Weakening cartography: on the formal foundation of functional hierarchies

The hierarchical organization of functional categories is a major theoretical conception in current generative grammar, and the "cartographic" implementation of this conception, as pursued in a long line of work since Rizzi (1997) and Cinque (1999), has been highly influential. See (1) for an illustration (adapted from Rizzi & Cinque 2016).

(1) a. [Force [Top* [Int [Top* [Foc [Top* [Mod [Top* [Q_{emb} [Fin [$Mood_{sa}$ [$Mood_{eval}$ [$Mood_{evid}$ [Mod_{epis} [$Tense_{pst/fut}$ [Mod_{nec} [$Aspect_{hab}$ [… [$Voice_{pass}$ [**Verb**]]]]]]]]]]]]]]]]]]]]]

b. [(Integrated) nonrestrictive relative clauses [Universal quantifiers [Demonstratives [Determiners [Ordinal numerals [Restrictive relative clauses [Cardinal numbers [Numeral classifiers [… [Material AP [Classificatory APs [Proper NP [**Common NP**]]]]]]]]]]]]

Challenges to classical cartography Despite the fruitfulness of the cartographic approach, its classical version has been the target of both empirical and conceptual criticism. Empirically, the specific hierarchies that have been proposed often rely on inconclusive data or not entirely objective judgments. Indeed, anticartographic phenomena like "transitivity failure" (TF) and/or flexible ordering (FO) have been observed across languages (see, e.g., Nilsen 2003, van Craenenbroeck 2006, Zwart 2009, Truswell 2009, Cole & Hermon 2012, Bruening 2019, and Larson 2021). See (2) for some examples (extracted from the foregoing sources).

(2) a. In Venetian, the orders Topic≺Focus≺C and C≺Topic both exist.
b. In Norwegian, 'possibly'≺Neg and Neg≺'always' but 'always' ≻/≺ 'possibly'.
c. In English, the ordering of A_{size} and A_{color} is subject to interspeaker variation.
d. In Imbabura Quechua, 1_{SG}≺Prog and Mod_{des}≺1_{SG} but Prog ≻/≺ Mod_{des}.

Sometimes TF/FO can be explained away by movement (as in Zwart 2009), but inasmuch as base-generated flexible ordering exists (as in (2c)), that is a challenge to the Strong Cartographic Hypothesis (SCH) as formulated in (3).

(3) Functional categories all fall in selectionally determined linear orders.

Aside from the aforementioned empirical problems, the SCH also suffers from a fundamental conceptual problem: There is no a priori reason to think that the order relation on functional categories is *linear*. Indeed, the linearity condition is an impressionistic stipulation based on selected data rather than a justified principle. In particular, phenomena like TF and FO make the linearity condition look highly unwarranted.

Weakening cartography Against the above background, this paper explores the room of flexibility in the definition of functional hierarchies, trying to answer the following question:

(4) To what extent can we weaken the SCH without losing the core insight of cartography?

To answer this question, we need to revisit two aspects of the SCH: *i*) the type of the order relation underlying functional categories, and *ii*) the criterion against which the functional categories are ordered. First of all, inasmuch as a functional hierarchy implies an order relation on a set of functional categories, and the task of cartography is to give each category a unique position in its hierarchy, the order in question does not have to be linear. Mathematically, a linear order (reflexive, transitive, antisymmetric, total) is a very special type of order relation—it is a special case of partial order (reflexive, transitive, antisymmetric), which in turn is a special case of preorder (reflexive, transitive). The relevant conditions are concisely defined in (5).

(5) A binary relation $\sqsubseteq$ on a set P is *reflexive* if $\forall p \in P, p \sqsubseteq p$; *transitive* if $\forall p, q, r \in P, [(p \sqsubseteq q) \wedge (q \sqsubseteq r)] \Rightarrow (p \sqsubseteq r)$; *antisymmetric* if $\forall p, q \in P, [(p \sqsubseteq q) \wedge (q \sqsubseteq p)] \Rightarrow (p = q)$; and *total* if $\forall p, q \in P, p \sqsubseteq q$ or $q \sqsubseteq p$.

To my knowledge, there have only been two previous studies attempting to "save" cartography by weakening its order relation. Song (2019) proposes a partial order–based weakening, mainly aiming to accommodate "flavored" categories, such as the various types of little *v* in the literature, some of which (e.g., Chomsky's *v* and *v**) do not enter mutual selection and hence are incomparable in the ambient order relation. Larson (2021), on the other hand, proposes a preorder-based weakening of the SCH (more exactly a total preorder–based one). Abstracting away from theory-internal issues (e.g., Larson reinterprets the order relation as one on features rather than one on categories), this proposal essentially gives us functional hierarchies with cycles (due to the lack of antisymmetry), which can accommodate base-generated FO.

Proposal Building on Song (2019) and Larson (2021), I propose a further weakened SCH, where a functional hierarchy is defined just as a preorder. See (6) for a more precise formulation.

(6) Weak Cartographic Hypothesis (WCH): All functional hierarchies are preorders. Some of them are furthermore total preorders, partial orders, or linear orders.

Thus, all of the following are legal shapes of functional hierarchies (I use $\rightarrow$ to denote instances of the order relation and use {} to enclose incomparable elements):

(7) a. $X \rightarrow Y \rightleftarrows Z \rightarrow W$ b. $X \rightarrow \{Y_1, Y_2\} \rightarrow Z$ c. $X \rightarrow Y \rightarrow Z$

That being said, I agree with the impression behind the SCH that functional (sub)hierarchies are typically linear orders. To capture this impression, I adopt a localized view of functional hierarchy: what linguists usually present as projection "spines" only exist as local, selectional properties in the grammar (which are specified on individual categories), from which the spines can be naturally deduced. A crucial aspect of my proposal—and also one that distinguishes it from previous proposals—is that this deduction is not a simple format conversion but involves a switch of ordering criterion: from a local, derivational selectional criterion to a global, ontological scopal criterion, as specified in (8).

(8) If Y *functionally selects* X in syntactic derivation, then X *can fall in the scope of* Y in the ontological structure containing them. The latter criterion defines functional hierarchies.

A major advantage of not treating functional hierarchies themselves as selectional orders—and more generally, that of separating derivational and ontological structures—is that we can evade the transitivity pitfall now, which is presented in Bruening (2019) and Larson (2021) as a major challenge to classical cartography and has to a large extent motivated their extra theoretical technicalities. The pitfall is that, if functional hierarchies are viewed as selectional hierarchies, then they cannot be transitive since c-selection is nontransitive, but this means they involve no order relation at all, contrary to common intuition (recall that even the weakest order relation, preorder, requires transitivity). By contrast, on the scopal perspective in (8), functional hierarchies are naturally transitive, since transitive scoping does not imply transitive selection.

The bigger picture Above we have only considered individual functional hierarchies, but the same proposal can be extended to the entire functional category inventory, which is another advantage of the WCH over the SCH. In classical cartography, each linear order can only define a single functional hierarchy (i.e., the verbal, nominal, etc. hierarchy). By contrast, since preorders allow incomparable elements, the WCH can define individual hierarchies and their amalgamation in the same way.

References

Bruening, B. 2019. Disjunctive selection is necessary for "Hierarchy of Projections" and it accounts for transitivity failures. Ms. University of Delaware.

Cinque, G. 1999. *Adverbs and functional heads*. Oxford: Oxford University Press.

Cole, P. & G. Hermon. 2012. The order of verbal affixes and functional structure in Imbabura Quechua. In Brugé et al. (eds.), *Functional heads: The cartography of syntactic structures*, 288–303. Oxford: Oxford University Press.

Larson, R. 2021. Rethinking cartography. *Language* 97(2): 245–268.

Nilsen, Ø. 2003. Eliminating positions: Syntax and semantics of sentence modification. Universiteit Utrecht dissertation.

Rizzi, L. 1997. The fine structure of the left periphery. In Haegeman (ed.), *Elements of grammar*, 281–337. Dordrecht: Kluwer.

Rizzi, L. & G. Cinque. 2016. Functional categories and syntactic theory. *Annual Review of Linguistics* 2: 139–163.

Song, C. 2019. On the formal flexibility of syntactic categories. University of Cambridge dissertation.

Truswell, R. 2009. Attributive adjectives and nominal templates. *Linguistic Inquiry*

40: 525–33.

van Craenenbroeck, J. 2006. Transitivity failures in the left periphery and foot-driven movement operations. *Linguistics in the Netherlands*, 52–64.

Zwart, J.-W. 2009. Unchartered territory? Towards a non-cartographic account of Germanic syntax. In Alexiadou et al. (eds.), *Advances in comparative Germanic syntax*, 59–84. Amsterdam: John Benjamins.