How to merge a root

1. Introduction[*]

The main goal of this paper is to show that four central stipulations—or axioms—of currently prevalent theories of roots can be derived in a principled manner from the theory of Merge. The four stipulations in question are the following: (a) roots have no grammatical features, (b) roots have no syntactic category, (c) roots are defined structurally rather than lexically, and (d) roots are dominated by functional material (rather than the other way around). The theory of Merge we put forward builds on Jaspers (1998), Fortuny (2008), Zwart (2009a, 2009b, 2010), and others in assuming that this operation is inherently asymmetric. We show that as a by-product of this asymmetry, the first merge operation in each cyclic domain[1]—called Primary Merge in this paper[2]—creates a radically empty structural position at the bottom of the structure in which a root can be inserted at the level of Vocabulary Insertion. The four abovementioned properties of roots can then be shown to follow straightforwardly from this theory.

This paper is organized as follows. The next section introduces—and where necessary, provides new supporting evidence for—the four properties of roots under discussion. We show that while all four of them are empirically well motivated, they do not follow from anything in the theory and hence essentially have to be stipulated. Section three introduces the theory of asymmetric Merge and discusses the special position occupied by Primary Merge in such a system, while section four shows how the four central properties of roots follow without any additional assumptions from the theory outlined in section three. Section five explores a number of theoretical consequences of our proposal. We show that the theory of roots put forward here leads to a model of the grammar in which all non-complements are spelled out first, in a separate derivation, until finally the root derivation is constructed. We further point out that although our analysis is compatible with core assumptions about Vocabulary Insertion in Distributed Morphology, it leads to an empirically more adequate insertion mechanism. Section six sums up and concludes.

2. Four axioms about roots

2.1 Introduction

This section introduces the four axioms about roots under discussion here (see in particular Halle and Marantz 1993, Harley & Noyer 1999, Borer 2005a, 2005b, 2009a, 2009b, 2013). About three of them we are fairly brief, as the arguments in support of these claims are well-known (see the references just mentioned) and hence need not be reiterated here. The fourth one, however, i.e. the fact that roots have to be defined structurally rather than lexically (see section 2.4), we discuss in more detail, as this is one of the areas where existing theories of morphology take a different stance. We present new evidence from word formation in Dutch supporting the hypothesis that roots have to be defined structurally.

2.2 Roots have no grammatical features

As discussed in detail by Borer (2005a), open- and closed-class lexical items differ considerably in the degree of flexibility they allow in their interpretation. For example, a lexical item such as the English word *stone* can be used in a wide variety of ways, some nominal and some verbal. A handful of them is illustrated in (1).

(1) a. I've got a stone in my hand.

b. There's too much stone and metal in this room.

c. They want to stone this man.

d. Billy-Bob should lay off the weed; he's always stoned.

The first two examples show that *stone* can be used both as a count noun ((1)a) and as a mass noun ((1)b), while in (1)c it is a transitive verb and in (1)d one that is obligatorily passive. As soon as functional material is added to this root, however, the interpretation becomes completely rigid. A structure such as *three stones*, which contains plural marking and a cardinal,[3] is always and only interpreted as a count nominal expression; it can neither function as a mass DP, nor as a verbal element. More generally, while substantive formatives are extremely malleable and can be coerced any which way subject only to the extent of our imagination,[4] functional ones are very rigid in their denotation and any attempt to tweak it leads to ungrammaticality rather than uninterpretability. For example, **three much stones* is illicit as it is both marked as a mass nominal expression by the functional vocabulary item *much* and as a count nominal expression by the functional vocabulary item *three* and via plural marking.

The absence of grammatical features thus constitutes the first property of roots under discussion here. In the context of this paper, it is worth pointing out that while this claim provides a straightforward account for the difference in interpretive flexibility between substantive and grammatical formatives, it does not itself follow from anything in the theory (see also below, section 2.4 for more discussion); it remains a stipulation.

2.3 Roots have no syntactic category

The second property of roots follows more or less directly from the first one. If a root has no grammatical features, the logical consequence is that it has no syntactic category either (cf. the examples in (1)). This point of view is further corroborated by two lines of reasoning. First of all, it is becoming increasingly clear that a large number of tasks—if not all—traditionally ascribed to (the categorial characterization of) roots, in particular in terms of argument licensing (agreement, case, thematic roles), is in fact performed by (temporal, aspectual, event-introducing) functional projections (cf. Marantz 1997, Borer 2005a,b, 2009b, Adger 2011). The sole function of the root is to add conceptual meaning to the structures built by syntax, but for this it does not need to have a syntactic category.

The second reason for not assigning category labels to roots is that it introduces a large degree of redundancy into the system (Borer 2005a:20). Suppose the word *stone* was categorized either as N or as V. One would then still have to stipulate that the noun *stone* can only merge with D, while the verb *stone* only merges with T. In more technical terminology, D selects for (or checks the categorial features of) N(P) and similarly for T and V(P), thus effectively leading to a reduplication of the nominal/verbal characterization of this projection (see Doetjes 1997 and Grimshaw 2009 for a proposal along these lines). In the approach adopted here, however, an acategorial root that merges with D is interpreted as nominal and one that merges with T is interpreted as verbal.

Summing up, there are considerable empirical and theoretical advantages to adopting the idea that roots are acategorial. Ideally, however, one would like to derive this property from more fundamental primitives of the theory, a goal which neither Distributed Morphology nor Borer's Exo-Skeletal Model achieves at this point.

2.4 Roots are defined structurally, not lexically

As pointed out in section 2.1, this is an issue with respect to which there is disagreement among current formal theories of morphology. We show that a crucial factor in this debate is the question of whether vocabulary items—including roots—are inserted early or late. In the former case roots have to be defined lexically, while in the latter a structural definition is called for. This section points out a correlation between the way roots are defined and their point of insertion, and provides new evidence from Dutch in support of the late insertion approach. The conclusion will be that roots are not marked as such in the lexicon, but that they correspond to a particular position in the syntactic structure.

2.4.1 Roots that are inserted early are defined lexically

Suppose the lexical item *stone* was inserted at the very start of the syntactic derivation. In that case, there is only one way to account for its extreme malleability (see above, section 2.2), i.e. by stipulating that this lexical item itself has no grammatical features.[5] In this respect it would differ from functional items such as *many* or *the*, which are inherently marked for [+count] and [+definite] respectively. More generally, the distinction between roots and non-roots would be made in the lexicon: roots are lexical items without grammatical features, whereas non-roots are lexical items with grammatical features. Whenever a root is merged into the derivation, its (conceptual) meaning can be coerced any which way by the syntactic context, but when a non-root is merged, its grammatical features determine whether it can be legitimately inserted or not—and if not, the result is ungrammaticality, not uninterpretability.

The most explicit advocate of the lexical definition of roots is Borer's (2005a,b, 2009a,b) Exo-Skeletal Model (henceforth XSM). In this theory vocabulary items come in two varieties: lexical ones (henceforth LVIs)[6] and functional ones (FVIs). The former correspond to open-class items, the latter to closed-class ones. LVIs do not bear any grammatical features, and their semantics is malleable and dependent on the syntactic structure in which they are inserted. FVIs on the other hand are marked for grammatical features and have a rigid and fixed denotation.

Borer proposes that phonological indices[7] of vocabulary items (henceforth VIs) are inserted early, i.e. in Narrow Syntax. As a result, an FVI interacts with the syntactic derivation via its grammatical features, whereas an LVI does not bring any such features into the structure. Each time such a featureless VI is merged, a root is created. This means that roots are defined lexically in the XSM; it is the absence of grammatical features on LVIs that makes them into roots.

Summing up, under a lexical definition the relevant dividing line between roots and non-roots is situated in the lexicon. What distinguishes a root from its functional structure is a lexical property; the former is the result of merging a featureless VI, the latter results from merging a VI with grammatical features. As such, there is a strict division between the two classes of VIs.

2.4.2 Roots that are inserted late are defined structurally

A key innovation of Distributed Morphology compared to preceding morphological theories is the so-called Late Insertion Hypothesis (cf. Harley & Noyer 1999).[8] It concerns the idea that the phonological expression of syntactic terminals is provided only post-syntactically, in the mapping to PF. In other words, syntax only manipulates abstract bundles of grammatical features, not actual vocabulary items. Given that roots do not introduce any such grammatical feature bundles, Late Insertion-based models make a distinction between root and non-root (or functional) *terminal nodes*. That is, there are specific positions in the syntactic structure that will serve as the insertion site for roots at the level of Vocabulary Insertion. These positions are characterized by the absence of grammatical features and as such they do not play any active role in the syntactic derivation. The way in which this intuition is usually implemented is by merging the feature [Root] into the structure (see Halle & Marantz 1993, Harley & Noyer 1998, 1999). This feature can be seen as a (syntactically inactive) placeholder or diacritic that signals to the relevant post-syntactic mechanism that a root should be inserted in this position. Technical details aside, though, it should be clear that late insertion of vocabulary items forces one to define roots structurally rather than lexically.

2.4.3 Interim summary

The previous two subsections have made clear that early insertion of vocabulary items leads to a lexical definition of roots, while late insertion is only compatible with a structural one. A root is defined lexically when it results from merging a *vocabulary item* that has no syntactic features; it is defined structurally when a particular (type of) *terminal node* is featureless. The next section explores the empirical predictions made by these two definitions.

2.4.4 Supporting evidence for the structural account: functional vocabulary items in root position

We have just outlined the differences between the lexical definition of roots in early insertion models and the structural one in theories adopting late insertion. The question is now to what extent these two accounts can be empirically distinguished. It is clear that in the standard scenario, i.e. functional vocabulary items (such as *the*) being merged in functional terminal nodes and lexical vocabulary items (for example *book*) in root terminal nodes, the two theories make the same predictions (albeit with different theoretical machinery). As soon as we diverge from this simple picture, however, differences emerge. Suppose we want to use an FVI as a root. In an early insertion model this state of affairs is simply unformulable. The mere presence of grammatical features on a VI will cause the projection headed by this VI to be recognized as functional rather than lexical. As a result, FVIs can never head lexical projections. In the Late Insertion-model, however, there is no *a priori* ban on merging a particular type of VI in a root terminal node. Given that this position is nothing but an empty placeholder, it should in principle be possible to merge either LVIs or FVIs there.[9] The use of FVIs as roots thus constitutes a potential testing ground for distinguishing between the lexical and the structural definition of roots.[10] Consider in this respect the following examples from Dutch:

(2) Ik heb het **waarom** van de zaak nooit begrepen.
I have the why of the case never understood
'I have never understood the motivation behind the case.'

(3) In een krantenartikel komt het **wat/hoe/wie/waar**
in a newspaper.article comes the what/how/who/where
altijd voor het **waarom**.
always before the why

'In a newspaper the what/how/who/where always precedes the why.'

(4) De studenten **jij**-en onderling.

the students you-INFINITIVE amongst.one.another

'The students are on a first-name basis with each other.'

(5) Martha is mijn tweede **ik**.

Martha is my second I

'Martha is my best friend.'

(6) Niets te **maar**-en!

nothing to but-INFINITIVE

'Don't object!'

(7) Paard is een **het**-woord.

horse is a $\text{the}_{\text{neuter.def}}$-word

'*Paard* takes a neuter article.'

Each of these sentences exemplifies the use of an FVI in a root position. In (2) and (3) a *wh*-pronoun is merged under a nominal structure, while in (5) the personal pronoun *ik* 'I' is. Examples (4) and (6) illustrate that a personal pronoun and a conjunction can be inserted under a verbal structure, while (7) illustrates the use of a definite article as the non-head part of a compound. One could of course argue that these are exceptions, and that what is inserted in root position in (2)-(7) is not an FVI, but rather a root which is homophonous with an FVI. As it turns out, however, the use of FVIs in root position is productive. Consider first the data in (8).

(8) a. het getik van de klok

the GE-tick of the clock

‘the ticking of the clock.’

b. het gefluit van de vogels

the GE-whistle of the birds

‘the whistling of the birds.’

Dutch has a derivational word-formation process of *ge*-prefixation to form nouns referring to a pluractional event. As is illustrated in (9), this type of word-formation productively allows FVIs to occur in root position.[11]

(9) a. Ik hoef al dat ge-**maar** niet.

I need all that GE-but not

‘I don’t like those constant objections.’

b. Ik hoef al dat ge-**alhoewel** niet.

I need all that GE-although not

‘I don’t like those constant considerations.’

c. Ik hoef al dat ge-**of** niet.

I need all that ge-or not

‘I don’t like those constant alternatives.’

d. Ik hoef al dat ge-**hé** niet.[12]

I need all that GE-PRT not

‘I don’t like this constant need for confirmation.’

e. Ik hoef al dat ge-**waarom** niet

I need all that GE-why not

‘I don’t like the constant need for justification.’

f. Ik hoef al dat ge-**nooit** niet

I need all that GE-never not

'I don't like the constant unwillingness.'

g. Ik hoef al dat ge-**ik** niet

I need all that GE-I not

'I don't like all this egocentricity.'

Rather than assume that FVIs are systematically ambiguous between a functional and a root reading—clearly an undesirable move—we take the data in (2)-(9) to show that FVIs can be used as roots. As pointed out above, this finding argues against an early insertion based lexical definition of roots and in favor of the structural late insertion approach. Simply put, whether or not a lexical item is a root is not due to certain inherent characteristics or properties of that lexical item, but depends solely on the structural position in which this element is merged. Certain slots in the syntactic structure—typically, the low(est) ones, see the next section for discussion—turn whatever is merged in that slot into a root.

This conclusion is further corroborated by an aspect of the data in (2)-(9) left undiscussed so far. Recall that a structural definition of roots goes hand in hand with late insertion. This predicts that the grammatical features of FVIs used as roots will not have any syntactic effect: at the point of Vocabulary Insertion, the syntactic derivation is already over. This is indeed what we see in (2)-(9). For example, the FVI *waarom* 'why' in (2) does not type the sentence as a *wh*-question (cf. Cheng 1997), nor is it subject to (otherwise obligatory) *wh*-movement. In other words, the syntactic derivation does not take the grammatical features of an FVI into account when this FVI is used as a root. Similarly, the personal pronoun *ik* 'I' in (5) does not trigger first person singular agreement when used as a subject, but rather (default) third person singular (see (10)), suggesting that its inherent [ϕ]-features are not visible to the syntactic derivation.

(10) Mijn tweede ik {*ben/is} ongelukkig.
my second I am/is unhappy
'My best friend is unhappy.'

In the same vein, the conjunction *maar* 'but' in (6) cannot take a sentential complement when used as a verb, as shown in (11). This means that its selectional features are inactive in (6).

(11) * Niets te maar-en je hebt veel werk!
nothing to but- INFINITIVE you have much work

In short, a root position is like a Bermuda Triangle for grammatical features: regardless of which element is inserted there or what its feature specification is, it will not affect the course of the syntactic derivation in any way. Needless to say, this observation is straightforwardly compatible with a late insertion approach.

2.4.5 Summary

In this section we have introduced the third property of roots under discussion in this paper. We have shown that roots should be defined structurally rather than lexically, i.e. there are designated positions in the syntactic structure where whatever is merged in that position starts functioning as a root. Just as was the case in the previous two sections, this analysis—successful though it may be in accounting for data such as those in (2)-(11)—remains stipulative and does not follow from independent principles in late insertion models of the grammar.[13]

2.5 Roots are merged lower than functional material

The fourth and final property is perhaps the most basic of the four, partly also because it long predates the XSM- or DM-perspective on lexical categories. It concerns the fact that lexical categories are dominated by functional material, rather than the other way around: DP dominates NP, but NP doesn't dominate DP, TP dominates VP, but VP doesn't dominate TP, etc.[14] In traditional, pre-DM/XSM-days, this hierarchical asymmetry could be made sense of by arguing that in a bottom-up derivation, the lexical projections first introduce the conceptual notions which the functional material then subsequently ties to a particular speech-act or situation (by situating the event in space and time, identifying its referents, adding information-structural distinctions, etc.). In the perspective on roots outlined above, however, this simple account breaks down. We have shown that roots are nothing but structural positions that play no role whatsoever in the syntactic derivation. With this in mind, it is unclear why they should necessarily be merged as the first/lowest element in a cyclic domain. Worse still, given that roots are acategorial and featureless (see above, sections 2.2 and 2.3), how can any functional head select for (and hence be merged with) a root?[15] The next section shows how these problems dissolve under a Merge-based definition of roots.

2.6 Summary: desiderata for a theory of roots

The past four sections have introduced and discussed four central properties of roots: (a) they have no grammatical features, (b) they have no syntactic category, (c) they are defined structurally rather than lexically, and (d) they are dominated by functional material rather than the other way around. One thing all four of them have in common is that they have to be stated as primitives of the theory. They do not follow from any independent properties of our model of the grammar, and hence, they essentially constitute a list of four separate axioms or stipulations (depending on one's perspective). Formulated more positively, what we would like our grammar to generate is a structural position at the beginning of the derivation that is acategorial and radically featureless, where root material can be inserted during (late) Vocabulary Insertion. In the next section we show that the first instance of asymmetric Merge creates precisely such a position.

3. Asymmetric Primary Merge and the null derivation

3.1 Introduction

This section introduces a theory of Merge which the next section will use to derive the four basic properties of roots outlined above. We proceed in two steps. Section 3.2 argues, following Jaspers (1998), Langendoen (2003), Zwart (2009a, 2009b, 2010) and others, that Merge is inherently asymmetric and that pair merge rather than set merge is the default—and arguably the only—structure-building mechanism in natural language. In section 3.3 we focus on the very first Merge operation in a derivation—termed Primary Merge here—and show that it involves merger with the null derivation. Section 3.3 sums up.

3.2 Asymmetric Merge

The standard technical implementation of the structure-building operation Merge in present-day minimalist theorizing is so-called set Merge. That is, Merge combines two (possibly complex) syntactic objects α and β into the set containing (precisely) these two elements, i.e. $\{\alpha, \beta\}$ (see for example Chomsky 1995:243). When considering only this bare minimum, Merge seems to be a completely symmetric operation, which takes two elements of equal stature and yields a new object that is neither linearized nor hierarchically organized.[16] More generally, Merge (α, β) = Merge (β, α). In the remainder of this section, however, we present a number of arguments—taken from Chomsky (1995), Jaspers (1998), Langendoen (2003), and Zwart (2009a, 2009b, 2010)—suggesting that the picture just sketched is too simple, and that there is an inherent asymmetry to Merge (see also Cormack & Smith 2005, Di Sciullo & Isac 2008, Franco 2011, Osborne, Putnam & Gross 2011). Accordingly, we adopt Zwart's (2010:7) conclusion that pair Merge rather than set Merge is the basic structure-building principle of natural language.

The first complication is highlighted by Chomsky himself. After introducing the definition given above, he points out that output conditions dictate that mere set formation does not suffice (Chomsky 1995:243). Given that different types of constituents (for example verbal and nominal ones) are interpreted differently at LF and PF, the distinction between them should somehow be encoded in syntax. Put differently, Merge (α, β) is not symmetric because either α or β is the head of the newly formed constituent and as a result projects its category label onto that constituent. Chomsky implements this by assuming that either α or β functions as the label of the newly formed constituent, i.e. Merge (α, β) = $\{\alpha, \{\alpha, \beta\}\}$ (with α the label of the complex constituent). As pointed out by Langendoen (2003:3), however, $\{\alpha, \{\alpha, \beta\}\}$ is set-theoretically equivalent to the ordered pair $<\alpha, \beta>$.[17] In other words, by admitting that one of the two elements combined by Merge projects, we are led to the conclusion that the proper characterization of this operation involves pair Merge rather than set Merge.

A second form of asymmetry was first observed by Jaspers (1998). He draws attention to what he calls Derivational Asymmetry, i.e. the fact that for every Merge operation, one element is derivationally prior to the other. Put differently, one element was already part of the derivational workspace before Merge took place, while the other is newly added to that workspace as a result of the operation—more specifically, as a result of the application of Select preceding Merge, see section 3.3 for discussion. Derivational Asymmetry is also appealed to—though in a slightly different form—by Epstein (1999:337), who rules out c-command from a head to its specifier on the grounds that at the point in the derivation when the c-command domain of the head is determined, the specifier is not yet a member of the derivational workspace. It is clear that an implementation of Merge in terms of pure set formation does not succeed in capturing Derivational Asymmetry, as set merge is a strictly symmetrical operation.

Thirdly and finally, Zwart (2009b:163) raises the following conceptual argument against set Merge. The fact that this operation takes precisely two elements as its input remains a stipulation—necessary though it may be to derive binary branching. Chomsky (2006:5) calls this "the simplest case", but as 1 is the absolute minimum of elements an operation can manipulate, an implementation of Merge that can reach this minimum is to be preferred over one that uses two syntactic objects as its input. As we discuss below, Asymmetric Merge achieves this goal.

Summing up, there are good reasons to assume that Merge is asymmetric and as a result, that this asymmetry should be built into the technical implementation of this operation. In this paper we adopt and adapt Zwart's (2009a, 2010) definition. It is given in (12).

(12) **Unary Merge** (pre-final version)

Merge selects a single element from a resource[18] and includes it in the object under construction.

Zwart (2009a:62, 2010:7) argues that the output of this operation yields an ordered pair, so that when an element α is taken from the resource and added to δ, the derivation currently under construction, the result is $<\alpha, \delta>$.

Before we can proceed, there is one aspect of the definition in (12) that needs further clarification. In particular, we want to make explicit what the notion "element" refers to in this definition. It is an assumption rarely made explicit in current (morpho)syntactic literature (though see Chomsky 1995:383n27, Drury 1998:76n20, Fortuny 2008:18) that the objects combined by Merge are *sets* of features.[19] For example, under the (common) assumption that T° is a combination of person, number, gender en tense features, it follows that the set consisting of these four features acts as a single atomic element for the operation Merge (Marantz 1997:2). Accordingly, we refine the definition of Unary Merge as follows:

(13) **Unary Merge** (final version)

Merge selects a single subset from a resource (for example $\{\alpha\}$), includes it in the derivation under construction (δ), and yields an ordered pair (for example $<\{\alpha\}, \delta>$, assuming $\{\alpha\}$ projects).

With this discussion as background, we now turn to the first application of Merge.

3.3 Primary Merge

An application of Merge that usually does not get a lot of attention in the literature is the very first operation in a derivation, which we call Primary Merge here. In a system based on symmetric set Merge, Primary Merge introduces a complication. Normally, Select takes an element from the resource and combines it with (the root of) the current derivation via Merge. In the case of Primary Merge, however, there is no such derivation. This leaves one of two options for Select. The first is to assume that in the case of Primary Merge, Select can exceptionally take two objects from the resource rather than one (see also Zwart 2010:8). It is clear that this is not a very desirable move. By allowing Select to target either one or two objects, we introduce a degree of arbitrariness into the system that can only be maintained by pure stipulation—if 1 or 2, why not 3 or 4 or 42? Moreover, it is not clear how the selection of two objects can be limited to only the first step of the derivation. One seems to predict the possibility of ternary merge at a later point in the derivation. The second option is to assume that Select always targets precisely one element from the resource, but that in the case of Primary Merge, the first application of Select does not immediately feed into Merge. Put differently, Select takes the first element from the resource in anticipation of the merger operation that will take place after it has applied a second time. Just like the first scenario, this one has little appeal, as we are now introducing into the system a substantial degree of lookahead and a concomitant increase in computational workload.

Part of this problem is alleviated under the perspective sketched in the previous section. As is clear from the definition of Unary Merge in (13), this operation always and without exception targets a single element from the resource. What remains to be determined, then, is what it means to be 'included in the object under construction' when in fact there is no such object yet. We propose to take the definition in (13) as literally as possible. When an element $\{\alpha\}$ is the first one to be taken from the resource by Unary Merge, it is included into an empty derivational workspace, i.e. the object under construction is the empty set Ø (see also Zwart 2010:8). The output of this instance of Merge is no different from any other: it yields an ordered pair, in this case $\langle\{\alpha\}, \emptyset\rangle$. In other words, Primary Merge is identical to all other Merge operations. All of them yield an ordered pair, the only difference being that in the case of Primary Merge the right-hand member of this ordered pair is the empty set.

Let us consider how a(n abstract) derivation would proceed under the assumptions outlined above. Suppose we use the resource R = $\{\alpha, \beta\}$ as the input for a derivation. The first instance of Unary Merge takes a subset from R, say $\{\alpha\}$, and includes it in the object under construction, i.e. Ø, yielding the structure in (14).

(14) 2
$\{\alpha\}$ Ø

The question at this point is what the label of this complex constituent is. So far we have been proceeding under the assumption that merging an element from the resource to the derivation under construction yields an ordered pair of which that newly-merged element is the left-hand member. However, recall that in the previous section we converted Chomsky's labeled structure $\{\alpha, \{\alpha, \beta\}\}$ into the ordered pair $\langle\alpha, \beta\rangle$. This means that being the left-hand member of an ordered pair correlates with projection, not with being the most recently merged element. When discussing projection/labeling, Chomsky (1995:244f) discerns two classes of situations. In the first, the structural configuration unambiguously identifies one of the two elements undergoing Merge as the projecting member. These configurations include a head merging with a complex constituent (the head projects) and movement/internal Merge (the moving element does not project—though see Donati 2006 for a different view).

In the other case—i.e. a head merging with a head or an XP externally merging with an XP—it is the featural specification (and possibly the concomitant checking relation) that determines which of the two will project. With respect to the structure in (14), we contend that it falls into the first category. That is, it is always unambiguously clear that {α} will project, regardless of its feature specification. The reason for this is twofold. First of all, Ø is completely and radically empty: it has no category, no grammatical features, no specification of any kind. Under the uncontroversial assumption that projection involves passing on or copying information from a daughter node onto its mother, this radical emptiness makes Ø inherently incapable of projecting. Secondly, if Ø were to project, this would incorrectly identify the constituent in (14) as an empty derivation, thus obscuring the fact that (the non-empty element) {α} has already been merged into that derivation.[20] Summing up, then, the complete representation of the Primary Merge operation described above is as in (15).[21]

```
(15)      {α}
        2
      {α}     Ø
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At this point, Unary Merge takes {β} from R and merges it with the structure in (15). Supposing that {β} is the projecting element, this Merge operation yields the ordered pair <{β}, <{α}, Ø>>, which can be graphically represented as in (16).

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(16)      {β}
        2
      {β}     {α}
            2
          {α}     Ø
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In short, the theory of Merge developed in this and the preceding section entails that every derivation begins with a radically empty element, which accordingly sits at the very bottom of the syntactic structure. While representations such as the one in (16) might seem unorthodox at first, they are certainly not unprecedented. For instance, Zwart (2009b, 2010) also assumes that Primary Merge involves "merger with nothing/the empty set" (Zwart 2010:10). His implementation, however, differs from ours in two ways. Firstly, his system is strictly top down—or rather, left-to-right: what Merge does, is split the resource into an ordered pair consisting of one item from the resource as left-hand member and the remainder of the resource on the right. When the last member of the resource is thus split off, what remains as the right-hand member is the empty set. A second—more important—difference is that Zwart does not assume this empty set to occupy a structural position in the phrase structure representation (see for example Zwart 2009b:164). As has become clear from the above discussion (and see also the next section), in our proposal the position created by merger with the empty set is real and plays a central role in natural language.[22]

The idea that Primary Merge involves merger with the empty set is also found in Fortuny (2008). He starts out from a particular implementation of set Merge, whereby this operation takes two subsets from the resource and yields the union of those subsets (Fortuny 2008:18). Moreover, in order for Merge to be successive, at least one of the two subsets must be the output of an immediately preceding application of Merge. For Primary Merge, this entails that one of the two elements targeted by Merge must be the empty set Ø. When Ø is merged with a first subset from the resource, for example {a}, the output is the union of those two sets, i.e. the singleton {a}. This singleton can then be used as input for the second application of Merge, for example {b}, to yield the union of those sets, i.e. {a, b}, and so on.

Note that, just as was the case in Zwart's system, the impact of the initial empty set on the remaining derivation is non-existent. This is exactly where Fortuny's analysis differs from ours: while we agree that Primary Merge involves the null set as one of its members, we claim that this empty position is a syntactic terminal that receives a phonological exponence in the post-syntactic morphological module (see below, section 4).

A third and final parallel to the existing literature we want to draw here concerns Guimarães's (2004:221ff) Starting Axiom, which states that the first branching node in every single derivation involves the empty set as one of its sisters. Just like Zwart, though, Guimarães works in a top-to-bottom fashion, and just like both Zwart and Fortuny, the empty set postulated by the Starting Axiom plays no further role in the syntactic derivation. It is there "just to guarantee the appropriate syntactic configuration" (Guimarães 2004:222). As we will now proceed to demonstrate, this empty position has a far more central role to play in the system developed here.

3.4 Summary

In this section we have introduced and discussed our theory of Merge. Following Jaspers (1998), Langendoen (2003), Zwart (2009a, 2009b, 2010) and others, we have argued that this operation is asymmetric and that it yields ordered pairs rather than unordered two-membered sets. We then focused on the very first instance of Merge in a derivation (Primary Merge) and concluded that it involves the empty set as one of its members. This implies that every derivation begins with a radically empty and featureless slot at the most deeply embedded position in the structure. In the next section we argue that this is where roots are inserted in the post-syntactic module.

4. Deriving the properties of roots

4.1 Introduction

This section combines the insights of the previous two. Section two introduced four central properties of roots and showed that while empirically well supported, they do not follow from anything in the theory and hence have to be stipulated as axioms. The previous section led to the conclusion that Merge is asymmetric and that the first application of Merge involves the empty set as one of its members. Here we argue that the empty structural position thus created serves as the vocabulary insertion site for roots. We first (in section 4.2) go through a sample derivation of a nominal constituent to illustrate how exactly the theory of Merge interacts with that of roots, while section 4.3 returns to the basic properties of roots outlined in section two.

4.2 Asymmetric Primary Merge of roots: a sample derivation

This section presents a sample derivation of the nominal constituent *the books* as an illustration of how our view on Merge meshes with the syntax of roots. Recall that we adopt Late Insertion of vocabulary items. This implies that the resource from which Merge draws contains only grammatical features. Moreover, roots play no role in the syntactic derivation and they are defined structurally. As a result, there are no features in the resource that refer to or anticipate the merger of a root (see also note 13). For the example at hand, this means that the resource is a set containing a definiteness feature and a plural feature, i.e. R = {[+def], [+pl]}.[23] Based on this resource, the derivation proceeds as follows. Unary Merge first selects the singleton containing the plural feature from R and merges it with the empty set. Given that the latter is featureless, it is the plural feature that projects (see section 3.3 for discussion). This is shown in (17).

(17) {[+pl]}
2
{[+pl]} Ø

Next, the definiteness feature is targeted by Merge. It too projects its own structure, thus yielding the representation in (18).

(18) {[+def]}
2
{[+def]} {[+pl]}
2
{[+pl]} Ø

At this point, the syntactic derivation is finished and the structure is handed over to PF.[24] One of the operations on the way to the interface with the articulatory-perceptual system is Vocabulary Insertion (see Harley & Noyer 1999 for discussion). When confronted with the structure in (18) the grammar searches its Vocabulary for matching vocabulary items and it encounters the following VIs:[25]

(19)	a.	/ðə/	↔	[+def]
	b.	/s/	↔	[+pl]
	c.	/buk/	↔	Ø

The phonological exponents on the left-hand side of the vocabulary items in (19) are inserted into the terminal nodes of the structure in (18), and the derivation converges as the nominal constituent *the books*.[26]

4.3 Returning to the four root axioms

The derivation in (17)-(19) demonstrates how the empty position created by asymmetric Primary Merge can serve as an insertion site for roots. This section returns to the four root axioms introduced in section two and shows how they follow straightforwardly from the theory developed so far. Recall that the properties of roots under discussion here can be summarized as in (20).

(20) a. Roots have no grammatical features.

b. Roots have no grammatical category.

c. Roots are defined structurally, not lexically.

d. Roots are merged lower than functional material.

The property in (20)c is the one that has featured most prominently in the preceding discussion. We pointed out that Late Insertion-based theories require that roots be defined as designated positions in the structure rather than as a special marking (featural or otherwise) on a specific subset of the lexicon. This conclusion follows directly from our theory of asymmetric Primary Merge. By merging an element from the resource to the empty set, the basic structure building mechanism creates just the required syntactic terminal. Moreover, given that this terminal is the empty set, it also follows that this position is completely featureless (cf. (20)a). Regardless of which vocabulary item is inserted in this position in the morphological component (and see below, section 5.3, for discussion of the insertion mechanism), during the syntactic derivation this position will be completely inert (see also Bresnan 1978, 1995 and Hale and Keyser 1993 for early discussion of the non-deterministic relation between lexical semantics and syntactic structure).

The fact that roots are acategorial also follows from our theory. Recall that Ø never projects. Given that it is radically featureless, it cannot pass on or copy its features onto a higher node. It is always the set that merges with Ø that projects and thus determines the category of the whole. If that set contains nominal features (as in (17)), then the vocabulary item inserted in Ø is interpreted as a noun; if it is verbal, then the root is interpreted as a verb, etc.

Finally, the fact that roots are merged lower than functional material is also an integral part of our analysis. The only stage at which the derivation(al workspace) is null is the very beginning and so the only Merge operation that can involve Ø as one of its members is Primary Merge. Given that the occurrence of roots is directly dependent on merger with Ø, this implies that roots are never inserted mid-derivation, i.e. dominating previously merged functional material (see below, section 5.2, for derivations containing multiple roots).

Summing up, then, the theory of asymmetric Primary Merge outlined in section 3 derives the four properties of roots discussed in section 2, thus reducing them to theorems of this theory. Given that these properties are empirically well motivated (see section 2 for discussion and references), we take this to be additional support for our theory of Merge.

5. Theoretical consequences of the analysis

5.1 Introduction

Section 4 has shown how the basic properties of roots can be reduced to theorems of the theory of (asymmetric) Merge. At the same time, however, our analysis has left two fairly central questions unanswered so far. We address them in this section. First (in section 5.2), we focus on the derivation of linguistic expressions containing more than one root. Given that root positions can only be associated with Primary Merge, we are led to adopt layered derivations for such expressions (cf. also Zwart 2009b, 2010). We explore the consequences of this analysis and conclude that all non-complements are spelled out first, in a separate derivation, until finally the root derivation is constructed. In section 5.3 we address the consequences of our proposal for Vocabulary Insertion. We show how the absence of any grammatical features in root positions straightforwardly allows all vocabulary items to be inserted in that position. Section 5.4 summarizes.

5.2 Derivations with multiple roots: layered derivations

5.2.1 Introduction

Recall from section three that Primary Merge merges a subset of the resource to the empty derivational workspace—or more technically, to the empty set. This empty syntactic terminal then serves as the insertion site for a root at the post-syntactic level of Vocabulary Insertion. Given that a derivational workspace by definition contains only one instance of Primary Merge, it follows that there is a one-to-one-correspondence between the number of roots a structure can host and the number of derivational workspaces it is the output of. We can formulate this as in (21).

(21) **One Derivational Workspace One Root (ODWOR)**

In every derivational workspace there is exactly one root, and for every root there is exactly one derivational workspace.

Needless to say, this principle raises analytical questions with respect to strings containing multiple roots such as the VP in (22)a or the clause in (22)b. The ODWOR-principle predicts that (22)a should be the result of two independent derivational workspaces (one for each root), while (22)b should contain three. More generally, the approach developed so far leads us to adopt the concept of layered derivations (in the sense of Zwart 2009b, 2010), whereby the output of one derivation(al workspace) can appear as an atom in the next one.[27]

(22) a. eat the cookie

b. The child eats the cookie.

In the remainder of this section we combine our analysis of roots with the layered derivations approach and show how data such as those in (22) can be accounted for in such a system. We consider two possible implementations. The first (section 5.2.2) is a conservative one, whereby layering of derivations simply means readmittance to the vocabulary resource without any further syntactic—in particular, opacity—effects. The second implementation (section 5.2.3) is more ambitious and assumes that layered derivations involve multiple spell-out, with concomitant opacity effects. The model we arrive at is very much akin to the radical version of Uriagereka's (1997) multiple spell-out model whereby all non-complements—including, in our view, the *v*-V-complex—are spelled out first, in separate derivations, until finally the root derivation is constructed. Section 5.2.4 sums up.

5.2.2 Layered derivations as readmittance to the resource

Zwart (2009b:161) defines derivations as layered when “the output of a previous derivation [appears] as an atom in the numeration for the next derivation”. Clearly, the most straightforward way of implementing this is by allowing the end result of one derivation or derivational workspace to be readmitted to the resource from which its members were originally drawn. In order to see how this would work, we now go through a sample derivation of the VP in (22)a. For expository purposes, let’s assume that this VP is the spell-out of a syntactic derivation built from the resource R in (23). (Recall that the resource in our analysis contains no information about roots.)

(23) R = {*v*, [+def]}

The first step of the derivation involves Primary Merge of {[+def]} with the empty derivational workspace, i.e. with the empty set. This is represented in (24). The resource R is revised accordingly as in (25).

(24) {[+def]}
2
{[+def]} Ø

(25) R = {*v*}

At this point the initial derivation is stuck. In particular, Merge cannot append {*v*} to the structure in (24) as this would violate the nominal functional sequence that is being built in (24).[28] Note that {*v*} cannot be (Primary-)Merged to the empty set either, as the derivation is no longer in its null state: it contains the structure in (24).[29] The solution lies in layering the derivation, i.e. in readmitting the object constructed in (24) to the resource. This yields the following representation for R:

(26) R = {*v*, <{[+def]}, Ø>}

This readmittance operation has cleared the workspace, and hence makes possible a new application of Primary Merge. This time, the operation selects {*v*} from R and yields the structure in (27). R is revised as in (28).

(27)
```
      {v}
     2
    {v}    Ø
```

(28) R = {<{[+def]}, Ø>}

Merge now targets the one remaining (complex) element in R and appends it to the structure in (27), yielding the representation in (29).[30,31]

(29)
```
                 {v}
          ei
        {v}              {[+def]}
      2      2
    {v}    Ø    {[+def]}    Ø
```

Given that R is now empty, the derivation can be handed over to the post-syntactic module. At the level of Vocabulary Insertion, the vocabulary items *eat*, *the* and *cookie* are inserted into the relevant syntactic terminals, and the structure in (29) is spelled out as the VP *eat the cookie*. The derivation in (23)-(29) has shown how the Primary Merge-based analysis of roots can yield surface strings containing more than one root.

A key ingredient of the analysis just presented is the assumption that the resource can contain elements that are the output of preceding derivations and hence syntactically complex. This assumption is corroborated by Ackema & Neeleman (2004:122-129) (see also

Zwart 2009b:172), who present a host of data that involve syntactically complex phrases as parts of words. Some relevant examples are given in (30).

(30) a. a sit-on-the-guidelines Euro policy

b. animal-to-human transplant experiments

c. go-anywhere-at-any-time-access

d. I feel particularly sit-around-and-do-nothing-ish today.

Summing up, the ODWOR-principle in (21), which is a logical consequence of our theory of roots, leads to the conclusion that a VP such as the one in (22)a contains two subderivations. This subsection has provided a first, simple implementation of this idea, based on Zwart's (2009b, 2010) notion of layered derivations. The next subsection adds a complication to the picture, viz. the idea that layered derivations create opacity effects.

5.2.3 Layered derivations and opacity

As was pointed out in footnote 30, the structure in (29) glosses over the fact that the operation Select does not target elements from the resource directly, but rather subsets of that resource. Accordingly, a more accurate representation of that structure would be the following:

(31) {*v*}
ei
{*v*} {<[+def], Ø>}
2
{*v*} Ø

The transition from (29) to (31) is not innocuous. Given that {<[+def], Ø>} is not of the form $\{\alpha, \{\alpha, \beta\}\}$—i.e. the output of an (asymmetric) Merge operation—it is not recognized by C_{HL} as a syntactically complex element, and instead is treated as an atom.[32] Put differently, the internal structure of this constituent has become opaque to any further syntactic operations (see also Zwart 2009b:173 on layered derivations creating opacity effects). Given that direct objects such as *the cookie* in the VP in (22)a are generally not islands for extraction, this implies that the derivation presented in the previous subsection cannot be correct. What we propose to change is the order in which the various subderivations are readmitted to the resource. In order to illustrate this, we turn to the more complex example in (22)b, repeated below.

(32) The child eats the cookie.

Given that this sentence contains three roots, it will involve a three-layered derivation (or three subderivations). For the sake of concreteness (and abstracting away from tense), let us assume the resource starts out as in (33).

(33) R = {*v*, [+def], [+def]}

As was pointed out above, derivations that are readmitted to the resource become opaque for further syntactic operations. The fact that subjects are islands for extraction suggests that the subject DP *the child* is merged first. This yields the structure in (34) and the modified resource in (35).

(34) {[+def]}
2
{[+def]} Ø

(35) R = {*v*, [+def]}

The structure in (34) is then readmitted to R, thus emptying the derivational workspace. The next subderivation involves the verbal structure. Zwart (2009b:175-178) argues that the *v*-V-complex constitutes a separate derivation, with concomitant opacity effects (and see Gallego 2010 for a very similar view). Translated into the machinery of the present paper, this means that *v* is merged with the null state of the derivation, yielding the structure in (36) and the modified resource in (37).

(36) {*v*}
2
{*v*} Ø

(37) R = {<{[+def]}, Ø>, [+def]}

At this point, the verbal structure is readmitted to R and merger of the direct object can proceed, as illustrated in (38). The resource R now only contains the output of the previous two subderivations, cf. (39).

(38) {[+def]}
2
{[+def]} Ø

(39) R = {<{[+def]}, Ø>, <{*v*}, Ø>}

The DP in (38) is then merged with the *v*-V-complex, as in (40).

(40) {<{*v*}, Ø>}
ei
{<{*v*}, Ø>} {[+def]}
2
{[+def]} Ø

Finally, the subject is merged, yielding the representation in (41).

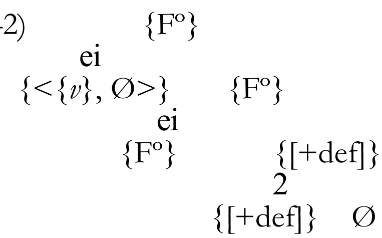
(41) {<{*v*}, Ø>}
ei
{<{[+def]}, Ø>} {<{*v*}, Ø>}
ei
{<{*v*}, Ø>} {[+def]}
2
{[+def]} Ø

Given that R is now depleted, the syntactic derivation is finished and the structure can be spelled out. At the level of Vocabulary Insertion, the syntactic terminals of (41) are matched up with their respective phonological exponents and the structure is spelled out as *The child eats the cookie*. Moreover, given that the direct object is not part of a structure that has been readmitted to R, it is correctly predicted not to be opaque for extraction. The subject and the *v*-V-complex on the other hand do resist such extraction. More generally, the approach just developed suggests that everything but the most deeply embedded internal argument is spelled out first, in a separate derivation. It is only when the most deeply embedded internal argument is reached that all subderivations are brought together into one syntactic representation.[33]

As the careful reader (as well as two LI-reviewers) undoubtedly has noticed, however, while the order of derivation just described correctly predicts the distribution of opacity effects across subject, verbal complex and direct object (opaque in the case the former two, transparent in the case of the latter), nothing we have presented so far *forces* the direct object to be merged last. While space limitations prevent us from exploring this issue in full here, we do want to sketch the general direction an answer to this question might take, which will at the same time lead to a further refinement of our analysis. Our approach consists in bringing together two independent strands of research. The first is Johnson's (2003) analysis of adjunct islands. The key difference between the direct object on the one hand, and the subject and verbal complex on the other is the fact that the former is a complement whereas the latter two are not. Let us start out from the (uncontroversial) assumption that being a complement implies having been merged with a head. Johnson (2003) primarily focuses on one half of that equation, i.e. if something merges with a head, then it must be a complement. He uses this to derive the fact that in a VP such as *flew after this talk* the adjunct *after this talk* is merged in a separate derivational workspace. Had it not, then it would have been a sister of V° and hence, it would (incorrectly) have been interpreted as an argument. We want to focus on the mirror image of Johnson's principle, i.e. if something is a complement, it should be merged with an X°. When applied to the direct object *the cookie* in the derivation in (32)-(41), this principle runs into problems: given that the verb is merged in its own separate derivational workspace—the only way to create the verbal root, see the previous sections for discussion—the merger between the verb and the direct object is not one between a head and a maximal projection, but rather between two maximal projections, thus incorrectly identifying the direct object as a non-complement.

Enter the second ingredient of our analysis. As was pointed out in section 2.3, there is a growing consensus in the literature that the introduction and licensing of arguments proceeds not via lexical heads directly, but through the intermediation of functional (temporal, aspectual, event-introducing) material (cf. Marantz 1997, Pylkkänen 2002, Borer 2005a,b, 2009b, Adger 2011). This means that it should not be the verbal complex itself that introduces the direct object in (32)-(41), but rather a functional head. This in turn solves the problem that was raised above in that the direct object can now once again be properly identified as a complement, i.e. as a phrase that has merged with an X°. Moreover, this X° is arguably part of the functional spine of the clause and hence needs to project. If we adopt Uriagereka's (1997:117) assumption that material that has been readmitted to the resource can no longer project,[34] it now follows that the direct object has to be merged last. The tree in (42) represents the modified syntactic structure for the VP *eat the cookie*.

(42)



Needless to say, the sketch we have just provided leaves several questions unanswered, but at the same time it forms a promising base for further research. Moreover, it is worth pointing out that the order of merge we have proposed bears a very close resemblance to the one Uriagereka (1997) and Drury (1998) arrive at on independent grounds, thus lending further plausibility to the proposal.

Summing up, under the assumption that layered derivations create opacity effects, the analysis proposed in the previous subsection had to be revised. We have shown that the set of assumptions adopted in this paper lead to a model of the grammar in which all non-complements—including, in our view, the *v*-V-complex—are spelled out first, in separate derivations, until finally the root derivation is constructed.

5.2.4 Conclusion

If the insertion of roots is a by-product of asymmetric Primary Merge, then each derivational workspace contains precisely one root. Accordingly, strings containing more than one root have to be the result of multiple—or more accurately, layered—derivations. This subsection has provided a concrete implementation of how such a multi-root derivation proceeds. The next section turns to the insertion mechanism responsible for assigning a phonological exponence to syntactic terminals.

5.3 The vocabulary insertion mechanism

5.3.1 Introduction

An aspect of our theory we have said very little about so far concerns the precise mechanism that matches up syntactic terminals with the appropriate vocabulary items (VIs). This issue is complicated by the fact that unlike previous Late Insertion models, we have shown that functional vocabulary items (FVIs) can be inserted in root positions (cf. the data in (2)-(11)). Most DM-accounts of Vocabulary Insertion assume a radically different insertion mechanism for functional terminal nodes on the one hand and root terminal nodes on the other (Halle and Marantz 1993, Harley and Noyer 1999). While the former are subject to competition (the VI that matches the syntactic terminal most closely in features being the preferred insertion candidate), insertion in the latter is determined by free choice. In DM this dual insertion mechanism leads to a strict division of labor between the functional and the lexical domain: FVIs always and only spell out functional terminal nodes, whereas LVIs always and only spell out root terminal nodes. At first sight, then, the DM-mechanism of

Vocabulary Insertion is ill-suited for the data discussed earlier in this paper. Recall from the preceding sections (in particular section 2.4.2 and note 13), however, that there is a crucial difference between the structurally defined root positions in DM and those in the present paper. While for us root terminal nodes are radically devoid of features, in DM these positions are explicitly marked as such. For example, classical DM postulates a special [Root]-feature in these positions (Halle & Marantz 1993). Only LVIs can be inserted in these root positions because they are the only vocabulary items that also carry this feature. In what follows we show that our proposal to do away with [Root]-features—or any comparable diacritic—has as a welcome side-effect that the DM-mechanism of Vocabulary Insertion now allows FVIs to be inserted in root terminal nodes as well. We proceed in two steps. First, in section 5.3.2, we lay out in detail the mechanism of Vocabulary Insertion of DM and show how it leads to a strict division of labor between the lexical and the functional domain. Then, in section 5.3.3, we show that giving up [Root]-features straightforwardly leads to a situation in which both FVIs and LVIs can be inserted post-syntactically in root terminal nodes.

5.3.2 Vocabulary Insertion in Distributed Morphology

As was pointed out above, DM assumes different modes of insertion for functional terminal nodes and root terminal nodes. The insertion of functional terminal nodes is regulated by competition. More specifically, FVIs are inserted into functional terminal nodes according to the Subset Principle in (43) (Halle 1997, Kiparsky 1973, Anderson 1986).

(43) **The Subset Principle**

> The phonological exponent of a Vocabulary item is inserted into a morpheme in the terminal string if the item matches all or a subset of the grammatical features specified in the terminal morpheme. Insertion does not take place if the Vocabulary item contains features not present in the morpheme. Where several Vocabulary items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen (Halle 1997:428).[35]

This procedure ensures that the VI whose feature specification matches that of the terminal node most closely will be the winner, essentially via an implementation of the Elsewhere Principle (see Caha 2009 for detailed discussion as well as an alternative in terms of supersets).

Root terminal nodes on the other hand do not trigger competition. Their insertion is based on free choice (Harley and Noyer 1998), although the precise way in which this free choice is implemented tends to vary. For example, Harley and Noyer (1998) propose that LVIs carry selectional features or at least a specification of the context in which they can be inserted (see also Embick 2010), while Harley & Noyer (1999) suggest that LVIs are endowed with the feature [Root] or with an index. What these options have in common, however, is that all LVIs have some sort of marking that they share with root terminal nodes, and that it is this marking that allows all of them to be inserted freely in such positions.

In sum, DM proposes that while functional terminal nodes trigger competition, root terminal nodes trigger free choice. The technical implementation of this dichotomy is feature-based. On the one hand, functional terminal nodes have specific grammatical features and only those vocabulary items that carry a (possibly non-proper) subset of those features can enter the competition for insertion. On the other hand, both root terminal nodes and lexical vocabulary items are endowed with a [Root]-feature, thus making it possible for any LVI to be inserted in any root terminal node.

5.3.2 Vocabulary Insertion without root markers

In what follows we adopt DM's twofold insertion mechanism outlined above. However, when we combine it with our earlier result that root terminal nodes are radically empty (i.e. that there is no [Root]-feature), it turns out that the mechanism also allows FVIs to be inserted in root positions, exactly as required.

Assuming a root marker is problematic for two reasons. Firstly, we have shown, based on the data in (2)-(11), that FVIs can be inserted in root terminal nodes. This implies that the diacritic that allows LVIs to be inserted in such positions—say, a [Root]-feature—should be present on FVIs as well. Such a move, however, would render this diacritic meaningless, as it would now be present on *all* VIs and as such would no longer distinguish roots from non-roots. Secondly, if FVIs were endowed with a [Root]-feature, then by the Subset Principle this feature should be present on functional terminal nodes as well, thus further hollowing out the concept of a [Root]-feature. In short, the DM-approach to Vocabulary Insertion in terms of a [Root]-feature faces considerable problems in light of data such as (2)-(11), where a functional element shows up in a typically lexical context.

That said, however, we do want to adopt the general machinery behind DM's insertion mechanism including the bifurcation between the insertion mechanism underlying functional terminal nodes and the one underlying root terminal nodes. We only deviate from this proposal in giving up on the idea that a root is marked by a designated feature. In what follows, we discuss the consequences of this adaptation for roots.[36]

Recall that root terminal nodes trigger free choice. Consequently, anything can be inserted. In DM free choice was limited to LVIs: only those vocabulary items that were marked with the same diacritic as the root terminal node could realize it. Given that we have given up this diacritic, free choice is unlimited. That is, *any* vocabulary item, whether lexical or functional, can now be inserted in root terminal nodes. In particular, there is no reason why FVIs should be prevented from being inserted in this position. The fact that their featural content is a superset of that of the root terminal node—by definition, because the featural content of the root terminal node is always the empty set, see the previous section—or the fact that LVIs are closer matches of this feature set is irrelevant. Competition does not apply to root terminal nodes, only to functional terminal nodes; vocabulary insertion into the former is subject to free choice. In other words, by giving up the [Root]-feature—or any comparable diacritic—it follows straightforwardly from the DM-mechanism of Vocabulary Insertion that both functional and root vocabulary items should be able to realize root terminal nodes. Given that this is exactly what we find (cf. the data in (2)-(11)), this is a most desirable outcome, and it further strengthens our case for giving up the [Root]-feature.

5.4 Conclusion

This section has explored two important consequences of the theory outlined in the first four sections of this paper. On the one hand, we have shown how the Primary Merge analysis of roots leads to layered derivations in the case of strings containing more than one root, while on the other we have argued that the elimination of specific root diacritics straightforwardly allows both functional and lexical vocabulary items to be inserted in root terminal nodes.

6. Conclusions and prospects

This paper has shown that four commonly assumed properties of roots follow without stipulation from an articulated theory of Merge. We have proposed to treat the very first instance of Merge as identical to all other applications of this operation. As a side-effect of this uniformity, every syntactic derivation starts out with a structurally empty syntactic terminal in its most deeply embedded position. We have identified this position as the insertion site for roots, thus deriving their featurelessness and acategorial nature, while at the same time allowing for the insertion of functional vocabulary items in root terminal nodes. This last point was an important—and, as we have shown, empirically well-motivated—aspect setting our analysis apart from previous DM-based accounts of Vocabulary Insertion.

At the same time, our proposal has been shown to have far-reaching consequences in quite disparate portions of the grammar. It provides new evidence for the layered derivations approach to expressions containing more than one root and for the hypothesis that roots never directly take arguments. Exploring some of these consequences in more detail is a task we look forward to taking up in future research.

7. References

Abels, Klaus. 2009. Some implications of improper movement for cartography. In: J. van Craenenbroeck (ed.) *Alternatives to cartography*. Berlin: Mouton de Gruyter. 325-359.

Adger, David. 2011. Labels and structure. lingBuzz/001252

Aelbrecht, Lobke. 2010. *The syntactic licensing of ellipsis*. Amsterdam: John Benjamins.

Ackema, Peter and Ad Neeleman. 2004. *Beyond morphology. Interface conditions on word formation*. Oxford: OUP.

Anderson, Stephen R. 1986. Disjunctive ordering in inflectional morphology. *NLLT* 4:1-31.

Baltin, Mark. 2013. Deletion versus pro-forms: an overly simple dichotomy? *Natural Language and Linguistic Theory* 30:381-423.

Belder, Marijke De. 2011a. *Roots and affixes*. PhD Diss., Utrecht University.

Belder, Marijke De. 2011b. A morphosyntactic decomposition of countability in Germanic. *The Journal of Comparative Germanic Linguistics* 14.3:173-202.

Belder, Marijke De and Jeroen van Craenenbroeck. 2013. *On vocabulary insertion*. Ms. CRISSP/HUBrussels/KULeuven.

Bobaljik, Jonathan. 2008. Where's Phi? Agreement as a Post-Syntactic Operation. In: Harbour, Daniel, David Adger & Susana Béjar (eds.) *Phi-Theory: Phi features across interfaces and modules*. Oxford: OUP, 295-328.

Bobaljik, Jonathan, and Höskuldur Thráinsson. 1998. Two heads aren't always better than one. *Syntax* 1: 37-71

Borer, Hagit. 2005a. *In Name Only: Structuring Sense vol I*. Oxford: OUP.

Borer, Hagit. 2005b. *The Normal Course of Events: Structuring Sense vol 2*. Oxford: OUP.

Borer, Hagit. 2009a. *Categorizing Roots*. Paper presented at Roots, Universität Stuttgart, June 10-12, 2009.

Borer, Hagit. 2009b. Roots and categories. Handout of a talk presented at the 19th Colloquium on Generative Grammar, Vitoria-Gasteiz, Faculty of Letters (Gradu Aretoa), University of the Basque Country.

Borer, Hagit. 2013. *Taking Form. Structuring Sense Volume III*. Oxford: Oxford University Press.

Bresnan, Joan. 1978. A realistic transformational grammar. In: Halle, Morris, Joan Bresnan and George A. Miller (eds.) *Linguistic Theory and Psychological Reality*. Cambridge, MA: The MIT Press, 1-59.

Bresnan, Joan. 1995. *Lexicality and Argument Structure*. Paper presented at the Paris Syntax and Semantics Conference, Paris, October 12-15, 1995.

Caha, Pavel. 2009. The Nanosyntax of Case. PhD Diss., University of Tromsø. lingBuzz/000956.

Chomsky, Noam. 1995. *The minimalist program*. Cambridge, MA: The MIT Press.

Chomsky, Noam. 2000. Minimalist inquiries: the framework. In: R. Martin, D. Michaels, & J.Uriagereka (eds.) *Step by Step: Essays on Minimalist Syntax in Honor of Howard Lasnik*. Cambridge, MA: The MIT Press.

Chomsky, Noam. 2006. Approaching UG from below. Ms. MIT.

Cinque, Guglielmo & Luigi Rizzi. 2010. The cartography of syntactic structures. In: G. Cinque & L. Rizzi (eds.) *Mapping spatial PPs: the cartography of syntactic structures*. New York: Oxford University Press.

Cormack, Annabel and Neil Smith. 2005. Linearisation: adjuncts and arguments. *UCL Working Papers in Linguistics* 17:111-129.

Doetjes, Jenny. 1997. Quantifiers and selection: On the distribution of quantifying expressions in French, Dutch and English. PhD Diss., Leiden University.

Donati, Caterina. 2006. On WH-head movement. In: L. Cheng & N. Corver (eds.) *Wh-movement: moving on*. Cambridge, MA: The MIT Press.

Drury, John E. 1998. The promise of derivations: atomic Merge and Multiple Spell-Out. Ms. University of Maryland.

Drury, John E. 1998. The promise of derivations: atomic merge and multiple spell-out. GAGL 42(2). http://irs.ub.rug.nl/dbi/475d4439bc6d5

Embick, David. 2010. Localism versus Globalism in Morphology and Phonology. Cambridge, MA: MIT Press.

Embick, David and Rolf Noyer. 2001. Movement Operations after Syntax. LI 32(4): 555-595.

Enderton, Herbert B. 1972. *A mathematical introduction to logic*. New York: Academic Press.

Epstein, Samuel D. 1999. Un-Principled Syntax and the Derivation of Syntactic Relations. In: S. Epstein and N. Hornstein (eds.) *Working Minimalism*. Cambridge, MA: The MIT Press.

Fortuny, Jordy 2008. *The emergence of order in syntax*. Amsterdam: John Benjamins.

Franco, Ludovico. 2011. The strict asymmetry of Merge. Ms. Università Ca'Foscari, Venezia.

Gallego, Ángel J. 2010. Locality and anti-locality in a Merge-based system. Handout of a talk presented at the *Antilocality and snowballing movement* workshop, GIST, Ghent, June 2010.

Gelderen, Véronique van. 2003. Scrambling unscrambled. PhD. Diss. Leiden University.

Grimshaw, Jane. 2009. The extended projection. Rutgers University, Ms.

Hale, Kenneth and Samuel Jay Keyser. 1993. On argument structure and the lexical expression of syntactic relations. In: Hale, Kenneth and Samuel Jay Keyser (eds.) *The view from Building 20: Essays in Honor of Sylvain Bromberger*. Cambridge, MA: The MIT Press, 53-109.

Halle, Morris. 1997. Impoverishment and fission. In Papers at the Interface, edited by Benjamin Bruening, Y. Kang, and Martha McGinnis, no. 30 in MITWPL, pp. 425 – 449. MIT, Cambridge, MA.

Halle, Morris & Alec Marantz. 1993. Distributed Morphology and the pieces of inflection. In: Hale, Kenneth & Samuel Jay Keyser (eds.) *The view from building 20*. Cambridge: MIT Press. pp. 111-176.

Harley, Heidi 2009. Roots: Identity, Insertion, Idiosyncracies. Talk presented at the Root Bound workshop, USC, February 21.

Harley, Heidi and Rolf Noyer. 1998. Licensing in the non-lexicalist lexicon: nominalizations, Vocabulary Items and the Encyclopedia. *MITWPL 32: Papers from the UPenn/MIT Roundtable on Argument Structure and Aspect*, edited by Heidi Harley, 119-137. Cambridge: MITWPL.

Harley, Heidi and Rolf Noyer (1999) State-of-the-Article: Distributed Morphology, *Glot International* 4.4, 3-9

Hoffman, J. 1996. Syntactic and paratactic word order effects. PhD. Diss. University of Maryland.

Hunter, Timothy Andrew. Relating movement and adjunction in syntax and semantics. PhD. Diss. University of Maryland.

Jaspers, Dany. 1998. Categories and recursion. *Journal of Applied Linguistics* 12:81-112.

Johnson, Kyle. 2003. Towards an etiology of adjunct islands. *Nordlyd* 31:187-215.

Johnson, Kyle. 2007. LCA+alignment=RNR. Handout of a talk presented at the Workshop on Coordination, Subordination and Ellipsis, University of Tübingen, Germany, June 2007.

Kiparsky, Paul. 1973. Elsewhere in phonology. In: Kiparsky, Paul and Stephen R. Anderson (eds.) *A Festschrift for Morris Halle*. New York: Holt, Rinehart and Winston.

Kuratowski, Kazimierz. 1921. Sur la notion de l'ordre dans la théorie des ensembles. *Fundamenta mathematicae* 2:161-171.

Koppen, Marjo van. 2005. *One probe - two goals: Aspects of agreement in Dutch dialects*. PhD Diss. Leiden University.

Langendoen, D. Terence. 2003. Merge. In: A. Carnie, H. Harley and M. Willie (eds.) *Formal approaches to function in grammar: in honor of Eloise Jelinek*, 307-318. Amsterdam: John Benjamins.

Levelt, Claartje et al. 1999. *A developmental grammar for syllable structure in the production of child language*. Brain and Language 68, 291-299.

Marantz 1995. Cat as a phrasal idiom: Consequences of late insertion in Distributed Morphology. MIT, Cambridge MA, Ms.

Marantz, Alec 1997. No escape from syntax. In A. Dimitriadis, L. Siegel, et al., eds., University of Pennsylvania Working Papers in Linguistics, Vol. 4.2, Proceedings of the 21st Annual Penn Linguistics Colloquium, 201-225.

Marantz, Alec. 2006. Morphology Lectures: Streaming Video. Lectures at the DEC of the ENS, Paris, October. http://www.diffusion.ens.fr/index.php?res=themes&idtheme=18

McCawley, James D. 1968. Lexical insertion in a transformational grammar without deep structure. In *Proceedings of the annual meeting of the Chicago Linguistic Society (CLS)*, eds. Bill J. Darden, Charles-James N. Bailey & Alice Davison, vol. 4, 71–80.

Moro, Andrea. 2000. Dynamic antisymmetry. Cambridge, MA: The MIT Press.

Munaro, Nicola and Cecilia Poletto 2003. *Sentential particles and clausal typing in the Veneto dialects*. University of Venice Working papers in linguistics 13.

Osborne, Timothy, Michael Putnam and Thomas M. Gross. 2011. Bare phrase structure, label-less trees, and specifier-less syntax. Is Minimalism becoming a dependency grammar? *The Linguistic Review* 28:315-364.

Partee, Barbara, Alice Ter Meulen and Robert Wall. 1987. *Mathematical methods in linguistics*. Dordrecht: Kluwer Academic Publishers.

Postma, Gertjan and Johan Rooryck. In progress. Redesigning C_{HL} as the Single Tree Workspace. Ms. in preparation Leiden University/Meertens Insitute.

Pylkkänen, Liina 2002. *Introducing Arguments*. PhD Diss., MIT.

Sciullo Anna Maria Di and Daniela Isac. 2008. The asymmetry of merge. *Biolinguistics* 2.4:260-290.

Siddiqi, Daniel. 2006. Minimize Exponence: Economy effects on the morphosyntactic component of the grammar. PhD Diss., University of Arizona.

Starke, Michal. 2001. Move dissolves into Merge. A theory of locality. PhD. Diss. University of Geneva.

Starke, Michal. 2009. Nanosyntax – A short primer to a new approach to language. lingBuzz/001230

Starke, Michal. 2011. Towards elegant parameters: language variation reduces to the size of lexically stored trees. lingBuzz/001183

Uriagereka, Juan. 1997. Multiple Spell-Out. GAGL 40(6):109-135, http://irs.ub.rug.nl/dbi/475d443a2edd6.

Williams, Edwin. 2009. There is no alternative to cartography. In: J. van Craenenbroeck (ed.) *Alternatives to cartography*. Berlin: Mouton de Gruyter. 361-373.

Zwart, Jan-Wouter. 2009a. Uncharted territory? Towards a non-cartographic account of Germanic syntax. In: Artemis Alexiadou e.a. (eds.) *Advances in Comparative Germanic Syntax*. Amsterdam: John Benjamins.

Zwart, Jan-Wouter. 2009b. Prospects for top-down derivation. *Catalan Journal of linguistics* 8:161-187.

Zwart, Jan-Wouter. 2010. Structure and order: asymmetric merge. To appear in Cedric Boeckx (ed.) *Oxford Handbook of Linguistic Minimalism*. Oxford: OUP.

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[1] As will be made explicit in section 5.2, we define cyclic domain as the extended projection of a root.

[2] We use Primary Merge rather than first Merge, as the latter is often used more generally to refer to the merger between a head and its complement. It should be clear, though, that this is a merely descriptive label and that no theoretical significance should be attached to it.

[3] See Borer (2005a:119) on the functional nature of cardinals.

[4] Note that we do not mean to imply that words such as *stone* are completely devoid of content altogether. For one, it is listed in Vocabulary and as such has a phonological matrix (and hence phonological features). Secondly, Encyclopedia constrains its meaning by linking the vocabulary item and the syntactic structure in which it appears to particular conceptual knowledge (Marantz 1995). However, phonological features and information from Encyclopedia do not affect the syntactic derivation; they only become relevant post-syntactically (Marantz 1995, Borer 2005a).

[5] One could of course also assume a productive—and pervasive—mechanism of category conversion allowing roots of one category (for example the noun *stone*) to be converted into another (for example the verb *stone*). See De Belder (2011a) for arguments against this alternative.

[6] LVIs are called *listemes* in Borer 2005a,b and *roots* in Borer 2009a,b. They correspond to what we have been calling—and will continue to call—roots.

[7] A phonological index is an abstract index that refers to all possible surface instantiations of one root. For example, *think* and *thought* are both referred to by the same phonological index. Borer assumes that the index bears a phonological resemblance to the root, hence the term *phonological* index.

[8] Note that the concept of late insertion long predates the advent of Distributed Morphology. The idea that lexical items are not inserted at the beginning of the derivation was prominent in the Generative Semantics era (see in particular McCawley 1968). A noticeable difference between the two, though, is the fact that for McCawley, (certain) lexical items are inserted *during* the derivation (specifically, after certain transformations, see McCawley 1968:72), rather than at the very end of it, as in standard DM. Thanks to a reviewer for pointing out the parallelism, and to Omer Preminger (p.c.) for providing the necessary background.

[9] Needless to say, a lot will depend on the precise insertion mechanism for VIs. This is an issue we take up in detail in section 5.3.

[10] For the opposite state of affairs, i.e. LVIs that are merged in functional terminal nodes, see Borer 2005a:10n4, De Belder 2011a and De Belder & van Craenenbroeck 2013.

[11] The translations given here are only indicative. The precise interpretation of these examples may vary according to the context.

[12] We follow Munaro & Poletto (2003) (among many others) in assuming that sentential particles are FVIs which realize a functional head in the clausal left periphery.

[13] Note in particular that in order to account for the data in (2)-(11) a DM-analysis based on the [Root]-feature would have to assume that all VIs—both LVIs and FVIs—are endowed with such a feature, thus rendering it technically trivial. See section 5.3 for detailed discussion.

[14] This statement should of course be relativized to cyclic domains: within one cyclic domain functional projections dominate lexical ones. This is an issue we return to in detail in section 5.2.

[15] Note in this respect that Borer (2009b:1) has to state as an axiom that "Extended projections must have an L [i.e. lexical, mdb & jvc] core".

[16] Recursive operations of set Merge obviously do yield hierarchical structure, but we are focusing on the output of a single Merge operation here.

[17] The most standard definition of ordered pairs is that of Kuratowski (1921) given in (i) below (see also Partee, Ter Meulen & Wall 1987:27). The definition referred to by Langendoen (2003) is the so-called short definition, see for example Enderton (1972). For a formal proof that the short definition satisfies the characteristic property of ordered pairs—i.e. $\langle a, b\rangle = \langle c, d\rangle$ if and only if a=c and c=d—see http://us.metamath.org/mpegif/opthreg.html.

(i) $\langle a, b\rangle =_{def} \{\{a\}, \{a, b\}\}$

[18] We follow Zwart in using the neutral term 'resource' here, rather than lexicon, Numeration, lexical (sub)array or any of the other alternatives available in the literature. As far as we can tell, our proposal is compatible with all of these implementations.

[19] In DM the operation responsible for creating these sets is called fusion or bundling, see Marantz 2006, Bobaljik & Thraínsson 1998, Pylkkänen 2002, De Belder 2011b for discussion and examples.

[20] As a reviewer points out, projection of the empty set might be employed in "situations of radical ellipsis – if these exist". While we agree that this is a promising perspective, one that possibly ties in with recent discussions of opacity effects in ellipsis sites, see Aelbrecht (2010) and Baltin (2012), it would lead us too far afield to pursue it here.

[21] A reviewer correctly points out that the reasoning developed in this paragraph might raise the question of whether the asymmetry we detect in Merge is inherent (i.e. part of the Merge operation itself) or derivative (i.e. due to the elements participating in the Merge process). We adopt the first alternative, for the reasons outlined in (the literature mentioned in) subsection 3.2 as well as the beginning of this subsection. That being said, though, it is not inconceivable that an alternative implementation of our proposal (one in terms of set Merge, with the asymmetry due to the elements undergoing Merge, and the first element from the resource undergoing set Merge with the empty set) is also feasible. As the remainder of the analysis will not hinge on this, we do not explore this alternative any further.

[22] As Zwart (2010:6) points out, the LCA might necessitate positing an empty position independently of any considerations related to Merge. Given that this principle depends on asymmetric c-command in order to convert hierarchical structure into linear order, the merger of two non-branching nodes—i.e. precisely the kind of structure that is created by Primary Merge—yields a non-linearizable structure. Chomsky proposes that such configurations must be rendered asymmetric (for example via movement) before they reach the PF-interface (see also Moro 2000 for related discussion), but more generally, one might require that every right-branching structure ends in an empty position (see Johnson 2007:5n6 for a similar solution). The fact that the perspective on Merge developed in this paper yields precisely this result on independent grounds thus serves as additional support for our proposal.

[23] For the sake of exposition, we abstract away from any other grammatical features that might underlie the DP *the books*. For example, most DM-analyses would include a *n*-head in R.

[24] As for the question of what triggers Spell-Out, we consider—but will not choose between—two possible options: either the structure is spelled out because/when the resource is depleted, or because/when a phase head is encountered (in this case {[+def]}). Under an implementation of phases in terms of lexical subarrays, these two options might reduce to one.

[25] We return in detail to the properties of the vocabulary insertion mechanism in section 5.3.

[26] Note that the plural morpheme is spelled out to the right of the root whereas the tree in (18) suggests it is linearized to its left. See Embick & Noyer 2001 for extensive discussion of the various ways in which this inversion can come about. Given that this issue is orthogonal to the reasoning developed in the main text, we gloss over it for expository purposes.

[27] Note that Zwart 2009b, 2010 is not the only one proposing (something like) this. See e.g. Uriagereka 1997, Starke 2009, 2011, Johnson 2003, and Hunter 2010 for similar proposals. As a reviewer points out, one might even consider labeling or projection to have a comparable effect as derivational layering through the *is a*-relation. See also section 5.2.3 for some more discussion.

[28] Note that we are assuming that functional projections are merged according to a universal functional sequence, as is common in cartographic work (cf. Cinque & Rizzi 2010), and that failure to adhere to this sequence leads to ill-formed structures (see also Abels 2009 and Williams 2009 for related proposals). The question of whether this functional sequence is part of UG or whether can be further derived, e.g. from the selectional requirements of the heads involved, is orthogonal to our main concern. See also Starke 2001 for discussion.

[29] More generally, what this illustrates is that our conception of Primary (and Unary) Merge prohibits multiple configurations to be built in tandem. For argumentation that a single tree workspace is to be preferred over a multiple tree workspace, cf. Postma & Rooryck in progress.

[30] The representation in (29) glosses over one complication, i.e. the fact that Merge should not select the member of R in (28) as is, but rather the singleton set containing that member (cf. the definition in (13)). We return to this issue below.

[31] Note that (29) illustrates another consequence of our analysis of roots: a root can never directly take arguments. For example, merging the direct object in (24) directly with the verbal root—i.e. readmitting it to the resource and then appending it to the null derivation via Primary Merge—would only cause the object to project further, and would not yield a verbal structure. For extensive argumentation that roots indeed have no argument structure, see Borer 2013.

[32] Note that readmittance to the resource can thus also be seen as a trigger for Spell-Out (see note 24): a piece of structure can only be readmitted to the resource when it is spelled out, which allows it to be treated as a syntactic atom again. See also the similar line of reasoning behind Uriagereka's (1997:115) proposal that all complex specifiers require Spell-Out prior to Merge.

[33] We will not go into the technical details of how exactly—or even if—the various subderivations are brought together into one representation in narrow syntax, as this exceeds the main topic of this paper. See Uriagereka 1997, Van Gelderen 2003, and Hoffman 1996, among others, for relevant discussion.

[34] Note that we are translating Uriagereka's proposal into our own terminology here: phrases that we consider to be readmitted to the resource constitute separate "command units" in his proposal.

[35] Note that Halle uses the term '(terminal) morpheme' for what we have been calling—and will continue to call—'(syntactic) terminal node'.

[36] Note that we do not adapt any of the assumptions for functional terminal nodes. The insertion mechanism in this domain thus remains unaltered.