

MAGNETIC GRAMMAR

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Languages differ, and they do so at possibly every level of grammatical description: phonology, morphology and syntax (and maybe semantics). Unfortunately, the work in these subfields has become separated over the years, mostly as a result of specialization. This is also true for the theories of variation; although there have been general proposals such as Principles and Parameters or Optimality Theory to account for the way in which languages vary across domains, there is in actual practice no general theory anymore, and the way in which parameters or constraint ranking is conceptualized is very differently in different subfields. This makes it very hard to build a language typology that captures variation in all modules: while syntax refers to some primitives, phonology refers to completely different ones.

We believe that this is an unfortunate state of affairs. We would argue that it is implausible that language learners use different kinds of mechanisms to acquire different aspects of their native language. We propose a theory that spans at least the modules of phonology and syntax, trusting that this will also be able to encapsulate morphological variation and hoping that it can be expanded to even further modules of grammatical description. This paper proposes to replace the purely formal features posited in a substantive body of syntactic work, or the constraint ranking envisaged in current phonological Optimality Theory, by *forces* operating on syntactic and phonological primitive items, which we identify as features. We posit that there are only two such forces in natural language: *attraction* and *repulsion*; that these forces are always binary (they operate between two features at the same time) and that such forces are operative in a cross-modular fashion.

We wish to propose that language variation is not a result of syntax-PF mapping non-isomorphism, nor of idiosyncrasies imposed by the SM system, but it is rather intrinsic to the tools that are used by the two modules. In particular, we propose that syntax and phonology work with the same set of features, which are however defined in a more articulated fashion than usual. Features are empty functions, the value of which is determined by the interface systems (semantics for syntax; phonetics for phonology). These shells have, aside from a possible internal architecture, a specification for attracting or repelling other features. The feature system of syntax and phonology is thus representable as follows:

$$(1) \quad F \supset_G, G^*H, H$$

where F , G and H are three random features, and F is specified as attracting G , while G is specified as repelling H , and H has no specification. This model, which we call Magnetic Grammar, has the advantage to present a cross-modular, uniform apparatus which encodes variation at its core.

Any two elements within a module may either attract or repel each other, and they do so on a language-specific basis. We show how such a model of ‘magnetic grammar’ (MG) can capture

many of the properties formerly ascribed to formal features (Fs), without suffering from some of the conceptual and empirical problems that current models have.

The paper is organized as follows. In Section 1 we discuss language variation and way it is tackled across modules; in Section 2 we discuss the similarities between syntax and phonology, with particular attention to features; magnetic grammar is also introduced there. Section 3 provides some examples of attraction, in syntax and phonology; Section 4 is about repulsion. In Section 5, we give some thoughts on acquisition. Section 6 contains the conclusions.

1. LANGUAGE VARIATION

The issue of language variation is addressed quite differently in syntactic and phonological studies. In generative syntax, the computational system of language is considered unique; what needs investigation is the locus of variation (for instance, interface conditions that are different in different languages; parameter settings; features). Traditional parametric approaches consider Universal Grammar as an articulated system with many open parameters that receive their setting during language acquisition. According to traditional macro-parametric approaches, the grammar of a specific language gets fixed once and for all at acquisition (Chomsky 1981 ff., Chomsky & Lasnik 1993, Baker 1996, 2008, Huang 2005, and many others). Contemporary Minimalist approaches have rephrased the parametric approach in terms of featural setup. The Borer-Chomsky conjecture (as in Baker 2008) states that parametric variation can be attributed to featural differences on some given lexical items, such as functional heads. Microparametric approaches reduce variation to the lexicon, and syntactic variation to functional heads. It is not completely clear how these features interact with interface conditions. Most likely, the correct interpretation of the Borer-Chomsky conjecture with respect to the Strong Minimalist Thesis (Chomsky 1998), according to which language is the optimal solution to interface conditions, is that the featural setup is established language by language in conformity with interface conditions.

Be as it may, the mechanisms that narrow syntax has in place to account for variation are reduced to the single lexical items or to interface conditions. Variation is not generated by applying different kinds of operations (like, different kinds of Merge) to syntactic items. The Merge operation is the driving force of syntactic structure building. Displacement is also a sort of Merge (internal Merge). We leave agreement aside for the moment.

In phonology, theories of variation take different forms and tackle different issues. Phonological work worries less about the locus of variation, for instance the setup of features, but more about models of variation in the grammar. We can group roughly the ideas about variation into three main streams: variation is due to the application of different rule systems (SPE, Chomsky & Halle 1968); variation is attributable to parametric settings, pretty much like the ones we find in syntax (Hayes 1995); or variation can be described in a constraint ranking fashion, as in Optimality Theory (Prince & Smolensky 2004). In particular the SPE system differs radically from the idea of a unique operation applying to different items and external conditions yielding variation, as in the MP. OT is an interesting case of a “filter-based” system, whereby phonology generates freely a potentially infinite number of expressions, and a mechanism filters them, based on the constraint ranking of a given language.

Free generation and filtering recalls very much the radical MP mechanism according to which narrow syntax generates a virtually infinite number of expressions, which then crash at the interface (some kind of filter; Chomsky 1995).

We do not wish to indulge too much on the differences between these mechanisms for the creation of linguistic expressions: what matters for us is underlying the difference between syntactic and phonological approaches to variation. This point being made, we cannot but notice that this way of considering what we can call cross-modular approaches to variation is not very economical. Syntax and phonology work under different assumptions, making use of different primitives. In our view, this is not the best way to proceed on Occam's razor considerations. We believe it to be quite unlikely that syntax and phonology work with completely different tools. In this paper, we wish to explore an alternative way to go about variation, involving cross-modular devices for handling linguistic (both syntactic and phonological) variation.

2. WHAT SYNTAX AND PHONOLOGY MIGHT HAVE IN COMMON: FEATURES

We concentrate our investigation on syntax and phonology, leaving semantics aside for this article under the assumption that semantics is compositional and isomorphic to syntax. We will also leave morphology aside, and concentrate instead on syntax and phonology, two modules that are considered to be non-isomorphic for domains (Selkirk 1980, Nespor & Vogel 1986, but see more recently D'Alessandro & Scheer 2015 and Bonet *et al* 2018).

Phonology and syntax share many things: they are both hierarchical in some way (though syntax is recursive and phonology isn't). Syntactic computation, however, takes place based on hierarchical structure, while phonological computation considers linear order. Both syntax and phonology have some sort of cyclicity. We will not discuss these differences and similarities here. Our assumption is roughly that both syntax and phonology operate in similar ways, and the differences emerge because of their interfaces (semantics for syntax; phonetics for phonology).

While keeping these considerations in the background, here we wish to focus on one device that has been largely used in both syntax and phonology, and that we believe has not been exploited to its full potential: the feature. Following the Borer-Chomsky conjecture, we take the locus of variation to be features. Differently from them, we assume these features to have a richer setup, allowing them to describe both syntactic and phonological items, as well as accounting for microvariation in these two modules.

Rather than a complete theory, this is a programmatic paper, with the aim of rethinking linguistic tools in a cross-modular fashion.

2.1. LINGUISTIC PRIMITIVES: FEATURES

Features were first proposed by Jakobson & Halle (1956) to classify English phonemes. Every phoneme was identifiable by means of binary features. These features referred to some salient characteristic of the sounds that Jakobson & Halle wished to describe. The list of features proposed by Jakobson & Halle, which could describe every English phoneme, is in (1):

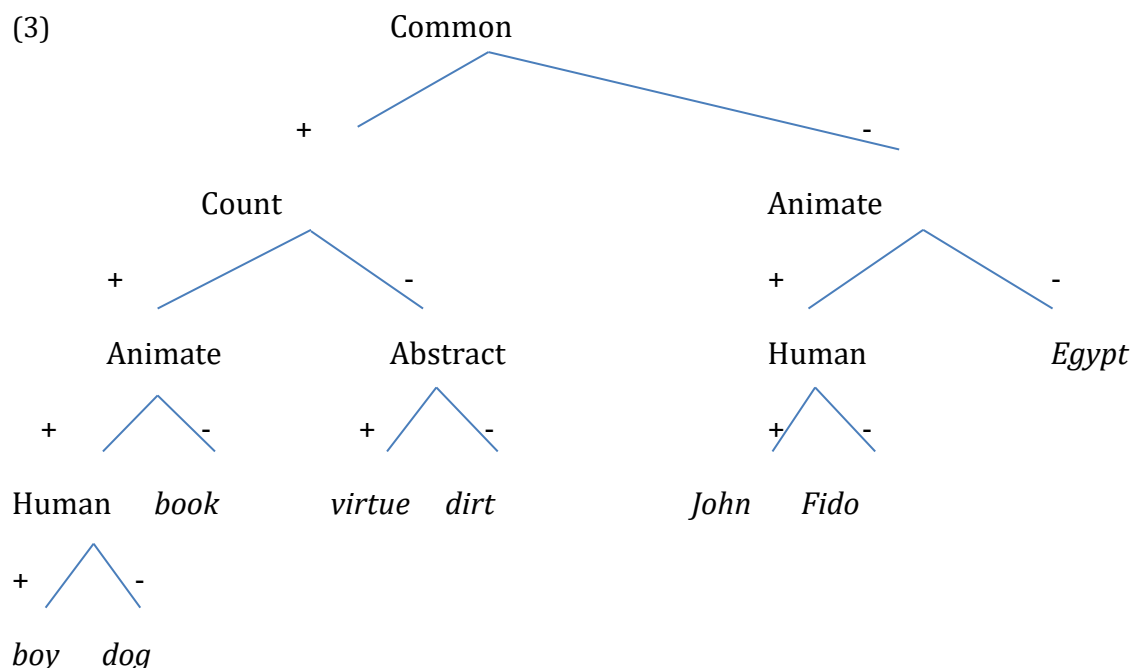
- (1) vocalic/non-vocalic, consonantal/non-consonantal, compact/diffuse, grave/ acute, flat/plain, nasal/oral, tense/lax, continuant/interrupted, strident/mellow

Underneath this inventory was furthermore the claim that the feature set was universal. Other languages might need more or different features to make phonologically relevant distinctions, but in the end the feature matrix for every phoneme in every language was the same, and defined in the same way.

It was again Jakobson, in (1958), who proposed features also for syntax, with the intent to describe the case system of Russian. Franks (1995:42) summarizes Jakobson's enterprise as follows: "The three necessary and sufficient features proposed in Jakobson (1958) for describing the Russian case system were [\pm quantified] (*obëmnyj*), [\pm directional] (*napravlennyj*) and [\pm marginal] (*periferijnyj*). Jakobson (1958, 179) defines these "semantic marks" as "focusing upon the extent to which the entity takes part in the message," "signalizing the goal of an event" and "assigning to the entity an accessory place in the message," respectively". Jakobson classified Russian case as follows:

- (2) nominative = [$-$ marg, $-$ quant, $-$ dir]
 accusative = [$-$ marg, $-$ quant, $+$ dir]
 genitive = [$-$ marg, $+$ quant, $-$ dir]
 instrumental = [$+$ marg, $-$ quant, $-$ dir]
 dative = [$+$ marg, $-$ quant, $+$ dir]
 locative = [$+$ marg, $+$ quant, $-$ dir]

As Jakobson was well aware, his system overgenerated case possibilities. In particular, two combinations: [$-$ marg, $+$ quant, $+$ dir] and [$+$ marg, $+$ quant, $+$ dir] could not be found in Russian. Quite soon after, features started being used to define syntactic categories. Specifically, Chomsky (1965) explains how features are crucial for phonological operations. For instance, there are rules targeting only voiced consonants. How can we make sure that we select all segments that are voiced? By expressing voice as a feature. Each segment with a [voice] feature will be then easily selectable as a target for the rule. Each phonological unit must be designed as a set of features, so that the phonological component can target all element characterized by one or more features. This also holds for syntactic rules, according to Chomsky (1965). In fact, each lexical formative must be characterized by a unique set of features. Chomsky continues with proposing the following general featural architecture for nouns:



Observe that the feature diagram for Chomsky specifies two things: first, the nature of the feature (animate/count/human etc.), often called DIMENSION or ATTRIBUTE, then the presence of the

feature on a lexical item. According to Chomsky, a feature must be represented as $[\alpha F]$, where ($\alpha = +$ or $-$). This was called a BINARY feature system: we specify the characteristic of the element (whether a noun is countable, animate) and whether this characteristic is or is not found on a syntactic element.

The theory of features has fragmented and evolved up to present day, but the debate is still ongoing regarding the right way to represent features. Syntactic features like GENDER, NUMBER and PERSON cannot be easily represented in a diagram like that in (2), unless there is the common understanding that each node has a different ontological status. A language like German, for instance, with three genders, is quite difficult to represent in a binary feature system.

In this context, it is worthwhile mentioning two notable alternatives to binary feature systems. The first, called PRIVATIVE feature system, is already somehow included in the diagrams we have seen above: according to this representation, a feature may or may not be present on an item. Think for example of ANIMACY: a noun can have an [animate] feature, or not. For instance, the noun computer in a privative system would not have an [animate] feature. The noun girl, instead, would. The limits of privative systems are obvious: while they account quite well for binary systems (singular vs plural, masculine vs feminine), they fail to describe accurately more complex systems.

The second alternative is the one which is currently used in most of agreement literature within the generative framework. It is known under the name of ATTRIBUTE-VALUE and consists of a system, in which each feature has two “layers”: first, what we called the dimension, and then the specification of the value for this dimension. The way attribute-value features are represented is the following:

(4) [attribute: value]

For example, 1st person would be indicated as in (5):

(5) [person: 1st]

This system is very powerful, and can describe all possible items in language. The risk that using such a system may cause is that of overgeneration.

For the purposes of this paper, we will consider monovalent features: we will not separate attribute and value, but we will consider each feature as fully specified and distinct from others. The proposal, we believe, can be extended to other ways of feature representation.

2.2. LINGUISTIC PRIMITIVES: FORCES

Linguistic representations, we propose, have two types of primitives: syntactic and phonological items (of the X, XP, feature sort in syntax, and of the feature, segment, syllable, foot sort in phonology) on the one hand, and forces operating on those primitives on the other hand.

The only forces that seem to be at work are the tendency for elements to get embedded in the same domain (we call this the ATTRACTING FORCE, \supset) and the (conflicting) tendency for elements to get outside of each others domain (REPELLING FORCE, $*$). These can be represented as follows: $A \supset B$ means ‘item A attracts item B’, and $A * B$ means: ‘item A repels item B’. The proposal is that language acquisition consists solely of learning the set of forces operative on syntactic/phonological items.

For this paper, we will mainly focus on features, under the assumption that their specification percolates to any element including them.

In particular, we propose that these forces are seen as properties of the primitives themselves. For instance, suppose that a hypothetical language only has a labial nasal *m* and no other nasals, although it has other labials (say, *p* and *b*), and that the relevant features are [Nasal] and [Labial]. We can then formalize this as assuming that the inventory of features in the language is as follows:

- (6) [Nasal \supset Labial]
 [Labial]
 [Coronal*Labial]
 [Voice*Nasal]

This notation says that the toy language has three features, [Nasal], [Labial] and [Voice]; furthermore, [Nasal] attracts [Labial], the language does not have sounds that are both [Labial] and [Coronal] and [Voice] does not go together with [Nasal]. The assumption is that all feature combinations are allowed, in which the requirements on all features are satisfied. These are:

- (7) a. [Nasal \supset Labial, Labial] = [m]
 b. [Labial] = [p]
 c. [Labial, Voice*Nasal] = [b]
 d. [Coronal*Labial] = [t]
 e. [Coronal*Labial, Voice*Nasal] = [d]
 f. [Voice*Nasal] = floating voice

The reader can check that these are indeed the only segments that can be generated with this feature set. Other combinations ([Nasal \supset Labial, Labial, Voice*Nasal], [Nasal \supset Labial], etc.) all show a clash between features: some feature attracts another feature that is not there, or some feature repels a feature which is. With this toolbox, we can construct the segments [t, d, p, b, m, h], because they consist of features that go together, but not a voiced nasal or a nasal that is not labial.

The proposal is that (6) is the only thing the child will have to learn when s/he is learning the consonants of our toy system: features and their magnetic properties. A general computational system – we are neutral with respect to the question whether this is language-specific or not – will be able to put together all features in segments (syllables, words, and higher order domains), as long as their feature specifications are met: [Nasal \supset Labial] is fine in any segment that has [Labial], [Voice*Nasal] is fine in any segment that does not have [Nasal] (and [Coronal*Labial] in any segment without [Labial]. Otherwise, features are freely combinable to segments.

In essence, this toy example illustrates the core of our proposal, which can be applied also to syntax.

The grammar of a language consists of:

- a. a set of primitives of the shape [F \supset G, *H,...], with F, G and H labels of features (or nodes containing them)
- b. a universal combinatorial system

We assume, in line with a consensus in the literature, that the combinatorial systems of phonology and syntax may be different – e.g syntax has self-embedding structures whereas phonology does not, or only to a limited extent, while notions like *left* and *right* seem more central to phonological computation than to syntax. We will not be concerned with the precise nature of the computational system putting together the features in higher-order structures, as we believe that our proposal is compatible with many different views on this. In practice, in this paper we assume what we take to be more or less standard views on computation and representation in syntax (roughly, the kind of structure produced by operations of Merge and Agree) and phonology (roughly, autosegmental structures within a prosodic hierarchy).

3. ATTRACTION

3.1. ATTRACTION IN SYNTAX

Within syntax, attraction triggers movement: a feature (or feature bundle) will be attracted to another feature in order to satisfy an attraction requirement on one of the features or feature bundles involved. Take the following (simplified but well-known) taxonomy of verb movement in Western European languages:

(8) a. Romance: V-to-T

| | | | | | | |
|--------|---------|--------|----------|---------|------|----------|
| Au | cinéma, | Pierre | embrasse | souvent | Jean | (French) |
| At-the | cinema | Peter | kisses | often | John | |

‘Peter often kisses Richard at the cinema’

b. Germanic: V-to-C

| | | | | | |
|----------------|--------|-------|------|-------|---------|
| In de bioscoop | kust | Piet | Jan | vaak | (Dutch) |
| in the cinema | kisses | Peter | John | often | |

‘Peter often kisses John at the cinema’

c. English: no movement

At the cinema, John often kisses Mary

The crucial data here is the relative order of subject, verb and adverb (Emonds 1978, Pollock 1989). English represents something relatively close to the underlying order. In French, the verb is moved to a position higher than the adverb – the T head. In Dutch, it moves even higher, to a position above the subject, the C head.

In terms of our analysis, we can express these differences in terms of different verbal features for the three languages:

(9) a. Romance: [V; T \supset_V ; C]
 b. Germanic: [V; T; C \supset_V]
 c. English: [V; T; C]

This model is obviously too simplistic. A number of issues need to be tackled for it to work. The first one is the fact that V is strictly speaking not a feature, but a category. The second is that, assuming that features and categories are the same thing for the moment (see in this respect Zeijlstra 2008), the V feature could move on its own, without the need to pied-pipe the host.

These questions recall very closely the debate around strong and weak features of early Minimalism. Strong and weak features were first used to account for overt and covert movement. The difference between features that require movement, in early MP, and features that do not require it is not in the nature of the features, but in a further specification attached to them: features can be weak or strong. Strong features trigger movement, i.e. they force the element hosting them to move overtly, in syntax. Weak features also require movement, but this movement can happen at LF, covertly. Strong features are in fact visible at PF and must be checked before the interface is reached or the derivation will crash. Weak features are invisible at PF and can be checked after Spell-Out, at LF.

A better way to redefine covert movement, which evoked at the time the just abandoned D-structure, was to imagine a system in which features can move independently from their hosts. Chomsky explored in fact the possibility that only features move, carrying along “enough material for convergence” (Chomsky 1995:262). Leaving aside the discussion on PF convergence, which Chomsky himself did not address, the important element for us is that features could move independently from their host (allowing the dismissal of covert movement).

In Chapter 4 of the MP, Chomsky considers both options. He considers the possibility that features can move without their host, i.e. that it is features, not morphemes, that move. This step towards the independence of features from their host was in the air around the 1990. In particular, Halle & Marantz were discussing the possibility that morphemes are abstract entities, called “Q” by Halle, to indicate variables for complex symbols. Reconceptualizing morphemes as abstract entities, separating features from their “hosts” as Distributed Morphology was starting to do was an important step towards feature independence.

Weak and strong features had their advantages. One of them was as we said the possibility to describe overt and covert movement systematically. The concept of weak feature later evolved in features moving or being evaluated independently of the host. This brought to the definitive separation of agreement and movement.

Attributing a weak and strong value to features also had its disadvantages, first and foremost the total arbitrariness and possible circularity of this definition. In Romance, V had a strong feature (recall that strength was not defined on the attractor in the beginning, but on the moving element) which determined V-to-T. V-to-T was due to a strong specification on V in Romance. This looked like an ad hoc descriptive tool, which did not capture the essence of the moving phenomenon (not more than postulating a EPP does, in any event). While the *ad hoc* stipulation still represents an obstacle, we do not believe the arbitrariness of strength specification, translated into attract/repel in our terms, to be necessarily an issue. Reducing variation to the level of features and assuming that children need to learn featural specifications just like they learn lexical items is perfectly plausible. The feature specification for strength (attraction or repulsion in our case) can be easily learnt this way; from a microvariational viewpoint, it is not at all strange that languages would have slightly different feature specification (see for instance Pollock 1989, but also Schifano 2018 on the different landing sites of verb movement in Romance).

Attraction can therefore be easily specified on a feature and learnt easily. The issue of how to obtain a macroparametrical effect starting from microparameters stays open (we tentatively suggest a *Uniformity of the Input* approach à la Roberts 2010, but will not delve into this issue any further).

Head movement, of the sort taking place in Romance and Germanic, can be easily captured within our system.

As for XP movement, the situation becomes slightly more complicated, precisely for the reasons just mentioned. Why does the whole XP move with the feature? Why is there pied-piping of the whole phrase, when the feature could just move on its own? As stated above, we propose that the feature with its magnetic specification is the target of computation, but also that the specification percolates to the head and the phrase containing the feature. Whether the “nodes” are pied-piped, and which part of the phrase is pied-piped is determined parametrically by language. As an example, consider wh- movement.

As known, Chinese is a language with wh- in-situ, while English displays wh- movement. We can express these facts in terms of magnetic grammar as follows:

- (10)
- | | | |
|------------|-------------|------------------------|
| a. Chinese | wh- in situ | $C \supset \text{wh-}$ |
| b. English | wh- in C | $C \supset \text{whP}$ |

English and Chinese only differ for the quantity of syntactic material that is pied-piped by the feature (see also Cheng and Rooryck 2000).

Displacement in syntax can be easily accounted for through this mechanism.

We can see attraction at work also paradigmatically, by looking at the kind features that occur together with given functional heads. Consider for example subject-verb agreement. One simplified way of representing it is the following:

- (11)
- | | | |
|---------|------------------------|-------------------------------------|
| Russian | rich ϕ -agreement | $T \supset p, \supset n, \supset g$ |
| Dutch | not-so-rich agreement | $T \supset p, \supset n$ |
| English | poor agreement | $T \supset \text{- participant}^1$ |
| Chinese | no agreement | |

Starting from the assumption according to which verbal morphology reflects the featural setup of inflection, we can describe the Russian agreement system as one in which T attracts person and number, and in some cases gender. As for Dutch, T attracts person and number only, and so on. The paradigms of agreement inflectional endings, we claim, are a manifestation of feature magnetism.

The advantage of this system is that it can easily describe some grammatical fringe phenomena that have often be considered quirks of the system (like verb movement, or scrambling).

3.2. ATTRACTION IN PHONOLOGY

As noted by Nevins (2010), vowel harmony in phonology works very similarly to syntactic agreement: there are elements “in need” of a specification, which copy their value/specification

¹ We represent the English agreement system like this for lack of a better way to capture the fact that 3rd person singular (i.e. no person, Benveniste 1966) is the only morphologically marked inflectional ending.

from the most prominent one. In both cases, the underlying force is one of assimilation, i.e. of particles wanting to acquire the same features as some

Vowel Harmony in Turkic languages is an easy example to illustrate this point. Turkish, for example has a simple 8-vowel system, that can obviously be described perfectly with three features (Kabak 2011):

| | | | | |
|------|---|---------------------|---|----------------------------|
| (12) | u | {Vowel} | i | {Vowel, Front} |
| | a | {Vowel, Low} | e | {Vowel, Front, Low} |
| | u | {Vowel, Round} | y | {Vowel, Front, Round} |
| | o | {Vowel, Low, Round} | œ | {Vowel, Front, Low, Round} |

If we only look at the inventory, we thus see a symmetric system: no feature attracts or repels any other feature in the lexicon. Yet, Turkish also famously has vowel harmony, both of the rounding type and of the fronting type. We concentrate initially on the latter, but will return to rounding harmony afterwards:

| | | | |
|------|---------------|--------------------|--------|
| (13) | kuuz ‘girl’ | kuuz-lar ‘girls’ | |
| | ip ‘rope’ | ip-ler ‘ropes’ | |
| | sap ‘stalk’ | stap-lar ‘stalks’ | |
| | el ‘hand’ | el-ler ‘hands’ | |
| | pul ‘stamp’ | pul-lar ‘stamps’ | |
| | jyz ‘face’ | jyz-ler ‘faces’ | |
| | son ‘end’ | son-lar | ‘ends’ |
| | kœj ‘village’ | kœj-ler ‘villages’ | |

The suffix vowel is always Low, and never Round, but its specification for Front is dependent on the stem: if the stem has a Front feature, it spreads autosegmentally to the suffix, but if such a feature is absent, the suffix (also) stays back. This is the standard autosegmental analysis of vowel harmony.

Nevins (2010) argues that we should understand this analysis in terms of what he calls ‘neediness’: vowels want to be specified for certain features. We can translate this idea into our framework right away. A ‘needy’ vowel is a vowel that attracts certain features. Turkish vowels are needy for frontness, hence the Vowel feature in this language looks as follows:

(14) Specification of vowels in language with front harmony: $V \supset \text{Front}$

The question now obviously arises why Turkish has back vowels at all. Should not all back vowels in our inventory in (12) be disallowed? One way to get around this idea would be to posit that only some vowels have the specification in (14), viz. only the vowels in suffixes, because Vowel Harmony applies only to them. This is basically Nevins’ (2010) strategy: vowels can be arbitrarily marked for being needy, although in some languages all vowels are. Technically this way of going about it works, although it does not explain, for instance, why front vowels in suffixes do not harmonize to the stem (becoming back when the stem has a back vowel).

An alternative strategy would be to stipulate that vocalic features (or at least Front) need to belong to the stem in Turkish. Interestingly, this can also be formalized, given an appropriate theory of the lexicon. The feature Front would have the following specification: theory of the lexicon. The feature Front would have the following specification:

(15) **Front** \supset Stem

Where ‘stem’ is some morphological or even semantic feature that is exclusive to stems (i.e. to lexical items that can occur as independent words). (15) says two things about the feature **Front**: (i) that it can only be sponsored by the stem and not by a suffix, and (ii) that it can only be underlying, and not epenthetic. This means that if a stem vowel happens to not be **Front**, there is little we can do about it. Changing our assumptions so far a little bit, this means that we end up with a vowel within a stem that is not entirely perfect, but since there is no possible repair, we keep it as it is. Back vowels are in this sense ‘marked’. However, in case there is a suffix without a **Front** vowel and a stem with such a vowel, there is a way to keep all features happy, viz. by spreading the **Front** vowel from the stem to the suffix.

Note that under this alternative view we get to an idea of grammaticality that is somewhat similar to that of Optimality Theory in its original form (Prince and Smolensky 1993/2004). There is a conflict between two features in case of a stem with (only) a back vowel, such as *sap*. The features of the vowel are as follows:

(16) /a/ in Turkish: {Vowel \supset Front, Low}

The vowel is incomplete. However, since there is no **Frontness** available, there is nothing we can do but epenthesize one:

(17) /a/ in Turkish after possible repair: {Vowel \supset Front, Low, Front \supset Stem}

There is still something missing, viz. the **Stem** feature. However, this feature cannot be epenthesized. We assume that the lexical affiliation of a feature can not be changed by computation: we cannot all of a sudden make an epenthetic vowel ‘part of the stem’. This is in line with the theory of Coloured Containment (Van Oostendorp 2006), which states that morphological affiliations of phonological material never change: something that belongs to a morpheme underlyingly will always belong to that morpheme.

This means that (17) is beyond repair, but it does not explain why in Turkish we still prefer (16) (a back vowel in the stem, with an unsatisfied **Vowel** feature) over (17) (a front vowel in the stem, with an unsatisfied **Front** feature). This is the point where we could adopt the idea of ranking from OT. However, the ranking mechanism would here be heavily simplified: all features in a language would be ranked, but nothing else. Furthermore, this means that *all* attraction and repulsion properties of a given feature are at the same level of ranking. With respect to classic OT, the ranking properties thus are extremely minimal: we have a feature ranking rather than a constraint ranking. In particular in Turkish we would have:

(18) **Front** \supset Stem $>$ Vowel \supset Front

Furthermore, there is no need to build huge candidate sets and compare them in parallel, as in Classic OT. Evaluation can stay purely local. Once we have reached (16) in the derivation, we can notice that there is nothing to be done. Inserting a **Front** feature to satisfy the needs of **Vowel** will only make things worse, per (18). That is why we do not undertake this step: the only things to be compared are the current situation and the result of an eventual repair. If in a new cycle we do at a back suffix vowel to a front stem, on the other hand, we can satisfy the needs of both features at

the same time, and it is worth spreading the stem Front feature to the needy vowel in the suffix, so that we can satisfy all features.

In all cases, there exist “disturbing” elements, elements that intervene in between other elements that are in a certain relationship and interrupt it. Given two elements A and B, if A and B are driven by an attracting force, there cannot be any element C, of the same nature of B intervening between the two. This “intervention” is found both in phonology (some vowels interrupt vowel harmony) and in syntax (relativized minimality effects).

4. REPULSION

4.1. REPULSION IN PHONOLOGY

Repulsion is the opposite of attraction. When a feature F attracts another feature G, F is only satisfied if it finds G in its domain. When a feature F repels G, F does not want G in its domain. We only need to distinguish between the two forces in a theory in which features are monovalent rather than binary. Within binary feature theory, obviously $F *_{\neg} G$ has the same meaning as $F \supset \neg G$. From a purely formal point of view, therefore, adding repulsion to a theory of attraction is not much more than adding a negation to the syntax of features. Yet we believe that repulsion is a handy addition to the notational apparatus, not just because many current features within phonology and syntax do indeed assume monovalency, but also because it seems more convenient to understand certain phenomena in terms of repulsion.

Here is a rather simple example. Many languages allow Round vowels (/u/) and Front vowels (/i/) but not vowels that are Front and Round at the same time (*y/). This is easy to describe in terms of repulsion, for instance postulating that the relevant features are $\text{Front} *_{\neg} \text{Round}$, Round. We could get the same effect with binarity and $\text{Front} \supset \neg \text{Round}$, Round, but that would capture less straightforwardly that front rounded vowels are simply more marked than front unrounded vowels (since in the case of the binary theory, we would state that front vowels want to acquire a feature [-Round], rather than getting rid of [Round]).

One could say that avoidance of front rounded vowels is an example of repulsion. This hierarchy of features can also be used in order to derive another kind of phenomenon, that can also be illustrated on the basis of Turkish. We already noted that this language also has rounding harmony, which can be illustrated with the genitive singular suffix (in the righthand column below):

| | |
|-----------------|---------|
| (19) kuz ‘girl’ | kuz-un |
| ip ‘rope’ | ip-in |
| sap ‘stalk’ | stap-un |
| el ‘hand’ | el-in |
| pul ‘stamp’ | pul-un |
| jyz ‘face’ | jyz-yn |
| son ‘end’ | son-un |
| kœj ‘village’ | kœj-yn |

The genitive suffix has an underlying vowel that is not specified for anything but the basic vowel feature; different from the plural suffix, it is not specified for Low, so that the genitive vowel is

always high. Apparently, this Vowel feature does not just attract Front, but also Round. Its full specification in Turkish thus looks as follows:

(20) Specification of vowels in language with front and rounding harmony: $V_{\supset \text{Front}, \supset \text{Round}}$

Given that rounding harmony is also asymmetric, we have to assume that also the Round feature can only come from the stem, and that it is placed in the same place in the hierarchy:

(21) $\text{Front}_{\supset \text{Stem}}, \text{Round}_{\supset \text{Stem}} > \text{Vowel}_{\supset \text{Front}, \supset \text{Round}}$

However, the examples in (13) show that this is not the whole story yet. Low suffix vowels undergo frontness harmony, but not rounding harmony. The reason for this is probably a tendency of Low vowels to resist Roundedness. In other words, the following is the complete hierarchy of features in Turkish:

(22) $\text{Low}^*_{\text{Round}} > \text{Round}_{\supset \text{Stem}} > \text{Vowel}_{\supset \text{Front}, \supset \text{Round}}$

To see how this works, consider the derivation of the form *pul-lar*. In the first cycle, we only look at the stem vowel, which has the features $\{ \text{Vowel}_{\supset \text{Front}, \supset \text{Round}}, \text{Round}_{\supset \text{Stem}} \}$ because it is an /u/. The feature $\text{Round}_{\supset \text{Stem}}$ is satisfied because it does indeed belong to a stem. The feature $\text{Vowel}_{\supset \text{Front}, \supset \text{Round}}$ is looking for a Front feature, but it cannot find this. However, the only option to acquire one would be to insert a $\text{Front}_{\supset \text{Stem}}$, which would itself be unsatisfied. And since Front is a stronger feature in the hierarchy than Vowel, we decide not to do this, and keep /u/ as is.

We then add the suffix *-lar* which has a vowel $\{ \text{Vowel}_{\supset \text{Front}, \supset \text{Round}}, \text{Low}^*_{\text{Round}} \}$. The Vowel feature is needy and looking for a Front and a Round feature. The Front feature is not present in the stem (if it were, it could be attracted), but the $\text{Round}_{\supset \text{Stem}}$ feature is. That feature is also satisfied, because it is linked to the stem. However, in this case the feature $\text{Low}^*_{\text{Round}}$ resists connection to the Round feature. Since Low is higher in the hierarchy, hence stronger, it will not allow satisfaction of the wishes of the Vowel feature.

Repulsion forces are also clearly at work in phonology in OCP-related phenomena. The OCP (obligatory contour principle) has been proposed as an acting principle in morpho-phonology by Leben (1973) regarding the impossibility of identical high tones to occur next to each other and has been figuring in the literature ever since. In the course of time, the OCP has come to indicate any process impeding the co-existence of two identical features (or even more widely, phonological elements) in each other's vicinity. When two elements violate the OCP, their sequence is not allowed, hence repair strategies must be put in place, by changing one of the two offending elements or by deleting one.

Here is a classic case of a phenomenon usually ascribed to the OCP. In Shona, the word *mbwá* has an underlying high tone. However, this high tone turns into a low tone if the word is preceded by a preposition *né* 'with' that also has a high tone:

(23) $\textit{né-mbwá} > \textit{né-mbwà}$

In terms of the theory we are presenting here, OCP can be seen as an effect of auto-repulsion: Bantu languages like Shona have a High tone feature that looks as follows:

(24) OCP on high tones: $H_{\supset H}$

The high tone does not literally repel itself (or else it would not surface) but it does repel other instances within its domain, in this case the prepositional phrase. (The low tone which does surface on the noun can either be analysed as a default tone, so not having a feature at all, or as the result that the nominal vowel does attract a low tone because toneless vowels do not exist in the language.)

4.2. REPULSION IN SYNTAX

Something very similar to OCP is at work in syntax, namely the ban on symmetrical structures, where two phrases are in a sisterhood relation (XP YP configuration, in Chomsky's 2011 terms). When two phrases are in the equivalent relation as adjacency in phonology (namely direct sisterhood, like for example in a small clause), one of the two must move. This theory of movement, first proposed by Andrea Moro (2000) to resolve XP YP configurations in predicative sentences/small clauses (or to create asymmetry, in his terms) consists in the resolution of a dissimilation problem: two elements that are "identical" (under the right formulation) cannot occur next to each other structurally.

Repulsion in syntax is also not a new concept. Platzack (1996) already proposed a Repel [F] operation at work triggering a phrase marked as [Repel F] to move out of the domain hosting [F]. This proposal was followed by that of Van Craenenbroeck (2006), who shows convincingly that some syntactic sequences cannot be accommodated in the clause.

Van Craenenbroeck examines the following data from Venetian, where the *wh*- phrase precedes the complementizer:

(25) Venetian, Van Craenenbroeck (2006:53)

a. WH < CHE

| | | | | | |
|----|---------|-----|------|----------|--------------------|
| Me | domando | chi | che | Nane ga | visto al marcà. |
| me | I.ask | who | that | Nane has | seen at.the market |

'I wonder who Nane saw at the market.'

b. CHE < WH

| | | | | | |
|------|---------|------|-----|---------------|---------------|
| * Me | domando | che | chi | Nane ga visto | al marcà. |
| me | I.ask | that | who | Nane has seen | at.the market |

In Venetian, the *wh*- phrase precedes the complementizer. The complementizer in turn always precedes clitic-left dislocated phrases, as in the following examples:

(26) Venetian, Van Craenenbroeck (2006:53-54)

a. CHE < CLLD

| | | | | | |
|-------------|---------------|------|--------|-----------|--------------|
| Me dispiase | che a Marco | i | ghe | gabia | ditto cussi. |
| me is.sorry | THAT to Marco | they | to.him | have.subj | told so |

'I am sorry that they said so to Marco.'

b. CLLD < CHE

| | | | | | | |
|---------------|----|------------|------|--------|-----------|-------------|
| * Me dispiase | a | Marco che | i | ghe | gabia | ditto cussi |
| me is.sorry | to | Marco THAT | they | to.him | have.subj | told so |

This given, we would expect the *wh*- to precede the clitic-left dislocated sentence, by transitivity. This is not the case, however:

(27) Venetian, Van Craenenbroeck (2006:53-54)

a. WH \nleftarrow CLLD

* Me domando a chi el premio Nobel che i ghe lo podarà dar.
me I.ask to who the prize Nobel that they to.him it could give

b. WH \nleftarrow CLLD

* Me domando a chi che el premio Nobel i ghe lo podarà dar.
me I.ask to who that the prize Nobel they to.him it could give
intended: 'I wonder to whom they could give the Nobel Prize.'

c. clld < wh

Me domando el premio Nobel a chi che i ghe lo podarà dar.
me I.ask the prize Nobel to who that they to.him it could give
'I wonder to whom they could give the Nobel Prize.'

Van Craenenbroeck proposes an analysis in terms of repulsion within focus domains. What is crucial is that he assumes a [Repel Focus] feature forcing a CLLD phrase to leave any Focus domain. Normally, it is enough for the CLLD element to move to the left periphery. If the Focus domain is however enlarged through wh- movement to spec,CP, movement to the left periphery is no longer sufficient to obey the [Repel Focus], and the CLLD phrase must move outside the clause (like in 27c).

We can rephrase Van Craenenbroeck's intuition in our formalism in the following way:

(28) Top *_{Foc}

Where with [Foc] we broadly indicate also wh- elements. CLLD phrases are topics (Rizzi 1997), and in Venetian it seems that they cannot be structurally adjacent to Foci.

Another example of repulsion in morphosyntax can be found in Romance, where for instance some restrictions to co-occurrence of some elements apply, when these elements are in the same domain. One such phenomenon is negative imperatives in Italian, as in (25):

(29) a. Di=mme=lo

say.IMP=me.DAT=it.ACC

'Say it to me'

b. *non di=mme=lo

NEG say.IMP=me.DAT=it.ACC

c. non dir=me=lo

NEG say.INF=me.DAT=it.ACC

'Don't say it to me'

In Italian and in many Romance languages, an imperative cannot be combined with a negative. This phenomenon has been explained in many different ways: considering the place in the structure of the negative and the imperative as crucial (Rivero 1994, Rivero & Terzi 1995), or the nature and/or possible lexical ambiguity of the negative operator (Zanuttini 1997). In our system, we can express this ban on co-occurrence as feature repulsion: in some languages,

(30) NEG *IMP

Examples of repulsion are also found, paradigmatically, in morpho-syntax.

4.2.1. REPULSION IN MORPHO-SYNTAX

Some cases of repulsion in morpho-syntax regard the paradigmatic ban on mutual co-occurrence of identical/very similar clitics in clitic clusters. In Spanish, the cluster *le lo*, with two *l*-clitics (3rd person, according to Kayne 2003), is banned. The OPC sequence is repaired by impoverishing the first clitic, from a 3rd person to an impersonal clitic (Bonet 1991):

(29) a. Spanish
 **le=lo* > *se=lo*
 him.DAT=him.ACC IMP= him.ACC
 ‘it to him’

This restriction can be expressed, in our terms, as feature repulsion of the sort F^*F . For this particular case, $3p^*_{3p}$.

A similar case is at work in Italian, with the cluster formed of two phonologically identical clitics, *si si*, one of which is impersonal and the other reflexive. Also in this case, a repair mechanism is established replacing the impersonal *si* with the locative clitic *ci* (Cinque 1988):

(30) **si=si guarda* > *ci²=si* *guarda*
 IMP=REFL looks > LOC=REFL looks
 ‘one looks at oneself’

In this case, we are again in the presence of a morpho-syntactic OCP, a F^*F where the F is plausibly an underspecified 3rd person feature (or an impersonal one, see D’Alessandro 2007).

Last, in the Abruzzese dialect of Mascioni, this morpho-syntactic OCP is repaired through the cancelation of one of the clitics, as shown by Manzini (2014):

(31) **li=lu* *a* > *li* *a*
 him.DAT=it.ACC gives it gives
 ‘S/he gives it to him’

In some cases, the mutual exclusion involves combinations of features. One such case is for instance the PCC (Bonet 1991), which excludes some combinations of direct and indirect objects. The strong version, by Bonet (1991), is as follows:

(32) Strong Person-Case Constraint: In a combination of a weak direct and indirect object, the direct object has to be 3rd person.

(27) excludes the possibility of a 1/2 internal argument clitic/weak pronoun in the presence of a weak/clitic indirect object.

The weak version of the PCC is more lenient of the co-occurrence patterns, and allows a 1/2 person DO if the IO is also 1/2 person. Languages vary with respect to which version of the PCC they adopt.

The generalization expressed by the PCC is thus the following:

(33) Strong PCC:

Given two weak pronouns/clitics,
*1/2 DO if IO

The weak version is instead:

(34) Weak PCC:

*1/2 DO if 3 IO
*3 DO if IO

The PCC is often rephrased in terms of case: a 1/2 person accusative clitic/weak pronoun cannot co-occur with a dative pronoun (strong PCC); a 1/2 person accusative clitic/weak pronoun cannot co-occur with a dative clitic/weak pronoun unless this dative is 1/2 person.

Within our system, we can express the PCC as follows:

(35) Strong PCC: IO* DO [1/2]

(36) Weak PCC: IO[3] * DO[1/2]

The exact mechanism of this feature interaction is at the moment still unclear. The PCC suggests that repulsion mechanisms between features are in place, but that the internal structure of the feature bundle needs to be taken into account for computation.

Some mysteriously banned clitic clusters in Italo-Romance can also be accounted in this fashion:

(37) Pescarini (2011:12)

| | Spanish | Italian | Vicentino |
|-------------|---------|---------|-----------|
| a. Dat Acc | se lo | glielo | ghe lo |
| b. Acc Dat | * | * | * |
| c. Dat Imp | * | gli si | ghe se |
| d. Imp Dat | se le | * | se ghe |
| e. Dat Refl | * | gli si | ghe se |
| f. Refl Dat | se le | * | se ghe |
| g. Acc Imp | * | lo si | lo se |
| h. Imp Acc | se lo | * | se lo |
| i. Acc Refl | * | * | * |

| | | | |
|----------------|-------|-----------|-----------|
| j. Refl Acc | se lo | se lo | se lo |
| k. Imp Dat Acc | * | * | se ghe lo |
| l. Dat Acc Imp | * | glielo si | ghe lo se |

As (35) shows, the distribution of these clitic clusters and the restrictions on their occurrence vary per language. According to Pescarini, this distribution reflects a hierarchy according to which *se* > *3p* > *imp*. Furthermore, clitic placement is case sensitive (see also Franks 2018 on clitic placement based on linear considerations). What matters for us is that we can express this system in a feature repulsion fashion. Feature repulsion can be sensitive to parametric restrictions, but it can also be totally arbitrary, just like lexical items are.

5. LEARNING FEATURES

The theory of Magnetic Grammar has the advantage that it is relatively simple and offers a rather precise view of the locus of language variation: this is only to be found in the features. Since theories of variation, especially within the generative tradition, are typically closely connected to theories of acquisition it is worth pointing out that also theories of acquisition seem fairly easy to set up.

The learner will have to pay attention, first, to cues that a certain feature is present or absent in the input. This is probably not an easy task, but there presumably is no theory of phonology or syntax in which one does not have to learn that the language has Voiced consonants or a Past tense. Within Magnetic Grammar, the child furthermore has to learn the attraction and repulsion properties of these features. We assume that when learning a feature, the child initially posits that it attracts *and* repels all features already existing in the inventory. In other words, if the learner has established that the language already has the following inventory:

(38) {F, G}

And furthermore the child established that it needs to add a feature H, she will posit that it initially has the following properties:

(39) $H \supset F, \supset G, *F, *G$

These properties are obviously conflicting, but those conflicts will also be certainly resolved immediately, as the feature occurs in a certain context: it will belong to one or more forms that the learner has observed, otherwise she has no reason positing it. If the segment has an F, the child will now that she should retract **F* from the specification of H; if it does not, she knows that she should withdraw $\supset F$. And similarly for G; so that just from inspection of one form, the child knows which of the two conflicting demands should be withdrawn.

Van 't Veer (2015) has shown that this method (in his case: positing cooccurrence constraints on features immediately when they arrive, and then withdrawing them, without ever going back and positing new cooccurrence constraints) works as a learning strategy for segmental inventories and also seems to model fairly well the order in which children learn those inventories. We have of course a slightly different model here, but we have been able to implement an algorithm in functional Python that seems to be working just as well. We think there is no specific reason to

believe that this should work differently for syntactic features, given the fact that the formal systems are the same; but we would have to compare the results of our algorithm with those of studies on syntactic feature learning in human infants.

Obviously, the algorithm would have to be refined for some of the extensions we proposed, for instance for learning the feature hierarchy discussed in sections 4 and 5. However, learning algorithms have been successfully explored for e.g. OT constraint hierarchies and it does not seem far-fetched to believe at least some of those could be applied also to this case, in particular as it is much simpler than what is proposed here. (From some work with pencil and paper on the Turkish case, it seems likely that we can arrive at the hierarchy by assuming that every new feature starts at the bottom of the list, and rises only when the evidence requires it.)

6. CONCLUSIONS

We have proposed a fairly simple procedure for describing a wealth of phonological and syntactic phenomena. It should be noted that most of the analyses presented here are not completely new; they can often be seen as notational variants of existing analyses, very often even of mainstream analyses. The main advantage of the current proposal therefore is a conceptual one: it shows that standard analyses in syntax and phonology are very similar and can be expressed in the same theoretical language. There is no special reason to think that they are as ‘different’ as they have been sometimes made out to be.

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