Mathematical comparison of Linguistic Categories without Universal Spines

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1 Preliminaries

1.1 Against Innate Categories

- Psychological implausibility of innate categories
- Increasing number of necessary categories with further research
- Attested variation in formal properties of categories across languages (example of inflectional vs non-inflectional plural below)

Plural marking	English	Halkomelem
absence of plural marking = singular	yes	no
obligatory agreement	yes	no
plural can be selected for	yes	no
form-meaning mismatches (pluralia tantum)	yes	no
complementarity with classifiers	yes	no
bare plurals can be arguments	yes	no
restricted to nouns	yes	no
can occur inside compounds	no	yes
can occur inside derivational morphology	no	yes

(Wiltschko, 2008, Table 6)

1.2 Maximise Minimal Means

- Introduced in (Biberauer and Roberts, 2015) and following.
- The child postulates categories as a response to departures from Saussurean form-meaning arbitrariness in the linguistic data.
- Radically impoverishes what should be contained in UG.

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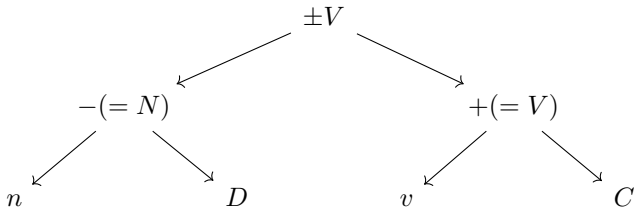


1.3 Extended Projections

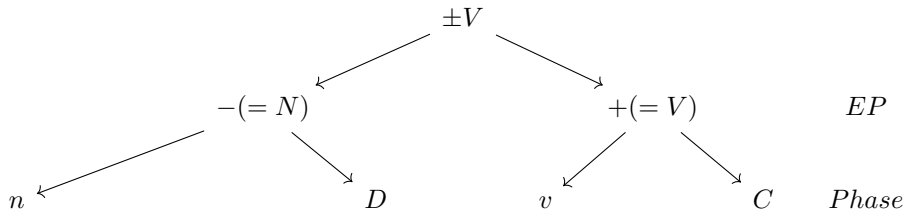
- Extended Projections (Grimshaw, 1991) refer to a lexical head and its related higher functional heads.
- Points to consider:
  - Verbal and Nominal as core Extended Projections (NEP and VEP)
  - but sources in Evans and Levinson (2009) for languages that don't distinguish these.
  - Further EPs showing internal hierarchies - adpositional, adjectival - although these might not have the same status as the core two
  - Mixed Extended Projections (Borsley and Kornfilt, 2000) - NEP and VEP as one combined EP - harmonic?
- **Importantly, we do not want to assume that EPs must contain the same number of categories.**

1.4 Relations between sets of categories

- It is useful, and should be expected if we are making use of third factors, for there to be similarities in the structures of sets of categories.
- There are many examples of this in the literature but they are often conflicting.
- Assuming innate categories it is easy to see how these would arise, but this is not trivial with neo-emergentism.

(2) assumes symmetries in neo-emergentism.

(2)



(*Biberauer*, 2017*a*, (23))

(3) shows two (conflicting) suggestions for direct correspondences between categories.

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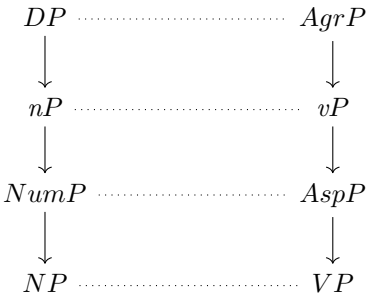
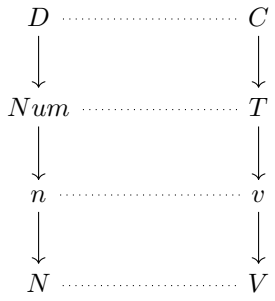


(*Megerdoomian*, 2008, (42))

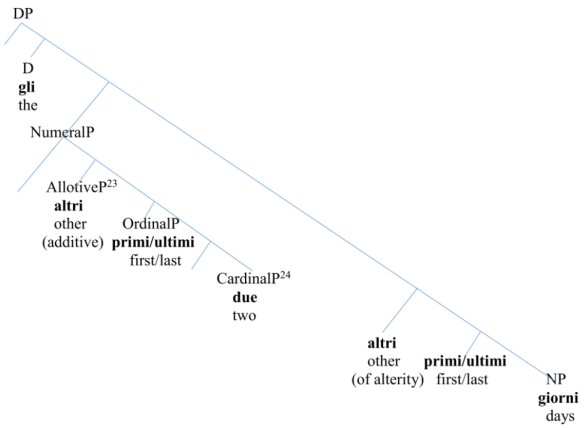


(*Roberts*, 2024, (21))

(4) shows a sub-EP within the NEP which is isomorphic to a subset of it.

(4) a. 'Gli altri primi due altri primi giorni'
'The other first two other first days'
(Cinque, 2022, (29))

(29)



1.5 Universal Spines

Wiltschko (2014) notes similar to the above (43):

(5) a. There is evidence for the universality of categories

b. Languages vary in their categorial inventories

Wiltschko suggests that there is a cognitive 'Universal Spine' which language specific categories can associate to with various parameters.

(6) discourse-linking > anchoring > point-of-view > classification
(Wiltschko, 2014, (49))

1.6 Mathematics of comparison

We can view an EP as a partially ordered set (poset). For every two elements (a, b), there may be the relation (a $\leq$ b), (b $\leq$ a), or no relation. This relation has the following properties.

- Reflexivity (a $\leq$ a) - every element is related to itself
- Antisymmetry - if (a $\leq$ b) and (b $\leq$ a) then (a $\bar{\text{b}}$)
- Transitivity - if (a $\leq$ b) and (b $\leq$ c) then (a $\leq$ c)

Standard cartographic EPs are totally ordered in that every pair of elements is comparable.

(7) $\boxed{\text{VEP}}$ $\quad V \mapsto Appl \mapsto v \mapsto Asp \mapsto T \mapsto Mod \mapsto Fin \mapsto Foc \mapsto Top \mapsto SA$

Flavoured categories, found in Distributed Morphology (eg. Cuervo, 2003), are a case where we need partial orders.

(8) $\boxed{\text{VEP}}$ $\quad V \mapsto Appl \longmapsto \begin{matrix} v_{\text{BECOME}} \\ v_{\text{GO}} \\ v_{\text{CAUSE}} \end{matrix} \longmapsto Asp \mapsto T \mapsto Mod \mapsto Fin \mapsto Foc \mapsto Top \mapsto SA$

- This can also be abstracted to a category in category theory.

- Elements are objects, and the $\leq$ relation is represented by a morphism between objects.
- We are looking for functors between EPs which preserve the internal structure of objects and morphisms.

(9)

$$\boxed{\text{VEP}} \quad V \mapsto Appl \mapsto v \mapsto Asp \longmapsto T \longmapsto Mod \mapsto Fin \mapsto Foc \mapsto Top \mapsto SA$$

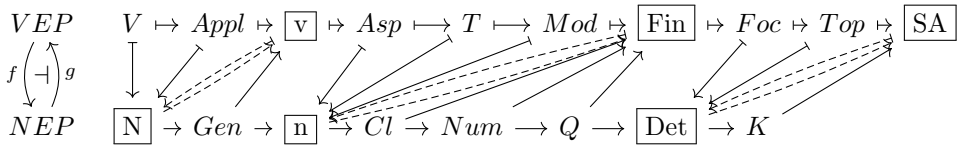
$$\boxed{\text{NEP}} \quad N \mapsto Gen \mapsto n \mapsto Cl \mapsto Num \longmapsto Q \longmapsto Det \mapsto K$$

- The strongest forms of cocmparison of posets are ruled out as we want posets of different cardinalities to be comparable.
- A weaker form of comparison is called an Adjunction in category theory (nothing to do with linguistic adjunction).
- For posets, this takes the form of a galois connection.
- For posets A and B, a galois connection is a pair of order reversing functions f: A $\rightarrow$ B and g: B $\rightarrow$ A such that f(a) $\leq$ b if and only if a $\leq$ g(b).
- In simple terms, after a round trip between functions, a can only increase or stay the same, whereas b can only decrease or stay the same.
- f is the left Adjoint function and g is the right Adjoint.

1.7 Song 2019

- Song (2019) attempts to formalise a comparison between emergent EPs making use of an Adjunction.
- This suggestion (pg. 214) (where the choice of categories is arbitrary) has no problems mathematically.

(10)



However Song rejects this potential Adjunction on linguistic grounds:

- This adjunction applies asymmetrically between EPs.
- There is an unintuitive skewing of conventially equivalent categories like V and N.
- More broadly, for every two EPs, the highest element of one and the lowest element of the other have a special status which needs motivating.
- This does not seem to fit in with what would be expected for Adjunctions.

Song (whose dissertation is far more broad than just this matter) concludes that the optimal linguistic Adjunction makes use of a Universal Spine to mediate between EPs (pg. 218).
This US can mediate between more than two EPs, and has fewer elements than EPs.

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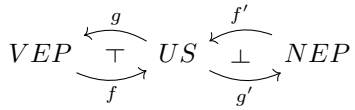

We want to minimise what is considered innate, as far as is reasonable in linguistic theory.
If we can maintain a mathematically and linguistically meaningful comparison between EPs without a mediating Universal Spine, this would be an interesting path for research.

2 Against a Universal Spine

The status of Universal Spines to linguistic theory is not fully clear, so they cannot be directly disproven.
In spoken languages, linking categories to functional domains is an subjective task.

2.1 Sign Languages

- Sign languages do support basic equivalences with the basic tripartite division of VP - TP - CP. (Pfau et al., 2018)
- Agreement Verbs, or agreeing auxiliaries, have been argued to correspond to TP categories - with possible differences in Word Order (Proske, 2022).
- Question words are found at peripheries of clauses as expected for C elements, but can be to the right - with the help of non-manual marking throughout (Cecchetto et al., 2009).
- An interesting cartographic proposal - hierarchy maps onto height elements are articulated at (Bross, 2020).

In sign languages, Universal Spines rely on preconceptions.

2.2 Psychology

- It's hard to interpret psychological and neurological evidence given differing granularities from theoretical linguistics (Poeppel and Embick, 2017).
- Neo-Emergentism could be used in modelling variation from atypical acquisition - such as deficits in morphology usage in autistic children (Chen et al., 2023; Barlotucci and Albers, 1974).

3 A model of asymmetric Extended Projection Comparison

3.1 Asymmetry of EPs

- There are asymmetries between the N and V in acquisitional (Gentner, 1982; Tardif, 1996) and semantic domains.
- If there are also Adjectival, Adpositional etc. EPs, symmetry seems even harder to maintain.

3.2 Element asymmetry

We cannot neutrally speak of asymmetries between functional categories, given the lack of objective symmetrical findings.
For example, there have been many suggestions for the top of a Nominal Extended Projection, including the following (Corver, 2013):

- Determiner (Biberauer, 2019)
- Case (K) (Bittner and Hale, 1996)
- Quantifier (Shlonsky, 1991)
- Classifier (Cheng and Sybesma, 1998)

Lexical elements are more likely to be symmetrical, which can still be achieved with an Adjunction.

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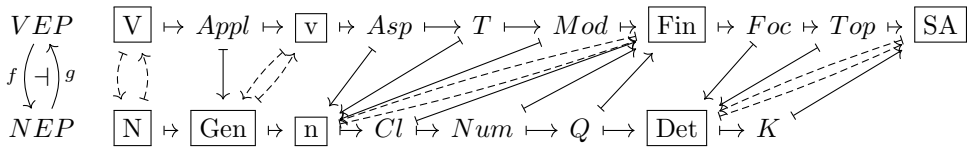


Left Adjoints are typically associated with adding some (free) structure. They can be seen as the most efficient solution to some problem. It is not clear to me what relevance this has here.

4 Potential applications and predictions of the model

4.1 Maximise Minimal Means

Adjunctions could be used to model emergent many-to-one phenomena in linguistic data. Languages are filled with examples which can be modelled as an order-preserving relation between two posets (although where these posets arise from is not trivial). This includes data relating to linearisation like the Final-over-Final Condition.

Mixed Extended Projections have been suggested in the literature to explain harmony effects that permeate both core EPs. This includes data from nominalisation and the Final-over-Final Condition (FOFC) (Biberauer, 2017a) given below.
This contrasts with languages like German, where FOFC clearly does not hold between the two EPs.
Buli:

(13) a. *dɛ̀ mángò-kú-lá*
ate mango-DEM-DEF

'ate that mango' (Hiraiwa (2005a), cited in Hein and Murphy (2022)).

b. *mángò-kú dɛ̄-kā*
mango-DEM eat-NMLZ

'eating the mango'
(Hiraiwa (2005b), cited in Hein and Murphy (2022)).

German:

(14) $[_{CP}$ *dass*$_C$ *ich* $[_{TP/VP}$ $[_{DP}$ *den*$_D$ *Mann*] *sehe.*$_{T/V}$]]

'That I see the man.'

I don't offer a specific model here, but this Adjunction model seems more promising in explaining the different relations between EPs that can occur.

Another case of many-to-one monotonic relations between categories highlighted by Biberauer (2017b) comes from Pesetsky (2013). As shown in the examples below, for a subset of nouns, feminine agreement can optionally start above a certain point in the NEP.

(15) a. *Nov-yj vrač-∅ prišla-∅.*
new-M.NOM.SG doctor-NOM.SG arrived-**F**.SG

The new doctor arrived. (26b)

b. **Nov-aja vrač-∅ prišël-∅.*
new-**F**.NOM.SG doctor-NOM.SG arrived-M.SG

The new doctor arrived. (26c)

c. *Glavn-yj/*Glavn-aja vrač-∅ poliklinik-i skazal-a, čtoby...*
head-M/*F.NOM.SG doctor-NOM.SG clinic-GEN.SG say-PST.F.SG that.SUBJ...

'The (female) head doctor of the clinic ordered that...' (27a)

d. *U nas byl-a očen' xoroš-aja zubn-oj vrač-∅.*
by us COP-PST.F.SG very good-F.NOM.SG dental-M.NOM.SG doctor-NOM.SG

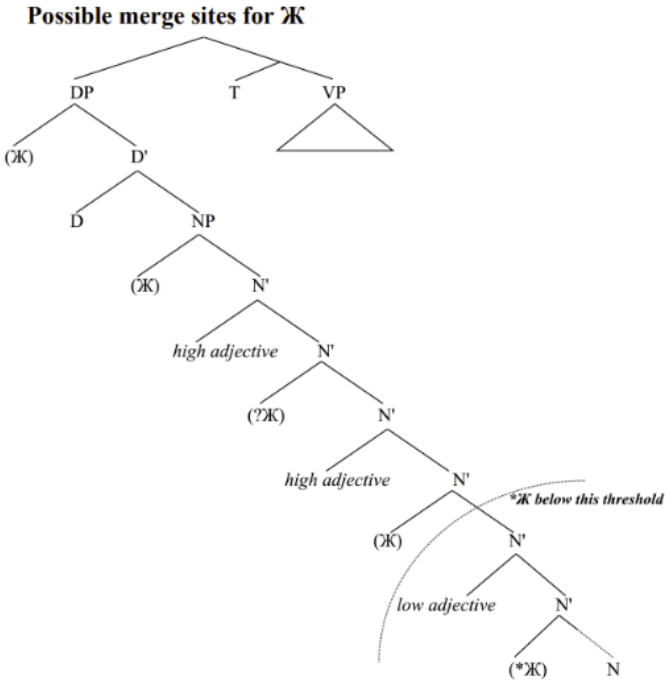
'We had a very good (female) dentist.' (28b) (Skoblikova, 1971, pg.183)

e. *?U menja očen' interesn-aja nov-yj vrač-∅.*
by me very interesting-NOM.F.SG new-NOM.M.SG doctor-NOM.SG

'I have a very interesting new (female) doctor.' (29a)

f. ***U menja očen' interesn-yj nov-aja vrač-∅.*
by me very interesting-NOM.M.SG new-NOM.F.SG doctor-NOM.SG

'I have a very interesting new (female) doctor.' (29b)



This model might have predictive power for diachrony and the order of acquisition, with possible links to work on acquisition in Maximise Minimal Means by Bosch (2023).

4.2 Edges and Acategorial Elements

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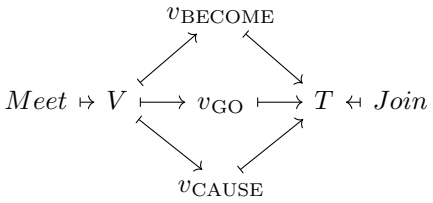

- Left Adjoints preserve joins, and right Adjoints preserve meets.
- Song views the top of each section in his model as a non-stipulative way of deriving phases, points of information transfer (Chomsky, 2001).
- In the models presented here, certain categories cannot be flavoured, but the exact ones differ between Song's and my approach.
- The model here may be less useful for phases given the differing cardinalities, but it might tie in better to theoretical work on dynamical phases (Bošković, 2014).

Sentence-final particles encompass a wide variety of uninflecting elements, whose semantic information can vary in expected positions in a Universal Spine.

(17) *Tā chī-le fan* ***le***
3SG eat-PERF food PERF

'He has eaten'
(Paul, 2014, pg. 86)

- The position and behaviour of certain sentence-final particles has been subject to debate, with Erlewine (2017) and Song (2019) providing interesting explanations that contrast with this model. Following Biberauer (2017b), sentence-final particles might be analysed as outside of EPs, being able to attach to different categories.
- This could fit in this model better than with a Univeral Spine.

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