Recursion Restrictions: Where Grammars Count

Hilda Koopman

Abstract Since recursion is a fundamental property of human languages, it is puzzling that we regularly find cases where recursion is impossible or restricted. In this paper we argue that these restrictions follow from an independently necessary property associated with individual lexical items, which encodes sensitivity to phonological properties. These restrictions must be stated on the output of the syntactic derivation, when syntactic structures are transferred to phonology as expected in current late spell-out models. The main idea is that phonological properties can be "grafts" on the structure-building requirement of a lexical item, referred to as an epp property, which can then be viewed as a repository of the finely grained knowledge speakers have of the phonological properties associated with local syntactic environments. In this view, restrictions on recursion, though accidental, can be straightforwardly and simply accounted for as arising from the way that independently necessary properties interact in specific local syntactic environments. This accounts for a number of well-known effects, including left branch restrictions, restrictions on center embedding, and complexity effects.

Keywords Recursion • Interface • Spell-out • EPP • Syntax

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1 Introduction

Since recursion is a fundamental property of human languages, it is puzzling that we regularly find cases where recursion is impossible or restricted. This paper explores how to investigate and understand such restrictions. It argues that they follow from an independently necessary property associated with individual lexical items, a property that encodes sensitivity to phonological properties. These restrictions must be stated on the output of the syntactic derivation, as expected in current late spell-out models, and they effectively rein in recursion in very specific local syntactic environments. This accounts for a number of well-known effects, including left branch restrictions, restrictions on center embedding, and complexity effects.

This paper makes a proposal about the nature of the phonological knowledge that is integrated into lexical properties, and argues, on the basis of a case study of verbal complexes in Dutch and Hungarian, that the grammar requires a limited amount of counting to capture the recursion restrictions.

More particularly, building on Koopman and Szabolcsi (2000) and Koopman (2002), I will show that recursion restrictions are to be accounted for at the syntax-phonology interface, when syntactic structures are transferred to phonology under current late spell-out models. The main idea is that phonological properties can be "grafts" on the structure-building requirement of a lexical item, referred to as an epp property, which can then be viewed as a repository of the extremely finely grained knowledge speakers have of the phonological properties associated with local syntactic environments. In this view, restricted recursion, though by itself accidental, can be straightforwardly and simply accounted for as arising from the interaction of independently necessary properties. The present account integrates finely grained phonological knowledge with local structural syntactic properties of syntactic atoms, yielding a more complete view of how to account for an individual speaker's knowledge, and providing some insight into individual variation.

The paper will proceed as follows. Against a general theoretical background where there is no separate morphology, it first addresses what needs to be said about individual atoms of syntactic structure that were previously dealt with in morphology. It argues that these LIs, or heads, can impose various types of phonological properties on their second merged objects (formerly called 'Specs'). Such properties, I argue, should be localized as part of the structure building epp of an LI, and depend on and vary according to the individual atom. In particular, these properties encode the maximum size of phonological material allowed in a specific location, as measured on the output of the syntactic derivation, by (limited) counting of the number of nodes dominating pronounced material, and separating it from the sisternode with which it is merged. This essentially phonological property reins in recursion, as we will show for several different cases. This discussion sets the stage for a particular case study in the domain of verbal complexes in Dutch and Hungarian, building on Koopman and Szabolcsi (2000) and Koopman (2002). Here we find two instances of recursion restrictions. One case is particularly interesting and revealing, because the restriction on recursion, which must be stated on the

output of the syntactic derivation, is found where phonologically light material is syntactically embedded, allowing to rule out a possible prosodic account. It is here that the particular syntactic derivations lead to a uniform understanding of the restriction, and where it can be shown that the grammar needs to allow for a limited amount of counting, so as to allow for the observed variability between speakers, dialects, and across languages. If this analysis is on the right track, it provides insight into the type of syntactic derivations we need to adopt.

2 Some Theoretical Background

The discussion in this paper is cast within a particular version of the Minimalist Program, and takes the following set of axioms as a point of departure:

- There is a single computational system for building structure, and that is syntax. It departs from Distributed Morphology, and earlier accounts of morphology, and assumes that there is no structure-building in either post- or pre-syntactic components (cf. Koopman 2005a, b). The difference between words and phrases is one of output size, not one of modules, or atoms, or ways of composition (head or phrasal movement).
- Syntactic atoms (LIs) are tiny and can be semantically or phonologically meaningful: they are *not* the fully inflected lexical items familiar from much work. These small atoms enter into the structure building component (Merge, Bare Phrase Structure, Chomsky 1995). Syntax is fundamentally decompositional, and antisymmetric (Kayne 1994, 2000).
- Lexical properties of LIs, including phonological properties, must be satisfied strictly locally, under sisterhood (first or second Merge Sportiche 2005). Agree plays no role in the properties of lexical items in question in here (and perhaps not for agreement either—see Koopman (2006)).

Since lexical properties drive derivations and determine which representations converge, it becomes crucial to establish what these properties are. Starting from "bound morphemes" which often are out of syntacticians' sight, Sect. 2.1 argues that syntactic atoms can impose very specific phonological requirements on their second merged objects (which I sometimes refer to as 'Specs', for convenience), and proposes that these are "grafts" on the structure building epp. These finely grained and varying phonological properties can yield restrictions on recursion, in effect filtering out well-formed syntactic derivations that do not pass the phonological conditions imposed by specific LIs. The ensuing ungrammaticality is thus a result of unsatisfied, specifically phonological, properties of lexical items.

It is against this general background that I will turn to the domain of verbal complexes in Dutch and Hungarian, building heavily on the syntactic derivations motivated in Koopman and Szabolcsi (2000) and Koopman (2002), where we recast the complexity and splitting filters as phonological properties of the epp. The domain of verbal complexes lends itself well to this investigation: we find restrictions in

recursion, as well as micro- and macrovariaton, which restrict both the possible analyses of the variability, and the factors that must enter into the account. The Koopman and Szabolcsi (2000) syntactic derivations that underlie the particular phenomena are highly determined, general and uniform, and yield non-trivial results for Dutch, German and Hungarian. The syntactic derivations provide syntactic vocabulary that allows us to directly relate the observed restrictions on recursion to the derivational output. The restrictions will be shown to be (1) sensitive to the presence (but not to the absence) of phonological material in a designated Spec at spell-out, (2) sensitive to the depth of embedding of pronounced phonological material, even if that material is phonologically light on the surface (say a light foot, or a CV syllable), (3) sensitive to syntactic category, and (4) are variable within a particular language or language area, and across languages. Restricted recursion, though largely arbitrary, can be accounted for straightforwardly and simply as a result of independently necessary properties, provided of course we have the right kind of syntax.

2.1 On the Notion Bound *and the epp*

Under the single engine hypothesis, all word formation is syntactic structure building: there is no difference between derivation, inflection, compounding, or syntactic phrase formation. This implies that properties traditionally taken to be morpheme-specific are potentially properties of any LI. It is important in this respect to consider the properties of "bound morphemes", and what these reveal about general properties that could, in principle, characterize any individual LI.

As an atom, an LI merges in the spine with a constructed syntactic representation (its complement). English bound morphemes additionally require a particular category to their left (Williams 1981 RHHR), i.e. they require second merge of a specific category. At transfer, LIs can be spelled out (i.e. past tense *–ed*), or not. The English little v_{cause} that merges with change of state complements famously lacks any phonology ([clean $[_v]$), as does the root question LI Q, which triggers T to C in English. This second merge requirement of bound morphemes is familiar: it looks just like what syntacticians have called the epp (Koopman 2002, 2005a, b), a requirement a head can have to build structure of a particular category (epp_{cat}). Thus the entry for English past *-ed* can be written as $epp_{[V]}$; v has epp$[_V]$, and Q has $epp_{[Tfinite]}$. Some LIs may require "phonological", i.e. [+ph] material in their Specs, a property which I will code as follows:

(1) $epp_{cat[+ph]}$

These Specs will end up containing [+ph] material; this is simply what being bound means.

It is in this sense that a phonological property can be "grafted" on the epp_{cat}. The epp forces a particular piece of structure, but in addition, it can further require the presence of phonological material in that category at spell-out.

As another example, finite T (or some head in the T region) and *'s* D both require a subject of the D category (epp_d): yet Spec TP can be silent as a result of wh-movement (*who did they believe—would sign this petition?*), but Spec DP may not (**who did you like —'s brother*).

For some LIs then, the specifier ends up containing pronounced phonological material at spell-out; others allow subsequent extraction. For the purposes of this paper, I simply code this distinction as follows, awaiting further understanding.

(2) a. T_{finite} epp_d
b. D_s $epp_{d[+ph]}$

Can [+ph] be further specified?

What Kinds of Phonological Properties Can Be Imposed on [+ph]?

As is well known, LIs (individual affixes) seem to be able to impose a variety of phonological properties. These are typical of suffixes (and perhaps never of prefixes). Since suffixes have a second merged element on their left, these heads have an epp structure-building feature.

Affixes can be sensitive to syllable structure, impose particular metrical structure, as well as minimal and maximal size requirements. For example, the spell-out of Korean affixes routinely depends on whether an affix follows a consonant or a vowel. Nominative is spelled out as *-i* after a consonant, but *-ka* after a vowel, hence spell-out needs to see the syllable structure of the item in the Spec.

Affixes sometimes impose a *minimum* size requirement, say at least two syllables. To meet such requirements, languages insert expletive materials. Sometimes however affixes seem to impose a *maximum size* requirement ("no larger than x"). For example, the English comparative *–er* is often said to merge with an A no larger than a 'light foot' (*happy-er vs *yellow-er, *intelligent-er*).[1]

How exactly should we understand "no larger than x"? As we will see, this notion cannot always be measured in terms of the phonological vocabulary, number of syllables or feet, or phonologically coherent constituents ('words'). As will be argued in this paper, there is a notion of maximum "phonological size" that is measured on a local syntactic output. I will argue that it is this notion that plays a crucial role in restricting the possible outputs of syntactic derivations. Restrictions on recursion thus are to be understood as representations that fail to converge because they violate properties of lexical items, in particular the maximum [+ph] size requirement.

[1]Throughout this paper, the question of interspeaker variability arises. Some speakers are perfectly happy with yellower, but others are not. This variability is expected (see Sect. 3 for further discussion), and should make fine predictions about correlating patterns of judgments and systematic interspeaker differences.

2.2 *More on Maximum Phonological Size and Restrictions on Recursion*

This section forms the background for the discussion of verbal complexes in Sect. 3, and establishes the following:

(3) (i) $epp_{cat[+ph]}$ can vary as to the maximum allowed number of syntactic nodes dominating the phonological form (notated as $epp_{cat[ph\ \mathbf{max}:(number)]}$ for an individual LI).
(ii) $epp_{cat[+ph\ \mathbf{max}:(number)]}$ leads to restrictions in recursion.
(iii) different LIs can set different $epp_{cat[ph\ \mathbf{max}:(number)]}$, which leads to messy surface patterns.

So here we are not directly interested in what is regular and beautiful, but rather in finding out where exactly the beautiful design can break down on the surface. Insofar as there is a unified theme here, it will instead inform the boundary conditions on the syntactic derivations that allow us to state these in a uniform way.

Let us start with two English bound morphemes: past tense *-ed* and adjectival *–ing*. Both (second) merge with a V_{cat} constituent, which must contain [+ph] material at spell-out, $epp_{V,[+ph]}$, yielding local structures like (4). Note that bare phrase structure labeling will be adopted everywhere, except for cases where confusion might arise.

(4) a. $[_T\ [_V\ [_N$father$]\ [_V$e$]]\ [_T$ed$]]$
b. $[_{`ing'}[_V\ [_V$melt$]\ [_V$e$]]\ [_{`ing'}$ing$]]$

While this example suggests that *-ed* and *-ing* each require epp_V, this is not sufficient to account for their differences. As the following examples show, the constituent that $[_T$ed$]$ merges with must be comparatively[2] small in size; *–ing,* on the other hand, seems to be able to merge with a bigger structure (taking compositionality into account):

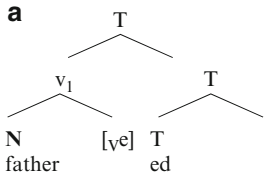
(5) a. *the person who $[[_A$sad$]\ [_V$seem$]$ ed$]$
b. $[[[_A$sad$]\ [_V$seem$]]$ ing$]$, (cf *good-looking, foul-smelling*)

If we look at the syntactic representations, (5a) is excluded with T *-ed*,[3] but fine with *-ing*. T *-ed* is only compatible with small constituents, but –ing is not restricted in this way.

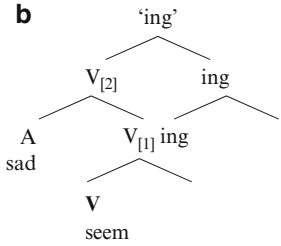
[2]Comparatively, because we know from decomposition of the VP domain that such transitive structures are in fact syntactically quite large.

[3]Richard Kayne (personal communication) finds *they homeschooled all their children, they wrongfooted us twice last night*, perfectly acceptable. This may imply that the structures in (5a) are different w.r.t. size and perhaps category. The general point made here is that there are differences in the relative sizes of structures and that restrictions on relative sizes can be an arbitrary property of individual heads.

(6) **a**



b



The size can be measured on the output of the syntactic structure by the following procedure:

(7) locate the most deeply embedded category with [+ph] material (boldfaced above); count the nodes that separate it from the sister of T or *-ing*, (annotated in the representations for convenience).

This gives a rough measure of depth of embedding, which will be sufficient for our purposes. What matters here is the difference in depth of embedding, not the exact number of words, though in many (but not all) cases, further embeddings will lead to more phonological material. Here is how this will be annotated on [+ph] (max[n])

(8) a. T_{ed}, $epp_{catV,[+ph],\ max[1]}$
b. ing, $epp_{catV,\ [+ph],\ max[2]}$

(8a) will filter out (5a), since it will not satisfy the lexical requirement. Other imaginable outputs are excluded as well, like piedpiping a big verbal projection for example. The net effect is that the output condition forces a derivation which obeys (8a), i.e. the verbal structure must be split up.

Next, we broaden the discussion, bringing in the head spelled out as the phrasal affix '*s* with $epp_{\ d\ [+ph]}$. This affix does not care so much[4] about the size and depth of embedding of phonological material in its Spec. It allows coordination of the second merged DP, which neither *-ed*,*-ing*, or plural allow, as well as possessor recursion:

(9) a. *he [$_V$[close [$_v$e]] and [$_V$open [$_v$e]]]-ed the doors every day
b. * [$_V$[$_V$sad seem] and [$_V$crazy look]]-ing
c. [$_{DP}$[$_{DP}$The king of England] [and [$_{DP}$the queen of France]]]'s offspring
d. [$_{DP}$[$_{DP}$John], [$_{DP}$Mary] [or [$_{DP}$Bill]]]'s house
e. [$_{DP}$[$_{DP}$[$_{DP}$my] father]'s friend]'s car

Coordinated structures are basic recursive structures, embedding a node of the same type under the mother node [$_x$ [$_x$] [and [$_x$]]]. (9a) and (9b) illustrate contexts

[4]Though speakers vary in their tolerance to right-branching relative clauses (e.g. %the queen that you adore's minister).

in which recursion fails, (9c–e) contexts where it does not. Regardless of what we say about coordination, the structures in (9a) and (9b) are immediately excluded by their [+ph max: n] settings: the number of nodes that dominate ph material in these examples necessarily exceeds the number in (7). The max size setting thus rules out coordination, and any type of recursion. LIs which lack such a setting, or which allow a much bigger size setting, like English's, allow recursion under coordination or other types of recursion.

[+ph max] is specific to individual LIs. It varies with the individual LI, as *-ing* and *-ed* show, and some LIs may lack such restrictions altogether. The settings must be established on the basis of primary data, and thus are expected to vary slightly between speakers and across regions.

They can also varies cross linguistically. The size restriction of English *-ed* is not shared by Japanese or Korean past tense Ts, which allow coordination and disjunction of the verbal constituents on their left, and behave in this respect like "phrasal affixes".

Another of our examples, English *'s*, which allows recursion, differs from the German head that licenses prenominal genitives, which does not. German prenominal genitives are largely restricted to bare proper names or pronouns (Longobardi 2001, p. 567), and coordination of these elements is not allowed. No such restriction holds for the postnominal genitive position, suggesting this is a particular property of a D head on the left edge of the DP, not a property of genitive case itself.

(10) *Marias sorgfältige Beschreibung Ottos*
Maria's careful description of Otto

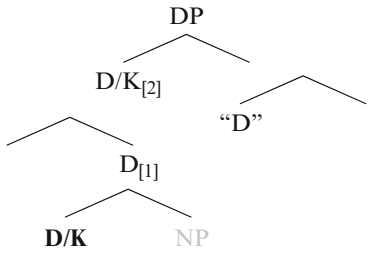
(11) *??Des Zeugens/*Dieser Frau/*Meiner Schwester/sorgfältige Beschreibung Ottos*
The witness's/this woman's/my sister's /careful description of Otto

(12) * *[Marias und Susies] sorgfältige Beschreibung Ottos*
Maria's and Susie's careful description of Otto

(13) Marias sorgfältige Beschreibung des Zeugen/ dieser Frau/ meiner Schwester
Maria's careful description of the witness/this woman/my sister

How can we capture this distributed restriction in German? Here only names and pronouns survive the derivation. These are the elements independently known to be associated with the D region. This makes the approximate structure in (14) a very reasonable candidate for the syntactic configuration at transfer to the phonology. If we consider the boldfaced D and count the number of nodes dominating the pronounced material, we find roughly the $\text{epp}_{\text{d [+ph max [2]]}}$:

(14)



The starred example in (11) violates the [+ph max size] of the epp of "D", regardless of the finer details. Inserting [+ph] material as the complement of D (i.e. pronouncing N) will obligatorily lead to additional hierarchical structure dominating N, and violate the [+max] setting. This may yield the impression that number of words or syllables could be relevant. I address this issue in Sect. 3, where I will show that the determining factor here must be the syntactic configuration. Similarly, coordination of names (12) or other recursions are excluded because they violate the max [+ph] properties of this particular German LI.

Under this view, it is expected that maximum phonological size can be set differently for different speakers and regions, as it must be deduced on the basis of primary data, mapping sound structures onto syntactic structures. Confronted with the examples above, one hears sometimes that there are varieties of German, or speakers of German who accept such sequences, and hence the data are somehow invalidated. Note that this cannot be taken to mean that speakers who have restrictions have bad judgments, or that judgments are unreliable. This is simply a consequence of the fact that speakers end up with different settings, reflecting their different linguistic exposures. Variability in max size is expected to correlate with distributional properties elsewhere in very precise ways for individual speakers, and exploring such correlations thoroughly will be important in the future to understand the finer details of the syntactic representations.

Finally, max [+ph] size requirements can be "grafted" on the epp of any LI, regardless of the height at which the latter seems to enter the derivation. Indeed, for some LI merged early in the derivation, it could be argued it is compatible with just a small phonological size because that is all that is present in the derivation at that point (assuming constituents are built up from small parts—cf. Sportiche's split D hypothesis (1998, 2005), Kayne's adpositions (2000, 2005)). It is important to point out in this respect that size restrictions routinely show up for LIs that are generally taken to be merged *high* in the derivation, like particular Ds or Cs. This seems to be the case for the German prenominal genitives discussed above, or, for example, the root C that hosts the finite verb in Dutch verb second.

2.3 When Max Size Is Set Differently for Individual LIs: English C, T and V

If individual LIs can have different max [+ph] associated with them, we expect to find distributional effects. Only those syntactic derivations in which the max size is respected will converge. Other in principle well-formed syntactic outputs, including recursive structures, will be 'filtered' out, because they will violate lexical requirements. Such factors seem to be at work in the distributional properties of English modals, finite verb forms of *have* and *be*, and the auxiliary *do*, versus all other verb forms, as we sketch below.

English root questions require T to C movement, driven by the need to satisfy Q, [epp$_{\text{Tfinite [+ph]}}$]. Within Bare Phrase structure, this epp property could in principle be satisfied by second merging any T constituent with C, subject to locality. However, merging TP will not converge in English root yes/no questions (though it will in superficial head-initial languages with final question particles). Instead, the English C_Q shows effects of a size restriction (related of course to Germanic T to C) with a small max size 2: [[$_{\text{T[1]}}$**V T**] Agr$_{[2]}$] [C]. Only those Vs which are merged highest in the Cinque hierarchy (1999), i.e. the tensed modals, the last resort auxiliary *do,* all finite instances of *be*, and finite forms of perfect *have*, survive in this environment. If all other English finite verbs are necessarily "bigger", i.e. have further nodes embedding them because of the syntactic hierarchy, they will never survive in this C environment.

But English verbs are compatible with finite T ($T_{[hab]}$ or $T_{[past]}$). This is non-problematic, as in this environment, only the [+ph] size requirement of these Ts (wherever these might be merged) needs to be satisfied: C does not enter into the picture. It is only when T is forced to merge with other heads, like Neg and Focus which, perhaps not accidentally, happen to share the properties of $C_{+Q,}$ that we find the size restriction, because now the [+ph] max of the epp of Neg and Focus come into play. This view attributes much of the mystery of the distribution of Vs in English to an independently motivated and necessary property of the epp. Specific phonological knowledge, stored as part of the epp, can filter out otherwise perfectly well-formed syntactic structures. Such representations do not converge because they violate particular lexical properties of the syntactic atom.

Under the single computational engine, any type of LI with an epp property could have [+ph max] restrictions associated with it. These are expected to vary between speakers (as primary data vary), regions, and languages, and to be instrumental in the slow, incremental, and LI-specific induced syntactic drifts and changes.

Against this background, we now turn to the question whether [+ph max] could yield a further understanding in specific cases of recursion, and what variability we could expect to find and not find. The remainder of this paper explores these issues for verbal complexes in Dutch and Hungarian, which provide a particular window into recursion restrictions, how these arise and what they may tell us about

the grammar. Here in turn we can find support for specific theories of syntactic structure building, as the outputs of the derivations yield the structures on which the relevant phonological restrictions can be simply stated.

3 Verbal Complexes: Restrictions on Recursion and Variability

Here we turn to recursion in the domain of verbal complexes in Dutch, German, and Hungarian, drawing heavily from Koopman and Szabolcsi (2000), and Koopman (2002).

In (standard) Dutch, recursion of infinitives is restricted on the left of the finite verb (one recursion is fine, but not two). To the right of the finite verb, sequences of three or four embedded infinitives are routine. German infinitives, on the other hand, happily recurse to the left of the finite verb. This suggests the effects of a particular LI in Dutch with a [[+ph],max] restriction, which the equivalent German LI may simply lack. If so, we expect to also find intermediate cases of [[+ph],max] restrictions, where a slightly bigger size is allowed, say, two recursions are fine, but three are excluded. As we will see below, this state of affairs seems to hold of a particular variety of Hungarian.[5]

In order to get to the relevant syntactic output structures, the discussion will need to become more technical and precise. Indeed, as the simpler examples discussed so far show, it is the syntactic output structures that provide insight into how to understand the recursion restrictions found, and these will enable us to investigate further predictions about the actual patterns of variation. If successful, the study of these seemingly exceptional and messy patterns holds valuable information about the form of the output of the syntactic derivations, and hence about the way these outputs must have been built by the derivations.

3.1 Dutch Verbal Clusters and Restricted Recursion

In (standard) Dutch, an infinitival verb can appear to the left or right of a finite verb. However, Dutch verbal clusters show restrictions on recursion of infinitives to the left of the (finite) verb, but not to the right. Note that these variable orders do not correspond to any interpretative differences. They seem, as Jean Roger Vergnaud once told me, "to be a pure reflection of the workings of the computational system". The surface patterns are given below (with the terminology used by Koopman and Szabolcsi (2000) in italics). Numbers refer to the hierarchical order, with 1 (*wil* 'want') selecting 2 (the infinitive *zwemmen* swim) as its complement:

[5]Other varieties of Hungarian appear to lack such restrictions.

(15) a. . . . zwemmen wil *Inverted orders/Roll-up*: 21
. . . swim.inf want+T
b. . . . wil zwemmen *English order*: 12
. . . want swim.inf

However if 2 itself selects for an infinitival complement (3), only the 123 order is acceptable; 321 is excluded, as are the other four possible orders. Why would this be the case?

(16) a. *. . . zwemmen willen zal *Inverted orders/Roll up: *3-2-1*
swim.inf want.inf will
b. *. . . zal zwemmen willen **132*
will swim.inf want.inf
c. *. . . zwemmen zal willen *Climbing orders: *312*
swim.inf will want.inf
d. *. . . zal willen zwemmen *English orders: 123*
will want-inf swim.inf

As the patterns in (15) show,[6] infinitivals can form embedded 21 orders, but an infinitive cannot be to the left of another infinitive (that selects for it), even when separated by a finite verb. These patterns are exceptional from a Dutch-internal perspective, as well as a micro- and macro-comparative perspective.

Within the broader Dutch paradigm of complex verbs, the starred 312 patterns are exceptional: only infinitivals disallow this pattern, particles, adjectives, bare nouns, directional PPs, and participles all yield the 312 (or for that matter 4123, 51234) patterns[7]. An example with a participle is shown below:

(17) . . . geschreven *wil hebben* 3_{Part} 1_{fin} 2_{inf}
ge.write.part want have.inf

Second, while these strings are excluded in standard Dutch, they do occur in certain Dutch dialects (cf. Barbiers 2002). Third, both 312 and 321 patterns surface in similar clustering languages like German and Hungarian (abstracting from the position of the tensed verb in Hungarian). In particular, take the 312 pattern in (16c): this order shows up in all German varieties with *zu*-infinitivals and participles, as well as in the so-called IPP environment in Southern varieties of German (Den Besten and Edmondson 1983; Wurmbrand 2004).

[6]The *213 pattern is left out of consideration here. Barbiers (2002) argues this order is universally impossible. Koopman and Szabolcsi (2000, p. 173) list all the conditions that must hold at the same time for a derivation to even yield this pattern. This leads to the expectation that this order will surface very rarely.

[7]I have nothing to say about this mysterious fact. It could be a historical accident or perhaps it is not. It seems to also be found in English in the form of the double-ing constraint (Ross 1972). See Appendix 1 for further discussion.

(18) a. *ohne singen zu wollen* $3_{inf}\ 1_{zu}\ 2_{inf}$
without sing.inf to want.inf
'without wanting to sing'
b. *singen hat wollen* $3_{inf(ipp)}\ 1_{fin}\ 2_{inf}$
sing.inf has want.inf
'. . . has wanted to sing'

This pattern is also found in neutral clauses in Hungarian (clauses without any focus or negation) (Koopman and Szabolcsi 2000: p. 74 (108)):

(19) *Dolgozni fogok akarni* $3_{inf}\ 1_{fin}\ 2_{inf}$
work.inf will-1sg want.inf
'I will want to work'

But, within Hungarian dialects, there seems to be one region in which such structures show further restrictions on recursion: while 312 is fine, adding another infinitive clustering predicate in this dialect yields *4123. (cf. Sect. 3.3 for further discussion.)

How do these restrictions fall out? The proposal here is that these can be accounted for in a unified way: they reflect different settings of $epp_{[[+ph]max]}$ calculated on the output of the syntactic derivation in a specific local configuration.

The next sections introduce the basic background for the syntactic derivations, just enough to show how the restrictions on recursion follow from the [[+ph], max] setting of a specific linguistic atom. The interested reader is referred to Koopman and Szabolcsi (2000) for fully specified derivations.

3.2 Verbal Clusters: What Must Be Captured and How to Capture It

Starting from the general properties that any analysis of verbal clusters should capture, we outline the particular implementation given by Koopman and Szabolcsi (2000). This analysis is, as far as I know, the only theory which provides insight into how to capture the variable orders and deal with the restrictions on recursion. This will allow just enough detail to focus on the output of the syntactic representations that underly the different orders at the point of transfer to phonology. These can be ordered in terms of [max size], which in turn allows the relevant restrictions to be stated quite simply. The 312 orders will turn out to be particularly important and revealing, as these allow us to test if syntax indeed provides the vocabulary that is responsible for stating the restrictions. Then we discuss suggestive data that show that the predictions of variation made by these representations are indeed borne out.

What an Analysis Should Achieve

1. Analyses for verbal clusters should extend beyond infinitives and participles. Verbal complexes with infinitives and participles are part of a more general pattern of complex verb formation (for example, Dutch verb particle constructions, e.g. *opbellen* 'up call', bare adjectivals, e.g. *schoon maken* 'clean make.INF', bare nominals, e.g. *piano spelen* 'piano play.INF', directional small clauses, e.g. *naar huis gaan* 'to home go.INF', and other small clauses). Such complexes are ubiquitous in clustering languages.
2. Analyses should account for the fact that the two parts of a cluster can be manipulated separately, yielding discontinuous surface constituents (for example, Dutch *op te bellen* 'to call.INF up', verb second *bel hem nu op* lit. 'call him now up').
3. The different surface orders should fall out from the derivations, without any additional stipulations.
4. (At the very least) the following two properties of the relevant verbs should be captured: first, the verbs participate in cluster formation (not all verbs do), and second, their individual needs must be satisfied (some verbs select for infinitives, some for participles, some for *te* complements).
5. Analyses should capture the distribution of the (bare) infinitival, *te*-infinitival and participial morphology.
6. Analyses should yield insight into where and how languages differ.
7. And finally, they should yield insight into the restrictions on recursion, and do so by using independently motivated mechanisms.

Koopman and Szabolcsi (2000)

Koopman and Szabolcsi (2000) propose a unified analysis attempting to achieve these goals, with movement (second merge) the only means to satisfy the lexical properties locally. The analysis is summarized below. Note that within bare phrase structure, there is no difference between head and phrasal movement, the only distinction will be one of size.

1. We stipulate that there is a general complex verb formation configuration that governs all complex verb formation. This is mediated by a head (arbitrarily named V+), which merges with V as its complement, and requires a small clause to second merge with it. This yields a configuration in which the V complement can in principle be separated from the small clause in V+, depending on what attracts it. But nothing in principle prevents them from internal merging (i.e. moving) together as a unit, and both possibilities are attested within the same internal grammars. Depending on which option is taken, the surface patterns will be different.
2. Clustering verbs (restructuring verbs) form complex verbs (again a stipulation). This means they consist of V+ and V, with V+ attracting a V+ from the complement (i.e. forming a complex verb). The derivation must succeed in

satisfying the configuration outlined above. Given locality of selection, a V+ constituent must undergo second merge with the V+ of the restructuring verb at some stage in the derivation. This can be achieved either by V+ extraction from the complement, or by pied-piping, subject to the extension condition (Chomsky 1995).

3. Clustering verbs select for particular types of complements (infinitives, participles, *te*, etc.). Note that the single computational engine forces the projection of infinitival morphology (Inf), participial morphology, and *te* to be in the (narrow) syntax: there are no other places to build structure.
   (a) Assuming Inf first merges with V+, there are two options to satisfy the needs of Inf morphology (it selects for V as a specifier): either V second merges with Inf (stranding V+), or V + second merges along with V. Both options are available in the grammars of the three languages, and lead to different surface constituencies and orders.
   (b) Infinitival complements are always "CPs": C needs to be typed as infinitival: this forces Inf to merge with C.
4. Surface constituency is the result of external and internal merge (this is all that is available), and derivations obey the extension condition and locality. In the course of the derivation, there are very few options[8]: they concern whether the Spec extracts (splits the structure into smaller parts), or whether pied-piping occurs (keeps local parts together). Spec extraction keeps the derived structures small, but creates discontinuous structure, pied-piping keeps local parts together, but yields heavy phonological constituents.
5. Individual heads can have what we called complexity filters associated with them; here these are renamed as epp[[+ph] max]. These are an important locus of variation, both between speakers and between languages, and these are responsible for reining in recursion.

The Output of the Syntactic Derivation Yielding 12, 21, 123, 312 and 321 Orders

Given these derivations, we can examine the linear orders, and match these to their output syntactic structures (elements will be pronounced in positions where all properties have been satisfied). Thus, we can zoom in on the particular configurations that yield 21, 312 or 321 structures (which were of interest because of the restrictions on recursion). These structures can be arranged in terms of the [[+ph] max] size. This ranges from 0 in Dutch, for the 12 and 123 patterns (there is no local phonological material present at spell-out—the infinitive is pronounced at the edge of the infinitival CP, and distributes like a CP), to the smallest number *n* of possible

[8]Other choices leading to variability depend on the height of merger of functional material and order.

nodes, which gives the 21 orders, to $n + 1$, the next smallest possible amount of structure embedding, which is associated with the 312 pattern, to the maximum size in this location, $(n + 1) + x$, which gives the 321 pattern. The following table gives the possible patterns for Dutch.

(20) Dutch: V+[epp, Inf[[+ph] max]]

	12	123	21	312	321
	+ph max:[0]	+ph max:[0]	+ph max:[n]	+ph max: [n+1]	+ph max [[n+1]+x]
epp_{inf} [+ph max: [0-n]]	√[9]	√	√	*	*

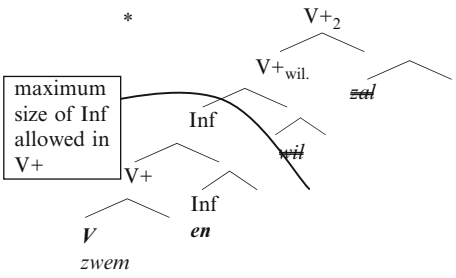
What is relevant here is that the output of the syntactic derivations provide the vocabulary to state the restrictions, reflecting an independently necessary algorithm which captures the sensitivity of the distribution of phonological material to depth of syntactic embedding. Indeed, this is expected if syntactic structures are directly transferred to phonology.

More on the 312 Order

The 312 orders are particularly important. Under the current analysis, these are excluded because of a [+ph] max size associated with the category Inf, as shown below.

(21) * . . . *zwemmen zal willen*
swim.inf will want.inf
' . . . will want to swim'

(22)



[9]Suppose there is a language that is just like Dutch, but where the epp of V+ requires [+ph], i.e. the presence of phonological material in V+. This will rule out *V1 V2 orders, but allow for 312 orders, (found in some German varieties (Wurmbrand 2004) (with 312 occurring in the IPP context.

As expected 312-forms are possible in certain contexts in German and in neutral contexts in Hungarian: this follows from the idiosyncratic absence of a [[+ph] max] restriction.

This particular derivation yields an output in which an infinitive is syntactically embedded in a specifier. On the surface however, it just looks like there is a simple infinitive. So access to the syntactic structure must be the determining factor for ruling out this pattern.

Similarly, for certain Dutch verbs, the infinitival and participial forms are indistinguishable segmentally and prosodically. Yet, these forms are strongly excluded when the syntax calls for an infinitive, but fine in contexts where the syntax calls for a participle.

(23) a. Dat hem toch zoiets (*overkomen) zou moeten/ zou moeten overkomen!
that him PART so-something (overcome.inf) would must.inf/would must.inf overcome.inf
'That something like this should have to happen to him!'

b. Dat hem toch zoiets overkomen zou zijn/zou zijn overkomen!
that him PART so-something overcome.part would be /would be overcome.part
'That something like this should have happened to him!

Thus, to exclude the 312 context, reference to the syntactic category infinitive is crucially necessary, and that is exactly what the present proposal expresses.[10]

These examples are important in other ways as well; they show that purely surface prosodic constraints play no rule in excluding these examples, though they might look relevant in other cases. Under the account pursued in this paper, the contrast between (23a) and (23b) is entirely expected as it is dependent on the depth of syntactic embedding dominating Inf, which plays a role in accounting for other excluded cases as well.

3.3 Do Grammars Really Count? Where Embedding Twice Is Fine, but Thrice Is Too Many

If the proposal here is on the right track, we should also find cases of languages or dialects which have a slightly larger cut off for recursion, and allow recursion twice, but not a third time. That is, we expect to find grammars that allow a limited amount of counting. What would such a case look like? As Koopman and Szabolcsi (2000, p. 124) discuss, in the context of Cinque's (initial) restructuring proposal,

[10]See Koopman (2002) for further discussion of problems with the prosodic account in Den Besten and Broekhuis (1989), and the processing account in Broekhuis (1992).

some Hungarian speakers simply "do not accept climbing across two infinitives, regardless of their relative order" (Koopman and Szabolcsi: p. 124 (31) and (32)):

								Hungarian "B"	Hungarian "A"
(24)	a.	Haza	fogok	akarni	menni		4-1-2-3	OK	OK
		home	will-	want.inf	go.in				
		'I'll want to go home'							
	b.	Haza	fogok	akarni	kedzeni	Menni	5-1-2-3-4	OK	*
		home	will.I	want.inf	begin.inf	go.inf			
		'I'll want to begin to go home'							

Within the perspective of the current paper, these facts immediately suggest an answer: in the 4123 configuration in (24a), 4 (a particle) formed a complex verb with 3, which subsequently extracted and combined with Inf, 3 is embedded under 2 which has subsequently extracted, etc., ultimately yielding the representation: [[[**4**] ~~3~~] ~~2~~] ~~1~~] [**1** [**2** [**3**]]]. But suppose that for some dialect, (which turns out to be spoken in the Széged area, see Szendrői and Tóth (2004), this output also sets [+ph max] of the LI that has attracted the remnant constituent containing 4. This rules in (24a) but rules out (24b), as the additional cycle will yield a violation of [+ph max].

This in turn leads to predictions about the correlations we expect to find. Restrictions on recursion come about as a special phonological property of the epp. These should show up only in cases where V+ is filled, and be sensitive to the size of the constituent at the end of the derivation. Within the context of Hungarian, where the three possible orders (roll up, climbing, and English orders) are allowed by all speakers (albeit in different contexts), we expect the judgment patterns in (25), based on the first column, where V1 has extracted to T. Of particular relevance are the (c) patterns of Hungarian Széged.

(25) a. If V1 [V3 V2 ~~V1~~]] is √ *then* √: V3 V1 V2 *and* √ V1 V2 V3
b. If V1 [V4 V3 V2] is √ *then* √: V4 V1 V2 V3 *and* √ V1 V2 V3 V4
c. **If V1 [V4 V3 V2] is *** ***then* *: V4 V1 V2 V3** **but √ V1 V2 V3 V4**

At this point, the actual correlating patterns found within speakers have not been investigated, but the following data from Szendrői and Tóth (2004) are suggestive enough to warrant further inclusion here. In their questionnaire-based study of the regional distribution of verbal complexes in Hungarian, Szendrői and Tóth (2004) find that speakers in this particular region neither allow climbing nor four verb inverted clusters, as expected. Judgments on English orders improve comparatively as expected, Szendrői and Tóth however suggest that these should not be considered acceptable in this area either, and state that "speakers of this region seem to have a general aversion to verbal clusters".

This conclusion appears to be too hasty, as we need to understand what to measure improvement against. In fact, their data show the predictions go in the right directions. The raw questionnaire data (on a three point scale) show a 100 % rejection of climbing and inverted orders, but a 20 % improvement or acceptance

of the English order (their Fig. 10). This may look like a minor effect, but if we look at the acceptance rates of such cases in the overall study we see the same pattern. Throughout the Hungarian region, there was a very high number of negative answers for three or four verb clusters in the English orders (40 % no, 30 % maybe, 30 % yes) with inverted orders degrading 20 % (60 % no, 20 % yes, 20 % maybe). Given the fact that speakers in the Szeged region in question start out with 100 % no for inverted and climbing orders, an 80 % no, which is a 20 % improvement. This might well be all that is expected for English orders anyway. Interestingly, throughout the Hungarian region, the acceptability rates of the three orders with 3/4 clusters follow the predictions: full roll-up inversion is consistently judged worse than climbing orders, and English orders are judged most acceptable. This is expected from the thesis in this paper, where maximal phonological size is measured on the output of syntactic structures, with fully inverted structures of the biggest phonological and syntactic size, climbing structures next on the scale, and English structures lightest. These data then seem to make a reasonable case for the suggestion that grammars indeed must allow a limited amount of counting, where this is restricted to matching phonological material with syntactic outputs as a function of the epp[+ph max] of specific LIs. While further investigation should confirm if the predictions about distributions indeed hold up, it is remarkable that the proposed syntactic derivations together with independently motivated interface condition that is sensitive to structure dominating phonological material not only create order in understanding where and why recursion fails.

4 Conclusion

This paper focused on how to understand recursion restrictions given current theoretical understanding. It argues that such restrictions are to be accounted for by independently necessary phonological properties, which can be "grafted" on the structure building epp. These have the effect of reining in recursion. We discussed, in particular, cases in which recursion is restricted in the domain of verbal complexes. Here, specific syntactic derivations provide the vocabulary to understand particular idiosyncratic cases of recursion, which result from the sensitivity of phonological material to syntactic embedding in highly localized contexts. The epp of any atom thus serves as a repository of the finely grained knowledge speakers have of the phonological properties associated with local syntactic environments. If this hypothesis is on right track, recursion restrictions are expected to be limited to particular syntactic configurations (not in first merge but second merge cases). They are expected to not be absolute, but to vary according to region or perhaps generation, as the [+ph max] setting is set on the basis of primary input data.

In effect, then, the study of the messy and variable patterns leads to factoring out the general workings of syntax from the specific interactions with phonological insertion. But this is only possible in light of fully explicit and detailed syntactic

derivations since only these will lead to insights into the treatment of variability and specific predictions that can be verified or not.

While the paper focused on the [+ph max] restrictions and their relation to recursion, this study can start to make some sense of the data reported in Bresnan and Ford (2010). In their study of double object construction in American and Australian English varieties, Bresnan and Ford find that speakers of each variant have different probabilistic knowledge of the constructions that corresponds to corpus data (where available). Importantly, in Australian English but not American English, the length and phonological weight of the first object in the double object construction plays a significant role. Within the present paper, this suggests a different settings of the [+ph max] settings for the head hosting the first object, with Australian English allowing a small max, and American English a much bigger one. This looks comparable to the difference between German pronominal genitives and English pronominal genitives, or the difference between the different sizes Japanese T and English T can host (Sect. 2.2). This may reflect an absolute size restriction, or statistical knowledge about with the [+ph] properties associated with the epp, i.e. about particular phonological shapes. Thus, the [+ph] properties grafted on the structure-building epp could be the very locus where all such knowledge is represented and stored.

Appendix A: A Possible Linearization Account for the Recursion of Infinitives?

We add here a short discussion of Norvin Richards (2006) linearization account. Richards Proposes a general constraint on linearization, which imposes distinctness of linearization of categories within the same phase, a kind of modern incarnation of the OCP, and applies it to doubl-ing. Adapting parts of Kayne's (1994) LCA, his proposal in essence prohibits two categories within the same phase from being spelled out, because they would yield a conflicting linearization statement. He applies this to a number of different phenomena (distinct markings on DPs, the doubl-ing filter (Ross 1972, but see Koopman 2002 for an explicit proposal along the lines in this paper). Applied to Dutch, this proposal would prohibit the linearization of two infinitives within the same phase, but not across a phase boundary. It is easy to adapt Richards (2006) to Dutch, given the syntactic analysis developed in Koopman and Szabolcsi (2000) and outlined here. Indeed, inverted infinitives end up occurring in the same V+ constituent (hence within the same phase), but infinitives in the VT1 Vinf2 Vinf3 order are each in CPs, hence separated by a phase boundary $[_C\ V_{inf}\ [_C\ V_{inf.}$. This would allow some understanding as to why Inf is subject to the restriction on recursion but other categories are not, which under the account in this paper is purely a historical accident. However, the proposal does not extend (easily) to any of the other observed and excluded patterns. It will not extend to exclude the 3 1 2 pattern with infinitives in Dutch (**zwemmen wil kunnen*), as here the infinitives

do not seem to be in the same phase as the selecting infinitive. Nor will it allow a simple understanding of variation, i.e. what happens with Dutch dialects or speakers that allow such patterns, or with German and Hungarian speakers? How do we let the right cases in? If Richards needs Koopman and Szabolcsi (2000) to understand Dutch, the problem then is how to allow German and Hungarian which allow surface constituents of this type. Richards proposal could force a double structural analysis where preverbal infinitives in German and Hungarian are or can be in their own CPs or within smaller constituents, but this would lose all the basic insights of Koopman and Szabolcsi's analysis (see Koopman and Szabolcsi for an argument against this option), and any hope to model the observed variability between individual grammars. This analysis will have nothing to say about the Hungarian cases where it seems you can invert twice but not three times, and where the restriction on recursion does not seem sensitive to a particular category, just to dept of embedding in a specific location. And finally, it will have nothing to say about other cases of restrictions on recursion, and the general notion of [+ph] size that is independently needed, and that seems widely applicable.

References

Barbiers, S. (2002). Book review: Koopman, H. and Szabolcsi A. 2000. *Verbal Complexes: Journal of Comparative Germanic Linguistics, 6*, 53–79.

Bresnan, J., & Ford, M. (2010). Predicting syntax: Processing dative constructions in varieties of American and Australian english. *Language, 86*(1), 168–213.

Broekhuis, H. (1992). *Chain government: Issues in Dutch syntax*. Leiden: HIL.

Chomsky, N. (1995). *The minimalist program*. Cambridge, MA: MIT Press.

Cinque, G. (1999). *Adverbs and functional projections: A cross-linguistic perspective*. New York: Oxford University Press.

den Besten, H., & Broekhuis, H. (1989). Woordvolgorde in de werkwoodelijke eindreeks. *GLOT, 12*, 79–137.

den Besten, H., & Edmonston, J. (1983). The verbal complex in Continental West Germanic. In W. Abraham (Ed.), *On the formal syntax of Westgermania* (pp. 155–216). Amsterdam/Philadelphia: John Benjamins Publishing Company.

Kayne, R. (1994). *The antisymmetry of syntax*. Cambridge, MA: MIT Press.

Kayne, R. (2000). *Parameters and universals*. New York: Oxford University Press.

Kayne, R. (2005). *Movement and silence*. New York: Oxford University Press.

Koopman, H. (2002). Derivations and filters. In A. Alexiadou, E. Anagnostopoulou, S. Barbiers, & H. Gaertner (Eds.), *Dimensions of movement: From features to remnants* (pp. 151–189). Amsterdam: Benjamins Publications.

Koopman, H. (2005a). On the parallelism of DPs and clauses in Kisongo Maasai. In A. Carnie (Ed.), *Verb first* (pp. 281–303). Amsterdam/Philadelphia: John Benjamins Publishing Company.

Koopman, H. (2005b). Korean (and Japanese) morphology from a syntactic perspective. *Linguistic Inquiry, 36*, 601–633.

Koopman, H. (2006). In defense of the Spec head configuration. In C. Boeckx (Ed.), *Agreement systems* (pp. 159–199). Amsterdam/Philadelphia: John Benjamins Publishing Company.

Koopman, H., & Szabolcsi, A. (2000). *Verbal complexes* (Current studies in linguistics 34). Cambridge, MA: MIT Press.

Longobardi, G. (2001). The structure of DPs. In M. Baltin & C. Collins (Eds.), *The handbook of contemporary syntactic theory* (pp. 562–604). Malden/Oxford: Blackwell Publishers.

Richards, N. (2006). *A distinctness condition on linearization*. ms, MIT. http://web.mit.edu/norvin/www/papers/Distinctness2.pdf

Ross, J. (1972). Doubl-ing. *Linguistic Inquiry, 3*, 61–86.

Sportiche, D. (2005). Division of labor between reconstruction and merge: Strict locality of selection and reconstruction paradoxes. http://ling.auf.net/lingBuzz/000163

Szendrői, K., & Tóth, I. (2004). Hungarian verbal clusters: Results of a questionnaire survey. In K. Kíss & H. van Riemsdijk (Eds.), *Verb clusters. A study of Hungarian, German and Dutch* (pp. 87–121). Amsterdam/Philadelphia: John Benjamins Publishing Company.

Williams, E. (1981). On the notion 'Lexically related' and 'Head of a Word'. *Linguistic Inquiry, 8*, 101–139.

Wurmbrand, S. (2004). West Germanic verb clusters: The empirical domain. In K. Kíss & H. van Riemsdijk (Eds.), *Verb clusters. A study of Hungarian, German and Dutch* (pp. 43–87). Amsterdam/Philadelphia: John Benjamins Publishing Company.