Towards a (minimalist) Theory of Features: preliminary notes[i]

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ABSTRACT: This write-up reviews the bibliography on a (yet to come) Theory of Features, reviews its desiderata, and posits some theoretical and methodological prerequisites for it. It then goes on to make suggestions on how such a Theory should be compiled and also proposes some fundamental tenets on which it should be founded. These tenets are centred around the idea that purely semantic features do not exist and that (possible) formal features are signs abstractly encoding a limited number of archaic concepts. Speculations on the correct formalism for features, on how to assemble a reliable repertory of features, and on how they make functional heads are offered.

KEYWORDS: feature, concept, evolution, sign, functional head, interface, acquisition, grammar

1. The primacy of formal features

During his presentation at the Abralin 'The Minimalist Program: Achievements and Challenges' online event on 6 July 2020, Marcel den Dikken admits what everyone working in the field seems to already know, namely that "the Minimalist Program doesn't have currently a theory of features".

Similar observations are already in place in Adger and Harbour (2008), who review the history of attempts to come up with a theory of formal features. In doing so they dedicate some space to Muysken and van Riemsdijk (1986b), who establish the fundamental desiderata of a Theory of features:

(1) "[H]ow many are there?", "what are they?", "how do they distribute over syntactic structures?"

Unlike an HPSG or CG theory of features, a minimalist theory of features would have to be founded on certain (bio)linguistic assumptions. To begin with, features in general will have to be conceived as "instructions to the interfaces" (Chomsky 1995). As Zeijlstra (2008) puts it, *phonological* features are instructions to the interface between the combinatorial system of language and articulatory-perceptual systems; semantic and (interpretable versions of)

formal features are instructions to the interface between the combinatorial system of language and conceptual-intentional systems.[1]

In other words, the features posited will have to abide by expectations of psychological reality; therefore, they should not be conceived either as mere diacritics ('flags') for particular structural relations or as the shorthand of particular structural operations. This probably means that the likes of SLASH, Strong, EDGE, Brody's * Spell-Out feature, or Merchant's E (for ellipsis) features are all out of the picture, unless they can somehow be independently motivated.

(2) Formal features must be motivated as instructions to the C-I interface.

Generally speaking, "independently motivated as instructions to the interface" is a term to necessarily be satisfied before including a feature into any feature inventory. True, the membership and organisation of the actual inventory would be open to empirical discoveries, second thoughts on the appropriate taxonomies, and similar considerations – a matter I will return to in Section 5.2.

Hence, on the one hand the theory will have to be built both on the psychological reality of features and on their being motivated as interface instructions, as opposed to them solely triggering grammar internal operations, such as (external) Merge, or to them flagging dependencies, such as co-indexing. At the same time, in order for said theory to be coherent, our approach to features will have to be in unwavering consideration of their role in grammatical relations and operations.

In other words, we begin with syntactic or, more aptly, *formal* features. The whole rationale would go like this: we expect formal features to both reflect some sort of concept (in the broadest sense) relevant to the C-I interface and also play a role in grammatical computation (in the narrow sense); we cannot motivate a formal feature as a potential trigger of a grammatical relation and/or operation *unless it functions as an instruction to the C-I interface.*

For example: a purported feature [X] could be construed as an instruction to the C-I interface (e.g. animacy) *and* it plays a role in grammatical computation: [X] is a good candidate for a formal feature. On the contrary, a feature [Y] could be posited to play a role in grammatical computation (e.g. motivate Merge) *but* could not be construed as an instruction to the C-I interface: [Y] is not a good candidate for a formal feature.

[1] The "interpretable versions of" caveat is necessary also because this definition de facto excludes Case (Chomsky 2001) and grammatical gender features (Kramer 2015; Panagiotidis 2018) from among formal features, as they probably possess no interpretable versions and/or their values are not readable at the relevant interface; e.g. the [feminine] value of the gender feature in the Italian noun *chiesa* ('church') is not an instruction in any coherent way.

Briefly put:

(3) Formal features will have first to be motivated as interface instructions and then to be shown to play a role in grammatical relations and operations.

2. The primacy of formal features

Formal features must sharply be distinguished from purely semantic features, should such features exist. As Biberauer and Roberts (2015, 3) put it: "The formal features are […] interpretable or uninterpretable and, as such, are visible for syntactic operations such as Agree and Merge. The semantic features, on the other hand, are invisible to the core computational system (Narrow Syntax), but presumably visible at the semantic interface."

Cowper and Hall (2014, 146) make the same point: "We can say that a feature is active if the grammar crucially refers to it in any way. In the case of potential morphosyntactic features, then, it is not enough to show that the semantic content of a feature is present in the encyclopedic meaning of some lexical item; rather, to be considered active it must be involved in inflectional paradigms, or trigger syntactic movement or agreement, or play some other demonstrably formal role."[2]

Briefly put, and in the spirit of Adger and Svenonius (2011, 18), what matters in formal representations and in grammatical operations is a different set of features than those *possibly* involved in "meanings such as whatever distinguishes camels from reindeer or a joke from an insult". More curtly, we must at least distinguish lexical semantics (feature-based or not) from formal features and our theory thereof.

The above quotes essentially elaborate on (3). An example of the formal-semantic distinction is gender. We know that Slavic possesses grammatical gender features because these are involved in concord and agreement phenomena: indeed, the grammar refers to gender. We also know that English possesses semantic gender features because they are involved in the pronominal paradigms; again the grammar refers to gender, although it does so not via Move or Agree, but by making it manifest on *functional heads* – cf. footnote 2. Interestingly, this makes semantic gender a *formal* feature: if it is marked on functional heads, then it matters for grammar.

[2] Cowper and Hall's criterion for distinguishing between formal and semantic features is (correctly I think) whether "the grammar crucially refers to it in any way". This is a more relaxed criterion than that of Zeijlstra (2008), who claims that "[c]hecking of uninterpretable features […] forms a diagnostic test to distinguish interpretable formal features from purely semantic features […]". He continues to lay out "three properties that could be harnessed to test for the presence of a feature [uF]: its semantic uninterpretability, the triggering of an operation Move and the triggering of an operation Agree. […] [A]ll three of these properties reduce to one single property: doubling."

At the same time, we can nevertheless safely claim that Turkish makes *no* use of gender features because gender distinctions (e.g. man-woman, mister-missus, boy-girl etc.) are indeed made but have no grammatical effect whatsoever: they are purely expressed within the domain of lexical semantics and only marked on contentful elements ('lexical heads'). Whether Turkish gender distinctions, not a matter of formal features, are encoded by way of semantic features is a different matter, to which we will return below.

One point to keep in mind is the one made in the Adger and Svenonius quote cited above: we somehow expect formal features not just to encode instructions to the C-I interface, as in (2) and (3), but also to point to concepts and functions of a particular sort – something we return to in Section 3.3.

Having clarified that semantic (if existent) features and phonological features are excluded from the empirical domain of a theory of (formal) features, we move on to present the desiderata of such a theory.

3. Four issues in a Theory of Features

Three fundamental desiderata of a Theory of Features would be the following : "how many are there?", "what are they?", "how do they distribute over syntactic structures?" (Adger and Harbour 2008, 5; citing Muysken and Riemsdijk 1986a, vii). These can be formulated as the following four issues that must be addressed by a Theory of Features

I. What are formal features?
II. What is the correct *formalism* for them?
III. Why are particular concepts encoded, or rather: are *encodable*, as formal features (e.g. mass / number) and others are not (e.g. colour / brightness)?
IV. How do formal features combine into functional elements (e.g. Indo-European number); are they relevant in the case of 'modifiers' (e.g. Mandarin *men* plurals)?

The four questions are elaborated on below.

3.1. What

Formal features have already been described as instructions to the interface between the combinatorial system and the conceptual-intentional systems that at the same time "[are] involved in inflectional paradigms, or trigger syntactic movement or agreement, or play some other demonstrably formal role" (Cowper and Hall 2014, 146; cited above).

We therefore pre-theoretically understand formal features i) as a subset of semantic features or ii) as a set whose intersection with semantic features is non-empty and whose intersection with phonological features is the empty set (Zeijlstra 2008; Adger 2010; Emonds 2011; Adger and Svenonius 2011; Cowper and Hall 2014 and elsewhere). The conviction that formal features cannot be articulatory motivated, i.e. their intersection with phonological

features must be the empty set, originates from solid empirical observations about the Autonomy of Syntax (cf. Newmeyer 1998, chap. 2).

Clarifying the above observations, in the weakest formulation, formal features are *about* semantic interpretation. As per (3), formal features regulate grammatical relations (e.g. Locality), operations (e.g. movement), and realisations (e.g. morphological contrasts) which in turn are sensitive to Animacy, Individuation, Definiteness, Quantification, Transitivity, Aspect, Tense, Mood, Finiteness, Illocutionary Force and the like – not to *phonological* properties such as voicing, height, roundness etc. Hence, formal features, which by definition drive and constrain grammatical operations, originate in cognition rather than in articulation (Hauser, Chomsky, and Fitch 2002; Hinzen 2006; Emonds 2011; Berwick and Chomsky 2017; Nóbrega and Miyagawa 2015; Golston 2018).

What is a formal feature? How exactly are concepts like those listed in the previous paragraph grammaticalised? In order to answer these questions, we must keep in mind that formal, not semantic, features are the true parallel of phonological features which are motivated by articulatory contrasts (Dresher 2014). Hence phonological features are motivated by the A-P systems but at the same time they play a role in the workings of a combinatorial system, phonology. Similarly, as already stated, formal features are motivated by contrasts the C-I systems make available, provided that such contrasts play a role in the workings of the combinatorial system, syntax – i.e. the combinatorial system underlying word and sentence formation (Harley and Noyer 1999). This parallelism is no more than a re-affirmation of the old Martinet precept of the 'double articulation' of language, popularised in the English-speaking literature by Charles Hockett (Emonds 2011; Golston 2018).

Thus, phonological features, like semantic features (if they exist), are irrelevant for the workings of syntax. At the same time, formal features express concepts, or whatever we wish to call elements relevant for the C-I systems, that can somehow (more on this below) be quantised: concepts that are encodable or, more informally, 'featurable'.

This of course begs the next question: whether there exists a fixed inventory, a closed set, of formal features (as has been understood for decades) or features emerge during acquisition through heuristic processes (Cowper and Hall 2014; Dresher 2014; Biberauer et al. 2014; Biberauer and Roberts 2015 among others). This is an empirical issue and it could possibly be completely orthogonal to the concerns of a theory of formal features, which should in principle be compatible with both solutions. Having said that, a theory of features should at the same time constrain what formal features an acquirer may and may not posit. We return to this in Section 3.3.

3.2. Privative, equipollent, or more?

The actual *form* (and 'form' must be understood here in a rather abstract sense) of features is a more or less unresolved matter. There are roughly speaking three options: features are either *privative*, *equipollent*, or of an [attribute:value] format.

The privative system is the simplest: a feature is there or isn't there.[3] The equipollent system is the familiar +/- one, established by the linguists of Prague School (and popularised in the English-speaking literature by Roman Jakobson) for phonological representations (see also Nevins 2008).

Adger and Svenonius (2011) successfully discuss the limitations of privative feature systems in establishing natural classes, which are necessary e.g. for Locality and defective intervention effects. On top of that, Cowper and Hall (2014) convincingly show that it cannot be the case that privative feature systems are universal. In the meantime, Harbour (2011) focuses on the intricate number system of Kiowa, demonstrating the inadequacy of a privative feature system in describing it; he also explores and dismisses what he calls a *pseudoprivative* alternative, i.e. using different versions of the same feature (e.g. F and F') in order to capture three-way distinctions. More recently, unpublished work on Marshallese suggests that a successful description of the pronominal system of the language must allow number to be expressed as a privative feature but person features as equipollent ones.

If (formal) features do not belong to a fixed UG repertory but are arrived at by the acquirer precisely as she pays attention to contrasts (and/or distinctions) expressed by grammar, as seems to be the emerging consensus (Emonds 2011; Dresher 2014; Cowper and Hall 2014; Biberauer et al. 2014; Biberauer and Roberts 2015; Biberauer 2019 and elsewhere), the availability of all three systems (privativity, equipollence, and the [attribute:value] format) would come as no surprise, as long as they would optimally accommodate the grammar-specific data. Which feature system is at play will then ultimately be an empirical, grammar specific matter.

3.3. Which concepts can be encoded as features?

From the seemingly unlimited range of concepts available to human cognition only a tiny subset is encoded as formal features, including but not restricted to Animacy, Individuation, Definiteness, Quantification, Transitivity, Aspect, Tense, Mood, Finiteness, Illocutionary Force etc. This matter is eloquently presented in Cinque (2013, 50–52), who for instance notes (ibid., 50): "Verbal projections in clauses grammatically encode (through affixes, particles, auxiliaries, etc.) distinctions relating to the external and internal temporal constituency of events (tense and aspect) and the speaker's attitude toward the truth of the proposition (mood), but they are never found to grammatically encode such human cognitive universals as ''shame'', ''mourning'', ''sexual taboos'', etc. , nor otherwise

[3] "Privative […] characterizes systems where atomic features may be present or absent, but have no other properties" (Adger 2010, 187).

cognitively significant concepts like ‘‘worry’’, ‘‘peril’’, ‘‘fear’’, ‘‘hunger’’, ‘‘love’’, ‘‘death’’, ‘‘awe of god’’, etc.”

Even this remark should be enough to dismiss the typical blasé assumption that formal features encode ‘cognitively salient’ categories – the specimen of ‘cognitively salient’ universals that never get encoded as formal features that is sampled in the Cinque quote above is quite telling.

This issue becomes even more pressing if feature systems are assembled on the basis of linguistic data during the course of acquisition, perhaps in the way sketched in Biberauer et al. (2014), Biberauer and Roberts (2015), and Biberauer (2019). For instance, how come acquirers never attempt to assemble noun classification systems on the basis of the very salient bright / dark (and, even, red) contrast? Why has the wealth of manner-of-motion types expressed among English verbs never yielded a grammatical taxonomy thereof? Why do noun classificatory feature systems may be based on animacy and sex, size and shape, but never on brightness and/or colour? What privileges the concept of surprise (in miratives) over that of worry, of desire or volition over that of fear, of failure (in frustratives) over that of shame (Cinque 2013, 51), those of honorificity and deference over a range of diverse attitudes towards other humans?

There are precious few attempts to address the question of what kinds of concepts are encodable as formal features. Adger and Svenonius (2011, 18) make the following crucial point: “However, the kinds of meanings which distinguish edibles from inedibles and draft animals from mounts are arguably different from those with which formal semantics is concerned, and it is there we find the language of logic, set theory, predicate calculus, and other tools. Notions such as quantification, negation, gradability, boundedness, telicity, plurality, and so on are part of this system. Let us use the term SEMANTICS for such formal representations, excluding vaguer, prototype-based meanings such as whatever distinguishes camels from reindeer or a joke from an insult.”

Roberts and Roussou (2003, chap. 5) go one step beyond and formally define functional categories as precisely those terms that are purely *logical*, i.e. “invariant under isomorphic structures” (their (45)). If functional categories are composed exclusively of formal features, which would be the zero hypothesis, then formal features would exclusively express “the logical content [which is] independent of the external factors, or in von Fintel’s (1995) words, insensitive to facts about the world”.

One can of course hardly downplay the importance of logical operators in the creation of formal features. Still, claiming that formal features are about categories “such as quantification, negation, gradability, boundedness, telicity, plurality” etc. is circular: these categories (and not others) are “part of this system” because we understandably built our formal semantics on the basis of natural language: the real question is why these categories, and not others, are part of the system in the first place. An answer to this would be along

the lines of the approach of Roberts and Roussou to what makes a category functional: what is "restricted to logical meanings". Again, this is true of formal features like those underlying quantificational elements as well as those involved in individuation, modals, negation, and even Tense and Aspect. However, already Roberts and Roussou point out that "[t]he status of demonstratives is unclear […] The question of the status of Person features also relates to the demonstratives; essentially the question here is whether 1st- and 2nd-person features can be seen as logical elements". Such reservations hold a fortiori for mirative, frustrative, honorific features – and the like.

Before moving on, let's just concur with Adger and Svenonius that "whatever distinguishes camels from reindeer or a joke from an insult" must be relegated to semantic features, or whatever will have to replace them in a system that takes its Encyclopedia seriously.

Now, Golston (2018; 2019a; 2019b) has shown in some detail that concepts encoded as formal features predate the emergence of the human species. Interestingly, Emonds (2011) had already argued that only concepts that predate the emergence of Homo sapiens sapiens (apparently the 'languaged' species of the genus Homo) can be encodable as formal features. This already excludes the grammaticalisation of all artefact and human social organisation concepts, but also of the successor function (ibid., 56-7). Emonds (p. 58) immediately afterwards notices that "many other categories that are almost certainly part of primate cognition are not used in any system of syntactic computation: those of brightness, loudness, perceptions of speed and non-speaker centred motion, awareness of emotion (sadness, fear, anger, anticipation, sexual arousal, illness), and essentially all categories of feeling, taste and smell".

What Emonds offers is an insight worth exploring regarding which concepts are encodable as formal features: first of all, such concepts must be *discrete* (ibid., 51). Discreteness, a fundamental analytical category in understanding language at least since Charles Hockett, is a prerequisite for concepts to be encoded as formal features, filtering out at the same time all the categories listed in the quote above. Based on this, Emonds (2011, 59) goes on to posit *Lexical Labelling* (his 20):

(4) "Lexical items are associated with ("syntactic") labels or categories drawn from the store of the mutant primates' discrete visual concepts (their only conceptually discrete system)."

The above looks like a very promising starting point, as it provides a solid third-factor basis (Chomsky 2005) to understand what restricts the possible repertory of formal features. This will be relevant in both plausible scenarios:

- Whether formal features are listed in fixed UG inventory, pre-selected among discrete visually accessible concepts;

- Or there exists a subset of discrete visually accessible concepts that is readily featurable, as opposed to other ones, while features themselves are emergent, arrived at during acquisition.

Certainly, the discreteness requirement goes a long way. For instance, discreteness is important even when it comes to Tense: time is not treated by tense features as an undifferentiated flow but in discrete terms – something that is actually compatible both with the pronominal and with the quantification of theory of tense. At the same time, (visually accessible) discreteness again can hardly be the whole story about why surprise (in miratives) but not worry, desire or volition but not fear, failure (in frustratives) but not shame are grammaticalised, possibly encodable as formal features (Cinque 2013, 51). A Theory of Features needs say more on this matter.

3.4. From features to functional heads

Functional heads are feature bundles or, perhaps, feature structures (Harley and Ritter 2002a). As mentioned above, we would hope that functional heads only encode formal features, whether they be somehow pre-assembled or assembled directly from formal features available in the numeration, a la Hegarty (2005).

(5) Functional heads are made exclusively of formal features.

There are two points of some importance to be made here.

First, we need to at least distinguish between necessary formal features and interpretations emerging as (long-distance) syntactic relations. This is crucial in the face of the methodologically justifiable but substantially indefensible propagation of purported features in the last 35 years or so. Focus is a case in point: a structural relation that is usually captured as the result of adding a [Focus] feature on the desired item, hence violating Inclusiveness among other things. Tense is another case in point if something like the quantificational theory thereof is true (Von Stechow 1995; Demirdache and Uribe-Etxebarria 2000; Stowell 2007): if Tense is about the correlation between time intervals, then [past] features and the like are superfluous. This would eventually create a true tension between competing feature-based and structure-based explanations of phenomena.

Second, we need to (re-)examine how the known features are syntactically represented. In doing so, we must let the grammar itself do the explaining, precisely in how it treats the features (Marcel den Dikken, p.c.). A good case to examine is the following. Wiltschko (2008; 2014) aptly distinguishes between functional heads, her Units of Language (UoLs) and modifiers. Whereas we can stand by a conception of functional heads as consisting exclusively of formal features, modifiers might (also) encode concepts that are not necessarily encodable as features – work by Acedo-Matellán and Real-Puigdollers (2019) on classifiers might be relevant here.

Hence there is a difference between the workings of a Number (or similar) functional head (UoL) in Indo-European and the those of the optional Mandarin Chinese 'plurality' *men* modifier. These Wiltschko-style modifiers look a lot like pre-Fukui and Speas (1986) 'specifiers' and might turn out to be more than just 'adverbial' elements – see the claim in den Dikken (2019) that Person features inside nominal phrases are *always* located within such modifiers and never in the nominal spine / Extended Projection.

There are two ways to go about this. One is to say that number features do sit on a modifier like Mandarin Chinese *men*, but that they are inert: hence, they are semantic features. Alternatively, we can think of "plurality" on Chinese *men* on a par with Turkish gender: as a matter of 'lexical meaning', what Adger and Svenonius call "prototype-based meanings such as whatever distinguishes camels from reindeer or a joke from an insult". Given that no number features participate in any grammatical distinction, relation, or operation in Mandarin Chinese, based on (3) we need not posit a formal feature [Number] in Mandarin Chinese, just like we need not pose gender features for Turkish.

My point here is not to claim that modifiers can never host formal features (because den Dikken's account on Person features in nominal phrases seems to make a lot of sense) but to claim that in a grammatical framework where formal structures are matched with conceptual content late, (purely) *semantic features do not exist*. All matching of meaning with form is mediated via syntactic structures built on roots (Borer 2013a; 2013b; Panagiotidis 2020): not even the noun *cat* is an unstructured Saussurean sign (Marantz 1996; 1997). Actually, purely semantic features are a notational variant of meaning postulates dating from the sixties, a remainder of the classic but long discredited Katz-and-Fodor way of doing lexical semantics.

(6) Purely semantic features do not exist.

Moreover, the only kind of Saussurean encoding that exists in natural language, that is the only kind of matching of signifiers to signifieds without structure (cf. Borer 2013a), is that of formal features:

(7) Formal features are the only (unstructured) Saussurean signs in natural language.[4]

Indeed, formal features are limited (to discrete pre-human, possibly visually accessible, concepts) and they are also ancient (Nóbrega and Miyagawa 2015; Nóbrega 2018). More specifically, features are the only Saussurean signs in that they match a signifier and a signified without the mediation of structure. Features have a signifier in the sense of that

[4] Adger and Svenonius (2011, 15) are the first (to my knowledge) to look at features as Saussurean signs: "A given feature might consistently spell out in one way or another […].This simply reflects the usual Saussurean arbitrary pairing of phonological content with syntactic and/or semantic content."

they must be *somehow* be expressed, indirectly most of the time. This abstract signifier is combined with a signified which comes from a limited number of featurable concepts.

If, as Sauerland (2008) argues, semantic markedness of features is a thing, one distinct from morphological markedness, this would be exactly a property of features as signifieds; at the same time, morphological markedness would be a characteristic of features as signifiers. Again, such a signifier should be understood in the most abstract way possible, given that it is hardly ever the case that features are directly expressed via some phonological representation. Concerning features, a signifier can be conceived not as a form but as the *potential* for form.

4. Interlude

If semantic features do not exist and most denotation is 'lexically' mediated, i.e. via roots (Panagiotidis 2020) after structures are matched with Encyclopedia entries, we only need consider formal features in any Theory of Features.

In doing so we can felicitously combat the Boeckxian (Boeckx 2015) anxiety towards coming up with a theory of features that involves a messy repertory of too many members (e.g. the infamous [±married] feature of the Katz and Fodor era, and so on). We can also establish a clearer distinction of what goes to functional heads, i.e. only formal features according to (5), and what *must* be relegated to modifiers. Finally, we can have concrete expectations of what kinds of feature systems will never be assembled by acquirers.

It then turns out that a choice to exclude semantic features from a Theory of Features, initially made for methodological reasons, would end up reflecting substance, i.e. the actual inexistence of purely semantic features.

5. Sketching the Theory: answering the four questions

Let us now venture into *beginning* to answer the four questions framed and elaborated upon in Section 3. The discussion below is only a rough sketch of an emerging Theory of Features.

I. What are formal features?
II. What is the correct *formalism* for them?
III. Why particular concepts are encoded, or rather: are *encodable*, as formal features (e.g. mass / number) and others are not (e.g. colour / brightness)?
IV. How do formal features combine into functional elements (e.g. Indo-European number); are they relevant in the case of 'modifiers' (e.g. Mandarin *men* plurals)?

5.1. Formal features are (the only) Saussurean signs

Language, as discussed already in Section 3.1, is doubly articulated. The substance of the phonological articulation is phonological features: abstract instructions to the Articulatory-

Perceptual systems. Formal features are the only Saussurean signs in natural language, as in (7): they connect concepts with some *abstract formal realisation*. Crucially, unlike everything else in language, signification in the case of formal features is not mediated by structure, recall Section 3.4.

Beginning with simple cases, a [neg] feature has a signified, the logical operator ¬, and an abstract signifier, the realisation of which is down to the choice of exponents at Morphology. Crucially, a formal feature will *have* to be realised somehow, the vagaries of morphological Impoverishment, syncretism and/or feature deletion notwithstanding (Halle 1997; Calabrese 2008; Harley 2008 among others).

Something like a [Q] feature has a signified, the illocutionary Force of question, and in languages without Q-morphemes its signifier is the external Merge this feature might force, or the Agree relation it will establish, or similar.

What needs be stressed is that, in its idealised version, the following statement holds

(8) The signifier of formal features is realised i) as (part of) an exponence or ii) via a grammatical relation and/or operation.

Purely semantic features, as already claimed in (6), do not exist. If a feature with a signified has no signifier, it simply isn't there. There is nothing making manifest a feature [-married] on words such as *bachelor* or the horrid *spinster*; therefore there exists no feature [±married]. These are matters of lexical semantics, and meaning postulates are not features.

Recall that the account here, unlike the one sketched in Zeijlstra (2008) is flexible enough to allow us to differentiate between semantic gender in English as the result of a formal feature and lexical gender distinctions in a language like Turkish. In English, gender distinctions are marked on a functional head that creates pronouns, restricting their reference (Heim 2008), whereas in Turkish no gender distinctions are marked on any functional element.

Of course both English and Turkish possess a wealth of lexical items making gender distinctions; in Turkish they definitely are a matter of lexical knowledge, lexical semantics, the male-female distinction being in this case identical to "whatever distinguishes camels from reindeer or a joke from an insult" (Adger and Svenonius 2011, 18).[5] Similarly, Korean honorific features exist, they are formal features, in English honorification is a matter of lexical choice and lexical semantics, ultimately aboyt picking between different Encyclopedia items.

[5] The same distinctions on nouns in English (e.g. *actor-actress*, *duke-duchess*, *poet-poetess*) might or might not involve the semantic gender features made manifest on functional heads.

The division of labour regarding signification in natural language proceeds like this:

(9) A limited number of concepts are featurable, i.e. they can be directly expressed as formal features, every other concept will have to be signified by a structure involving (a) root(s).

Hence

(10) The range of concepts that are featurable gives us the range of the possible formal features in natural language.

Notice again that the statement in (10) is neutral between the idea that there exists a UG inventory of formal features and the emergentist approach reviewed in Section 3.3. I am nevertheless ready to explore the idea that the range of featurable concepts, hence the repertory of (possible) formal features, is restricted by Emonds' conjecture in (4). It is of course a matter empirical enquiry whether his (somewhat confusingly) so-called *Lexical Labelling* is accurate and whether it can be made to accommodate the Roberts and Roussou insight in Section 3.3 that formal features (also) encode logical elements.

What I am convinced about is that concepts serving as signifieds of formal features must definitely *predate the emergence of language in the species* (Emonds 2011; Nóbrega and Miyagawa 2015; Nóbrega 2018; Golston 2018; 2019a; 2019b). Coming to think about it, there is no alternative to this particular constraint on the concepts formal features may encode, unless of course one would be ready to assume that language is still evolving in quite significant ways.

The above should begin addressing I. and III. of our four questions.

5.2. Cataloguing formal features

On an empirical front, the best way to decide on the scope and validity of Emonds' conjecture in (4) is to carry out typological work that will do at least the following:

(11) How to compile an inventory of formal features
   a. List all and only the concepts that are encoded as formal features.
   b. Decide on feature-based versus structure-based interpretations.
   c. Let the grammar do the explaining: follow a careful, theoretically informed algorithm.

First we need of course to list all the concepts expressed as formal features cross-linguistically. This work will have to be carried out under the restrictive definition of formal features encapsulated in (3) and motivated throughout sections 3.4 and 5.1: namely listing only those features in a particular language that are "involved in inflectional paradigms, or trigger syntactic movement or agreement, or play some other demonstrably formal role"

(Cowper and Hall 2014, 146). In the light of (6), i.e. the inexistence of purely semantic features, one should e.g. count in [animacy] in Spanish but count [number] out in Mandarin Chinese, and so on. Moreover, given that we expect functional heads to be composed exclusively of formal features, as per (5), one could use Cinque (1999; 2006; 2013), Cinque and Rizzi (2010), and similar kinds of work as a starting point, even if we do not necessarily subscribe to strict cartographic approaches.

Second, now with reference to point b. in (11), one should remain mindful, as hinted in sections 1 and 3.4, of the inevitable analytical tensions between competing feature-based and structure-based explanations of phenomena. My personal feel is that, all other things being equal, structure-based explanations of phenomena win. Features are not to be proliferated *praeter necessitatem*.

To give but a rough example of this tension: do we really need (at least one) [Focus] feature in all languages? Even when we narrow down our sample to those languages that unambiguously express focus grammatically, is it always the case that we need to posit [Focus] features in them? Would it not be the case that in at least some languages a focus interpretation is the result of an A'-movement operation that might be otherwise motivated, i.e. not because of a purported [Focus] feature? A case in point would be V2, about which Biberauer and Roberts (2015, 16) note that its simplest analysis "requires the acquirer to postulate only a single left-peripheral head which is not specifically associated with formal features like [topic] or [focus]".

Third, "letting the grammar do the explaining" involves not only being consistent with the Theory of Features sketched here (or any other), but also making theoretical and methodological commitments and keeping them. This is more than a possibly vapid call for consistency or even for avoiding eclecticism, and it is more about having a solid theoretically informed method. I will briefly present here three such methods which I consider very promising.[6]

The first example is Ramchand and Svenonius' (2014) method of investigating English auxiliaries. In their drive to take advantage of the syntactic maps drawn out by proponents of the cartographic approach, while keeping an eye on the disparate origin of various constraints (a path explicitly followed by Biberauer 2019), they lay out the ingredients of their account:

(12) *The Ramchand and Svenonius (2014) analytical ingredients:*
   a. A Cartographic contribution—the ordering of syntactic nodes in the (conceptually grounded) functional sequence, for example giving us the order of T_{PERF} over V_{EVT} (Perf over Prog).

[6] My presentation of these three methods is as far as I am going to go in these notes towards probing question IV, namely "how formal features combine into functional elements".

b. A selectional contribution—for example the selection of Asp*$_{en}$ by T_{PERF}, rather than some other featural instantiation of Asp*.
c. A default rule for the spell out of heads in the eventive domain when those heads cannot be filled by raising. This gives us the illusion of *be* 'selecting' for the passive phrase and the progressive phrase.
d. A featural stipulation on English modals that they exist only in a morphological form that includes a Fin* feature, like the other tensed morphological forms. This needs to be a stipulation because it is an idiosyncratic fact about English (we give this real semantic content via world anchoring).

One might not agree with all the details of the account, or even the examples supplied in (12), but must definitely note that the "featural stipulation" comes last, once other factors at play have been considered. This tactics allows us to exhaust all other explanatory paths before actually positing formal features.

A second example comes from Wiltschko (2014). She begins by arguing against both a cartographically-inspired Universal Base Hypothesis and an 'anything goes' No Base approach, and goes on to argue for a Universal Spine Hypothesis (USH): four core functions must be satisfied by both clauses and nominal projections, but with considerable variability with respect to *which functional heads* (hence *features*) satisfy them.

These four core functions are deployed in clausal and nominal spines as domains of Classification, Point-of-View, Anchoring, and Linking. To give an example, while clausal Anchoring in English is taken care of by Tense, it is served by Person in Blackfoot, Location in Halkomelem, and Realis in Upper Austrian German (Wiltschko 2014, sec. 4.4). Wiltschko herself acknowledges (2014, chap. 8) that her USH can be used to make concrete claims about categorial repertories in different languages, thus about formal features, too. This program is further nunaced by a fundamental distinction between UoL's (functional heads) and modifiers (see also Section 3.4).

A third example, perhaps the most speculative and one that should be applied after something like the previous two has yielded results, is a taxonomic method suggested by Marcel den Dikken (p.c.). This method involves moving from partial formal feature inventories to potential feature geometries, the way Harley and Ritter (2002a; 2002b) did on ϕ-features of simplex pronouns. Once this is accomplished, then family relations among blocks of features could be traced and hopefully general feature patterns in different domains (e.g. ϕ, spatial, quantification, event, categorial, degree / scalar etc.) could be established.

For instance, it could well be the case that an identical 'point vs. stretch' pattern underlies number (singular vs. plural), space (point vs. path), events (points vs, episodes) etc. If this works out, questions like "what would be the counterpart of the gender system in other domains?" could then be asked. This way we could move to a more structured way of seeing

how different formal features fall into a potential feature system of sorts – as opposed to them being individual signs, as per (7). This could be true, i.e. it could be the case that feature taxonomies broader than those afforded by the [attribute:value] rendering are there, or it could be false: the matter is ultimately empirical.

This last issue however already invites discussion of the correct formalism of features.

5.3. On the correct formalism for formal features

Moving to question II. at the beginning of Section 5, I wish to reiterate the interim conclusion reached in In Section 3.2, namely that in an emergentist approach to the acquisition of features, formal features can be privative, equipollent or of the [attribute:value] sort, even in the same grammar and the same feature domain, e.g. the domain of ϕ features. At this point, the only way I can supplement that conclusion is to offer two somehow speculative points.

Adger and Svenonius (2011, 7) in their criticism of the privative feature formalism correctly point out that "in practice, feature classes are almost always assumed". This is so for the obvious reason that formal features cross-classify categories. Having said that, cross-classicisation is not always necessary within a particular grammar.

Suppose for instance that in some grammar there exist two equipollent person features, [±author] and [±participant], as in Halle (1997). Suppose also that, unlike what happens in Kiowa (Harbour 2007; 2011), there exists a privative [Atomic] feature: its presence is interpreted as 'singular', whereas its absence as 'plural'. Now, the feature being privative, we are not allowed, so to speak, to call it a 'Number' feature, because this immediately would impose an [attribute:value] format to it: [number:atomic]. Still, perhaps this does not matter in the particular grammar, provided that only a functional head – call it ϕ – can host these features and that it can host exactly three features: [±author], [±participant] and [Atomic]. Again, this is a fine statement provided that 'person' (i.e. [±author], [±participant]) and 'number' (i.e. [Atomic]) features are only present on this very ϕ head, a pronominal one presumably. No reference to an attribute [number] is necessary here.

This state of affairs would be reminiscent of semantic gender in English: whether we claim that English gender is expressed on a semantic gender head (Kramer 2009) as [masculine], [feminine] and nothing ('neuter', i.e. 'inanimate') is ceteris paribus a notational variant of claiming that it is expressed as [animate:masculine], [animate:feminine] and nothing. Perhaps it would make sense to go for the privative set [masculine], [feminine] and nothing, considering that gender is not marked elsewhere in English.

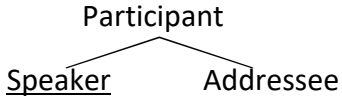
Going back to the ϕ head of our hypothetical grammar, the privative [Atomic] feature would have to be construed as [number:atomic] iff there is feature valuation involved: in this case it would contrast with [number:] (i.e. unvalued).[7] Therefore:

(13) Privative features can only be posited by the acquirer iff i) they do not cross-classify and ii) they never function as Agree Goals.

The second point is as follows. The restrictions regarding the syntactic activity of privative features seem unresolvable: once we posit an unvalued or an uninterpretable feature, a more complex formalism becomes necessary to express the feature that participates in the Agree relation, either an equipollent or an [attribute:value] one – see also footnote 7. Still, there is indeed a way to make privative features create feature classes, and that's no other than Harley and Ritter's (2002a; 2002b) feature hierarchy. Their feature-geometric analysis has undergone a lot of criticism (e.g. Harbour 2007; Nevins 2007), but it carries a potential advantage.

The feature-geometric account goes the opposite direction of what Adger (2010, 194–96) sees as a potential weakness of [attribute:value] systems: the possibility of such rich systems "allowing an entire category to be a possible value of another attribute", a weakness which he goes on to resolve invoking locality. In a feature hierarchy, all (privative) feature relations are local, locked together in dominance relations, which yield strict entailment relations. Consider for instance this fragment of the Harley-Ritter ϕ hierarchy:

(14)



As Harley and Ritter (2002a, 502) elaborate, the Person feature schema above offers the following options, not all of which are exploited in all languages:

- Participant vs. nothing (where 'nothing' will be interpreted as non-1st, given that Speaker is the default interpretation of the Participant node in this case)
- Participant (2nd) vs. Participant-Speaker (1st) vs. nothing (3rd)
- Participant (1st) vs. Participant-Addressee (2nd) vs. nothing (3rd)
- Participant (contrastive 1st) vs. Participant-Speaker (1st) vs. Participant-Addressee (2nd) vs. Participant-[Speaker Addressee] (1st inclusive) vs. nothing (3rd).

Details aside, we see how the feature geometric-approach could ultimately subsume an [attribute:value] system by essentially translating both attributes (e.g. Participant) and

[7] I am broadly following Adger and Svenonius (2011) here regarding unvalued features. Harbour (2007, 76–78) argues uninterpetability to result from a (bivalent) feature being valued both as + and -. Trivially, + and – can be construed as values of any given attribute, still leaving space for no value, i.e. unvaluedness (Adger 2010).

values (e.g. Addressee) into hierarchically arranged nodes.[8] This could be desirable if such hierarchical relations reflect the order of acquisition (e.g. the positing of features): Harley and Ritter (2002a, 499–501) already discuss this. Moreover, feature seeking algorithms like the one in Dresher (2014) can actually be mapped in feature-geometric terms, something that has already been acknowledged and implemented in the feature-positing algorithm of Biberauer, Holmberg, Roberts, and Sheehan (2014), Biberauer and Roberts (2015), Biberauer (2019) and elsewhere.

6. A provisional conclusion

There exist phonological features. These abstractly encode articulatory instructions. There also exist formal features, signs which abstractly encode a limited set of ancient concepts via grammar – as opposed to concepts realised via structures embedding roots. No other types of features exist.

Functional heads are composed exclusively of formal features. Formal features are probably emergent, acquired and not universally available in a UG inventory for the acquirer to pick from. However, the signifieds of formal features, i.e. the concepts that are 'featurable', are restricted by some general cognitive (i.e. UG-external) principle.

Formal features belong to families, therefore they can cross-classify categories. The correct formalism for features should capture their cross-classifying function, but perhaps it should be flexible enough to accommodate privativity when no such function is in place.

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[8] The equalisation of first-order and second-order features, i.e. of attributes and values (Adger 2010), could also accommodate defaults and markedness in individual grammars: the default interpretation of dominating nodes would be the unmarked one (cf. Sauerland 2008).

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