The cartographic program has investigated interesting cross-linguistic linear orderings among various sentence constituents. Its signature technical move is to postulate hierarchies of functional projections related by functional selection. I note three problems that functional hierarchies encounter in capturing linear order: ‘explanation’, ‘plenitude’, and ‘rigidity’. I compare linearity in cartography with linearity in the integers, which involves a single relation (<) ordering the domain. I consider work by Scontras et al. (2017) arguing for a single ‘inequality relation’ underlying the ordering of attributive adjectives in nominals and show how this result can be incorporated into a feature-driven theory of syntactic projection. This captures cross-linguistic linear orderings without appeal to functional selection or functional hierarchies.*

Keywords: syntax, cartography, adjectives, functional selection, functional projections, syntactic features

1. Introduction. The cartographic program (Beletti 2004, Benincà & Munaro 2011, Brugé et al. 2012, Cinque 1999, 2002, 2006, 2010, Cinque & Rizzi 2010, Hage- man 2012, Rizzi 1997, 2004, Shlonsky 2015, Svenonius 2014, Tsai 2015, among many others) has investigated interesting, apparently stable, cross-linguistic linear orderings among a variety of sentence constituents, including left-peripheral elements (1a), adverbs (1b), and attributive adjectives (1c).

(1) a. force > topic > focus > topic > finiteness > tense > … (Rizzi 1997)
b. habitual > repetitive > frequent > volition > celerative > anterior > … (Cinque 1999)
c. size > length > height > speed > depth > width > … (Scott 2002)

In accounting for such orderings, the signature technical move of linguistic cartography is to postulate hierarchies of functional projections related by functional selection (2a–c).

(2) a. [force [top [foc [top [fin [tense […]]]]]]]
b. [habitual [repetitive [frequent [volition [celerative [anterior […]]]]]]]
c. [size [length [height [speed [depth [width […]]]]]]]

Functional selection orders the phrases, which in turn orders the elements occurring within the phrases.

In this article I review some basic assumptions of the cartographic program, noting three problems with functional hierarchies employed as a means to capture linear order. I label these ‘the problem of explanation’, ‘the problem of plenitude’, and ‘the problem of rigidity’. I then compare linearity via functional hierarchies with linearity as observed in the familiar domain of integers. A key difference is that numerical linearity is the product of a single relation (<) ordering the entire domain, whereas cartographic linearity results from many, potentially quite disparate, selection relations applying pairwise. As I show, this difference frees numerical linearity from the problems attending functional hierarchies. I go on to consider recent work by Scontras et al. (2017) arguing that a single ‘inequality relation’ underlies the ordering of attributive adjectives in nomi-

* Early versions of this work were presented at the Second International Workshop on Syntactic Cartography (Beijing, 2017) and at the Biolinguistic Conference on Interface Asymmetries (NYU, 2017). My thanks to audiences at those events for comments and discussion, and my particular thanks to Si Fuzhen and Anna Maria Di Sciullo, the (respective) event organizers. I am grateful to two anonymous Language referees and to associate editors James McCloskey and Christina Tortora for critique and suggestions that considerably improved this work. Remaining errors and flaws are of course my own.

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inals, one that can be established independently of grammar. I demonstrate how this result might be incorporated into a feature-driven theory of syntactic projection that generates the crosslinguistic linear orderings investigated by cartography without appeal to functional selection or functional hierarchies. Finally, I extend this idea from adjectives to the general case, illustrating briefly with left-peripheral elements, as discussed in Rizzi 1997.

2. Functional hierarchies and functional selection. As noted above, cartography derives linear orderings by appeal to functional selection and functional projections. In brief, the approach postulates a series of functional heads α, β, γ, δ (etc.) in a series of concentric projections αP, βP, γP, δP (etc.), where each head stands in its own specific functional selection relation (Σα, Σβ, Σγ, …) to the projection beneath it, as in Figure 1.

Relevant linguistic items occupy head or Spec positions within these projections. The sequence of functional selection relations thus determines the sequence of projections, which in turn determines the order of linguistic items within those projections.

A key feature of this picture is that each head (α, β, γ, δ, etc.) functionally selects a single complement of a unique category. This property is definitional for Abney (1987) in distinguishing functional selection from the usual thematic selection operating in the argument structure of verbs. Thus whereas a verb like *behave*, which thematically selects a manner complement, will accept a range of categories (AdvP, NP, PP) in this function (3a), a functional head (e.g. Force) should select only a single category of complement (TopP) and no other (FocP) (3b).

(3) a. Alice [VP behaved [AdvP carefully]/[NP that way]/[PP in a tactful fashion]].
   b. [ForceP Force [TopP ...]/*[FocP ...]].

The architecture of cartography, as an approach to linear ordering in grammar, raises a number of interesting, fundamental problems.

2.1. The problem of explanation. Having the technical means to express linear ordering in a theory is not the same thing as having an explanation for why those orderings are found. In cartography, the linear orderings we observe reflect the functional hierarchies that are posited. And those functional hierarchies reflect the functional selection relations that generate them. Hence explanation in cartography must pursue these functional selection relations. In relation to the hierarchy in 1c/2c, for example, we are led to ask a series of questions like the following.
• What is it about a size head that makes it functionally select lengthP?
• What is it about a length head that makes it functionally select heightP?
• What is it about a height head that makes it functionally select speedP?

Since the functional selection relations ($\Sigma_{\text{size}}$, $\Sigma_{\text{length}}$, $\Sigma_{\text{height}}$, …) are all different, unique to each head type, the answers to these questions are all plausibly different as well.

To the best of my knowledge, current work in cartography has offered no answers to such question sets. When discussed at all, the sequence of functional selection relations appears to be either left as a bare fact about universal grammar or else treated as one whose ultimate explanation lies in the domain of semantics. The first view is exemplified by statements like the following (with the boldfacing mine).¹

UG expresses the possible items of the functional lexicon and the way in which they are organized into hierarchies. (Cinque & Rizzi 2008:53)

Comparison of many different languages may provide evidence for determining the precise relative order of the different functional projections by combining the partial orders overtly manifested by different languages into what, in principle, should be a unique consistent order/hierarchy, imposed by UG.

(Cinque & Rizzi 2008:48)

Conjectures as to the psycholinguistic motivation for [adjective order restrictions] need not be posed: [adjective order restrictions] fall out as a direct consequence of UG. (Scott 2002:97)

Although available in principle, this hypothesis plainly amounts to little more than a stipulation and one, furthermore, that emerging psycholinguistic data suggest is not correct. Recent experimental results by Leivada and Westergaard (2018) demonstrate that violations of cartographic orderings are not judged by native speakers to have the rigidity of hard-wired constraint violations, but have a gradient character (see §2.3 below).

What about the second view, then, the idea that functional selection sequences might somehow be deducible from semantics? In modern formal semantics, selection is standardly given in terms of logical or semantic type. An expression of type $<\alpha, \beta>$ selects a phrase of type $\alpha$ to yield a phrase of type $\beta$. This view can be employed to explain the selection between, for example, a functional head like D and its accompanying lexical NP. The two are of appropriate types for combination in the observed way (Figure 2a). But this view does not appear adequate to explain, for example, the orderings of left-peripheral elements (Figure 2b) or the orderings between modifier heads and phrases (Figure 2c). In the left periphery, heads select phrases of the type of propositions ($<s,t>$), and they project phrases of the same type ($<s,t>$). In the nominal domain, the heads select phrases of the type of predicates ($<e,t>$) and project phrases of the same type ($<e,t>$).² The complements are thus all semantically nondistinct in the formal sense. No orderings are predicted by semantic type. Unless semantic type in the relevant domains comes to be articulated at a much finer level of granularity than is currently entertained, formal semantics seems to offer little hope of explaining cartographic hierarchies.

Informal semantic accounts appear no more promising at present. Williams (2009) notes the suggestion that functional hierarchies might correspond to ontological mereologies of ‘eventualities’—for example, speech acts, facts, and events, with part-whole relations between them, so that events are part of facts, which are part of speech acts,

¹ I am grateful to Leivada and Westergaard (2018) for drawing my attention to the first two quotes, and to Mišmaš, Marušič, and Žaucer (2018) for drawing my attention to the third.
² See McNally 2016 for a definition of ‘modification’ that is useful in identifying this class of cases. I am grateful to a referee for this reference.
and so forth. Given this, one might attempt to explain the acceptable ordering of the adverbs in 4a versus the unacceptable orderings in 4b–d via the containment relations in the projections in which the adverbs occur, itself a reflection of ontological part-whole relations ($\sqsubseteq$). (Note: 4a–d = 2a–d in Williams 2009.)

(4) a. Speech act $\sqsubseteq$ Fact $\sqsubseteq$ Event
   John [frankly actually completely startled Bill]]].
   b. *John completely frankly startled Bill.
   c. *John completely actually startled Bill.
   d. *John actually frankly startled Bill.

As Williams notes, however, such an account cannot be maintained in any simple form given examples like 5 (= 2e in Williams 2009), which would on this account exhibit a speech act inside a fact.

(5) Fact $\sqsubseteq$ Speech act $\sqsubseteq$ Event
   John [actually said that [frankly he completely startled Bill]]].

Evidently, the ontology applies to ordering within a single clause only, a result that would appear to make the account of ordering dependent on grammar and projection, and hence not an independent explanation for it.3

3 These results do not foreclose ‘explanatory’ projects with more limited goals. For example, Rizzi (2017) observes that a left-peripheral focus can follow an interrogative head in Italian but cannot precede it, as in (i).

   (i) a. Mi domando se PROPRIO QUESTO, volessero dire.  \text{INT} \rightarrow \text{FOC}
   ‘I wonder if EXACTLY THIS they wanted to say.’
   b. *Mi domando PROPRIO QUESTO, se volessero dire. *\text{FOC} \rightarrow \text{INT}
   ‘I wonder EXACTLY THIS if they wanted to say.’

Rizzi suggests that this contrast is the product of additional relations obtaining within the functional hierarchy: specifically, an agree relation between a force head and INT, with which FOCUS interferes, and a binding relation between FOCUS and its trace, with which INT interferes (ii).

   (ii) *Mi domando FORCE PROPRIO QUESTO, se volessero dire \_ .

   \text{FORCE} \rightarrow \text{FOCUS} \rightarrow \text{INT} \rightarrow \_
2.2. The problem of plenitude. Capturing linear order via local functional selection relations entails that whenever we have two ordered linguistic elements X, Y (say *large* and *board*) in different projections in a functional hierarchy, we must have all projections between them (6a). ‘Truncated’ projections like 6b are unavailable.

(6) a. \[ \text{SIZEP} \text{large} \text{LENGTHP} \text{HEIGHTP} \text{SPEEDP} \text{DEPTHP} \text{WIDTHP} \text{NP board} \] 

b. \[ \text{SIZEP} \text{large} \text{WIDTHP} \text{NP board} \] 

This is because functional selection is not transitive. If head \( \alpha \) functionally selects \( \beta \) and \( \beta \) functionally selects \( \gamma \), it does not follow that \( \alpha \) functionally selects \( \gamma \). Ordering between \( X \), \( Y \) thus can be achieved only through the presence of entire intermediate sequences of heads and projections.4

This point entails that if the highest projection in a hierarchy is selected by a functional element and the lowest head in the functional projection selects some lexical phrase, the entire hierarchy must be present between them, even when no hierarchy elements are overtly realized (7). Broadly put, sentences and phrases must project complete functional hierarchies.

(7) \[ \text{DP the} \text{SIZEP} \text{LENGTHP} \text{HEIGHTP} \text{SPEEDP} \text{DEPTHP} \text{WIDTHP} \text{NP board} \]

As many have noted (see van Craenenbroeck 2009 and the references therein), this yields a dramatic proliferation of structure, with a single clause obliged to contain up to 150–200 phrasal projections by some estimates, the vast bulk of which are phonologically unrealized. The worry here is not some vague concern about ‘too much abstract structure’, but rather that this structure is uninterpreted at logical form (LF), or is ‘expletive’. This outcome would appear to clash directly with the natural and highly attractive proposal of Chomsky (1995) that syntactic outputs be ‘fully interpreted’, and that the structures presented to LF be ‘minimal’ in the sense of containing only elements that are legible to, and ‘meaningful’ at, the LF interface.

2.3. The problem of rigidity. Functional selection is not a gradable notion; a head \( \alpha \) either does or does not functionally select a phrase \( \beta \)P. If it does, then the specifier and head of \( \alpha \)P must precede all elements of \( \beta \)P (modulo displacement). Applied recursively, this point entails that functional selection yields RIGID ORDERS.5

In some cases, the hierarchies that have been proposed by cartographers do correspond to rigid ordering judgments by speakers. For example, the functional hierarchy for adjectival modifier heads that yields the ordering \( \text{size} > \text{color} \) corresponds to largely categorical judgments like 8a, with the one order good and the other strongly unacceptable. In other cases, however, the proposed orderings correspond to judgments either of weak preference (8b) or virtual fluidity (8c) (Truswell 2009).

(8) a. *big red barn ~ big red barn 

b. beautiful big house ~ big beautiful house 

c. circular red patch ~ red circular patch

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4 These points do not exclude ‘truncated projections’ altogether. For example, truncation might be possible, consisting of a continuous functional sequence from a certain category down. Haegeman (2010, 2012, 2013) has investigated this possibility in adverbial clauses.

5 Related ordering problems for cartography have been noted in the literature, including ‘transitivity failures’ (\( \alpha \subset \beta & \beta \subset \gamma \Rightarrow \alpha \subset \gamma \)) and apparent ‘ordering paradoxes’. See Bobaljik 1999, Nilsen 2003, and van Craenbenroec 2006 for discussion.
Functional hierarchies do not readily accommodate variability or gradability in speaker judgments about acceptable orderings, which occurs in many cases. Again, to the best of my knowledge, cartographers have offered no means to address this fact.  

2.4. Revisiting selection? A potential response to the observations above might be to revisit the notion of selection appropriate for cartographic projection. Since Grimshaw 1979, it has become standard to distinguish complement selection by category versus by semantics. Grimshaw urged this distinction on the basis of paradigms like 9a–b. Thus, whereas know and wonder both select clausal complements with interrogative meaning, only the former can take a nominal complement with implicit interrogative sense (a ‘concealed question reading’). This difference, Grimshaw observes, is plausibly due to the independent fact that only the former permits a nominal object (9c). If so, then selection for semantic features like interrogativity (s-selection) should be seen as independent of selection for categorial features like nominality (c-selection).

(9) a. Mary knows [CP what time it is]/[DP the time].
   b. Mary wonders [CP what time it is]/[DP the time].
   c. Mary knows/*wonders [DP a few things].

As noted in §1.1, semantics, whether understood formally in terms of semantic type or informally in terms of event-type reference, offers no clear basis for cartographic selection at this point. What about categorial selection? In fact, functional selection as defined in Abney 1987 is a form of pure categorial selection—one where selection is for a unique category. This yields the problems we have reviewed. Consider then the suggestion of a referee that we entertain a looser version of c-selection, one wherein functional heads are able to c-select for a range of complements, rather than a single type. Thus, given the ordering in 10a, suppose we allowed a head α to functionally select for the projection of ANY β hierarchically below it, so that size, for instance, could directly c-select for ANY OF LENGTHP, HEIGHTP, …, WIDTHP, and so forth. This move might seem especially attractive in response to the problem of plenitude. ‘Truncated’ projections like 10b (= 6b) would no longer be problematic; the issue of plenitude would disappear.

(10) a. size > length > height > speed > depth > width > …
   b. [sizeP large [widthP wide [NP board]]]

Nonetheless, apart from being a stipulative solution to the problem that adds nothing on the issues of explanation and rigidity, observe an interesting formal feature of this proposal. In allowing a head to functionally select for any item hierarchically below it, we are in essence treating categorial selection as TRANSITIVE.  For any α, β, γ in 7a, if α
functionally selects $\beta P$ and $\beta$ selects $\gamma P$, then $\alpha$ selects $\gamma P$. This point is revealing insofar as hierarchies like 10a are also connected (connex)—all elements in them are related—and they are antisymmetric—if $\alpha$ selects $\beta P$, then $\beta$ does not select $\alpha P$. This means that e-selection as defined here induces a single linear order on the entire set of functional heads, rather than a set of discrete, nonsymmetric relations holding pairwise. This result is interesting when we consider linear orders in mathematics in relation to the issues raised in §§2.1–2.3.

3. Linear orders in mathematics. Numbers, the canonical case of linear order in mathematics, compare interestingly on the issues discussed in §§2.1–2.3. The integers ($\mathbb{Z}$) exhibit a linear order, which is displayed in hierarchical fashion via the familiar number line (11).

(11) ... $-5 -4 -3 -2 -1 0 1 2 3 4 5 ...$

Crucial properties of this domain include the following: each number is related locally to each adjacent number by a relation $\mathcal{R}$. But the relation $\mathcal{R}$ itself is ‘nonlocal’ in the sense that it holds (or fails to hold) pairwise between all numbers on the line and is the same in all cases (i.e. $<$). Furthermore, the relation $\mathcal{R}$ can be independently defined. Assuming a prior characterization of the positive integers $\mathbb{Z}^+$ and a subtraction operation, $\beta \mathcal{R} \alpha$ iff $\alpha - \beta \in \mathbb{Z}^+$.8

Note that in this account, linear ordering among integers is not stated or explained via the number line (the ‘numerical hierarchy’). Rather, linear ordering is defined by a single underlying relation $<$ on the domain $\mathbb{Z}$. This has important consequences with respect to the three problems noted earlier with cartographic linearity. First, in the case of number, we know what explains their linear order; it is the relation $<$, which humans cognize and which we can characterize independently of specific number pairs. The ‘numerical hierarchy’—the number line—is entirely derivative on $<$. Second, since $<$ holds (or fails to hold) pairwise between all integers, we do not appeal to ‘intermediaries’ to explain relations between numbers—we do not say $2 < 5$ in virtue of $2 < 3 < 4 < 5$. Rather, $2 < 5$ because $5 - 2 \in \mathbb{Z}^+$. No comparable need for plenitude arises with numbers. Finally, the ordering of integers is rigid—$\alpha < \beta$ or $\beta < \alpha$ or $\alpha = \beta$—precisely because one of the following holds: $\alpha - \beta \in \mathbb{Z}^+$ or $\beta - \alpha \in \mathbb{Z}^+$ or $\alpha - \beta = \beta - \alpha = 0$. Rigidity is thus a byproduct of the specific relation $<$ and how it is defined. This implies that other domains organized by other relations need not be expected to show rigidity.

4. Subjectivity and adjectival order. Recent experimental results reported in Scontras et al. 2017 suggest a potential implementation of the ‘mathematical picture’ in a domain where cartographic approaches have been offered, viz. adjectival ordering. In brief, Scontras et al. examined twenty-six relatively frequent, imageable adjectives from seven different semantic classes (age, color, dimension, material, physical, shape, value) and considered them as attributive modifiers of two different classes of nouns (food, furniture). Table 1 (reproduced from Scontras et al. 20179) lists the specific lexical items chosen.

Experimenters elicited preference judgments on A-A-N object descriptions from fifty participants. These judgments involved manipulating a slider bar, as shown in Figure 3 (reproduced from Scontras et al. 2017).

8 See Beckenbach & Bellman 1961 for an accessible account of inequalities.
9 Table 1 and Figs. 3–6 below are reproduced unmodified from Scontras et al. 2017 (‘Subjectivity predicts adjective ordering preferences’, available at https://doi.org/10.1162/OPMI_a_00005). They are licensed under Creative Commons Attribution 4.0 International (CC BY 4.0) (https://creativecommons.org/licenses/by/4.0/) and are © 2017 Massachusetts Institute of Technology.
Simultaneously, Scontras et al. performed a corpus study of attributive A-A pairings using the Switchboard corpus and the British National Corpus. The preference study and the corpus study were highly correlated (83%), as shown in Figure 4 (reproduced from Scontras et al. 2017).

Scontras et al. (2017) then performed two follow-up experiments intended to probe the perceived subjectivity of a given adjectival concept. The first task simply asked participants to assess subjectivity of an adjective by means of a slider bar, as in Figure 5 (reproduced from Scontras et al. 2017).

The second task, called ‘faultless disagreement’, asked participants to assess disagreements between two speakers with respect to an adjectival predication, rating

---

| ADJECTIVE | CLASS | ADJECTIVE | CLASS | NOUN | CLASS |
|-----------|------|-----------|------|------|------|
| old       | age  | good      | value| apple| food |
| new       | age  | bad       | value| banana| food |
| rotten    | age  | round     | shape| carrot| food |
| fresh     | age  | square    | shape| cheese| food |
| red       | color| big       | dimension| tomato| food |
| yellow    | color| small     | dimension| chair| furniture |
| green     | color| huge      | dimension| couch| furniture |
| blue      | color| tiny      | dimension| fan| furniture |
| purple    | color| short     | dimension| TV| furniture |
| brown     | color| long      | dimension| desk| furniture |
| wooden    | material| smooth | physical| | |
| plastic   | material| hard  | physical| | |
| metal     | material| soft   | physical| | |

Table 1. Adjectives, nouns, and their semantic classes (reproduced from Scontras et al. 2017, table 1).

---

Figure 3. Example trial from experiment 1: ordering preferences. Participants indicated the more natural of two adjective-adjective-noun descriptions on a sliding scale. (Reproduced from Scontras et al. 2017, figure 1.)

Figure 4. Mean distance from noun inferred from naturalness ratings (preference), mean distance from noun calculated from corpus counts (corpus), mean subjectivity ratings (subjectivity), and mean faultless disagreement ratings (faultless) for adjectives grouped by their semantic class. Error bars represent bootstrapped 95% confidence intervals (DiCiccio & Efron 1996). (Reproduced from Scontras et al. 2017, figure 2.)
whether both speakers could be right or whether one of them had to be wrong. Example disagreements are given in 12.

(12) a. Mary says: ‘That apple is old.’
    Bob says: ‘That apple is not old.’
b. Mary says: ‘This desk is metal.’
    Bob says: ‘This desk is not metal.’

Presumably the more subjective the adjective—that is, the more relative to speaker point of view—the more raters would be inclined to accept disagreement without judging one of the parties to be wrong. As indicated in Fig. 4 (see ‘subjectivity’ and ‘faultless’), the results for the subjectivity and faultless disagreement tasks were highly correlated, strongly implying that they measure a common factor.10

Scontras et al. (2017) found that ordering naturalness was highly correlated with subjectivity as determined by scores on the subjectivity-judgment and faultless-disagreement tasks. Figure 6a below (reproduced from Scontras et al. 2017) plots individual adjectives, where the value on the naturalness scale indicates whether a given adjective prefers the first (value 1) or the second (value 0) position in an A-A-N combination. As can be seen, the lower the subjectivity score, the greater an adjective’s preference for the second position, closer to N. Subjectivity explained 85% of the variance, and faultless disagreement explained 88%.

Scontras et al. also computed results for pairs of adjective classes (e.g. age-color, value-dimension, etc.) in order to probe for A-A configuration effects. Figures 6a–b plot results for the pairings, where the subjectivity score reflects the difference in mean subjectivity score for the classes. Again, the subjectivity and naturalness scores are highly correlated (80%). Scontras et al. also note that ‘as the difference in subjectivity approaches zero, the naturalness ratings approach 0.5 (i.e. chance); ordering preferences weaken for adjectives of similar subjectivity (e.g. “yellow square” or “fresh soft”)’ (2017:58).11

10 The two tasks described in Scontras et al. 2017 do not appear to be of equal validity. Asking speakers to judge the subjectivity of an adjective, as in Fig. 5, amounts to asking them to apply the English word subjective to the term. It is not obvious prima facie that other languages will possess a lexical item with semantics similar enough to subjective to support valid crosslinguistic comparison. By contrast, faultless disagreement does appear to yield a plausible, crosslinguistically valid operationalization of subjectivity insofar as it is not ‘lexicon-dependent’ in the same way.

11 Extending comments in n. 6, a referee notes that the corpus searches and experiments of Scontras et al. 2017 involve ordering comparisons between individual adjectives, and questions whether such results can yield legitimate conclusions about the orderings of adjective classes. I must leave this as a matter for future research.
Scontras et al. (2017) expanded their experiment to a larger class of adjectives (78) and a larger subject pool (495) in order to rate naturalness. They also recruited a larger pool of subjects (198) to rate subjectivity and faultless disagreement. The results were essentially the same. In the supplemental materials to Scontras et al. 2017, the authors report adjectival ordering results based on some alternatives to subjectivity, for example, adjective inherentness (how essential an A’s meaning is to the N it modifies), intersective vs. subsective modification (the mode by which A composes with the N it modifies), and concept formability (whether A composes with N to form a complex, idiomatic concept). In all cases, they found subjectivity to be a better predictor of adjectival order.

The results in Scontras et al. 2017 on linearity in the adjectival domain are strongly reminiscent of what we observed with linearity in the numerical domain insofar as there appears to be a single ‘inequality’ relation that speakers can judge between AP classes: $\leq_{\text{SUBJ(ECTIVITY)}}$. This relation induces an order on the whole domain (size, length, etc.). Speakers appear to make use of $\leq_{\text{SUBJ}}$ in syntactic projection in the sense that their ordering preferences seem to reflect $\leq_{\text{SUBJ}}$. This in turn suggests an account of adjectival ordering that might avoid the three problems facing the cartographic account. Specifically, we would have some handle on what explains AP order, namely the relation $\leq_{\text{SUBJ}}$, which humans cognize (and ultimately grammaticize) and which we can characterize independently of specific adjectives and adjective classes. The hierarchy of projections would be derivative on $\leq_{\text{SUBJ}}$. Furthermore, since $\leq_{\text{SUBJ}}$ holds pairwise between AP classes, we need not appeal to ‘intermediaries’ to explain order—we do not say large precedes wide because size precedes length precedes height precedes speed precedes depth precedes width. Rather, large precedes wide because size $\leq_{\text{SUBJ}}$ width. There is no issue of plenitude. Finally, and importantly, adjectival ordering is predicted to be only as rigid as $\leq_{\text{SUBJ}}$ determines. For adjectives A1, A2 whose subjectivity is judged equivalent ($A1 \approx_{\text{SUBJ}} A2$), we predict fluidity. Hence we obtain some grasp on gradability in ordering judgments.

4.1. Why does subjectivity predict adjective ordering? The results in Scontras et al. 2017, while showing that subjectivity apparently plays a role in determining adjective order, do not show why it should play such a role. And indeed a variety of proposals have been made about this connection. Thus Scontras et al. (2019:17) argue that subjectivity ordering reflects pressures of reference resolution and that ‘most cases of multi-
adjective modification are such that ordering with respect to decreasing subjectivity maximizes the probability of correctly classifying the intended referent [given by the noun]. In a related vein, Hahn et al. (2018) propose that subjectivity and mutual information between adjectives and nouns, combined with memory limitations exerted in online processing, predict the adjectival orderings we observe. Although these proposals have the virtue of predicting crosslinguistic stability in adjective order given the presumed universality of reference resolution and information-theoretic variables, they also encounter a simple problem in explaining why the orderings observed with adjectives are not observed with corresponding relative clauses. Thus, whereas English speakers appear to have clear judgments about the ordering of the prenominal adjectives *big* and *red* in 13a–b, judgments seem considerably less clear with the relatives in 13c–d.

(13) a. the **big** **red** barn
   b. *the **red** **big** barn
   c. The barn [that is **big**] [that is **red**].
   d. The barn [that is **red**] [that is **big**].

On the plausible assumptions that (i) *big*/that is big and *red*/that is red denote the same properties of individuals and are equivalent in subjectivity, and (ii) relative clauses stack postnominally in the reverse pattern from how attributive adjectives stack prenominally, we might expect issues of reference resolution to be equivalent in the two cases, predicting equivalent ordering constraints for Scontras et al. (2019). Evidently, this is not what we find.12

One key difference between an attributive adjective and a corresponding modifying relative clause is that a head will have selection possibilities with the former that will be absent with the latter. Thus a head H will have strictly local access to A and its syntactic and semantic features in 14a, but not in 14b, where AP is embedded within a larger CP.

(14) a. [AP A] H
   b. H [CP … [AP A] … ]

Hence if ordering of adjectives is imposed syntactically by head selection for APs, as in the cartographic program, then the disparity between 13a–b and 13c–d is directly accounted for. By contrast, under semantic processing-based accounts like that in Scontras et al. 2019 or Hahn et al. 2018, the asymmetry between adjectives and relative clauses in ordering is unexplained. In the remainder of this article I continue to assume that adjectival ordering is grammaticized and should be given a syntactic account, laying out an approach within a modified version of the cartographic program.

5. Projection from prosets. Cartography ‘explodes’ traditional heads like CP and AP in a two-step move. First, it identifies a set of features representing (essentially) subcategories of the relevant domain. It then reanalyzes each feature as constituting a separate head of its own projection, organizing projections into a cartographic hierarchy (15a,b).

12 We might also note that ‘concentric reference specification’ seems to be considerably more complex than discussed in Scontras et al. 2019. Consider the natural orderings found with the locatives and temporals in (i).

(i) a. Let’s meet [in NYC] [in Central Park] [near the boat Pavilion] [at the benches].
   b. This committee will reconvene [at 8:00 am] [on Saturday] [January 4th] [(in) 2021].

With locatives like (ia), I find the natural (and relatively firm) ordering to be from the larger frame (NYC) to the smaller one (the benches). With temporals like (ib), however, the ordering from specific time point to larger concentric temporal units seems natural, although there seems to be more flexibility in order.
(15) a. 
\[
\begin{align*}
&\{\text{[FORCE]}, \text{[TOP]}, \text{[FOC]}, \text{[FIN]}, \text{[TENSE]}, \ldots \} \\
&\downarrow \downarrow \downarrow \downarrow \downarrow
\end{align*}
\]
\[
\begin{align*}
&\text{[FORCE]} \quad \text{[TOP]} \quad \text{[FOC]} \quad \text{[FIN]} \quad \text{[TENSE]} \quad \ldots
\end{align*}
\]

b. 
\[
\begin{align*}
&\{\text{[SIZE]}, \text{[LENGTH]}, \text{[HEIGHT]}, \text{[SPEED]}, \text{[DEPTH]}, \text{[WIDTH]}, \ldots \} \\
&\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow
\end{align*}
\]
\[
\begin{align*}
&\text{[SIZE]} \quad \text{[LENGTH]} \quad \text{[HEIGHT]} \quad \text{[SPEED]} \quad \text{[DEPTH]} \quad \text{[WIDTH]} \quad \ldots
\end{align*}
\]

However, it is exactly in separating the features as independent heads that the theory loses any way of ordering them via a single relation like subjectivity. And as we have seen, there is no clear way to import the latter into the selection relations that are taken to create the cartographic hierarchy.

5.1. THE BASIC PROPOSAL. I wish to suggest an alternative way of conceptualizing cartographic projection. I propose to retain the features identified by cartographers, but instead of projecting them as independent heads, I propose to organize them as ordered feature sets borne by a single head. These constitute total preordered sets, as defined in 16.

(16) Definition: If S is a set and ≤ is a binary relation on S, then ≤ is a preorder if and only if for all a, b, c ∈ S:

- a ≤ a (reflexivity).
- if a ≤ b and b ≤ c, then a ≤ c (transitivity).

A preorder is total if a ≤ b or b ≤ a for all a, b ∈ S. A set with its preorder is a preordered set (or proset).

The notion of preorder largely matches our intuitive grasp of subjectivity as a relation between adjectives. Thus every adjective (and adjective class) is as subjective as itself (reflexivity). If adjective 1 is less subjective than adjective 2, which in turn is less subjective than adjective 3, then it seems that adjective 1 should be less subjective than adjective 3 (transitivity). All adjectives (and adjective classes) are comparable in terms of subjectivity (totality). Finally, for two adjectives (or adjective classes) A1 and A2, it can be that A1 ≤SUBJ A2 and A2 ≤SUBJ A1, without A1 = A2; that is, subjectivity is not antisymmetric. I use parentheses to denote a proset, with order of elements indicated left to right, separated by commas. When two elements α, β in a proset are ordered equally, that is, when α ≤ β and β ≤ α, I indicate this with a slash between them, rather than a comma.

With these notions in place, I propose that prosets of features ([f1], [f2], [f3], ...) are borne by unexploded heads H, and ordered by a relation ≤R (17).

(17) H

\[
\begin{align*}
&\text{[f1]}, \text{[f2]}, \text{[f3]}, \ldots
\end{align*}
\]

I furthermore propose that the projection order of phrases aligns with feature order via agreement, as shown in 18. The organizing principle is ALIGNMENT, as specified in 19.

(18) a. b. c.
(19) ALIGNMENT: Features in a proset must undergo agreement in order from lowest ranked to highest ranked (here F1 to F3).

To give a concrete example that I later modify, suppose adjectival features specify potential attributes of nouns and that nouns are the designated bearers of adjective-feature proses. Then we might analyze projection of attributive adjectives as in 20a–d. In each case, as we adjoin an adjective of a given class, we execute a corresponding agreement relation between it and the nominal head. The feature proset on *mouse* plays a crucial role in organizing the merge order of its attributive modifiers (20a–b). Note that when two adjective classes are of equal subjectivity, their features are mutually unordered (for example, *[MATERIAL]* and *[COLOR]*, as indicated by the slash). Either order of phrases then becomes available under 19; see 20c–d.

(20) a. b.

Rigidity (or lack thereof) in the feature ordering reflects itself in rigidity (or lack thereof) in the projection order. Note, however, that the problem of gradience is not solved. As a referee rightly notes, the agreement mechanism described in 18 and 19 accommodates three situations for adjectives A1 and A2: A1 is ordered before A2, A2 is ordered before A1, and A1 and A2 are unordered. It does not accommodate a situation where there is merely a preference (*beautiful big house* ~ ?*big beautiful house*). In other words, the analysis incorporates subjectivity not as a gradient notion, but as an absolute three-valued one.13

5.2. A REFINEMENT. Although attractive in broad respects, the picture sketched above raises a technical issue. Observe that in 18b feature [r2] agrees with H across a closer feature [r1] of the same type, and similarly for [r3] in 18c. This situation represents a violation of RELATIVIZED MINIMALITY as articulated in Rizzi 1990, which prohibits a more distant syntactic relation between an element X and an element Z in the presence of a closer potential relation between X and an element Y; see 21.

(21) [X [... [ ... Y [... [ ... Z ... ]]]]

13 The issue of gradient acceptability for adjectival pairings (*beautiful big house* ~ ?*big beautiful house*) plainly intersects with the issue of gradient acceptability for sentence pairings (*That is a beautiful big house* ~ ?*That is a big beautiful house*). While sentence acceptability is widely conceded as gradient, how to accommodate this fact within grammatical theory is a subject of ongoing debate. For example, as pointed out by Lau et al. (2014), probabilistic grammars developed in statistical parsing do not offer a ready solution since, as noted in Clark & Lappin 2011, grammatical well-formedness cannot be directly reduced to probability.
Specifically, it violates the version of this idea developed in Rizzi 2004 as ‘featural relativized minimality’. On the latter, what is blocked in 21 are feature-agreement relations between a higher element X and a lower element Z in the presence of a Y bearing features of the same class as Z. Rizzi 2004 identifies these features as in 22.

(22) Classes of features
   a. Argumental: person, number, gender, case (relevant only for A-move-
      ment)
   b. [+Q] Quantificational: Wh, Neg, Measure, Focus, …
   c. [+Q] Nonquantificational
      i. [+Mod] Modifiers: evaluative, epistemic, Neg, frequentative, …
      ii. [+Top] Topic

Note that 22c includes modifier features (22c.i). Thus, on featural relativized minimal-
ity, agreement relations like 19a–d, which cross closer elements bearing features in the
same modifier class, are illegitimate.

One technical way of evading the featural relativized minimality problem, discussed
in detail in Larson 2014, is by interpolating ‘light heads’ in derivation, so that in place
of 18a–c we have 23a–d. Observe in particular the step in 23b, where we merge a light
head h of the same phrase type as H. h then attracts H (23c), which in turn allows the
merged β to agree with H without intervention by γ (23d).

(23) a. Merge modifier γ
   b. Merge light head h
   c. Attract head H
   d. Merge modifier β

Merge of the remaining α then follows the same sequence of light head Merge, fol-
lowed by raising of [h H h], followed by agreement on [r3].

I execute this proposal within modern feature theory, developing ideas in Pesetsky &
Torrego 2007. I begin from a basic distinction framing their views, namely that between
feature instances that are interpretable [i] and feature instances that are valued [v]. The core idea behind this division is that features resemble other kinds of syntactic
objects in needing to be ‘legible’ at the two interfaces of LF and phonetic form (PF).
The interpretable instance of a feature ([i]) represents its LF-legible aspect. The valued
instance of a feature ([v]) represents its PF-legible aspect. I follow Pesetsky and Tor-
rego (2007) in assuming that an unvalued feature instance probes downward under c-
command and agrees with another instance beneath it, in the simplest case, with a
valued instance (24).

(24) [i] probes [v] AGREE!
Once the two feature instances have undergone agreement, they are regarded as constituting a single syntactic object possessing both dimensions required for interface legibility.14

Also following Pesetsky and Torrego (2007), I assume the full space of possibilities for [+interpretable] and [+valued] feature instances (25), including instances that are NEITHER interpretable nor valued [F], and instances that are BOTH interpretable AND valued [iFv].

\[
\begin{array}{c|cc}
\text{+interpretable} & \text{iF} & \text{iFv} \\
\text{−interpretable} & F & Fv \\
\end{array}
\]

Of particular interest for our purposes is the feature type [F], whose status as neither interpretable nor valued allows it to play a PF/LF-neutral syntactic role in coordinating structural agreement relations. Notice that under the assumption that UNvalued features probe, instances of either type in the rightmost column will probe—either [iF] or [F].

Finally, I make two additional assumptions that are not part of Pesetsky and Torrego’s basic analysis, but that are crucial to the current account. The first concerns the distribution of valued feature instances on heads (26).

(26) 1H-1v: If a head bears a proset of feature instances, at most one of those feature instances can be valued.

The assumption in 26 can be viewed as a restricted version of the ‘nano-syntactic’ axiom that each syntactic feature correspond to an independent syntactic head—that features and heads align one-to-one. Under 26, alignment holds between valued features and heads, so that if a head hosts more than one feature of a given type, at most one can be valued. As we will see below, this constraint has the effect of requiring light heads to be interpolated in order to provide the valuation that cannot be specified on a single head alone, given 26.

The second assumption concerns the distribution of modifier features on modifiers and their heads (27).

(27) a. Modifier features are INTERPRETABLE (but unvalued) on modifiers.
    b. Modifier features are VALUED (but uninterpretable) on the heads modified
        (up to the constraint imposed by 26).
    c. Modifier features are UNINTERPRETABLE-UNVALUED otherwise.

Assumptions 27a–c are surely plausible. Given that red is a color, it makes sense to think that a modifier feature like [COLOR] would be interpretable on a modifier like red. Likewise it makes sense that a color term might mark its formal status as a NOMINAL modifier when occurring in attributive function. Valued status on a modified head might be taken to reflect that.

Under these assumptions, the derivation in 23a–d can be recast as in 28–32 below. We begin with a head H bearing a proset of modifier features ([F1v],[F2],[F2],[F3]), whose lowest-ranked member here ([F1v]) is valued and the remainder unvalued, assuming one valuation/head in a feature set (28).

(28) \[H ([F1v],[F2],[F2],[F3])\]

14 Pesetsky and Torrego’s conception replaces earlier ones like that in Chomsky 1995 wherein agreement values the interpretable feature and ‘checks’ the uninterpretable feature, enabling its later erasure. Here interpretable feature instances do not become valued but rather enter into agreement with valued instances. Likewise, uninterpretable features are not ‘erased’ upon agreement, but rather become part of a larger, chainlike structure that satisfies interface legibility requirements. See Pesetsky & Torrego 2007 for further discussion.
Given alignment (19), the first modifier to be merged must be $\gamma$-bearing $[f1]$, which is interpretable but unvalued ([i[f1]]) following 27a. $\gamma$ c-commands H, so the two can undergo agreement, as shown in 29. This yields a feature chain [i[f1]–[f1v] with interpretable and valued instances, a legitimate interface object.

(29) Merge $\gamma$ (agreement)

Observing now that we cannot simply repeat the process in 29 in attaching an additional modifier (29'). Such an attempt will fail for at least two reasons.

(29') Merge $\gamma$ (agreement)

First, 29' requires agreement between [ir2] and [r2] to cross a feature [i[f1] of the same type, violating featural relativized minimality as discussed above. Second, even if agreement could occur, it would not produce an interface-legible [f2] feature. Since the lower instance of [r2] is unvalued, the post-agreement feature object [ir2]–[r2v] will lack valuation and hence PF-visibility.

To solve both problems, we merge a light head $h$ bearing a valued instance of [r2]—the valuation that is precisely missing on H in view of 26. Merge of $h$ represents pure functional selection; light heads select their own categorial projections, whether lexical (HP) or functional (hP).

(30) Merge $h$ (functional selection)

The light head then attracts and raises the categorially matching head (H) in its c-command domain (31a). This movement brings $h$ and H into a mutual c-command relation; hence a probe-goal agreement relation can obtain between the unvalued-uninterpretable [r2] feature on H and the valued-uninterpretable [r2v] feature on $h$ (31b).

(31) a. Attract H

b. Agree
We now merge a second modifier $\beta$ bearing $[i\!f\!2]$. Since $\beta$ c-commands $H$, its unvalued $[i\!f\!2]$ instance can probe the unvalued/uninterpretable $[f\!2]$ on $H$, which has already undergone agreement with the valued instance $[r\!2v]$ on $h$ (32). This then yields a feature chain $[i\!f\!2]−[f\!2]−[f\!v]$ with both interpretable and valued instances, a legitimate interface object.

(32) Merge $\beta$

```
        β
        ↓
       [i\!f\!2]
      ↓
   h
  ↓
H
  ↓
γ
↓
H
``` [(i\!f\!2), [f\!2], [f\!v]] [(i\!f\!2), [f\!2], [f\!v]]

This sequence of operations, starting with 30, would repeat for the Merge of $\alpha$.

5.3. Projecting adjectival modifiers again. This revised view of projection has the interesting consequence of excluding an analysis like 20a–d where adjectival features are resident on a lexical N. Because the derivation in 28–32 requires successive head raising, such an analysis would yield an incorrect surface word order for nouns and attributive adjectives in which all but the initial adjective in a sequence would appear postnominally (33).\(^{15}\)

(33) A N A A
```
  small mouse furry mouse gray mouse
```

An alternative discussed in Larson 2014 and Larson & LaTerza 2017, and ultimately going back to Smith 1964, is to take $D/d$ as the syntactic head bearing modifier features.\(^{16}\) Developing ideas from generalized quantifier theory (Barwise & Cooper 1981, Keenan & Stavi 1986), Larson 1991 proposes that quantifiers in general bear two semantic selection features: $[\text{res}]$ for ‘restriction’ and $[\text{sc}]$ for ‘scope’, where the latter is ordered below the former. Suppose that adjectival features are ordered by the subjectivity relation and arranged between $[\text{res}]$ and $[\text{sc}]$. Then we can recast the derivation in 28–32 as in 34.

(34) a. Merge D-NP

```
   every
   ↓
  DP mouse
  ↓
(i\!f\!e\!s\!e), [\text{col}], [\text{dim}], [\text{sc}])
  ↓
  [i\!f\!e\!s\!e]
```

b. Merge $d[\text{col}v]$

```
   d[\text{col}v]
   ↓
  DP every mouse
  ↓
(i\!f\!e\!s\!e), [\text{col}], [\text{dim}], [\text{sc}])
  ↓
  [i\!f\!e\!s\!e]
```

\(^{15}\) A referee suggests the picture in 32 as potentially appropriate for Romance, ‘where a limited set of adjectives occur pre-nominally’. However, Romance postnominal adjectives are known to show the mirror order to Germanic languages like English (see Lamarche 1991, Laenzlinger 2005 for discussion). So this proposal does not appear to be feasible.

\(^{16}\) A referee notes the inference that, ceteris paribus, languages with adjectival modifiers should have determiners, whether overt or not. This inference is correct. See Larson & LaTerza 2017 for discussion.
Repeating this sequence of operations for the adjective *small* and for the *Pro* subject of *dP* (discussed in Larson 2014), we arrive at the structure in Figure 7a. This structure exhibits broad congruence to a more standard cartographic tree (Figure 7b), but there are crucial differences of detail.

First, in Fig. 7b the adjectival features [DIMENSION] and [COLOR] constitute separate functional heads standing in separate functional-selection relations to their complements. By contrast, in Fig. 7a, the corresponding heads are all d’s, and only a single functional selection relation is involved; d f-selects dP/DP.

Second, in Fig. 7b, ordering of projections must be stated through the distinct functional selection relations, as has been noted. In Fig. 7a, projection ordering is through the feature proset resident on D and by the constraint on agreement.

Third and finally, note that in Fig. 7b DimensionP and ColorP must be situated within the entire functional hierarchy of adjectival projections (represented by the triangles).
By contrast, in Fig. 7a, the D head bears a subset of the adjectival feature set, and only those features appearing in the subset tuple are projected. No other adjectival projections are present, even covertly. Figure 7a, but not Fig. 7b, thus exhibits the desirable ‘minimalism’ discussed earlier in connection with the LF interface.

**5.4. PROJECTING THE LEFT PERIPHERY.** The strategy pursued above for recasting the cartographic adjectival projection can be extended to the full range of cartographic domains. The three basic technical moves are the same in all cases:

- Recast the relevant f-hierarchy as a feature set \( F = \{ [f_1], [f_2], [f_3], \ldots \} \).
- Identify an independent ordering relation \( \leq_R \) on \( F \): \( [f_1] \leq_R [f_2] \leq_R [f_3] \leq_R \ldots \), generalizing the results in Scontras et al. 2017.
- Replace cartographic f-heads with a single head \( h/H \) relevant to the domain and bearing proses of \( F \) features, ordered by \( \leq_R \).

I briefly illustrate this general strategy for the cartography of left-peripheral projections, an area of inquiry initiated by Rizzi 1997, which offered the structure in Figure 8.

![Figure 8. The cartography of the left periphery.](image)

Here the topmost projection (ForceP) is understood to be the locus of the illocutionary force features selected by higher predicates: declarative, interrogative, exclamative, and so forth. Beneath ForceP are projections for Topic and Focus, where TopP must apparently be available both above and beneath FocP to allow for Italian example pairs like 35a,b, where they appear in either order.17

(35) a. Credo che a Gianni, **questo**, gli dovremmo dire domani.

\( \text{Top} \quad \text{Foc} \quad \text{TP} \)  
‘I believe that to Gianni, **this**, we should say tomorrow.’

b. Credo che **questo**, a Gianni, gli dovremmo dire domani.

---

17 Rizzi 1997 proposes that the Top projections in Fig. 8 are recursive, allowing (in principle) any number of topics above or below FocP. However, Benincá and Poletto (2004) argue forcefully against this view, and for a yet more finely articulated picture of the relevant domains. Here we are simply taking them to be unordered by \( \leq_R \). This will license ordering alternations like 35a–b equivalently to what we saw with adjectives in 20.
Finally, FinP is the locus of features associated with finiteness, nonfiniteness, and subjunctivity.

In line with the above discussion, we can rework Rizzi’s picture with the following steps.

- Recast the cartographic f-hierarchy for the left periphery as the feature set $\mathbb{L} = \{[\text{FIN}], [\text{TOP}], [\text{FOC}], [\text{FOR}]\}$.
- Assume a preorder $\leq_R$ on $\mathbb{L}$ yielding prosets like $([\text{FIN}],[\text{TOP}]/[\text{FOC}],[\text{FOR}])$, $([\text{FIN}],[\text{TOP}],[\text{FOR}])$, $([\text{FIN}],[\text{FOC}],[\text{FOR}])$, $([\text{FIN}],[\text{FOR}])$, and so forth.
- Replace Rizzi’s cartographic f-heads with a single head, for concreteness, the category E/e (for ‘expression’) proposed in Banfield 1973.

On the revised view, the left periphery will be generated by E/e heads bearing subsets of $\mathbb{L}$, organized in prosets, and projected along the same lines as in 28–32 above.

To give an example, Rizzi 1990 proposes that interrogative why is generated directly in its left-peripheral position as a specifier of ForceP, whereas other whs are moved to this position from within the clause. To derive examples like why Max left and who left, we assume an E head bearing $([\text{iFIN}],[\text{FOR}])$. We also assume that $[\text{FIN}]$ is valued on the T head of TP and interpretable on E, and that $[\text{FOR}]$ is interpretable on wh-phrases.\(^{18}\)

In the case of why Max left (36a), the derivation is as in 36b. The finite TP is first built up with a T head bearing $[\text{FIN}]$. E bearing $([\text{iFIN}],[\text{FOR}])$ then merges first with TP since $[\text{FIN}] \leq_R [\text{FOR}]$ (36b).

(36) a. $[eP \ \text{why Max left}]$
   b. $$
   \begin{array}{c}
   \text{E} \\
   \text{TP}
   \end{array}
   \quad \begin{array}{c}
   \text{Max} \\
   \text{T} \\
   \text{leave}
   \end{array}
   
   \begin{array}{c}
   \text{E} \\
   \text{TP}
   \end{array}
   \quad \begin{array}{c}
   \text{Max} \\
   \text{T} \\
   \text{leave}
   \end{array}
   
   \text{E} \quad \text{TP}
   \quad \begin{array}{c}
   \text{Max} \\
   \text{T} \\
   \text{leave}
   \end{array}
   $$

   In order to value $[\text{FOR}]$, the light e head $e_{[\text{FOR}]}$ is next merged. $e_{[\text{FOR}]}$ raises the E head and agrees with it on $[\text{FOR}]$ (37).

(37) $$
   \begin{array}{c}
   e \\
   E \\
   \text{EP}
   \end{array}
   \quad \begin{array}{c}
   \text{E} \\
   \text{TP}
   \end{array}
   \quad \begin{array}{c}
   \text{Max} \\
   \text{T} \\
   \text{leave}
   \end{array}
   $$

Finally, why is externally merged, agreeing with e on $[\text{FOR}]$ and satisfying its edge feature (38).

(38) $$
   \begin{array}{c}
   \text{why} \\
   \text{EP}
   \end{array}
   \quad \begin{array}{c}
   e \\
   E \\
   \text{EP}
   \end{array}
   \quad \begin{array}{c}
   \text{E} \\
   \text{TP}
   \end{array}
   \quad \begin{array}{c}
   \text{Max} \\
   \text{T} \\
   \text{leave}
   \end{array}
   $$

\(^{18}\) The idea that tense is interpretable within the higher left periphery, and not within the sentence itself, has a long history going back to at least Pullum & Wilson 1977. More recent echoes of this idea can be found in Chomsky’s (2000) discussion of T as a ‘defective category’.
Note that both [\textsc{fin}] and [\textsc{for}] now have interpretable and valued instances linked by agreement. Hence the structure is LF-legible.

The derivation for who left, 39a, is virtually identical, except that who (bearing interpretable [\textsc{for}]) is initially merged within TP. When E then merges with TP, it thus can undergo agreement for both of its features in order (1,2) with corresponding TP-internal elements (39b).

\[(39)\]
\begin{enumerate}
\item [\textsc{ep} who who left]
\item Merge E & TP
\item Agree [\textsc{fin}]
\end{enumerate}

Once again, [\textsc{for}] remains unvalued at this point. To value [\textsc{for}], e_{\textsc{forv}} is merged, raising the E head and agreeing with it on [\textsc{for}]. At this stage e_{\textsc{forv}} agrees with E, which in turn agrees with who. By transitivity, e_{\textsc{forv}} therefore agrees with who (40).

\[(40)\]
\begin{enumerate}
\item Merge e_{\textsc{forv}}
\item Raise E
\item Agree [\textsc{for}]
\end{enumerate}

Given its agreement with who, the light head may activate its edge feature, raising wh- to its specifier position (41).

\[(41)\]
\begin{enumerate}
\item Merge who
\end{enumerate}

Once again [\textsc{fin}] and [\textsc{for}] have interpretable and valued instances linked by agreement. Hence the structure is LF-legible.

As in the case of attributive modifiers, the central organizing element in these derivational scenarios is the feature proset, borne by a head, whose ordering fixes the order in which phrases are merged in structure. In the case of the left periphery, the nature of the ordering relation is unclear at this point. Whether it is subjectivity or some other equally general cognitive relation is plainly an empirical question to be explored in this program under some elaboration and development of the experimental methods pioneered by Scontras and his colleagues.19

6. CONCLUSION. Proceeding in the way sketched above would analogize the cartographic project in syntax to the most successful cartographic project yet executed in lin-

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19 Intriguing recent results by Jeretić and Tulling (2019), following the experimental paradigm of Scontras et al. 2017, suggest that intersubjectivity may supply the relevant ordering principle for the left periphery. Since this work is quite recent, I do not attempt to comment on it here.
guistics: universal phonetics. The familiar ‘cartography of human vowels’ is a space known to be determined by extralinguistic anatomical, perceptual, gestural, and acoustical factors. The linguistic system digitizes this space with features, representing perceptually salient, acoustically stable, gesturally replicable feature bundles as segments. Feature relations (e.g. close/open, front/central/back, etc.) reflect this extralinguistic organization.

The results in Scontras et al. 2017 suggest a comparable extralinguistic, cognitive space of attributes associated with entities, organized according to whether they pick out salient, objective, factual properties of things vs. subjective properties, plausibly an important attention space for creatures concerned with reality and survival. The linguistic system digitizes this attribute space with features, identifying stable bundles of these as modifier concepts. The relations between these features—their ordering—reflects extralinguistic organization, here the subjectivity relation. Under the broader project that these results suggest, a key aim for syntactic ‘cartography’ becomes identification of the core cognitive relations underlying the features and feature orderings found in the major projections. Identifying these relations would hold out the prospect of a genuinely explanatory cartographic project, one that current approaches, by their reliance on notions like functional selection, appear unlikely to achieve.

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