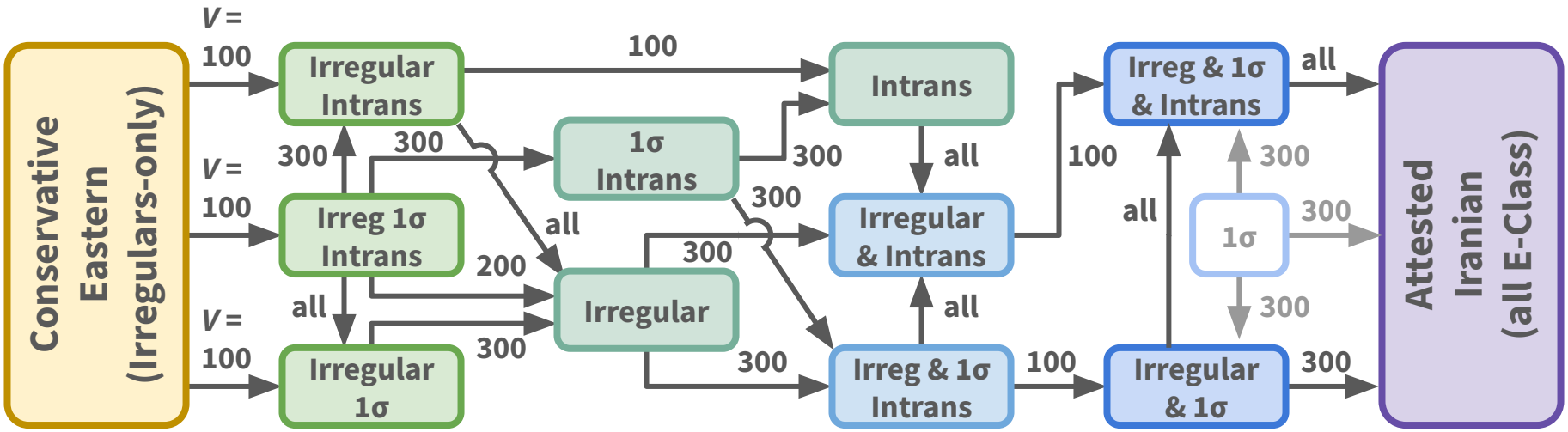

# Conclusions

## Analogical Extension: Just Fortuitous Analogical Leveling

- Analogical change is the population-level diachronic extension of individual learner over-generalization
- Leveling and extension share an identical mechanism
  Extension is just quantitatively less likely to be actuated

**The only reason we could draw this conclusion is because we committed to a mechanism!**

# Conclusions

## Phonological Change: A Necessary but not Sufficient Condition

- A phonological change is implicated in permitting this morphological change
  But only indirectly, through learner innovation
- **Change is a contingent process.** Acquisition and social factors come into play
  This change did not *have to* happen just because it could happen
- Necessary but insufficient condition is backed up by a typological survey

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- Necessary but insufficient condition is backed up by a typological survey

## Precise Predictions: A Directed Search for Armenian Varieties

- The quantitative learning approach here makes precise predictions
- We now have a lead for what to look for in related Eastern Armenian varieties

# Outline

- Language Acquisition and Change
- Generalization Learning as a Specific Mechanism of Change
- **A Process-Centered View of Change**

# The Tolerance Principle and Language Change

## Phonology

- Nasal /æ/-tensing in Philadelphia (Sneller et al, 2018)
- Transparent /aɪ/-Raising (Kodner & Richter, ‘20)
- “Rule Reversal” in Mid HIgh German (Richter, 2021)
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## Syntax

- Rise/Retreat of the *to*-Dative in ME (Kodner, 2020)
- Subj-exper psych verbs in ME (Trips & Rainsford, ‘22)
- DOM in Asia Minor Greek contact (Bağrıaçık & Altamaz)

## Semantics

**Many types of change:**
**Cross-cutting traditional levels of the grammar**

**A shared mechanism:**
**Innovations through generalization learning during language acquisition**

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**Cases of analogical extension**

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## Many types of change:

Cases of secondary split

Cases of analogical extension

**Cases of grammaticalization, reanalysis, and bleaching…**

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## Semantics

## A shared mechanism:

**Innovations through generalization learning during language acquisition**

## Many types of change:

Cases of secondary split
Cases of analogical extension
Cases of grammaticalization, reanalysis, and bleaching**…and more!**

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## Semantics

## Many types of change:

**Cases of change in a contact setting**

## A shared mechanism:

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## Semantics

## Many types of change:

Cases of change in a contact setting

**and specifically attrition-related**

## A shared mechanism:

**Innovations through generalization learning during language acquisition**

# Why do these case studies cross-cut classifications?

## An Old Idea: Taxonomies of Outcomes

- **These case studies share a mechanism (i.e., generalization learning)**
- **But the traditional classifications are based on outcomes**
- **The relationship between outcomes and mechanisms is complex**

  **→ they don't line up very well**

  **→ if our goal is to figure out how and why language changes,**

  **classifying and reclassifying of outcomes is unlikely to get us there**

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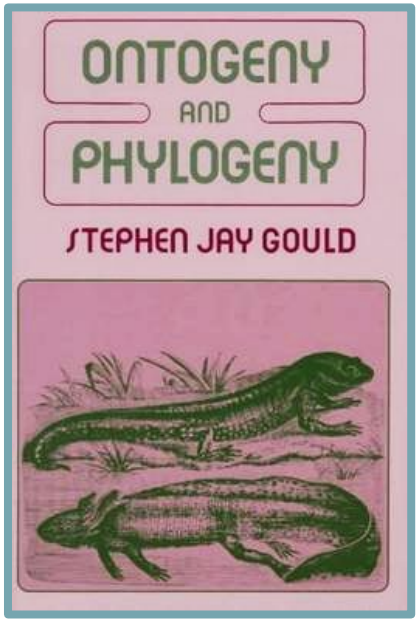
  **→ if our goal is to figure out how and why language changes,**

  **classifying and reclassifying of outcomes is unlikely to get us there**

## A Better Idea: A Taxonomy of Mechanisms

- **It would give us a very different view of the "landscape" of language change**
- **Would help explicate the "the hows and whys" of change**

# A Similar Problem in Biological Evolution



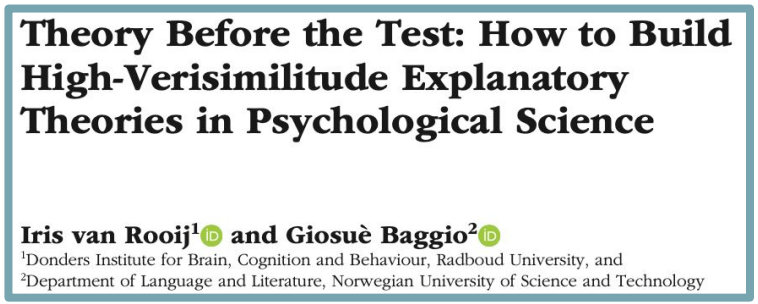

"The confusion between von Baer and Haeckel arises from **an unfortunate tradition in natural history, the emphasis of results rather than processes and their explanations**" (Gould, 1977, pg. 3)

"De Beer subdivides deviation according to where in ontogeny a new character appears and whether we shall consider its effect or the feature it replaces; **this confusion and proliferation [of classification schemes] illustrates the unnecessary complexities that we engender in *producing taxonomies of results* rather than *explications of processes.***"
(pg. 225, *italicization his*)

**An irrelevant aside: There are lots of ammonite fossils on the floors and walls of this building!**

# A Similar Problem in Cognitive Psychology

"Drawing on the philosophy of psychological explanation, we suggest that **psychological science, by focusing on effects, may lose sight of its primary explananda: psychological capacities.**"
(van Rooij & Baggio, 2021)


Theory Before the Test: How to Build High-Verisimilitude Explanatory Theories in Psychological Science

Iris van Rooij[1] and Giosuè Baggio[2]
[1]Donders Institute for Brain, Cognition and Behaviour, Radboud University, and
[2]Department of Language and Literature, Norwegian University of Science and Technology

"**However, effects are explananda (things to be explained), not explanations. …The effect itself is in need of explanation.** Moreover, effects such as we experimentally test in the laboratory are secondary explananda for psychology. **Ideally, we do not construct theories just to explain effects. Rather, [they] serve to arbitrate between competing explanations of the capacities** for cognitive control, speech perception, memory, and vision, respectively."

# A Partial Taxonomy of Actuation Mechanisms

NOT TO SCALE!

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- Metrical stress shift in English (Dresher & Lahiri, ‘22)

## Morphology

- Directionality in PGmc analogy (Kodner, 2020)
- Analogical ext’n in Late Latin pptcs (Kodner, 2022)
- “Irregularization” in EME past tense (Ringe & Yang, 2022)
- “Rule Reversal” in Iranian Armenian (Dolatian & Kodner)
- “Dative Sickness” in Mod Icelandic (Nowenstein et al, ‘20)
- Old/Mid English deriv’nal suffixes (Trips & Yang)

## Syntax

## Semantics

- Rise/Retreat of the *to*-Dative in ME (Kodner, 2020)
- Subj-exper psych verbs in ME (Trips & Rainsford, ‘22)
- DOM in Asia Minor Greek contact (Bağrıaçık & Altamaz)

# A Partial Taxonomy of Actuation Mechanisms

NOT TO SCALE!

| Phonology | Morphology | Syntax | Semantics |
|---|---|---|---|
| Nasal /æ/-tensing in Philadelphia (Sneller et al, 2018) | Metrical stress shift in English (Dresher & Lahiri, '22) | Directionality in PGmc analogy (Kodner, 2020) | "Dative Sickness" in Mod Icelandic (Nowenstein et al, '20) | Rise/Retreat of the *to*-Dative in ME (Kodner, 2020) |
| Transparent /aɪ/-Raising (Kodner & Richter, '20) | | Analogical ext'n in Late Latin pptcs (Kodner, 2022) | Old/Mid English deriv'nal suffixes (Trips & Yang) | Subj-exper psych verbs in ME (Trips & Rainsford, '22) |
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Generalization Learning

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Generalization Learning

Innovation During Language Acquisition

Misinterpretation of ambiguous input
Phonological side of hypocorrection
Interpretation of modals (cf Cournane 2017)

Biased Hypothesis Generation
Phonological reanalysis (Kiparsky 1968)
Economy biases (cf van Gelderen 2004, Biberauer & Roberts 2016)

Maximizing Parsing Success
Vowel mergers (cf Yang 2009)
Variational learning (Yang 2002)

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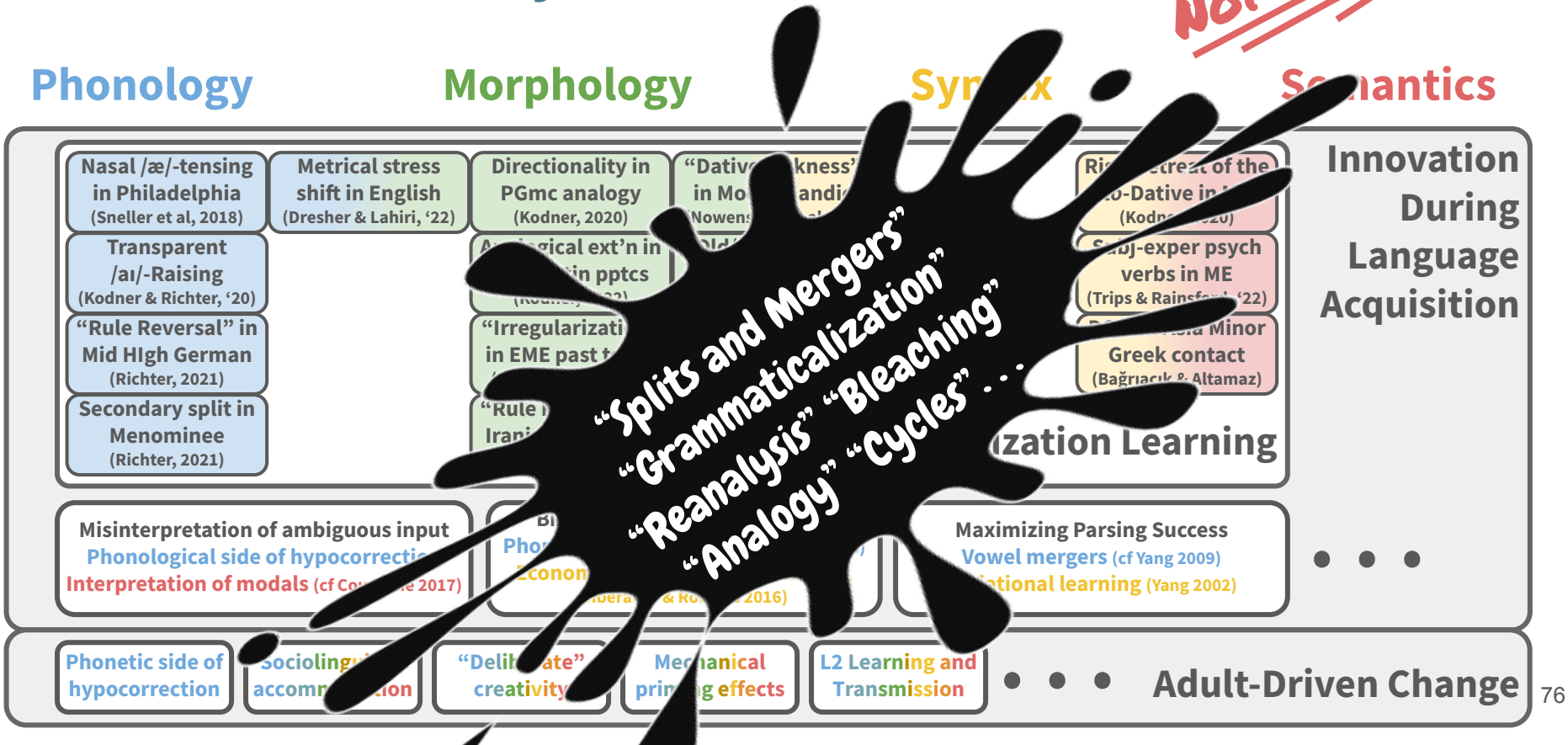
Phonetic side of hypocorrection | Sociolinguistic accommodation | "Deliberate" creativity | Mechanical priming effects | L2 Learning and Transmission | • • •

Adult-Driven Change

# A Partial Taxonomy of Actuation Mechanisms

NOT TO SCALE!

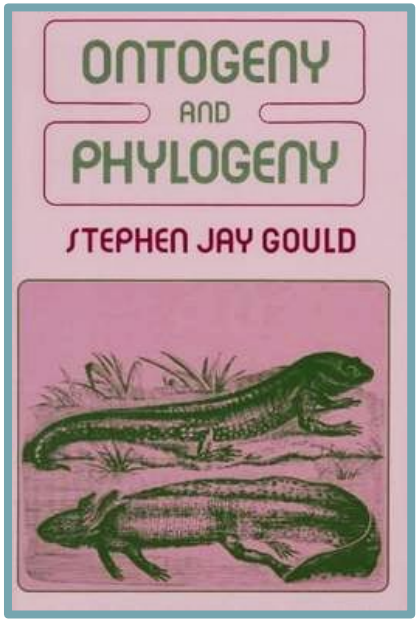


# How can we develop an explication of mechanisms?

## Old theories do not collapse under disconfirmatory evidence alone

**"Natural history does not refute its theories by cataloguing empirical exceptions to them (while working within a paradigm that engendered the theory in the first place)." (pg. 167)**

**"The data of natural history are so multifarious, complex, and indecisive that simple accumulation [of data points] can almost never resolve an issue. Theory must play a role in guiding observation, and theory will not fall on the basis of data accumulated in its own light." (pg. 6)**



# How can we develop an explication of mechanisms?

## Theory and empirical evidence should grow together

"A first thought may be to derive [a capacity] $f$ from observations of the input-output behavior of a system having the capacity under study. However, for anything but trivial capacities, where we can exhaustively observe (or sample) the full input domain, this is unlikely to work…**it is worth building a set of good candidate theories before selecting from the set.**"

"We argue that **even before (and interlaced with) putting computational-level theories to empirical tests, they can be put to theoretical tests, in what we call the theoretical cycle**, in which one assesses whether one's formalization of intuitive, verbal theories satisfies certain theoretical constraints on a priori plausibility."

**Theory Before the Test: How to Build High-Verisimilitude Explanatory Theories in Psychological Science**

**Iris van Rooij**[1] **and Giosuè Baggio**[2]
[1]Donders Institute for Brain, Cognition and Behaviour, Radboud University, and
[2]Department of Language and Literature, Norwegian University of Science and Technology

# How can we develop an explication of mechanisms?

## The promise of new methods for old languages

- **Cognitive science, language acquisition, and theoretical linguistics provide a wealth of models for learning, processing, and representation**
  **Traditional historical linguistics, sociolinguistics, corpus linguistics, and NLP provide a wealth of data and knowledge of human interaction**
- **Cognitive, quantitative, algorithmic models like the Tolerance Principle reveal connections between disparate surface phenomena**

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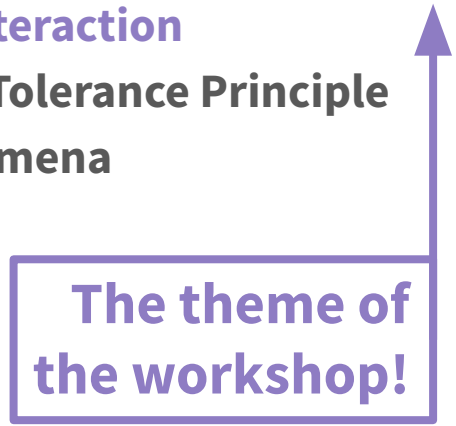

# The End

## Thank you!