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), in their review of the history of attempts to come up with a theory of formal features. In said review they dedicate some space to Muysken and van Riemsdijk (1986), who in turn lay down the fundamental desiderata of a proper Theory of Features:

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

Unlike HPSG or CG theories of features, extant and/or possible ones, a minimalist theory of features would have to be founded upon 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]

Consequently, beginning to address the 'how many' question in (1), the features posited will have to abide by expectations of psychological reality. This requirement is hardly obvious: features should not be conceived either as mere diacritics ('flags') for particular structural relations or as the shorthand of particular structural operations. Following this tenet probably entails 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 be independently motivated. Independent motivation amounts to their serving as instructions to the C-I interface. Thus,

(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 to which I will return 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. On the other hand, 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 *both* to reflect some sort of concept (in the broadest sense) relevant to the C-I interface *and* play a role in grammatical computation (in the narrow sense). So, indispensably:

(3) Formal features must be motivated as involved in grammatical operations and representations in the narrow sense.

The statements in (2) and in (3) taken together amount to that 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

[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. We revisit these in Section 6.2.

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 Internal Merge) but could not be construed as an instruction relevant to the C-I interface: [Y] is not a good candidate for a formal feature. Finally, a feature [Z] could be understood to encode instructions for the C-I systems but at the same time it is inert grammatically: to wit, it is not contrastively marked on functional elements, it is does not trigger grammatical operations, and it is not active in any Agree relations: should such a feature exist, [Z] is not a good candidate for a formal feature.

Summarising:

(4) Formal features will have to be motivated *both* as interface instructions *and* as playing a role in grammatical relations and operations.

The above is the strict scenario but it does make room for the workings of uninterpretable and unvalued features, which I will briefly review in section 6.2 – see also footnote 1.

2. The primacy of formal features

Once we have established formal features both as instructions to the C-I interface and as being "active", i.e. involved in grammatical computation, we then must sharply distinguish them 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]

[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."

What then 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" (Adger and Svenonius 2011, 18). More curtly, we must at least distinguish lexical semantics (feature-based or not) from formal features and our theory thereof.

In the light of the clarifications in the above quotes, we can now elaborate on (4) in a more precise way. Thus, an example of the formal-semantic distinction would be gender. We know that Slavic possesses grammatical gender features because these are involved in concord and agreement phenomena: indeed, such features are "active" in that play a role in grammatical relations and operations: Slavic grammars refer 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 English semantic gender a bona fide *formal* feature: if it is marked on functional heads, then it matters for grammar.

At the same time, we can nevertheless safely claim that Turkish makes *no* use of *formal* 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'). This is of course no novel line of argument, Corbett (1991, 146–47) has already stressed the importance of "agreement", precisely in establishing a gender category. Now, whether Turkish distinctions reflecting biological and social gender, certainly 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 (4), 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

As already stated in (1), 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?". These can be formulated as the following four questions 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)?

In the rest of this section these four questions are elaborated upon and placed into context.

3.1. What

Formal features in (4) 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 already 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. that 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):

(5) Whatever is driving grammatical operations is expressible in non-phonological terms; moreover, morphological and syntactic relations are expressible in non-phonological terms.

Building on the above observations, in their weakest formulation, we can return to (4) and claim that formal features are *about* semantic interpretation. As per (4), 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).

So, 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 and acquired by paying attention to such 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 *some* 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 both 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): language is organised i) at a non-signifying phonological level (what we now understand to involve its externalisation) and ii) at a signifying level (what we now understand to be FLN: the Faculty of Language in the Narrow sense).

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: formal features are about 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 matter in Section 3.3.

3.2. Privative, equipollent, or else?

The actual *form* of features is a more or less unresolved matter. The 'form of features' must here be understood here in a rather abstract sense: as their format, i.e. what the *internal* structure of features would look like (Adger and Harbour 2008; Adger 2010; Adger and Svenonius 2011). There are roughly speaking three options: features are either *privative*, i.e. completely unstructured, *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).

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

Adger and Svenonius (2011) successfully discuss the limitations of privative feature systems in establishing natural classes, 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. In doing so he also explores and dismisses a notational variant of privativity that he calls the *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. This of course sounds like a rather permissive stance but Cowper and Hall (2014) have very convincingly shown that the actual form of features is definitely not a matter resolved by Universal Grammar: there is no UG-constrained formal feature format along the lines of 'privative', 'equipollent' or '[attribute:value]'. Recalling Chomsky (2005), this entails that the actual form of features would perhaps originate in general design principles: such a task would be interesting to undertake but given the various coding (or similar) formats available to complex biological systems, a daunting one. This leaves us with the environment: the format of formal features is one that optimally accommodate the grammar-specific data.

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. In language after language we encounter the same conceptual categories both organising grammatical categories and being implicated in grammatical operations – despite the most candid attempts at exoticisation in some grammatical descriptions. These conceptual categories include but are certainly not restricted to Animacy, Individuation, Definiteness, Quantification, Transitivity, Aspect, Tense, Mood, Finiteness, Illocutionary Force and so on.

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 cognitively significant concepts like ''worry'', ''peril'', ''fear'', ''hunger'', ''love'', ''death'', ''awe of god'', etc."

Even the above remark should be enough to dismiss typical blasé statements that formal features encode 'cognitively salient' categories and leaving the issue at that: 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 quasi-systematic 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 (in optatives) over that of fear, of failure (in frustratives) over that of shame (Cinque 2013, 51), those of honorification 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 expressed as formal features: for instance, we expect conjunction and negation to be universal for rather obvious reasons, it also looks like they are expressed by way of formal features in all natural

languages.[4] Still, claiming that formal features are about categories "such as quantification, negation, gradability, boundedness, telicity, plurality" etc. is problematic in two ways:

First, it is circular. Categories "such as quantification, negation, gradability, boundedness, telicity, plurality" (and not others) are "part of this system" (i.e. Semantics) 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".

This brings us to the second problem. Indeed it is true that formal features like those underlying quantificational elements as well as those involved in individuation, modals, negation, and even Tense and Aspect are "restricted to logical meanings". 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: there are concepts encodable as formal features that can hardly be construed as "purely logical".

(6) Not all formal features encode 'logical' (i.e. narrow semantic) concepts.

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. These observations already exclude the grammaticalisation of *all* artefact and exclusively human social organisation concepts, but also of the successor function (ibid., 56-7).

Having said that, 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".

[4] Grammatically speaking there is always the option that, say conjunction, could be expressed with purely lexical means in a language. See Mitrović (2014) for a panorama of how conjunction may be expressed cross-linguistically, one that however does not seem to include purely lexical means.

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):

(7) "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 departure point for understanding what restricts the possible repertory of formal features. This departure point 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). Our Theory of Features will have to 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 online from formal features available in the numeration, a la Hegarty (2005).

(8) 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: it is a structural relation 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 – this is definitely so if modifiers are (sometimes) syntactically complex themselves.[5]

Hence there is a difference between the workings of a Number (or similar) functional head (UoL) in Indo-European and 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 would be 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 (4) we need not posit a formal feature [Number] in Mandarin Chinese, just like we need not pose gender features for Turkish.

3.5. Semantic features are superfluous

As already pointed out, far from claiming that modifiers can never host formal features, I wish to posit that in a grammatical framework where formal structures are matched with conceptual content late, (purely) *semantic features do not exist*.

In more detail, in separationist-realisational frameworks of grammar (Ralli 1988; Beard 1995; Halle and Marantz 1993; Harley and Noyer 1999 and elsewhere), all semantic

[5] Work by Acedo-Matellán and Real-Puigdollers (2014; 2019) on classifiers might be relevant here.

interpretation takes place at the interface between the combinatorial system, the grammar, and C-I systems, i.e. the interface that was also known as Logical Form (LF). More specifically, all matching of meaning with form is mediated via syntactic structures built around roots (Borer 2013a; 2013b; Panagiotidis 2020): not even the noun *cat* is an unstructured Saussurean sign (Marantz 1996; 1997). Of course, here we have the kind of rich conceptual meaning in mind that e.g. "distinguishes camels from reindeer or a joke from an insult" (Adger and Svenonius 2011, 18), what can perhaps still be loosely called 'lexical meaning'.

Semantic features that, unlike formal features, are grammatically inert were construed in order to decompose said 'lexical meaning' into primitives. So, these features were invoked upon in order to do lexical semantics, originating in Katz and Fodor (1963). Famously, *bachelor* would be decomposed into [+male] [-married]. This way of doing lexical semantics has long been superseded, but the idea that particular concepts are expressible in terms of grammatically inert features, i.e. semantic features, has persisted until today. In reality, those purely semantic features are nothing but a notational variant of meaning postulates; methodologically they are a remainder of that classic but obsolete way of doing lexical semantics.

Consider again the state of gender in Turkish: clearly there are female and male concepts expressed on lexical nouns, i.e. *n*P structures built around roots, but there is no evidence of a (grammatically) active gender feature. For instance, all pronouns are gender-neutral, including *o*(*n*) ('she / he') and *kendi* (a version of a *se*-anaphor). Do we need to posit a purely semantic (i.e. non-formal) gender feature in Turkish? Just like with the so-called 'plurality' of *men* in Mandarin Chinese, the answer is negative: all that has to do with masculinity, femininity etc. is retrieved in the Encyclopedia once a suitable structure built around a root reaches the relevant interface. This forces us to think that semantic features, grammatically inert instructions to semantics, are superfluous, therefore inexistent:

(9) Purely semantic features do not exist.

A fortiori, 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:

(10) Formal features are the only unstructured Saussurean signs in natural language.[6]

Here, 'unstructured' must be understood as "not involving structures built by the grammatical combinatorial system": it is not a statement about the format of features

[6] 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."

themselves, discussed in sections 3.2 and 5.3. A consequence of the inexistence of purely semantic features is that the 'signifieds' of features in general are those of *formal* features: they are limited (to discrete pre-human, possibly visually accessible, concepts) and they are also ancient (Nóbrega and Miyagawa 2015; Nóbrega 2018).

More specifically, (formal) features are the only Saussurean signs in language, in that they match a signifier and a signified without the mediation of grammatical structure. Now, features have a signifier in the sense of that they must be *somehow* be expressed, indirectly most of the time. As mentioned above, 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 concrete form but as the *potential* for form.

4. Interlude: why ridding ourselves of inert semantic features goes a long way

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 (8), 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. Some issues falling out of it are briefly touched upon, others will surely remain unaddressed at this very early stage. Recall that the questions we posed are the following:

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. Thus, phonological features are the elements that phonological processes manipulate.

Formal features concern the signifying level of articulation of language. Formal features are the only Saussurean signs in natural language, as in (10): they directly connect particular concepts with some *abstract formal realisation*. Crucially, unlike everything else in language, signification in the case of formal features is not mediated by syntactic structure, recall Section 3.5. Thus, formal features are the elements that syntactic processes manipulate.

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).

Moving on to something like a [Q] feature, this one is made of 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

(11) 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 (9), do not exist. If a feature with a signified has no abstract signifier, it simply is not there. There is nothing making manifest a feature [-married] on words such as *bachelor* or the horrid *spinster*; therefore there exists no feature [±married]. The semantic interpretation of contentful ('lexical') structures in language are a matter of lexical semantics, and meaning postulates are not features. Moreover, as noted in 3.5, contentful structures are built around a root.

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, a formal feature also restricting their reference (Heim 2008), whereas in Turkish no gender distinctions are marked on any functional element and these are a matter of lexical semantics of contentful structures meaning 'man', 'woman', and the like.

This, although 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, with 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).[7] Similarly, although Korean honorific features exist, and they are formal features, in English honorification is a matter of lexical choice and lexical semantics, ultimately about picking between different Encyclopedia items.

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

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

Hence

(13) 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 (13) 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 something like Emonds' conjecture in (7). 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.

[7] 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 above should begin addressing I. and III. of our four questions.

5.2. Cataloguing formal features

On the empirical front, the best way to decide on the scope and validity of Emonds' conjecture in (7) is to carry out in-depth typological work that will do at least the following:

(14) *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 (4) and motivated throughout sections 3.4 and 5.1. We must be careful to list 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 (9), 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 (8), 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.[8]

Second, now with reference to point b. in (14), 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 grammatical phenomena. My personal feel is that, all other things being equal, structure-based explanations of phenomena trump feature based ones. Features are not to be proliferated *praeter necessitatem*.

To give but a rough example of this tension, one mentioned earlier: 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

[8] We will however have to be very careful when admitting evidence exclusively from adverbs as making manifest a formal feature in a particular grammar. The cartographic heuristic procession 'adverb → functional specifier → dedicated functional head → distinctive formal feature' in Cinque (1999; 2006; 2013), Cinque and Rizzi (2010), and elsewhere *cannot be taken at face value* – not always, at least.

"requires the acquirer to postulate only a single left-peripheral head which is not specifically associated with formal features like [topic] or [focus]".

Third, and related to the V2 example above, "letting the grammar do the explaining" involves not only being consistent with the Theory of Features sketched here (or any other), but also both making theoretical and methodological commitments and keeping them. This is more than just 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 promising.[9]

The first example is Ramchand and Svenonius' (2014) method of investigating English auxiliaries: the order of auxiliaries and the interactions among them. 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:

(15) *The Ramchand and Svenonius (2014) analytical steps:*
   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).
   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 with the examples supplied in (15), but must definitely note that the "featural stipulation" comes last, once other factors at play have been considered. This tactic 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). According to her USH, four core functions must be satisfied by both clauses and nominal projections, allowing

[9] 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".

at the same time for considerable variability with respect to *which functional heads* (hence *features*) satisfy these functions.

These four core functions are deployed in clausal and nominal spines as domains of Classification, Point-of-View, Anchoring, and Linking. These functions can be served by different functional heads (and features). Exemplifying with reference to clausal Anchoring, Wiltschko argues that this core function in English is taken care of by Tense, whereas it is served by Person in Blackfoot, by Location in Halkomelem, and by 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 programme is further nuanced 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 perhaps be applied only after something like the previous two methods have 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 identified and 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, tough questions like "what would be the counterpart of the gender system in other domains?" could then be asked. This way we could move towards 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 we have tacitly assumed so far.

If the above method works, it would lead to positing general feature patterns in different domains, a *formal feature system*: it could consequently be the case that feature taxonomies broader than those afforded by the [attribute:value] rendering are in place. Of course it well be the case that no such system or systems exist and that only individual formal features exist: 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 within 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-classification 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, namely the [number:atomic] one. Still, perhaps this restriction privativity imposes may not matter in the particular grammar, provided that only one functional head – call it ϕ – can host these features and that it can host exactly three features: [±author], [±participant] and [Atomic]. In this case, no reference to an attribute [number] is necessary here, 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.

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 anywhere else in English: the presence of a privative [masculine] or [feminine] feature would entail animacy.

Going back to the ϕ head of our hypothetical grammar, the privative [Atomic] feature would have to be construed as [number:atomic] if and only if there is feature valuation involved somewhere in the grammar: in this case, and only in this, [number:atomic] would now contrast with [number:] (i.e. the unvalued version).[10] Therefore:

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

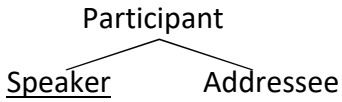
The second point is as follows. The restrictions regarding the syntactic activity of privative features seem unresolvable: once we posit an unvalued or an uninterpretable feature, a

[10] 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).

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 10. Still, there is indeed a way to make privative features create feature classes, and that is 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. Now, 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:

(17)



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 values (e.g. Addressee) into hierarchically arranged nodes.[11] 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.

[11] 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).

6. Two consequence of the proposed Theory of Features sketch

6.1. The root-derivational affix contrast in a world without purely semantic features

If we go by the hypothesis in (2) and (10), namely that formal features encode concepts of a particular sort, and if (9) is indeed the case, i.e. that grammatically inert semantic features do not exist, then we are faced with potential problems regarding the explanations available for particular empirical phenomena. One of these problems is what we are supposed to do with derivational affixes. Derivational affixes are typically understood as pure feature structures, which may attach to root structures or categorised structures such as *n*Ps (nouns), *v*Ps (verbs), adjectives (cf. Fabb 1988). Such structures are in practice assumed to comprise both formal features and inert semantic features.

Looking at suffixes like Portuguese *-eiro*, Greek *–(a)tz-* or the semantically rich affixes in Bella Coola (examples from Haspelmath and Sims 2010, 19–22, where there is some discussion of such affixes), one is faced with elements that appear to bear quite complex and/or concrete meanings: their interpretations look like those of nouns, although they are all clearly affixal. Thus, Portuguese *-eiro* means 'tree', with *pinheiro* being the word for 'pine tree', Greek *–(a)tz-* means 'profession' (at least in older dialects), with *pagot-atz-is* being the word for 'ice cream seller', whereas Bella Coola contains affixes such as *-lst* ('rock'), *-lik* ('body'), *-altwa* ('sky, weather'), *-an* ('ear'), *-uc* ('mouth') – and so on.

In a system where pretty much any concept can be fetched by a 'semantic feature', it is easy to capture the above: *-eiro* bears a semantic [tree] feature, *–(a)tz-* a [profession] feature, *-lst* a [rock] feature, *-uc* a [mouth] one. Inert semantic features are the answer to the rich content of some derivational affixes, i.e. of morphologically bound elements that are seemingly composed exclusively out of features, and not structures built around a root.

It is of course the wrong answer, because semantic features do not exist. What we are dealing with in affixes like those sampled above is obviously rich lexical meaning, as these derivational affixes pretty ostensibly encode nominal concepts (Acquaviva 2014). Even setting aside the (in)existence of semantic features, the issue of what the *syntactic* status of derivational affixes would be is a broader one.

This is an important question to ask because "affix" is a morphological analytical category that describes how a morpheme combines with other morphemes and "derivational" describes its morphological function (roughly, 'word making'). Identifying an element as a "derivational affix" reveals hardly anything about what structures these affixes are and what features they are made of. Being content with pretheoretically contrasting them with inflectional affixes is not enough, even if we somehow get our theory (correctly, I think) to understand inflectional affixes as exponents of functional heads.

It has of course been noted before that distinguishing between roots and derivational affixes is not always a straightforward matter. Panagiotidis (2014, 297–98) cites an empirical point raised by Pullum (2010) who considers "the endings of the words [such as] *–like*, *–esque*, *–ward*, *–proof*, *– (a)thon*, […] *–ism*, […] *–(o)phile*, *–(i)licious*, and *–gasm*". Pullum goes on to make the theoretical judgment "that only *–like*, *–esque*, *–ward*, and *–ism* should be called suffixes", with the rest of them roots. Panagiotidis in the above quote sides with Pullum in that "even an apparently easy question, such as whether an element like *–proof* is a root or an affix, must be decided on principled theoretical grounds" (ibid. 2014, 298).

Now, of course there are well articulated accounts casting *all* derivational affixes as roots, including those in De Belder (2011), Lowenstamm (2014), and Acedo-Matellán and Real-Puigdollers (2014). I agree with the above that all contentful derivational affixes are indeed roots, as also implied in Pullum's short treatment, including the examples from Portuguese, Greek, and Bella Coola presented at the beginning of this section, and also Pullum's *-proof*, *-(a)thon*, *-ism*, *-(o)phile*, *-(i)licious*, and *-gasm*.

The whole issue actually boils down to a choice between these elements being roots (or structures containing roots) and to positing inert semantic features fetching whatever the meaning(s) of *-ism* would be, or fetching a complex notion of 'loving something' as in *franco-phile*, *biblio-phile* etc. – even setting aside any nefarious connotations some of the nouns derived from it might have. At the end of the day, we have to choose between i) lexical meaning being expressible only by root-based structures and ii) inert semantic features that can fetch any kind of (nominal) concept. If the latter were the case, one would wonder why it is not the case that all (nominal) concepts can be encoded as inert semantic features.

Would the above entail that *all* derivational affixes are roots? Not necessarily, given that the analytical category 'derivational affix' is morphophonological, not syntactic: it has to do with their realisation and exponence, not with their structure. If only formal features exist, then we would expect that pure feature structures that surface as derivational affixes should also exist. A possible candidate for this is English *-ness* / *-ity*: it selects adjectives and yields nouns, usually of a very abstract sort. I think this suggests that it is an exponent of the nominaliser *n*, along with *-th* and, perhaps, the likes of *-ment*. Affixes like *-ize* would realise a special verbaliser *n,* one that bears a [causation] formal feature, independently motivated for English, next to a categorial feature [V].

If the 'menagerie' below, adapted from Panagiotidis (2011, 381), is anything to go by, derivational affixes could therefore belong to any of the four elements predicted below.

(18) *The elements of grammar*

	made of	*categorial status*	*includes*	*examples*

categorisers	formal features	[N] or [V]	*n*, *v*	*–ment*, *–th*
functional heads	formal features	uninterpretable [N] or [V]	Voice, Asp, T, C, D, Num…	*–ing*, *to*, *will*, *if*, *the*, *–s*
subcategorial elements / "inner morphemes"	formal features	categoryless	particles, low applicatives,, low causatives…	*–ee*, *de–*, *up*, *in*
roots	?	categoryless	roots	CAT, WORK, KTB

They could be roots (De Belder 2011; Lowenstamm 2014; and even a version of Acedo-Matellán and Real-Puigdollers 2014; 2019) or complex structures containing roots. In this case they can encode rich meanings, well beyond the limited language-specific repertory drawn from the pool of featurable concepts – recall (12). Derivational affixes could also be subcategorial feature structures (Marantz 2000; 2005; 2006; Pylkkänen 2008), made of formal features only and typically contributing to idiosyncratic interpretation due to their close affinity to roots before categorisation (Panagiotidis 2011; 2015, 67–70 and elsewhere). Some potential examples of derivational affixes being 'rich' categorisers, i.e. bearing more formal features than just the categorial one, have been mentioned above. Finally, they could also be bona fide functional heads, a suspicion that has already been around at least since Spencer (Spencer 1991; 2000).

6.2. Are all formal features instructions to the C-I systems?

It is now time to turn to a more challenging matter. If we are serious about the statement in (10), namely that formal features are signs, or even the statement in (4), regarding the conceptual motivation of formal features, we are facing the following question: what kind of signified, what kind of concept (let alone a prehuman one, as suggested in (7)) is there for structural Case features and for grammatical Gender features? What are we to make of classificatory morphological features such as declension and conjugation class features? Let us begin with the seemingly easier cases.

Case features

Agree for Case has already been argued to involve pairs of uninterpretable features that cancel each other (Chomsky 1995; 2000). This would entail that Case features are by definition without a signifier: no concept would be involved in Case. This is in principle not a problem for formal features *as a class*, because of the existence of Agree: i.e. an operation that

- either values versions of formal features, when the Goal for the Agree operation is unvalued, or
- renders them inaccessible ('checks them' or 'erases' them) for the C-I interface, when the Goal for the Agree operation is uninterpretable.

Still, if the Goal Case feature is valued but uninterpretable (e.g. [Case:nominative]) and the Probe Case feature is unvalued (e.g. [Case:]), then clearly neither of them is a sign in the sense of (10): neither is interpreted. This stands in contrast with a simple case of concord as in *these dogs*, where the unvalued Number feature of the demonstrative *these* probes the interpretable Goal (a plural feature, say on Num), gets valued via Agree, and is erased for the purposes of the C-I systems: the interpretable plural feature on Num is genuinely interpretable, a sign.

A way to solve this puzzle is to argue along with Pesetsky and Torrego (2001; 2004) that there is no dedicated Case feature: instead, Case on nominals is nothing but an uninterpretable version of a Tense feature.[12] This would render Case unexceptional.

Class features

A more serious problem for formal features as signs, i.e. as always signifying some concept, is class features, such as declension (for nominal paradigms) and conjugation (for verbal paradigms) class features. These seem to be grammar-internal flags that regulate which nominal or verbal (or even adjectival, e.g. in languages like Greek) paradigm a root will be categorised into. Russian is famous for how it arranges nouns into declension classes, whereas most students of classics still remember that a Latin root like AM will be verbalised as belonging to the first conjugation, yielding *ama-re* ('to love'), whereas a root like DEL will be verbalised as belonging to the second conjugation, yielding *delē-re* ('to destroy').

Alexiadou and Müller (2008) provide an account which exploits Agree in order to cast class features as Probes for it. These agree relations bring about inflectional classes in synthetic (or 'fusional') languages. Their system is elegant and has the advantage of incorporating the workings of class features into those of Agree. However, the problem encountered with Case is also present here: class feature Goals have no possible interpretation, their sole purpose would be to create morphological classes, a matter of grammar-internal classification. Class features display all three problems for a principled feature theory: a) they are certainly not instructions to the C-I interface, b) they regulate a grammar-internal affair – or rather: a matter relevant for externalisation, and, as a consequence of this, c) they are not reducible to something else, like Case most likely is.

[12] Pesetsky and Torrego argue both nominative and accusative to be uninterpretable Tense features. A more nuanced system, also accommodating the ergative-absolutive distinction is offered by Alexiadou (2001, chap. 5; 2003), where nominative is related with T and accusative with v.

It is possible that, when it comes to class features, we are better off without them, not just because they do not fit this sketch of a Theory of Features (or most, for that matter), but because inflectional class membership seems to be a much more complex affair. I will not go deep into this arduous matter at this point, but I will restrict myself to presenting a case where the choice of exponent interacts with the actual interpretation of verbs derived from the same root, suggesting that there might be more involved in class membership than meets the eye:

Spyropoulos, Revithiadou and Panagiotidis (2015) and Panagiotidis, Spyropoulos and Revithiadou (2017) make the case for several forms in the verbal system of Modern Greek (belonging to both major declension classes) as realising solely and exclusively the verbaliser *v*, to the exclusion of Voice, causativity, Aktionsart and so on. What is of interest for us here is particular sets of verbs that are derived from the same root and the same *v*, but with different interpretations, these interpretations being somehow correlated with the different *exponents* of the same *v* head (from Panagiotidis, Spyropoulos, and Revithiadou 2017, 46):

(19) Same root, same *v*, different realisations of *v* → different meanings

a.	kur-év-o	'I give a haircut, shear'
	kur-áz-o	'I tire/am tiresome'
	kur-ár-o	'I treat as a patient'
b.	mir-ón-o	'I anoint'
	mir-íz-o	'I smell'
c.	fort-ón-o	'I load/burden'
	fort-íz-o	'I charge (e.g., a battery)'

Given that no inflectional or any other formal features are involved in the differences between the verbs in the first triplet and the two pairs above, it is anyone's guess what kind of mechanism is involved in Greek and other synthetic languages when it comes to matching identical structures with different concepts on the basis of a difference in the exponence of a morpheme, i.e. a difference in class.

We have hardly resolved the puzzle of grammar-internal features, such as class features; however examples like (19) might prove helpful in better understanding another class of formal features that does not seem to be motivated as instructions to the C-I systems.

Gender features

Grammatical gender is a very interesting category. Having already set aside gender distinctions as a facet of lexical meaning, and lexical semantics, in languages where gender is grammatically inert, we are still facing a very particular type of formal features.

We have already seen that gender as a formal feature may either be marked on functional heads, e.g. those involved in English pronouns like *she* and *he*, or participate in concord relations, as in Slavic. Gender is of course semantically motivated, encoding animacy, sex,

plant-animal distinctions, and even a separate class for deities and the like, as Corbett discusses in chapters 2 and 3 of his (1991) magisterial survey.

At the same time, gender features seem to play a second role, that of abstractly and arbitrarily classifying nouns. In that they resemble class features, yielding familiar arbitrary results such as the sun being masculine in French and feminine in German, churches being feminine and temples masculine in Italian, house walls being masculine and city walls neuter in Greek – and so on.

A way to resolve this is to split gender features into two subclasses: on the one hand we have *semantic* gender, which is about genuine instructions to the C-I interface and seems to be located on a separate semantic head (Picallo 2008; Kramer 2009; Merchant 2014, 18–19; Panagiotidis 2018). Semantic gender is actually crucial with non-descriptive nominals such as pronouns and quantifiers, providing restrictions to the set of possible referents (Heim 2008; Panagiotidis 2018).

On the other hand, we have *grammatical* gender features, those responsible both for creating noun-classes and for gendered suns, feminine churches and the like. These look like they are situated on the *n* head (Acquaviva 2009; Kramer 2015; Panagiotidis 2018, 194). Besides the arguments for situating gender on *n* in the references provided, one will only have to think of pairs like the masculine *libro* ('book') and *libra* ('pound') in Spanish: both bear grammatical gender only, and this feature is what actually distinguishes between two very different sets of instructions to the C-I interface: one about fetching a BOOK concept, another set about fetching a POUND concept. Would that enabling or distinctive function of grammatical gender on *n* suffice to motivate it as a subclass of formal features? The answer is no, if we take (2), (4), and (10) seriously: a grammatical gender feature hardly provides instructions to the interface with the C-I systems, less so as a sign.

So, what are we to do with these features, given that they clearly have nothing to do with interpretation? I have no answer to offer at this stage, only two speculations, so the weary reader may skip directly to the Conclusion.

The first point is exactly about the 'lexeme-creating' function of gender in *libro / libra* and the like. This reminds us of (19), where three different forms enable the [$_{vP}$ *v* KUR] structure to fetch three very different concepts: SHEAR / CUT HAIR, TIRE, CARE FOR A PATIENT. Would it be the case that yet undetected grammatical gender features for verbs are involved in the categorisation? Note that still such features would not abide by (2), (4), and (10), as they would only indirectly affect interpretation. If there are formal features that serve purely to distinguish between structures, then the theory must address them.[13]

[13] Acedo-Matellán and real-Puigdollers (2019, 420–26) seem to propose a similar feature, generalising it in order to capture all cases of the so-called 'root allosemy'; this does not seem to be necessary though (Panagiotidis 2020).

The second point is what Corbett (1991) repeatedly and emphatically stresses throughout his survey: all gender systems contain a semantic core, with e.g. feminine mothers and masculine brothers (when they are based on sex). What this tells us is that you might have purely semantic gender feature systems, including English, as well as Tamil, Kannada and other languages (Corbett 1991, 8–13), but you never ever get grammatical gender systems in the absence of semantic gender. This plainly tells us that grammatical gender, although encoded on *n* as a class-maker, is parasitic on semantic gender, encoded on a higher syntactic head and serving as a true Saussurean sign. The implications of this parasitic nature of grammatical gender on semantic gender must be explored further.[14]

7. (An inevitably provisional) Conclusion

There exist phonological features. These abstractly encode articulatory instructions. There also exist formal features, signs which abstractly encode a limited set of pre-human concepts via grammar – as opposed to concepts realised via structures embedding roots. No other types of features exist, most notably: no grammar internal features and no grammatically inert semantic features.

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

Derivational affixes may belong to any of the four (or more) types of structures at play in the combinatorial system: roots, inner morphemes, categorisers, and (even) functional heads. Finally, all purported grammar-internal features must be explained away; this may turn out to be from an easy (Case) to a rather tough task (Class feature), with grammatical gender perhaps being a manageable middle case.

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[14] I look into gender features in the light of the proposals made here in work in work in progress (Panagiotidis in preparation).

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