Inflectional Morphology and the Developmental Sciences

Farrell Ackerman
University of California at San Diego

If you want to find new ideas, read old books: not only old linguistics books, but old books in comparative animal behavior and ontogenetic development. Adapted from somewhere.

The fact about science is that everyone who has a made a serious contribution to it is aware, or very strongly suspects, that the world is not only queerer than anyone has imagined, but queerer than anyone can imagine. ***This is a most disturbing thought, and one flees from it by stating the exact opposite.***

J. S. Haldane as cited R. G. Reid 2007:431[1]

Q: What do you do if you don't want to flee?

1. Reid,, G. B. 2007. *Biological Emergences: Evolution by Natural Experiment.* The Vienna Series in Theoretical Biology. MIT Press.

General Task

What is the relevance of the developmental sciences for language analysis?

What I am suggesting:

1. *Developmental sciences (both psychological and biological) offer conceptual insights about how to approach and explain objects within complex adaptive systems.*

2. *Developmental sciences offer toolkits for analyzing such objects.*

3. *When inflectional morphology is conceptualized as a complex adaptive system, then the relevance of the developmental sciences become evident.*

What I am not suggesting:

1. *Language, in particular morphology, derives from biologically guided domain-specific species-specific properties of humans.*

2. *I don't know whether this is so, but I do know that it is common in the developmental sciences to recognize that looking for instincts for X is often an obstacle for understanding traits and behaviors (Y-Z Kuo 1932; Schneirla 1966; Lehrman 1953, 1960, 1970; Gottlieb 1997; Amundson 2005; Blumberg 2009; Jablonka & Lamb 2005; Gilbert and Epel 2009, Hood et. al. 2010, among others.)*

Today's goal

Focus on

1) the instructiveness of how developmental sciences analyze familiar phenomena and "anomalous" phenomena without analytically privileging any particular type over the other;

2) ways in which morphological phenomena can be explained/motivated by viewing them in terms of the particular grammar systems in which they occur;

3) ways in which the organization of morphological systems can be measured and modelled using the tools standardly employed for the analysis of complex objects.

Standard tools and strategies of analysis in the developmental science

What are some modern tools and insights for morphological analysis over words and paradigms?

1. Recognition of the instructive value of identifying morphological anomalies, i.e., phenomena that don't comport with expectation and which raise questions concerning possible morphological systems and their organization.

2. Appeal to mechanisms of development for explaining why certain morphological patterns probabilistically arise, given a multiplicity of interacting factors over real time.

3. Statistical and Information Theoretic measurement, i.e., conditional entropy measures the relative information content of elements in pattern-based systems, identifying the implicative relations between words and thereby the systemic organization they participate in.

4. (Agent-based) Simulations permit mechanistic modeling of complex systems in order to test hypothesized mechanisms and paths of development. (J. M. Epstein 1999, 2006; S. Kirby 2001; S. Kirby & J. Hurford 2002, Wedel 2004, 2009, Oudeyer 2006, among others)

A stone

Nothing is built on stone; all is built on sand.
But we must build as if the sand were stone.
Jorge Luis Borges

A basic question:

What should count as stone for purposes of theoretical analysis in morphology?

A stone: Words and paradigms are the primary objects of *pattern-theoretic* morphological analysis.

Largely a rehabilitation of old ideas with some new insights and the use of quantitative and computational toolkits. (Paul 1880; Robins 1959; Matthews 1965, 1972, 1974; Morpurgo Davies 1978, 1998; Wurzel 1989; Anderson 1992; Aronoff 2004; Stump 2001; Pirrelli 2000; Gurevitch 2000; Milin et. al. 2009; Krott et. al. 2001; Moscoso del Prado Martin et. al. 2004; Hay and Baayen 2005; Blevins and Blevins 2009; Booij 2010; among others

7 guiding hypotheses

H1: Word and Paradigm Morphology is usefully viewed as type of Pattern-Theoretic Morphology.

H2: The word (realized by entities participating in a gradient between fully synthetic and fully periphrastic exponence), instead of the morpheme, is commonly the smallest meaningful (complex) structure in morphology;

H3: A pattern-theoretic perspective treats morphemes, where they exist, as simply the most transparent pattern of form-meaning mapping associated with words conceived as (complex) patterns (Blevins 2010).

H4: When the elements in these formal patterns are not analyzable as meaningful bits (morphemes), as frequently occurs, it is the *configurational pattern* which made up of such elements where the meaning of the whole reliably resides, i.e., words are *recombinant gestalts* that reuse the same pieces in new patterns for new purposes e.g., Harris' Georgian "unwillingness construction")

7 guiding hypotheses

H5: Words are fundamental units for paradigm organization and it is paradigmatic contrast between words that permits morphology to be the study of covariation between word shape patterns and word meanings, without a necessary appeal to classical morphemes;

H6: It is the implicational organization that inheres in paradigms between words that permits speakers to accurately generate novel forms for known lexemes;

7 guiding hypotheses

H7: Pattern-theoretic approaches to morphology (Word and Paradigm Morphologies) participate in a reconceptualization of grammar analysis which views morphological systems as complex adaptive systems. This permits the use of many of the assumptions and toolkits that guide the ongoing reconceptualization of complex structures in

Developmental Comparative Psychology and Psychobiology (D. Lehrman 1953, 1970; Y-Z Kuo, 1960; G. Gottlieb 1970, 1992, 1997; Karmiloff- Smith 1992; E. Thelen & L.B Smith 2003; G. Michel & C. Moore 1995; J. Elman et. al. 1997; J. Stiles 2008;; M. Bornstein & M. E. Lamb; 2010; K. Hood et.al. 2010, among others)

and

(Ecological) Developmental Evolutionary Biology (Ludwig von Bertalanffy 1933/1962; Paul Weiss 1939/196); Sewall Wright 1968; S. Gilbert et. al. 1996; Lewontin 2001, S. B. Camazine et. al. 2003; S. Oyama et. al. 2003; M. J. West- Eberhard, 2003; Amundson 2005; S.Gilbert & D. Epel 2009; A. Wallace 2011; Bateson & Gluckman 2011, among others.)

A deeply different conception of the relationship between perspectives on analysis and relevant methods of analysis in the developmental sciences and language than found in conventional Mainstream Generative research programs e.g., Biolinguistics. (Burraco & Longa 2010; Bateson & Gluckman 2011, among others.)

Organization of the presentation

1. *Competing conceptualizations of morphology (and grammar, more generally): Morpheme-Based versus Pattern-Based approaches*

   Moro (Kordofanian) variable morphotactics

2. *The lessons from linguistic anomalies: extending the possible*

   Cwaya (Kordofanian) SUBJ/OBJ reversal

3. *Systemic explanation: potentiating the possible*

   Tundra Nenets prenominal relative clauses

4. *Measuring and identifying the organization of paradigm systems*

   Low conditional entropy conjecture

5. Concluding observation

1. Competing conceptualizations of morphology

Empirical problem: There are some morphological systems which display variable morphotactics of markers internal to words.

Given the recognition of this phenomenon how should we account for variable affix order? (Luutonen 1997; Muysken 1988; J. Blevins 2001; Bickel et. al. 2006; Paster 2005; Caballero 2010; Stump 2006; Watters 2006; McFarland 2007; Manova & Aronoff 2010 Special Issue of *Morphology*, among others)

Variable morphotactics on Thetogovela Moro (Kordofanian)

Appreciation to Elyasir Julima and Ihklas Elahmer as our consultants

Basic morphotactics of Thetogovela Moro verb:

*{**SM1ST&2ND-**}**CM3RD.SM**-CLAUSE-[**OM**-ASP-ROOT-EXT-ASP/MOOD]* $_{MACROSTEM}$*-**OM-OM-OM**.INST-**OM**.LOC*

*Verbs with object markers (**OM**) display variable morphotactics for the **OM**: `pull'*

OM	Perfective	Imperfective
3SG NON-HUMAN	g-a-vəleð-ó	g-a-vəléð-a
1SG	g-a-vəleð-í-ɲé	g-a-ɲé-vəleð-a
2SG	g-a-vəleð-á-ŋá	g-a-ŋá-vəleð-a
3SG HUMAN	g-a-vəleð-ó-ŋó	g-a-ŋó-vəleð-a
1 INC. DUAL	g-a-vəleð-ə́-nda	g-á-ndə-vəleð-a
1 EX. PL	g-a-vəleð-álánda	g-a-ɲə́-vəleð-álánda
1 INC. PL	g-a-vəleð-ə́-ndŕ	g-á-ndə-vəleð-a-ŕ
2PL	g-a-vəleð-ə́-nda	g-á-ndə-vəleð-a
3pl	g-a-vəleð-ə́-lo	g-a-vəleð-a-lo

= Paradigmatic Gap

OM appears after the verb stem in the Perfective, but both before and after it in the Imperfective; 3rd plural **-lo** is always after the verb stem.

Competing analytic alternatives

Q: Should we regard the alternative orders as

1) derivable from some basic order or,

2) simply as co- equal constructional patterns serving as exponents for tone patterns and different/distinctive morphological property sets (Rose and Jenks 2011: under review)?

Alternative analytic options represent different bets and visions about the role of language variation in understanding morphology.

Two analytic options, stated baldly

H1: **Mainstream Generative Grammar**: Variation represents deviation from some selected canonical or basic form, itself (possibly) representing UNIVERSAL GRAMMAR.

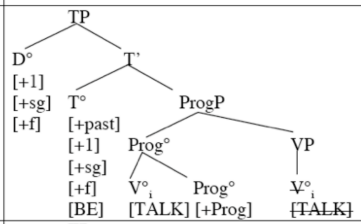
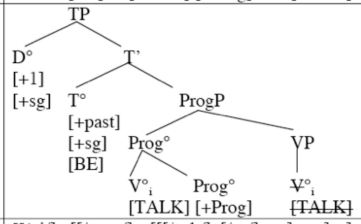
Q: So, which order, if either, is basic in Moro and what are the grammar principles responsible for producing the derived order(s)?

Designed to be predictive, with unpredicted patterns construed as providing new insights into morphological organization, rather than rousing Lounsbury's (1953) suspicions about the theoretical usefulness of a "fictive agglutinative analogue".

Current morphemic approaches

"...words don't exist, they are the phlogiston of linguistics. Everyone must say that sentences are built out of morphemes... We... expect a high degree of isomorphism, of the type expressed by Baker's (1985) Mirror generalization; although various affixal properties may lead to readjustment rules that end up masking syntactic structures; ... The extent of such readjustment rules **enriches** the morphological component of the grammar, (Boeckx, *Bare Syntax* 2008:63-64)

(3) A Distributed Morphology Derivation:

	Operation		Output
a.	**Syntax:** Construct Numeration by selecting feature (bundles) (List 1).	a.	{BE, [+1, +sg, +f]$_D$, [+past]$_T$, TALK, [+Prog]}
b.	**Syntax:** Construct interpretable sentence structure by Merge, Move of feature (bundles). (The output of this step is sent to LF for semantic interpretation, and to PF for Spell-Out.)	b.	
c.	**Morphology:** Manipulate makeup of terminal bundles to conform to language-specific requirements (e.g. by Impoverishment, on which more anon).	c.	
d.	**Morphology:** Realize (or 'discharge') the terminal nodes of the syntactic tree by inserting Vocabulary Items (List 2) into them, giving them phonological content.	d.	[[/aj/]$_D$ [[/wʌz/]$_{T°}$ [[[/tɑk/]$_V$[/ɪŋ/]$_{Prog}$]$_{Prog}$]$_{T'}$]$_{TP}$
e.	**Phonology:** Make morphophonological and phonological alterations to input as necessary to arrive at the optimal phonological form	e.	[ˈajwəzˈtʰɑkin]

Astonishing Hypothesis: Deviations from expectation count as discoveries that "enrich" our understanding of the morphology. Presumably the greater the departure from expectations, the more profound the enrichment. Couldn't the need for such enrichment count as evidence against the basic program? Does not explain the actual rarity of systematic and widespread agglutination nor morphotactic variation.

"Anomalies" teach us about the limits and nature of possible departures from the core, but they have little bearing on our beliefs about the essential nature of the core as morpheme-based. (language particular surface exponence is mere adornment).

Two analytic options, stated baldly

All (core) attested patterns are posited to follow from tree-theoretic architectural assumptions about language design guided by an innate language faculty.

Eschews redundancy as a basic property of morphological systems.

Words and paradigms are epiphenomena

Two analytic options, stated baldly

H2: **Pattern-theoretic (Word and Paradigm)**: Variations simply represent alternative realizations for form-meaning mappings, of greater and lesser complexity, with none having a particularly privileged status.

Q: So, what motivates the particular Moro constructional patterns and what do these patterns, however, (un)familiar tell us about natural language morphology?

Isn't designed to predict specific variations, largely to describe them, promoting an extremely flexible formalism, sufficient to describe all attested patterns and constrained to reflect systemic and contingent properties of grammars as well as human-specific capacities, rather than innate architectural language structures.

Permits redundancy in representations and frequency-sensitive storage of exemplars.

Words and paradigms are primary objects of theoretic analysis

Choosing H2

Basic General Strategy: *Provide detailed descriptions of cross-linguistically recurrent grammatical phenomena in all of their variety (without arbitrarily privileging any particular encoding).*

"Anomaly" doesn't exist in language, rather, lurking behind it are anomalous presuppositions and conviction that obtain in linguistic theory. A. Kibrik 2003:304

Constant Large Question: *What are the bounds of variability and what constrains it?*

> *Recombination of individual elements and ensembles of elements found in independent constructions are systemic redeployments of old elements within new configurations constrained by contingent properties and shaped by human cognitive and perceptual capacities.*

This alternative perspective turns apparently unruly rarity in grammar into instructive guidance about the nature of adequate linguistic architectures.

2. The lessons from grammar anomalies: extending the possible

Anomalies have an instructive role in biology

> Despite their characterization as errors of nature,the anomalous, when properly considered, force us to confront and correct those errors in our thinking that often impede scientific insight and progress." M. Blumberg *Freaks of Nature: What anomalies tell us about development and evolution.* Oxford University Press 2009:13

Guiding intuition: Recombinant potential in biological forms

Platypus: A furry, egg-laying, duck-billed, echolocating, venomous (when masculine) creature.

Two silly questions:

1. *Is the platypus more or less natural than the duck or the beaver?*
2. *Is the platypus a departure from a canonical duck or beaver, or is it the other way around?*

While all of the basic platypus properties are familiar, their alignments produce novel, historically contingent, and ecologically viable patterns.

The pattern is new, not the pieces (though, of course, the pieces themselves show variation).

"Anomalies" extend our notions of what is possible, and hence, natural.

Guiding intuition: Recombinant potential of grammar

...both kangaroos and platypus were representative rather than idiosyncratic anomalies... - H. Ritvo . *The platypus and the mermaid and other figments of the classifying imagination.* Harvard University Press. 1997:6

Similarly construed as **representative rather than anomalous patterns**, less familiar morphological constructions attest to logical possibilities that are not generally imagined or predicted.

Counts as suggestive evidence against "simplifying" uniformity assumptions.

Grammatical platypus: reuse of pieces in new configurations for new purposes
- pronoun incorporation, tone, grammatical function assignment, person-hierarchy.

Recombinant parts and patterns: Grammatical function marking within the verb (Ackerman & Rose in preparation)

Goal: Contrast grammatical function marking in two related languages which exhibit resemblances and striking dissimilarities.

Grammatical Function encoding within the word: Incorporated pronouns in Moro have dedicated forms and positions for the expression of SUBJ and OBJ.

Grammatical Function Reversal concerns the association of CM and PNM slots with either SUBJ or OBJ functions, depending on co-occurring feature sets and tone within the word.

Grammatical Function Assignment within the word: Moro

SUBJ pronominal paradigm:

1SG	e–g–
2SG	a–g–
3SG	CM–
1INCL DUAL	alə–g–
1PL INCL	alə–g...r
I PL EXCL	ɲa–g–
2PL	ɲa–g–
3PL	CM–

OBJ pronominal paradigm:

	Pattern 1		Pattern 2	
	PREFIX	SUFFIX	PREFIX	SUFFIX
1SG	–ɲe		–ɲə–	
2SG	–aŋa		–ŋa–	
3SG HUM	–ŋo		–ŋ^{w}ə–	
3SG NONHUM	–		–	
I INCL DUAL	–nḍa		–nḍə–	
1PL INCL	–nḍ(–)r		–nḍə–	–r
1PL EXCL	–alanḍa		–ɲə–	–alanḍa
2PL	–nḍa		–nḍə–	
3PL	–lo		–lo	

Pattern 1 (**SM**$_{\{1ST|2ND\}}$-)**CM**$_{SUBJ3RD}$-V-ASP-**OM**

Pattern 2 (**SM**$_{\{1ST|2ND\}}$-)**CM**$_{SUBJ3RD}$-**OM**-V-ASP

Dedicated SUBJ and OBJ positions occupied by dedicated pronominal SUBJ and OBJ markers.

1st and 2nd SUBJ always pronominal, 3rd either pronominal or gender agreement marker with lexical NPS; all OMs pronominal and do not reflect noun class of nominal, unlike (often) in Bantu.

Recombinant parts and patterns: Grammatical function marking within the verb (Ackerman & Rose in preparation)

Person Hierarchies recur in the morphologies of many languages: (Silverstein 1976; A. E Kibrik 2003; Haspelmath 2004; Siewierska 2004; Corbett 2006, Cysouw 2008, among others, but Bickel & Witzlack-Makarevich 2008 for critical evaluation.)

Several Kordofanian (Nuba mountains in Sudan) languages exhibit variants of a commonly attested Person Hierarchy:

{1 > 2 } > 3

deployed to indicate Grammatical function reversal.

Grammatical Function Reversal concerns the association of **CM** and **PNM** slots with either SUBJ or OBJ functions, depending on co-occurring feature sets as mediated by tone within the word.

Cwaya, Otoro, Tira, Koalib: morphological markers are associated with SUBJ or OBJ status depending on the person number values associated incorporated pronoun when 1 & 2nd co-occur with 3rd or when two 3rd persons co-occur.

Grammatical Function Reversal

(Klaiman 1992 for genera overview; Samvelian 2007 & Bonami and Samvelian 2009 on Sorani Kurdish; Baerman 2007 on Neo-Aramaic and *Inverse Marking* in several languages)

In Sorani Kurdish, reversals correlate with specific tense values, but a person or animacy hierarchy is not reported to be relevant.

a. (min) bo Namin = î da-kir-im
(I) for Narmin 3.sg am-buy.pres-1.sg
`I am buying it for Narmin'

b. (min) kiteb = im bo Namîn kir-î
(I) book 1.sg for Narmin buy.past-3sg
`I bought a book for Narmin'

c. ba dûrbi= mân dit-in
with binoculars-1.pl see.past-3.pl
`We saw them with bionoculars'.

2nd position clitic is associated with an OBJ pronominal and the verbal suffix is associated with the SUBJ in (a), but these grammatical roles are reversed in (b) in (c).

Grammatical Function Reversal in Cwaya: Simplified

(Samvelian 2007 & Bonami and Samvelian 2009 on Sorani Kurdish; Baerman 2007 on Neo-Aramaic and *Inverse Marking* in several languages)

Transitive verbs in Cwaya: (based on Guest 1998; Stevenson/Schadeberg on Tira and Otoro 2009; Schadeberg and Kossmann 2010; Quint 2006 on the role of tonal melodies for reversal in Koalib.)

Partial Pattern 1	**CM**$_{\text{SUBJ/OBJ}}$-V$_{\text{TRANS}}$-{**PNM**$_{\text{SUBJ/OBJ}}$-**3PL**$_{\text{SUBJ}}$}
Partial Pattern 2	**CM**$_{\text{SUBJ/OBJ}}$-TNS-{**PNM**$_{\text{SUBJ/OBJ}}$-**3PL**$_{\text{SUBJ}}$}-V$_{\text{TRANS}}$

CM = 3rd person, **PNM** = pronouns for 3 persons/2 numbers, **{ }** = variable position subtemplate with 2 slots.

Both **CM** and **PNM** can be SUBJ or OBJ with multiple exponence for plurality of SUBJ.

Observations:

CM is not a dedicated SUBJ marker and the variable slots in the verb are associated with **PNM**s are not dedicated **OBJ**s - unlike Moro.

Position of **PNM** within the verb template, like Moro, is (partly) an exponent of (sets of) morphosyntactic property sets.

1st and 2nd person

When 1st and 2nd co-occur, then there is only a single incorporated pronoun and it is the OBJ: **CM** functions as number agreement marker.

1. **nyi** **xa**-má-**nga**-ridi
   1SG.SUBJ **SG.SUBJ**-PAST-**2SG.OBJ**-play
   `I played with you'

2. **nga** **xa**-má-**nyí**-rídi
   2SG.SUBJ **SG.SUBJ**-PAST-**1SG.OBJ**-play
   `You played with me'

Independent pronoun co-occurs with CM displaying number agreement and when SUBJ is plural, then -**lla** appears after OM:

3. ánángá **la**-m-**á**-**lla**-rahm
   1pl.SUBJ **PL.SUBJ**-PAST-**2SG.OBJ**-**PL.SUBJ**-bite
   `We bit you'

{1,2} person and 3rd

When 1 or 2 co-occurs with 3rd, then both are incorporated into verb, but grammatical function is determined by tone, while segmental markers (generally) remain the same irrespective of function.

CM is a 3rd SUBJ exhibiting gender class and **PNM** is 1ST OR 2ND OBJ: HIGH TONE

Past tense vowel is high: **nga**-má-**ny**-apá — **CM$_{SUBJ}$-PNM$_{OBJ}$-V**

3SG-PAST.**1SG**.carry

`It carried me'

CM is a 3 OBJ and PNM is 1ST OR 2ND OBJ: LOW TONE

Past tense vowel is low: **nga**-ma-**ny**-apá — **CM$_{OBJ}$-PNM$_{SUBJ}$-V**

3SG.PAST.1SG$_J$.carry

`I carried it'

(**nga** here is a gender class marker that is segmentally syncretic with the 2.sg incorporated pronoun.)

Summary

Grammatical function status of CMS and PNMS reflects a 1 & 2 versus 3rd opposition;

Many of the same pieces are re-used for different purposes corresponding to words with different function assignments, i.e., the form **nga** can be a singular 3rd agreement marker, a 3rd singular incorporated **SUBJ** or **OBJ.**

Cross-linguistically person-hierarchies play a role in various morphological phenomena, languages have SUBJ and OBJ pronoun incorporation, languages have variable affix orders, languages have grammatical tone, person-number can be expressed discontinuously, there can be multiple exponence, so, in principle there properties can combine in novel ways.

Summary: Moro and Cwaya

Moro:	Pattern 1	(**SM**$_{\{1ST|2ND\}}$-)**CM**$_{SUBJ3RD}$-V-ASP-**OM**
	Pattern 2	(**SM**$_{\{1ST|2ND\}}$-)**CM**$_{SUBJ3RD}$-**OM**-V-ASP
Cwaya:	Pattern 1	**CM**$_{SUBJ/OBJ}$-V$_{TRANS}$-{**PNM**$_{SUBJ/OBJ}$-**3PL**$_{SUBJ}$}
	Pattern 2	**CM**$_{SUBJ/OBJ}$-TNS-{**PNM**$_{SUBJ/OBJ}$-**3PL**$_{SUBJ}$}-V$_{TRANS}$

Do these specific patterns follow from principles of grammar architecture or rather from the dynamics of historical contingencies within (related) grammar systems as constrained by principles of human cognition, and paradigm organization?

We don't have enough comparative data on Kordofanian to identify the specific systemic explanation(s) for the similarities and differences at play here.

But, we do have enough comparative data to motivate/explain a different "anomalous" phenomenon, namely *Possessive Relative Constructions.*

3. Systemic explanation of the possible: Potentiating the possible (Ackerman & Nikolaeva *Descriptive Typology and Grammatical Theory* To appear)

Empirical problem: Many genetically related and unrelated languages in Eurasia contain an unusual relative clause construction.

It is instructive about the nature of grammar organization, and hence, the nature of grammatical architecture more broadly construed.

The most felicitous description as well as the most insightful explanation (motivation) for this phenomenon suggests a pattern-theoretic approach to grammar analysis.

Similar in spirit to Harris' (2007) argument that systemic properties of grammars license 'odd' constructions such as Udi endoclisis and Georgian case marking.

Rather than looking at a single phenomenon in a lone language, we analyze an 'odd' construction **type** that appears in numerous related and unrelated languages.

Prenominal relative clauses

Many languages have externally headed prenominal NON-SUBJECT relatives:

[[$\emptyset_{GAP}$ ... V_{MC}]$_{LOCAL\ DOMAIN}$ **HN**]$_{EXTERNAL\ DOMAIN}$

NON-SUBJ NON-SUBJ

built house

`the built house'

Diagram 1

1. The relative functions as the modifier of the relativized head nominal (HN)
2. The local domain headed by the verbal mixed category (MC) is a full clause
3. The relativized nominal bears a NON-SUBJECT, (OBJ, ADJUNCT...) relation to the gap
4. Gap simply a convention for indicating that something is missing in the local domain that bears a syntactic & semantic relation to the V_{MC}.

Q: How is a pronominal SUBJ expressed?

Pattern 1

M(ixed)C(ategory)-inflected relative: person-number marker (**PNM**) expresses SUBJ pronominal on the $V_{\text{MIXED CATEGORY}}$

[[$\emptyset_{GAP}$ … V_{MC}-**PNM**$_{SUBJ}$]$_{\text{LOCAL DOMAIN}}$ HN]$_{\text{EXTERNAL DOMAIN}}$

Diagram 2

Eastern Ostyak (Uralic):

[[$\emptyset_{GAP}$ … wer-t-äm]$_{\text{LOCAL DOMAIN}}$ kiriw]$_{\text{EXTERNAL DOMAIN}}$

MAKE$_{MC}$-1SG.SUBJ BOAT

` the boat I will make'

Diagram 3

The PNM is *local* to the domain defined by the verb.

Pattern 2

Possessive relative - person-number marking (**PNM**) expresses SUBJ pronominal on the HN:

[[$\emptyset_{GAP}$ … V_{MC}]$_{LOCAL\ DOMAIN}$ HN-**PNM$_{SUBJ}$**]$_{EXTERNAL\ DOMAINN}$

Tundra Nenets (Uralic):

[[$\emptyset_{GAP}$ … ta-wi°]$_{LOCAL\ DOMAIN}$ te-**da**]$_{EXTERNAL\ DOMAIN}$
give$_{MC}$ reindeer-**3SG**
'the reindeer he/she gave'

Observation 1: The **PNM** seems to be in the wrong place, i.e., it bears a SUBJ relation to the V_{MC} heading the modifying clause. (runs afoul of *locality*)

Nominal Possessive Constructions: *Head-marking strategy*

serako te-**da**
white reindeer-**3sg**
`his/her reindeer'

Q: Is the resemblance between these independent constructions fortuitous?

Possessive relative clauses

Question 1: Do these distributions follow from any theory, i.e., are they predicted?

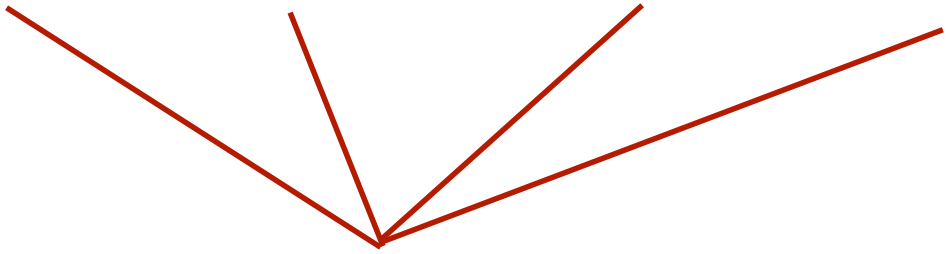
Observation 2: *Every theory can deploy its tools to redescribe these distributions: this is a minimal condition of adequacy for analysis.*

Basic Challenge: *Is there a way to motivate/explain why the Possessive Relative looks the way it does and is reliably identical to nominal possessives wherever it occurs?*

Pattern-theoretic gambit: Dynamic systems explanation

Guiding intuition: All languages with Possessive Relatives (PRC) contain the same four independent licensing constructions

Possessed Noun Morphological CX	Inflectable Non-finite V Morphological CX	Modifier-Head Syntactic CX	Non-finite V Syntactic CX



Possessive Relative Construction

Pattern-theoretic gambit: Dynamic systems explanation

Recombination of various elements found in independent morphological and syntactic constructions cooperate to probabilistically yield a systemic redeployment of a new configuration, the Possessive Relative.

Pr(c1, c2, c3, c4 | PRC) ≈ 1 If a language has PRC, it is potentiated by c1-c4.

Mongolic: Kalmyk, Dagur, Khalka Mongolian, Buriat; *Turkic*: Altai, Uzbek, Turkmen, Tuva, Shor; *Tungus*: Evenki; *Uralic*: Nganasan, Enets, Vogul, Mari; IE: *Western Armenian*; *Isolate*: Yukaghir

Pr(PRC | c1, c2, c3, c4) = ? If a language has c1-c4, can't predict presence of PRC.

What we want are disconfirming data.

Summary

Hypothesis that grammar is a complex system in which interactions between its many dimensions and their ingredients produce a canalizing or directing influence concerning what sorts of grammar properties and constructions may arise over time.

Potentiating influence rather than a deterministic one since in many instances structures permitted by particular interactions simply do not occur, though they could have, given different contingent conditions.

Certain structures possess an exceedingly low probability of arising, since systemic interactions are unlikely to produce them. (cf.Harris 2007)

Hypothesis: A series of contingent, systemic pathways, sometimes guided by analogy, together with human cognitive capacities probabilistically determine observed outcomes.

Q: What principles may guide the organization of syntactic and morphological systems and what is the nature of the resulting organization?

Don't know for the organizational system for syntax, but we have some ideas about morphology.

4. Measuring the organization of paradigm systems (Cherry, Halle, and Jakobson 1953; Moscoso del Prado Martín et al. 2004; Milin et al. 2009a, 2009b, D. Brown 2010; Surrey Morphological Complexity Project)

We've seen how complex morphological systems (Cwaya) can be recombinant combinations of familiar and how their interaction with syntax (Tundra Nenets) can produce unusual synchronic patterns that yield to systemic explanation.

This seems to suggest a lot of learning on the part of speakers, but how could learning of such complex systems occur?

How could complex morphological systems be easy to learn? (Ramscar & Dye 2010, Chater & Christiansen 2010; Ramscar 2011;

The Paradigm Cell Filling Problem (Paul 1890/1970; Paunonen 1974; Anttila 1977; Bybee 1985; Thyme 1989; Itkonen 2005, among others)

Speakers of languages with complex morphology and multiple inflection classes must generalize beyond direct experience, since it's implausible to imagine they will have encountered each form of every word

Paradigm Cell Filling Problem: Given exposure to an inflected wordform of a novel lexeme, what licenses reliable inferences about the other wordforms in its inflectional family? (Ackerman, Blevins, & Malouf 2009; Bonami et. al. 2010)

Morphological systems are not unstructured inventories but exhibit patterns of interdependence between forms.

These patterns are traditionally expressed in terms of implicational or predictive relations between elements.

A pattern involving elements A and B can be described in terms of the implicational relations between A and B.

The basic background

Inflectional morphology can exhibit spectacular complexity in:

i. syntagmatic, morphophonemic, suprasegmental structure of individual words;

ii. the size of inventories for morphosyntactic distinctions formall expressed by words;

iii. paradigmatic patterns that (classes of) words participate in.

This is the **External Complexity** or **E-complexity** of a morphological system

	'Weakening'		'Strengthening'	
	Sing	Plu	Sing	Plu
Nominative	**bihttá**	bihtát	baste	**basttet**
Gen/Acc	bihtá	bihtáid	**bastte**	**basttiid**
Illative	**bihttái**	bihtáide	bastii	**basttiide**
Locative	bihtás	bihtáin	**basttes**	**basttiin**
Comitative	bihtáin	bihtáiguin	**basttiin**	**basttiiguin**
Essive		**bihttán**		basten
		'piece'		'spoon'

Six cases and stem allomorphy with weak and strong consonant grades

Our guiding intuition

Morphological systems **must** be simple in ways that allow them to be learned and used by native speakers, irrespective of how complex words and paradigms may appear according to external measures.

> Morphological systems must permit speakers to make accurate guesses about unknown forms of lexemes based on known forms.
>
> Words participate in implicational relations with related words and this narrows the set of candidate possible forms associated with the known forms of a lexeme.

This is the **Internal Simplicity** or **I-simplicity** of a system

Information-theoretic measures: the intuition

Implications can be modelled by uncertainty reduction:

1) An element A implies B (or B is deducible from A) to the extent that knowledge of A reduces uncertainty about B.

2) The entropy of B, H(B), represents the uncertainty associated with B.

3) The conditional entropy of B given A, H(B|A) represents the remaining uncertainty given knowledge of A.

Conditional entropy provides a measure of how difficult it is to reliably guess e.g., one form of a word given another:

the lower the entropy, the more confident one can be about the form of an unknown word, with 0 conditional entropy representing complete uncertainty reduction.

Our hypothesis: I-simplicity

I-simplicity is measurable and quantifiable

Principle of Low Paradigm Entropy: Paradigms tend to have low expected conditional entropy, where Paradigm entropy is the average of conditional entropies among all pairs of words.

Gradation in first declension nouns in Saami (Bartens 1989:511)

	'Weakening'		'Strengthening'	
	Sing	Plu	Sing	Plu
Nominative	**bihttá**	bihtát	baste	**basttet**
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		'piece'		'spoon'

Given a NOMINAL SINGULAR form how easy is it to guess the LOCATIVE PLURAL form?
The lower the conditional entropy, the more certain one can be about a target form.

$$H(\text{LOC.PL}|\text{NOM.SG}) = H(\text{NOM.SG, LOC.PL}) - H(\text{NOM.SG})$$
$$= 1.0 - 1.0$$
$$= 0.0$$

Maximally Transparent Paradigms (Stump & Finkal 2007, To Appear)

Set-theoretically: Lexeme L is *maximally transparent* in paradigm P, if any cell in P can serve as L's sufficient form to predict the rest of its inflected forms. (Adapted from Stump and Finkal 2007)

Information-theoretically: if you know any single word, there is no surprise associated with identifying the previously unencountered forms of words or producing a target form.

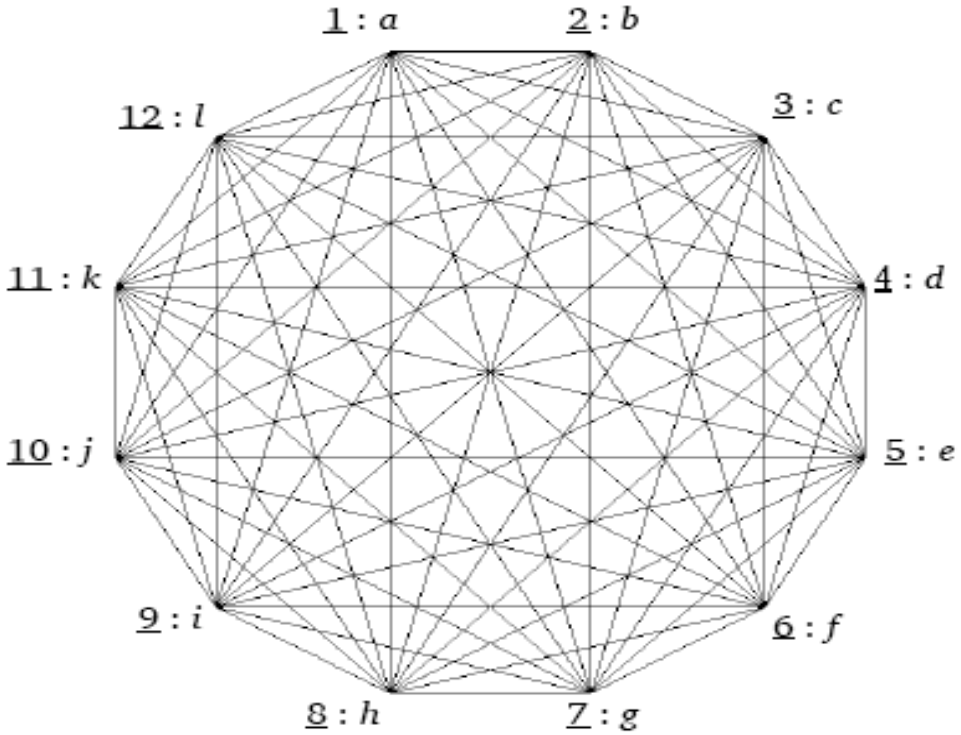
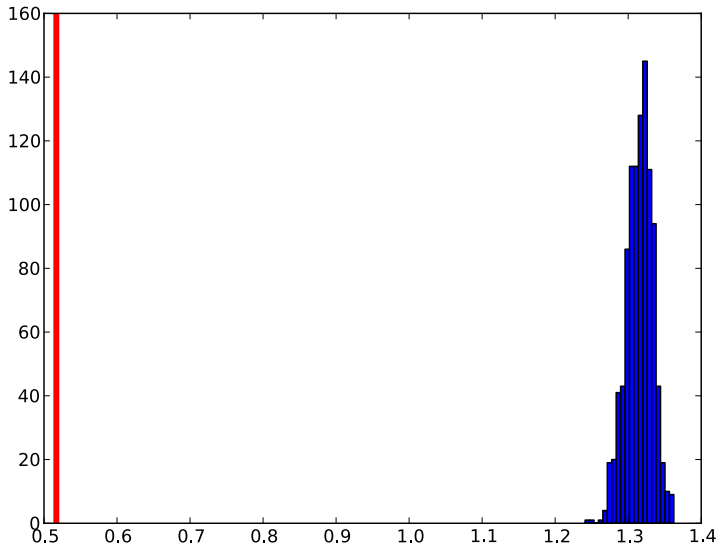


Figure 1. A maximally transparent paradigm with twelve cells

Results based on equiprobable type frequencies (Malouf and Ackerman 2010)

Language	Declensions	Cells	Realizations	Paradigm entropy	Bootstap Avg	Bootstrap *p*
Arapesh	26	2	41	0.630	0.630	1.000
Burmeso	2	12	24	0.000	0.000	1.000
Fur	19	12	80	0.517	1.316	0.001
Kwerba	4	12	26	0.428	0.523	0.001
Ngiti	10	16	68	0.484	1.019	0.001
Nuer	16	6	12	0.793	0.811	0.160
Russian	4	12	26	0.538	0.541	0.383

Fur



Summary

While detailed descriptive accounts of morphological systems found in grammars can provide a useful **entry point** for analysis, providing an upper bound on entropy calculations, they can also produce misleading conclusions about Paradigm Entropy (cf. Bonami et. al. 2011 and Sims 2011).

Exploring the validity of the Low Entropy Conjecture requires:

1) veridical **representations** for wordforms in order to reflect the actual stimuli encountered by speakers (we failed in our effort to model Tundra Nenets in this respect), as well as,

2) accurate type and token **frequencies,** since equiprobability assumptions, i.e., that the likelihood of encountering all patterns is the same, are unrealistic.

Paraphrasing Bonami et. al. (2011): this is **"tedious work"**, but it's both doable and necessary if we really want to understand morphological systems.

Following standard investigative procedures, we have to look where we're liable to be wrong, rather than where we suspect that we'll be right.

Tedious work: Modern Irish paradigm entropy (Malouf and Ackerman 2011)

Refining the hypothesis:

1,200 fully declined Irish nouns based on Carnie 2008 and reflecting transcription of orthographic conventions to more veridical phonetic representation:

H(COL|ROW)	COM.SG	GEN.SG	PREP.SG	COM.PL	GEN.PL	PREP.PL	E[ROW]
COM.SG		1.003	0.808	0.976	0.104	1.011	0.780
GEN.SG	0.723		0.840	0.039	0.602	0.010	0.443
PREP.SG	0.304	0.617		0.594	0.110	0.622	0.449
COM.PL	0.770	0.113	0.892		0.603	0.123	0.500
GEN.PL	0.467	1.245	0.976	1.172		1.250	1.022
PREP.PL	0.724	0.003	0.838	0.041	0.600		0.441
E[COL]	0.598	0.596	0.871	0.565	0.404	0.603	**0.606**

Expanding the data base to 10,000 fully declined nouns with type and token frequency information.

Questions being researched by this approach

1. How are words organized into patterns within a morphological system?
2. How can one identify implicative relations between words?
3. How might the implicative organization of a system contribute to licensing inferences that solve the paradigm cell filling problem?
4. How does this organization, and the surface inferences it licenses, contribute to the robustness and learnability of complex morphological systems?

5. Concluding observations: Morphology as a complex adaptive system

"In place of explicitly coding for a pattern by means of a blueprint or recipe, self-organized pattern formation relies on positive feedback, negative feedback, and a dynamic system involving large numbers of actions and interactions... environmental randomness can act as the **`imagination of the system'**, the raw material from which structures arise. Fluctuations can act as seeds from which patterns and structures are nucleated and grow. The precise patterns that emerge are often the result of negative feedback provided by these random features of environment and the physical constraints they impose, not by behaviors explicitly coded within the individual's genome." Camazine 2001:26

Moro morphotactics, Cwaya grammatical function reversal, Tundra Nenets relative clauses, and Estonian nominal declension paradigms arise in the "imagination" of their respective grammar systems which recombine cross-linguistically familiar ingredients into sometimes familiar and sometimes novel patterns in ways that make them learnable.

Alignments with big issues (adapting Stiles 2009 for developmental psychology)

Issue	Nativist	Developmental Science
Role of experience: core concepts versus acquired concepts	Core concepts constitute a small but essential subset of constructs. Core concepts are present in the absence of direct experience.	Concepts develop from the interaction of basic sensory and motor abilities and experience with the world. There are no core concepts.
Domain specific versus domain general (innate versus acquired modularity)	Core concepts are domain-specific and encapsulated from other imformation sources (i.e., they are modular from the start).	Domain general learning mechanisms underlie conceptual development. Modularity of systems is the normal product of development, not its startstate.
Invariance	One mark of a core concept is that it is constant over a span of development.	Because knowledge is emergent and constructed by the child, change is across development.
Universality	Core concepts are constant across cultures.	Ubiquity does not entail innate origination. Adaptation to universal conditions can produce common constructs.
Triggering versus induction	Environmental inputs serve to "trigger" the availability of core concepts.	Concepts are acquired and refined through induction, i.e., hypothesis formation and testing
	Evolutionary Psychology/ Developmental Biology/ Development Psychology/ Mainstream Generative Grammar	(Neuro-)constructivist/ Developmental Psychobiology/ (Ecological) Evolutionary Developmental Biology/ Pattern theoretic grammars/ Information-theoretic grammars