An evolutionary explanation for the Paradigm Economy Principle

Linguistic Society of America
January 9, 2010

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Paradigm Economy Principle

Carstairs (1984): There are as many inflection classes as there are realizations of the paradigm cell with the most realizations

Hungarian present indefinite verbs (factoring out phonologically conditioned allomorphy):

	INDICATIVE		SUBJUNCTIVE	
SING 1	*-ok*	*-ik*	*-ak*	*-am*
2	*-ol*	*-om*	*-∅*	
3	*-∅*	*-ik*	*-on*	*-ék*
PL 1	*-unk*		*-unk*	
2	*-tok*		*-tok*	
3	*-nak*		*-nak*	

Paradigm Economy Principle

This relation between number of markers and number of classes isn't obviously true in all languages (Moravcsik 2002, Blevins 2004, Hein & Müller 2009)

The PEP applies only to *irreducible* morphological complexity: morphological patterns which cannot be predicted by external factors (like phonology or semantics)

However, inflection class systems do consistently distinguish fewer classes than they could:

> Tundra Nenets has 14 NOM.SG. forms and 29 ACC.PL. forms, and 94 pairs (more than 29, but much fewer than 14×29=8,120)

Paradigm Economy Principle

What is the Paradigm Economy Principle a constraint on?

Representations (Müller 2007)

> Paradigm economy follows from mental representations
>
> But, what about exceptions? How extensive is our typological database?

Usage (Plank 1991)

> Paradigm economy follows from how language is learned or used
>
> But, what is the mechanism that leads to this pattern? And why is there irreducible morphological complexity at all?

Paradigm entropy

Other similar principles: No Blur Principle (Carstairs-McCarthy 1994), Interclass Syncretism Constraint (Noyer 2005), Inflection Class Economy Theorem (Müller 2007)

All of these principles describe a recurring pattern that their methodological assumptions miss: they are all ways that paradigms can be organized to have low conditional entropy

Speakers of languages with complex morphology and multiple inflection classes do not encounter every inflected form of every word

Paradigm Entropy: Given one wordform of a lexeme, how hard is it on average to predict one other wordform? (Ackerman, Blevins, & Malouf 2009)

Paradigm entropy

Nom Sg	**Gen Sg**	**Part Sg**	**Part Pl**	**Iness Pl**	
ovi	oven	ovea	ovia	ovissa	‘door’
kieli	kielen	kieltä	kieliä	kielissä	‘language’
vesi	veden	vettä	vesiä	vesissä	‘water’
lasi	lasin	lasia	**laseja**	**laseissa**	‘glass’
nalle	nallen	nallea	**nalleja**	**nalleissa**	‘teddy’
kirje	kirjeen	kirjettä	kirjeitä	kirjeissä	‘letter’

PART. PL. *-eja* → INESS. PL. *-eissa*

Paradigm entropy

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NOM. SG. *-i* → GEN. SG. *-en / -den / -in*

Paradigm entropy

Principle of Low Paradigm Entropy: Paradigms tend to have low expected conditional entropy (Malouf & Ackerman 2010)

Low paradigm entropy makes it possible for speakers to generate complete paradigms by identifying patterns of exemplary wordforms.

The PEP is simply a special case representing one of many ways that a language may display low entropy.

Inflectional systems with an unexpectedly large number of classes (w.r.t. the PEP) may be organized in ways that reduce paradigm entropy (Stump & Finkel 2007)

Explanation

Our central claim:

> Languages with low paradigm entropy (and, hence, transparency among classes of related wordforms) are efficient for speakers with finite experience to use.
>
> Speakers of languages with high paradigm entropy will tend to make errors, producing lower entropy variants
>
> The PEP holds (to the extent that it does) because it is one strategy for restricting the paradigm entropy

Explanation

Generative social science (Epstein 1999) “If you didn’t grow it, you didn’t explain it.”

“The Generativist’s Question: How could the decentralized local interactions of heterogeneous autonomous agents generate the given regularity?” (Epstein 2006)

“To explain a macroscopic regularity *x* is to furnish a suitable microspecification that suffices to generate it. The core request is hardly outlandish: To explain a macro-*x*, please show how it could arise in a plausible society. Demonstrate how a set of recognizable – heterogeneous, autonomous, boundedly rational, locally interacting – agents could actually get there in reasonable time.” Epstein (2006:51)

Explanation

Iterated Learning model (Kirby & Hurford 2002)

We start with a maximally complex language: given *c* paradigm cells with *r* realizations each, there are r^c inflection classes

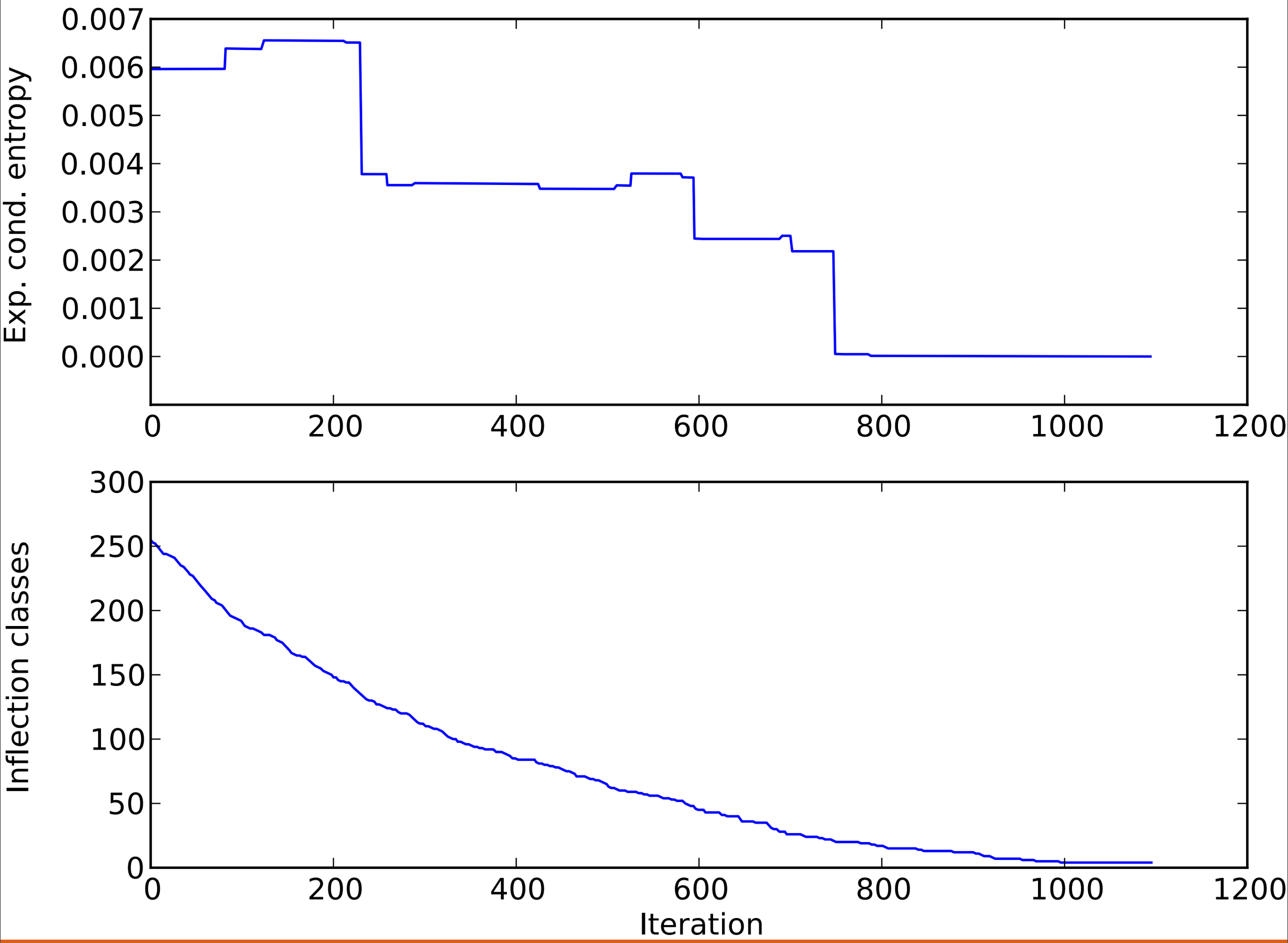
On each iteration, we randomly modify the language:

Select one cell of one inflection class as given

Guess the realization of another cell based on the given cell (occasionally, a new form is introduced)

Reconfigure inflection classes as necessary

Continue until we go 100 iterations without changing the number of inflection classes


Exp. cond. entropy
0.007
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Inflection classes
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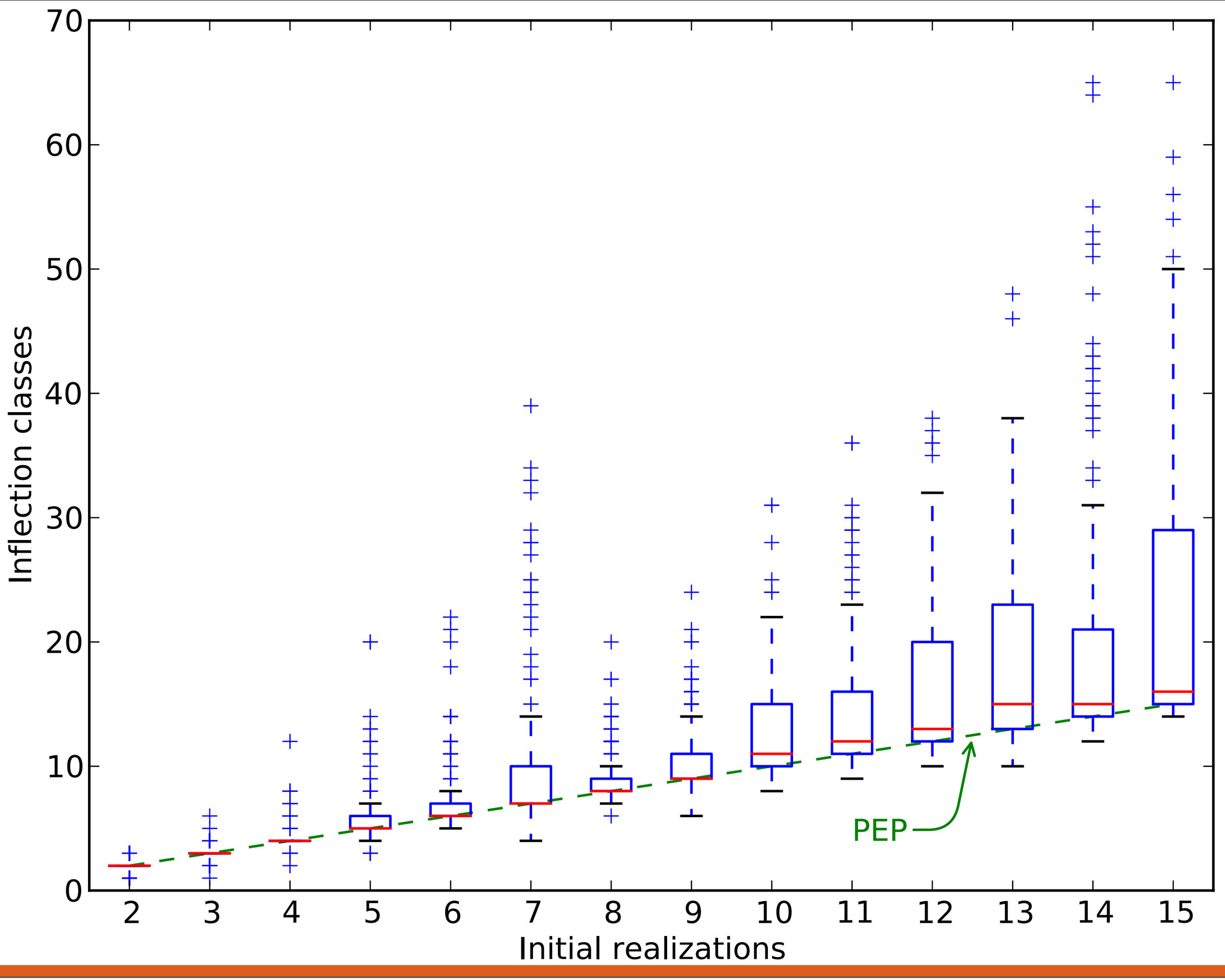
600
800
1000
1200
Iteration


Inflection classes
Initial realizations
PEP
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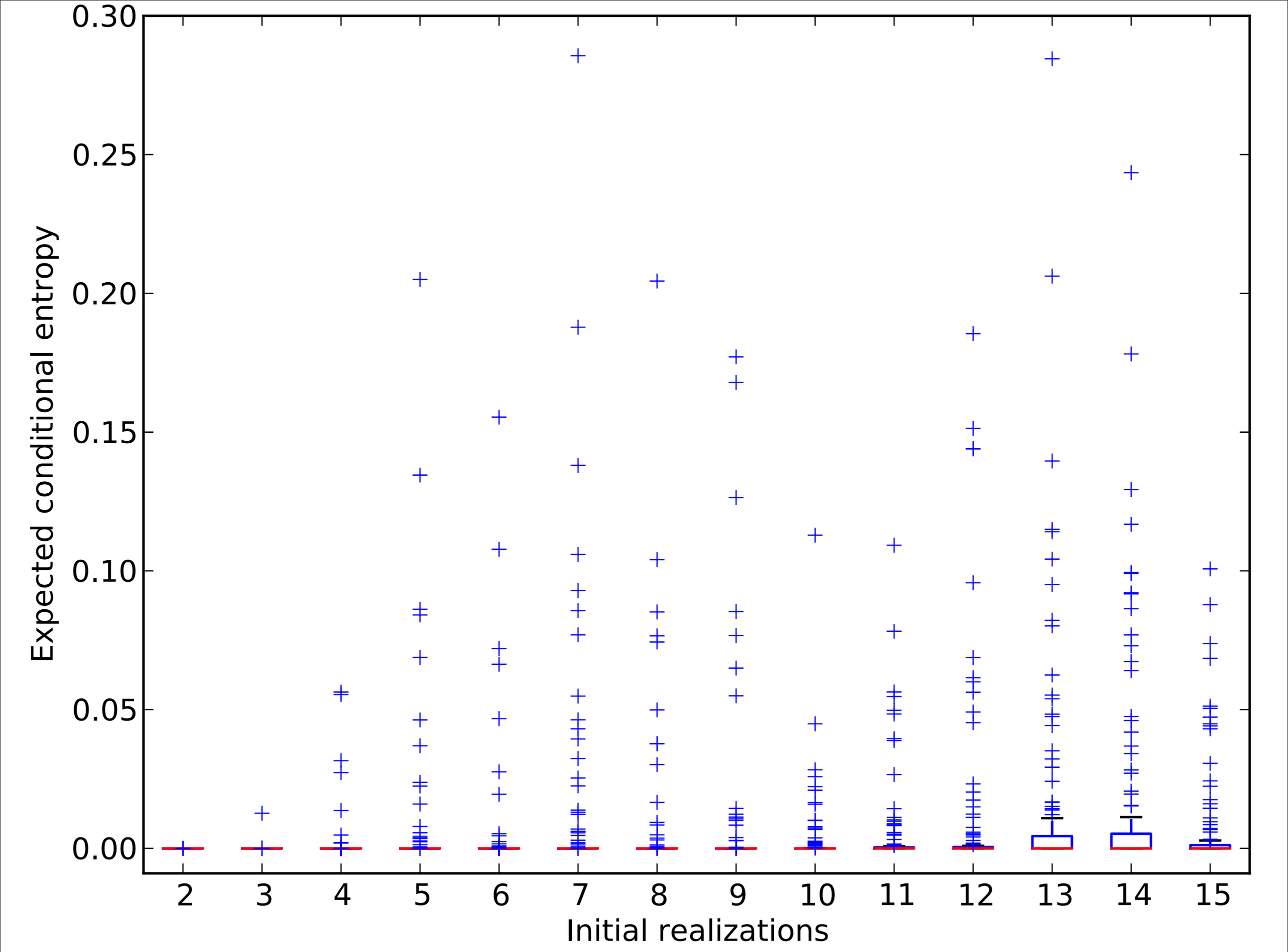
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Expected conditional entropy
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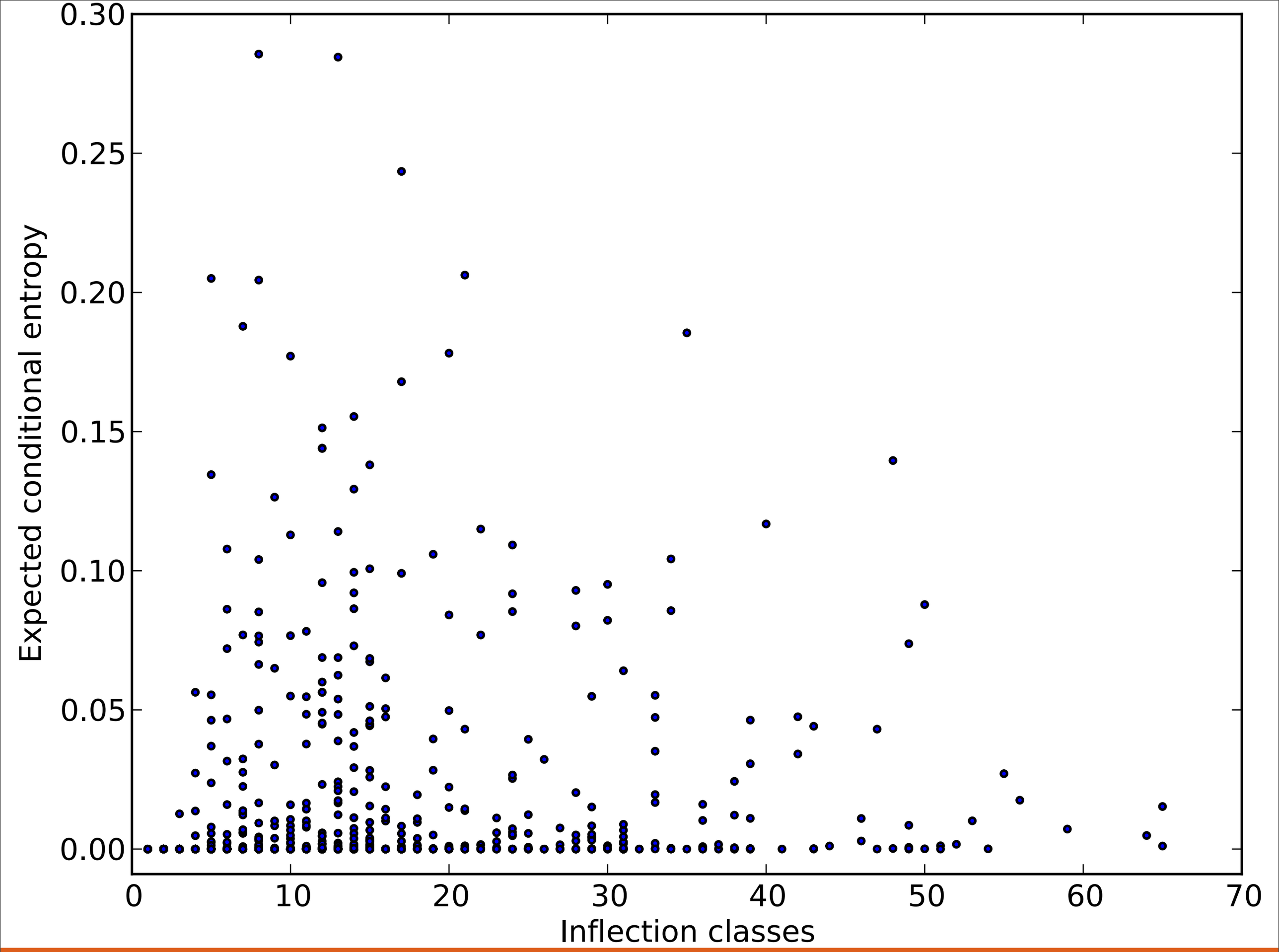
Initial realizations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Expected conditional entropy
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Inflection classes

Simulation prospects

We start with a plausible mechanism (small random changes to paradigms) by which high paradigm entropy languages might evolve to have low paradigm entropy

Many of these (simulated) languages fit the predictions of the PEP

Some do not, but even in these languages, most wordforms of most lexemes are predictable from most other wordforms

Language as a self-organizing complex system: Linguistic evolution explores the “adjacent possible” (Kauffman 2008)

Simulation prospects

Our simulations are plausible and like real languages in some respects, but very implausible and unlike real languages in others

- Very simplistic model of language evolution and use
- Many degrees of freedom (e.g., class and cell distributions)
- No account of external (semantic, phonological) properties of inflection classes
- Absence of intra-paradigm syncretism

What other pressures are there on morphological systems? (Note that knowledge of external factors can only *lower* paradigm entropy.)

How do they relate to natural trajectories from simple to complex to simple to complex.... ?

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