Arabic verbal nouns as phonological head movement

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Verbal nouns in Arabic have a complex morphophonological structure, as discussed by McCarthy and Prince (1990). Syntactically, on the other hand, they appear rather straightforward, since they behave essentially identical to gerunds in English, so that the analysis of Abney (1987) carries over to Arabic without much modification (cf. Fassi Fehri 1993). However, the two analyses are separate and not directly compatible. Fassi Fehri (1993) assumes an abstract *Ev* affix that nominalizes the verbal stem, without trying to account for the way the actual verbal noun form is derived. McCarthy and Prince (1990) discuss the morphophonological structure without linking it to a morphosyntactic analysis.

The goal of this paper is to link a morphophonological and a morphosyntactic analysis of verbal nouns in Arabic and to show how we can derive the phonological structure from the syntactic structure. The basis for the analysis is the observation that syntactic or morphological principles do not play a role in the construction of the phonological form: the form is construed by phonology on the basis of phonological principles only. The morphosyntactic structure only plays an indirect role, through principles governing the mapping from syntax to phonology. Specifically, it is shown that it is not necessary to assume head movement operations that solely serve to enable word formation. It is the mapping from syntax to phonology and the phonology itself that bring about the effect that more traditional analyses try to analyze through syntactic head movement.

1. Introduction

At first sight, Arabic verbal nouns —called *masdars* in Arabic— seem rather uninteresting. Their properties mimic those of English gerunds, with the exception that there is no equivalent to Abney's (1987) Acc-*ing* construction. However, from a morphological / phonological perspective, the picture is quite different. Masdars have an intricate morphological structure, discussed for example by McCarthy and Prince (1990), Fassi Fehri 1993 and Kremers 2007. This structure is interesting in and of itself, but when one considers the implications for the syntax underlying masdars, it becomes clear that masdars are very relevant to syntax and to theories on the syntax/phonology interface.

I assume, following Abney's analysis of English gerunds, that masdars are in essence *syntactic* structures: they are formed in syntax by converting a verbal projection into a nominal projection. As McCarthy and Prince (1990) argue, the nominalizer is overt and consists of a vocalic 'melody' of the form /i.a/. By attaching the nominalizer at different levels in the structure, we obtain different constructions: when the nominalizer is attached to V, turning it into an N head, the derivation yields a purely nominal construction (Ing-*of* in Abney's terminology). When the nominalizer is attached to VP, it yields a construction that is externally a noun but internally a verb (Poss-*ing*, as Abney calls it).[1]

In both structures, the morphemes that constitute the Arabic masdar are spread throughout the syntactic tree. There is no distinct subtree that contains all morphemes in the masdar form. The standard answer in syntactic analyses to such a situation is to assume that head movement takes place. However, head movement of this type[2] is driven by the need to

[1] As just mentioned, there is no equivalent in Arabic of the Acc-*ing* construction, which is the result of attaching the nominalizer at the level of IP. Why this should be the case is an open question.

[2] I explicitly do not wish to claim that *all* types of head movement are phonological. Head movement that has semantic effects must take place in syntax (cf. Lechner 2006).

build a word form; that is, it is essentially phonologically motivated, there is no inherent *syntactic* reason why it should take place.

In this paper, I show that there is in fact no need to assume syntactic head movement in this case. We do not need to create a distinct syntactic subtree containing all and only the morphemes that form the masdar. Rather, we can obtain the correct result by assuming a process of *phonological composition*, which takes the morphemes and combines them into a single word form. The way in which this process operates yields an effect that gives the impression that head movement has taken place in syntax, even though in fact it has not.

2. Theoretical background

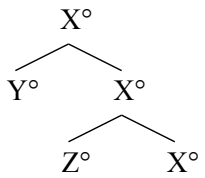
Before starting the discussion of verbal nouns in Arabic, it is necessary to discuss the main theoretical assumptions that I make.

2.1 Bare phrase structure and morphology

I assume a minimalist framework with merge as the single structure-building operation and with bare phrase structure (BPS). As Chomsky (1995) makes clear, BPS is essentially the kind of structure that we get when we adopt Merge and moreover, it is *all* we get. Specifically, traditional X-bar related notions such as 'minimal' and 'maximal' projection are derivative, they are not primitive notions of the theory. A minimal projection is simply the lowest element in a projection chain, an element that is not itself generated by merge. A maximal projection is the highest projection in a projection chain.

One important consequence of this is that there can be no such thing as a complex head. That is, a structure such as the following cannot exist:

(1)



This structure is supposed to be a complex head, i.e., a head that consists of three separate heads, X, Y and Z, which together build a complex word. Embick and Noyer (2001), working in the framework of Distributed Morphology, define such a structure as a Morphological Word (MWd),[3] which operates as a unit in syntax and may be subject to DM's morphological operations.[4] The structure in (1) is impossible in BPS because as soon as the head X merges with Z, the resulting projection is no longer minimal, i.e., it is no longer a head in the sense that Embick and Noyer (2001) require. In the structure here, the merger of X and Z yields an intermediate projection X, and the subsequent merger of Y yields a maximal projection of X.[5]

Since BPS does not allow us to single out a structure such as the one in (1), we are forced to adopt an even more radical unification of syntactic and morphological structures than DM proposes. There can be no separate morphological derivational operations other than

[3] Furthermore, the individual segments are defined as Subwords (SWd).

[4] Embick and Noyer's (2001) definition of MWd is all the more surprising given the fact that they do explicitly refer to Chomsky's bare phrase structure proposal.

[5] Of course, the structure in (1) may merge and X may project again, in which case the maximal projection would lose this status in favor of the newly created projection.

those that can be defined in either syntactic or in phonological domains. Although extensive discussion of this conclusion would go beyond the scope of this paper (but see Kremers (in preparation) for details), the analysis that I propose in this paper is inspired by and in line with it.

2.2 Parallel architecture

Another important assumption that I make is the idea of a parallel architecture. Although at first sight this may seem a rather radical departure from standard minimalism, I believe the idea follows quite naturally, even in current minimalist thinking. Chomsky (1965, 214, fn. 15) states that a linguistic sign is composed of semantic, syntactic and phonological features. This is a rather obvious statement, of course, but it does imply that once a syntactic head is introduced into the syntactic derivation, its semantic and phonological features become immediately available as well.[6]

If this is indeed the case, there is no reason to assume that the semantic and phonological features are not immediately processed. Why would the linguistic system postpone processing these features if they are available immediately? I therefore assume that as soon as two syntactic elements are merged, their phonological representations are combined by the phonological system.[7] Or, to be more exact, the phonological system *tries* to combine them. It does not always succeed, there are particular cases in which combining two phonological 'chunks' does not yield a licit phonological form. In these cases, the phonological system will postpone spelling out the two chunks until more material becomes available with which they can be combined to form a licit phonological form.

The parallel architecture proposed here has some important differences with the architecture proposed by Jackendoff (2002). Primarily, I assume that there is only one generative system, which is syntax. Jackendoff argues that semantics and phonology form generative systems in their own right, but in the architecture proposed here, phonological (and semantic) operations are still triggered by a syntactic merge operation. The difference with more traditional minimalist models is simply that they are instantaneous, rather than delayed.

Another difference with Jackendoff's (2002) system is that the current proposal does not require indices to connect semantic, syntactic and phonological representations. Jackendoff argues that a semantic or phonological structure receives an index which links it to a syntactic structure. Freidin (2003) rejects these indices on the basis of Full Interpretation, and I follow his assessment. Since there is only one generative component in the system that I propose, there is no need for such indices. A head that is merged is at all times linked to its semantic and phonological features. Crucially, there are only two ways to introduce semantic and phonological structure: such structure is either introduced through the merger of a syntactic head, or by principles governing the mapping of syntactic structure to semantic or phonological structure. There is no other way to introduce ("generate") semantic or phonological structure; specifically, the semantic and phonological subsystems cannot generate structure on their own.

Note that this does not mean that the semantic and phonological features are *available* to the syntactic component. The three groups of features are of a different nature and are therefore processed by different subsystems of the grammar. That is exactly what it means to say that semantics, syntax and phonology are different grammar modules: they operate on different types of features and do so by different combinatorial principles. It does *not* mean

[6] Note that in DM, this is clearly not the case. What that means is that in DM, the statement that a linguistic sign is composed of semantic, syntactic and phonological features is not so obviously true. This is one reason why, even though the analysis that I develop has a lot of affinity with DM, I do not consider it a DM-style analysis.

[7] And the same goes for the semantic features, although I do not discuss those here.

that the three types of features are separate and must be combined or linked at some point during or after the derivation.

From a minimalist perspective, a parallel architecture of the type sketched here makes sense for another reason: Spell-out is the operation that transfers (partial) structures to the interfaces of the Conceptual-Intentional and the Sensorimotor systems. Note, however, that these systems are in fact non-linguistic. That is, they do not generate linguistic (i.e., semantic or phonological) representations, they *interpret* them. But in order for such structures to be interpreted, they must be created first. It seems reasonable to assume that they are created as soon as their component parts become available, i.e., at the moment when the relevant syntactic heads are merged. Assuming anything else, e.g., that they are created as part of Spell-out, seems stipulative.[8]

2.3 Syntax-phonology mapping

As a final point, I make some specific assumptions about the syntax-phonology mapping. Specifically, I adopt two principles proposed by Ackema and Neeleman (2004):[9]

(2) **Input Correspondence (IC)**
If X selects (a projection of) Y, then Φ(X) selects ΦY).

(3) **Linear Correspondence (LC)**
If a node X is structurally external to a node Y, then Φ(X) is linearly external to Φ(Y).

Input Correspondence crucially depends on Beard's (1988) *Separation Hypothesis*, which I adopt and which essentially states that the morphosyntactic features of an affix are independent from its phonological form. We can (and should) therefore consider the syntactic and phonological behavior of elements separately. In this vein, Ackema and Neeleman (2004) argue that an affix must not attach to a head in syntax; it can attach to any element of the right category, regardless of its projection level. Only in the phonology is the affix required to attach to a prosodic word. They capture this observation by saying that if an affix X attaches in syntax to a structure Y, the phonological form associated with the affix attaches to the phonological form associated with the *head* of Y. Note that this is essentially the same claim that Abney (1987) makes in his analysis of English gerunds. In Abney's analysis, the affix *-ing* attaches to a projection of V (even an extended projection). Because Abney does not distinguish between syntactic structure and phonological form, he has difficulty ensuring that *-ing* attaches phonologically to the verb, but this is exactly the problem that IC is meant to solve.

The second principle that Ackema and Neeleman (2004) propose, Linear Correspondence, is a version of Partee et al.'s (1993) *Nontangling Condition*. In essence, LC says that two sister nodes are adjacent in the linear structure. If A is a head mapping onto the phonological string «a», and B is a non-head mapping onto «bcd», then the node K(A,B) maps onto «abcd» or onto «bcda», but not onto «bacd» or «bcad». That is, Φ(A) cannot interrupt Φ(B).

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[8] A parallel architecture of the type described here would also be able to account for look-ahead effects from syntax to phonology of the type described in Richards (2010). An operation in syntax (merge or remerge) may trigger an operation in phonology that leads to an illicit structure. To remedy such a situation, the syntactic operation may simply be blocked, or an additional operation may be required in syntax in order to save the phonological structure.

[9] But see also Sadock (1992) for two very similar principles. The notation Φ(X) refers to the phonological material associated with the syntactic head X.

For Ackema and Neeleman (2004), these principles are morphological principles (they make the explicit claim that morphology and syntax are distinct structure-building components of the grammar) but as I explain in Kremers (to appear), the principles apply to syntactic structures as well.[10] For LC, this is easy to see: it is a version of the Nontangling Condition, which is foremost a principle that holds between syntactic structures and the linear structures they are mapped onto. The issue is a bit less obvious for IC, given that Ackema and Neeleman (2004) propose it specifically to deal with affixes. However, as I discuss in Kremers (to appear), IC does not apply to *all* kinds of structures: it only applies to those structures that have a specific prosodic requirement in their phonological forms. Affixes have such a requirement: they require alignment with the right or left edge of a prosodic word. "Words" (in the traditional sense) usually do not have such a requirement, but there are syntactic elements that *do* have such requirements and are therefore subject to IC. They occur abundantly in sign languages: elements of this type are realized on an autosegmental phonological tier and are associated with more than one single manual sign, which precludes the possibility of a morphological analysis (see Kremers (to appear) for examples and discussion).

3. The data

With the theoretical assumptions out of the way, let us now turn to the data to be discussed. Arabic verbal nouns essentially allow two types of constructions (Fassi Fehri 1993; Kremers 2003):

(4) a. ʔaqlaqa-nī -ntiqād-u -l-rajul-i -l-mašrūʕ-a
annoy-1sg.OBJ criticizing-NOM the-man-GEN the-project-ACC
'The man's criticizing the project annoyed me.'

b. ʔaqlaqa-nī -ntiqād-u -l-rajul-i li -l-mašrūʕ-i
annoy-1sg.OBJ criticizing-NOM the-man-GEN to the-project-GEN
'The man's criticizing the project annoyed me.'

The data discussed in this paper are from Modern Standard Arabic (which is in essence a continuation of Classical Arabic).[11] The properties of masdars can be summarized as follows:

- Regular form (in most verb classes).
- Event structure.
- Subject takes genitive case.
- Object takes genitive case when no subject is present, otherwise accusative or PP.

The fact that masdars usually have a regular form is important, as it indicates that they are derived through rules. Masdars have event structure in the sense of Grimshaw (1990), which indicates that they do indeed have a verbal core. When a subject and/or object is present, masdars appear in the so-called *construct state* (e.g., Borer 1999; Fassi Fehri 1993; Siloni 2001; Kremers 2003): the highest argument (subject when present, otherwise object) receives genitive case and the masdar itself takes no definite article. If the object cannot be

[10] Of course, under the assumption that there is only a single structure-building mechanism underlying both syntactic and morphological structures, this follows automatically. But even if one were to maintain a syntax-morphology dichotomy, IC and LC would apply to syntactic structures, as discussed in the text.

[11] Spoken varieties differ substantially from Standard Arabic in some respects, but are also heavily influenced by it. The use and formation of masdars is by and large the same, although details differ.

assigned genitive case due to the presence of a subject (the head of a construct state in Arabic can only assign genitive to one noun), it is realized as a PP with the preposition *li* 'to, for', or it is assigned accusative case.

Masdars can also occur without arguments or with merely a prepositional object. In such cases, the masdar does not appear in construct state (it would not have anything to enter into a construct state with). Instead, it takes a definite article:

(5) al-iʕtirāḍ-u ʕalā -l-ḥukm-i
the-objecting-NOM on the-judgment-GEN
'the objection against the judgment'

4. Morphological structure

In Arabic, as in other Semitic languages, a root consists of (usually) three consonants. Stems are derived from such roots by inserting templates consisting of vowels and additional consonants. In this way, a total of 15 verb stems can be derived from a single root. These verb stems, or *classes*, as I will call them, are usually numbered with Roman numbers I-XV.[12] Often, a verb class contributes a specific meaning aspect to the basic meaning of the root (e.g., intensive, reflexive, reciprocal, applicative, causative). However, this system is not completely productive and there are many verb classes whose meanings are lexicalized and no longer related to the root meaning in any regular way. For example, class II expresses intensivity or causation, but the verb *ḥaddaṯa*, which is the class II form of the root ḤDṮ 'to happen' means 'to speak', not 'to make happen' or something similar.

Table 1 provides a list of all verb classes and their masdar forms modeled on the root KTB ('to write'). Note that these forms are for illustration purposes only. It is not the case that all of these forms are lexicalized as verbs. For the root KTB, classes I, II, III, IV, VI, VIII and X are, but the others are not.

class	perfective	masdar	class	perfective	masdar
I	katab	(irregular)	IX	iktabb	iktibāb
II	kattab	taktīb	X	istaktab	istiktāb
III	kātab	mukātaba	XI	iktātab	iktītāb
IV	ʔaktab	ʔiktāb	XII	iktawtab	iktiwtāb
V	takattab	takattub	XIII	iktawwab	iktiwwāb
VI	takātab	takātub	XIV	iktanbab	iktinbāb
VII	inkatab	inkitāb	XV	iktanbay	iktinbāy
VIII	iktatab	iktitāb			

Table 1: Masdar forms

The initial *i-* in classes VII through XV is epenthetic and not part of any morpheme. Looking at the masdar forms in table 1, one thing is immediately obvious: in ten classes (IV

[12] The Hebrew term for these verb stems is *binyan* (pl. *binyanim*), a term which has gained some use in Western linguistic discourse. The corresponding Arabic term is *wazn* (pl. *ʔawzān*) 'weight, measure'. Western Arabist tradition usually uses the terms *stem, form* or *pattern*. I prefer the term *class* because the stems denote different derivational classes (different 'classes of verbalizers', as one reviewer puts it). This use of the term *class* differs slightly from its use in the sense of 'morphome' (i.e., an element added to a root/stem without any link to syntax or semantics), as is common in lexical morphology. One important difference is that in those cases, the root/stem itself is marked as belonging to a specific class (requiring a specific morphome), while here any class marker can in principle combine with any root. Note that the numbering from I-XV is a Western tradition.

and VII—XV), the masdar has the vowel pattern *i-ā* or, in class XI, *ī-ā*. Since the first (morphemic) vowel in the verbal stem of class XI is also long, we may assume that the vowel length is part of the class pattern, not of the masdar. In fact, this is exactly what McCarthy and Prince (1990) assume. They analyze the masdar forms and come to the conclusion that they contain four morphemes:

(6) masdar morphemes:
  a. nominalizer
  b. non-finiteness marker
  c. class marker
  d. root

The root and class marker together form a lexical entry. For example, the root KTB 'to write' has a class I stem *kataba* 'to write', a class II stem *kattaba* 'to make s.o. write', a class III stem *kātaba* 'to correspond with s.o.', a class IV stem *ʔaktaba* 'to dictate', and several others.

For McCarthy and Prince (1990), the nominalizer is realized in most verb classes by the vowels /a.i/. That is, even though in those masdar forms that have /a.i/ the vowel /i/ is long, McCarthy and Prince (1990) assume that the vowel length is not part of the morpheme. Rather, they analyze vowel length as a marker of finiteness: a long stem-final syllable marks non-finiteness, while a short vowel marks finiteness. Although it is true that most masdar forms have a long stem-final syllable, this is only true of one other non-finite verb form: the passive participle of the first class. No other participle has a long stem-final syllable. (Other non-finite verb forms do not exist.) That is, the evidence for a separate non-finiteness marker is rather weak in my opinion, and I therefore assume that the long vowel is in fact part of the nominalizer. As we shall see below, the assumption of a separate non-finiteness marker actually runs into two problems, one of which is discussed in the next section, the other in section 9.

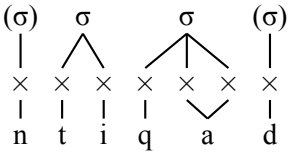
Let us for the moment proceed on the basis of McCarthy and Prince's (1990) analysis, including the non-finiteness marker. Once we look at the syntactic structure, it will become clear why this morpheme is problematic. Obviously, the four morphemes are not put together into a single word form by simple affixation. The best way to see how word formation works is to consider an example. The word form *intiqād* in (4) is the masdar of the class VIII verb *intaqada* 'to criticize'. Its morphemes are the following:

(7)

Root:	/nqd/	Nominalizer:	/i.a/
Class VIII:	$(\sigma)\sigma_{\mu}$	Non-finite:	$-\sigma_{\mu\mu}$
	|		
	t		

The phonological structure of *intiqād* is given in (8):

(8)



As discussed by McCarthy and Prince (1990), in Arabic it is necessary to distinguish a prosodic autosegmental tier on which syllable structure is represented. In (8), the syllabic tier is represented at the top, the segmental tier at the bottom. The structure is built up as follows:

the class VIII marker, a syllabic morpheme with one segmental position filled, combines with the non-finiteness marker. Note that this marker is a suffix, as indicated by the hyphen.[13] Therefore, it is suffixed to the class VIII marker. Additionally, an extrametrical syllable is added. This is a language-specific rule of Arabic: all Arabic stems end in an extrametrical syllable.[14]

The segmental elements are intercalated into this syllabic template according to the principle of Left-to-Right Association. The first root consonant /n/ is linked to the coda of the initial extrametrical syllable (which is syllabified with the preceding word in a postlexical process or otherwise an epenthetic /i/ is added, as mentioned above). The second root consonant is linked to the onset of the third syllable, which is the non-finiteness marker, because the onset of the second syllable is already filled by /t/. The third root consonant could in principle be associated with the coda of the third syllable (that is, Arabic phonology allows this) but this would mean that the final extrametrical syllable remains empty. Instead, then, the third root consonant is linked to the onset of the extrametrical syllable (and is then syllabified with either a case ending or with the following word, depending on the formal level of the language utterance). The vowels of the nominalizer are also distributed from left to right: the /a/ is linked to the nucleus of the first full syllable, the /i/ to the nucleus of the second full syllable. Because this nucleus consists of two positions, the vowel spreads, yielding a long vowel.

What is important to note here is that the form *intiqād* is composed through phonological principles: Left-to-Right Association orders the segments, Alignment ensures that the non-finiteness marker is suffixed to the class VIII marker and the language-specific requirement that each p-word end in an extrametrical syllable ensures that the third root consonant is not contained in the second full syllable (i.e., the third syllable overall). No reference to morphological or other principles are necessary. Ideally, this is always the case: the phonological forms of the elements involved, combined with universal and language-specific phonological principles, determine what the final form looks like. Principles regulating the morphosyntactic structure do not play a direct role: they can only influence the phonological form through the mapping of syntax to phonology.

5. Syntactic structure

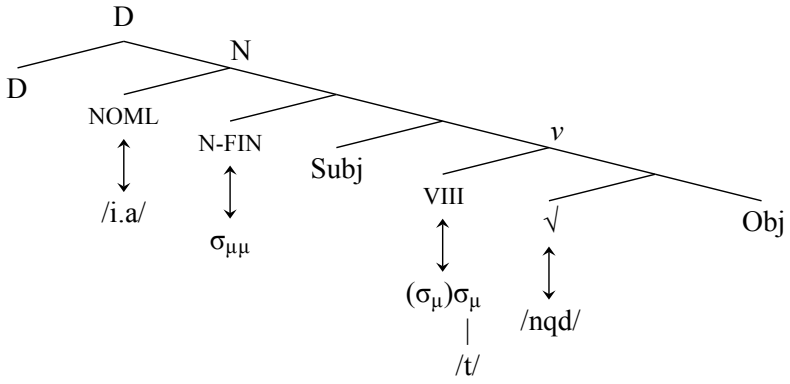
With McCarthy and Prince (1990)'s analysis in mind, let us look at the syntactic structure of masdars. If we want to accommodate all four morphemes that McCarthy and Prince (1990) propose, we may assume the following tree structure for the (equivalent of) the Poss-*ing* construction:[15]

[13] In actual fact, I assume that pre- and suffixes are characterized by an alignment requirement (cf. Kremers in preparation). The hyphen is just a convenient way of indicating this.

[14] It may be possible to implement this as a general requirement that the third consonant of a root is right-aligned with the prosodic word, but I will not pursue this option here.

[15] Note that this structure differs somewhat from the one I proposed earlier in Kremers (2007). The structure in the text seems more feasible to me now, but in actual fact, for present purposes it does not really matter which structure we assume. As mentioned in the introduction and as I discuss more extensively below, the crucial point is that there is no distinct subtree containing all four morphemes. No matter what structure we assume for Arabic masdars, it will always have this property.

(9)

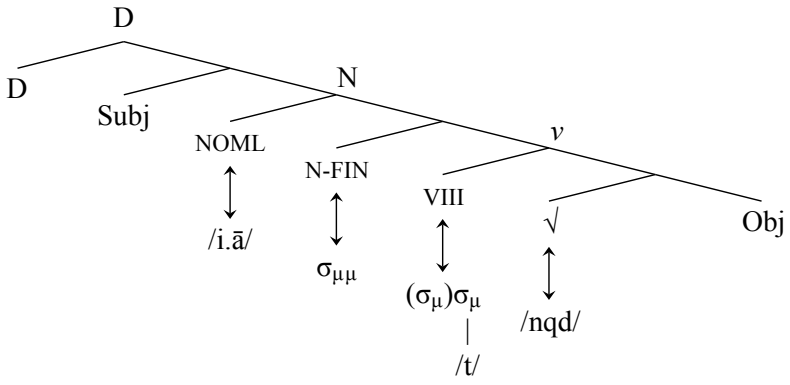


Three of the four morphemes are easily identifiable: the root is obviously the a-categorial lexical element; the class VIII marker is a verbalizing element, so we can identify it with the verbalizer *v*. It is the combination of root plus verbalizer that carries a lexical meaning.[16] Furthermore, the nominalizer is obviously the head that nominalizes the verbal projection, so it must merge last.

The non-finiteness marker presents us with a bit of problem, however. Although this marker is associated with finiteness, it does not seem feasible to identify it as a T head, because T would be much higher in the structure. It would then merge higher than the nominalizer, but this does not make sense, because once the structure is nominal, it is no longer compatible with a finite/non-finite feature. Alternatively, we could assume that the nominalizer merges higher than T, but then we would expect the equivalent of an Acc-*ing* construction. Since this construction does not exist in Arabic, this analysis is not an option.

The problem recurs in the equivalent of the *Ing-of* construction. Here, the nominalizer merges lower in the structure:

(10)



The problem is that not only the nominalizer but consequently also the non-finiteness marker must be assumed to merge low in the structure. In fact, it would seem that the non-finiteness marker always needs to merge just below the nominalizer. For this reason, we may as well assume that the two form a single head. Let us assume, then, that there is no non-

[16] Which conforms to Marantz' (1997) claim that "[t]he syntactic head that projects agents defines a locality domain for special meanings."

finiteness marker in the structure and that the nominalizer has the following phonological form:

(11) $\sigma_{\mu\mu}$ /i . a/

The syntactic structure of the masdar constructions changes, too, of course, but not dramatically. The non-finiteness marker is removed, other than that the structure remains the same.

The highest head in the trees in (10) and (11) is the determiner D. In Kremers (2003), I argue that construct state nominals are headed by a phonologically null D head that has a [+poss] feature which enables them to assign genitive case. Specifically, I argue that genitive case in Arabic is a structural case that is assigned through a standard Agree process between the D head and the highest nominal in its c-command domain. In the case of masdars, this is the subject if one is present and otherwise the object.

Longobardi (1994) argues that an empty D head cannot survive in syntax. The noun must move to it in order to provide it with semantic content. I adopt this assumption, although in a somewhat different form. First, the notion of an "empty D head" is ill-defined in the current model, and in the sense it was intended in Longobardi (1994), it is useless here. For Longobardi (1994), an empty D head is a head with no phonological content. However, in this sense, *all* heads are empty in the current model, because the phonological features are not part of the syntactic structure. Morphosyntactically, the construct state D head is definitely not empty, because it contains at the very least a [+poss] feature.[17]

I therefore assume that a D head requires an index, a syntactic feature modeled on the equivalent feature in HPSG: the index feature allows the nominal to be identified syntactically; it consists of a set of φ-features that enable this identification and that are available for agreement. A D head that does not possess an index must obtain one, normally from the noun that it embeds. The D head in a construct state lacks this index feature but obtains it through movement of N to D. When the nominal is a masdar, however, the index is not provided by the lexical V head. Rather, it is provided by the head that converts the projection into a nominal one, i.e., by the nominalizer. I therefore assume that the nominalizer moves to D in order to provide it with an index.

Note that this movement is clearly syntactically driven. The D head lacks an index feature but requires one.[18] Crucially, however, it is not necessary for *all* the heads in the projection to move to D. The root and the class marker are not able to provide D with an index and therefore there is no syntactic trigger for moving them.[19]

6. Syntax/phonology mapping

With the syntactic structure in place, we can now look at the way in which the syntax is mapped onto the phonology. As mentioned in the introduction, the tree structure in (10)

[17] In my analysis in Kremers (2003), it also contains an unvalued [def] feature, which accounts for the so-called definiteness effect: in a construct state, the definiteness of the dependent (genitive-marked) noun determines the definiteness of the entire construct state construction.

[18] More precisely, it would probably be better to say that the D head has an unvalued index feature, which is valued by head movement. The index feature of the nominalizer is valued, as masdars are generally third person singular.

[19] Note also that I assume that syntactic head movement is actually reprojection (Georgi and Müller 2010). As a result of the impossibility of complex heads in BPS, head adjunction would actually create a new complement, raising the original complement to specifier status. Reprojection structures do not suffer from this problem.

does not contain a distinct subtree containing all three morphemes that are part of the masdar and excluding everything else. The root and the class VIII marker are visually close in the tree, but this is irrelevant, because they do not form a distinct subtree: the subtree encompassing the class VIII marker also contains the object.

This is in fact an important point. The root and the class VIII marker appear to be adjacent in the tree. Note, however, that in BPS, no order is defined in syntactic trees. Even if we take the mapping to phonology into account, the root and the class VIII marker would appear adjacent in the linear string only if two additional conditions are also met: first, the order of linearization would have to be spec-head-comp,[20] and second, the two elements would both have to be realized on the same autosegmental tier. The first condition is arguably met in Arabic, as Arabic is overwhelmingly a head-initial language, but the second is not: the class VIII marker is realized on the syllabic tier and the temporal extents of both elements overlap.

Additionally, the nominalizer is also not close enough to the root and the class VIII marker to form a distinct subtree. That is, the three morphemes making up the masdar are all separated in the syntactic tree, they do not form a single structure. This of course raises the question how the phonology "knows" that they have to be combined into a single word form. The more or less standard answer in such cases is to say that head movement takes place, but as already explained, I do not wish to take this step, because the relevant movements, V to VIII and V+VIII to NOML, have no syntactic trigger.

The solution to this problem, however, is straightforward. The principle of Input Correspondence gives us exactly the tool we need to ensure that phonology knows that the four morphemes need to be combined into a single word form: the class VIII marker selects the verb, and by virtue of IC, Φ(VIII) combines with Φ(V), even though VIII merges not with the V° head directly, but with a projection of V. The same holds for the nominalizer (or rather, the D+NOML complex).

That is, VIII selects V and NOML selects VIII. As a result, the phonological elements linked to these three heads are combined into a single form by the phonology. In the syntax, the heads remain separate, but in the phonology, they end up as a single prosodic word. In other words, we do not need a distinct subtree in syntax in order to ensure that the four morphemes are combined in the phonology. IC ensures that this happens.

7. Phonological composition

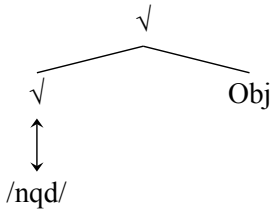
Through IC, there is a requirement in the phonology that the three masdar morphemes are combined into a single form. The next question we must answer is how this happens. Because each syntactic merge makes available the phonological features of the merged elements, phonological composition takes place in parallel with the syntactic derivation. In this section, I discuss this process in more detail, to see how exactly this happens.

I assume that the phonology does its job in the following fashion: there is a work space of sorts, in which phonological forms are built. Anything that is not a complete phonological form is kept here. Additionally, the phonology builds a representation of the eventual linear string. It is important to note that this string is only an *initial* string. It is not the exact phonetic representation of the string to be uttered. Postlexical phonological processes, for example, do not take place until the derivation (or a phase) is complete.

[20] Which is of course a given under the LCA, but the LCA is not without its problems. I do not adopt the LCA, mainly because phonological features may factor into the final form a phrase takes (for discussion, see Kremers (in preparation)). Furthermore, Abels and Neeleman (2009) show that the LCA is too strong a condition on linearization and that a more permissive system using linearization parameters combined with a restrictive theory of movement provides the same empirical coverage.

Let us see what happens when a masdar structure is derived. First, the object and the root are merged, yielding the following syntactic structure:

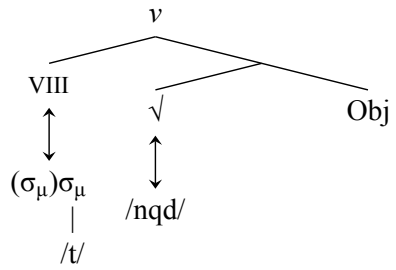
(12)



What happens exactly in the phonology in this step is not relevant for our purposes. I assume that the object is a phonologically complete unit and that it is placed into the phonological string to be formed. The root is not a phonologically complete unit: it does not constitute a licit phonological form, consisting of three consonants only. The root of course selects its complement, but there is no way in which the root can be phonologically integrated with it: the object does not provide any empty slots in which the consonants could be placed. Therefore, we may say that the root is kept in the phonological work space until it can be combined with other elements to create a licit form.

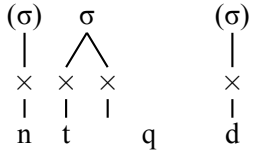
The next step is the merger of the class VIII marker. This yields the following syntactic structure:

(13)



The class VIII marker is also a phonologically incomplete form and is therefore also kept in the temporary work space. Because the class VIII marker selects the root in syntax, the two forms must be combined. Doing this yields the following phonological structure, which, however, is still incomplete:

(14)

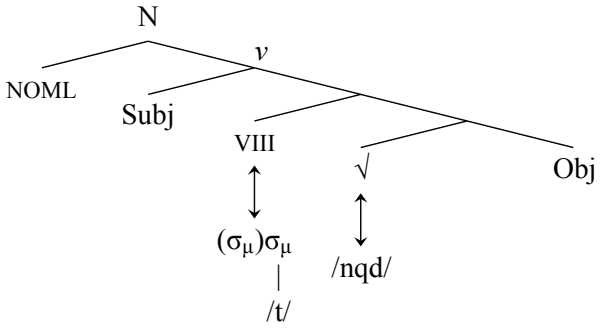


In this structure, the nucleus of the first full syllable is not filled and the root consonant /q/ is not associated with a slot position. Note that /q/ cannot be associated with the nucleus position, because Arabic phonology does not allow consonants in syllable nuclei. Note that I have already added the stem-final extrametrical syllable. Since this is a general requirement on stems in Arabic, it seems safe to say that it is immediately added.

After the class VIII marker, the subject is merged. Phonologically, the subject is treated the same way as the object: it is placed in the linear string, while the class VIII marker and the root, now combined, are kept in the temporary work space.

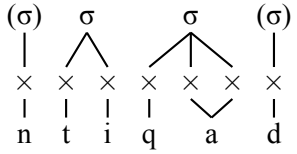
The next step is of course the merger of the nominalizer. This yields the following syntactic structure:

(15)



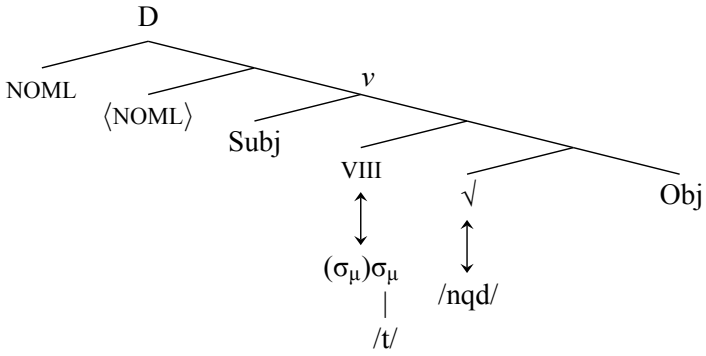
In the phonology, the vowels /i.a/ and the long syllable are added to the structure. The phonology can now fill the empty nucleus position of the first full syllable and it can link /q/ to a slot position. The resulting structure is (16):

(16)



This structure is complete, there are no unsatisfied phonological requirements. At this point, the form will be placed in the linear string, where the subject and the object are already present.[21] However, this does not complete the syntactic structure yet. There is still the D head that must be merged. Because the structure is a construct state, as described above, this D head requires NOML to D movement. As discussed, only the NOML head moves:

(17)



Obviously, when movement takes place in syntax, it should have the ability to change the phonology. Because the element to be moved is already in the linear string, there must be some way for the phonology to delete it again. I will leave the details of this process for future research, but it should be relatively straightforward: since phonology and syntax are built up in parallel, the links between the various syntactic heads and their phonological counterparts remain extant during the derivation (at least until spell-out). Movement consists of a remerge of the moved element not only in syntax, but also in phonology (and of course semantics).

[21] I have ignored the question of linearization here. Every time an element is placed in the linear string, it is necessary to take into account the requirements on linearization, but since Arabic is rather straightforwardly spec-comp-head, we do not need to dwell on this issue here.

Because of the still existing links, it is easy to identify the correct phonological structure that corresponds to the moved head or phrase.

One important assumption must be made here: I assume that phonology can only move *phonological* constituents. In syntax, it is the nominalizer that is moved. This head corresponds to the vowels /i.a/, but since these do not constitute a phonological constituent, the phonology must move the entire p-word *intiqād*; it cannot just move the vowels.

The phonological effect of the movement operation in the case at hand is actually not visible: the movement is vacuous. This is different for the equivalent of the *Ing-of* construction, in which the nominalizer is merged lower than the subject. In this case, the word form *intiqād* is completed before the subject is merged, so that its initial position in the linear string is in between the subject and the object. It is therefore the syntactic head movement of NOML to D that places the masdar in its final position.

8. The other masdar forms

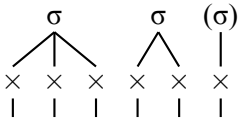
As table 1 shows, the masdars of verb classes IV and VII through XV are all composed in the same manner as the class VIII masdar. The masdars of classes II and V-VI are also formed regularly, but with different morphemes, which are discussed here. I do not discuss the masdars of classes I and III, because these do not follow the regular masdar pattern. Masdars of class I are irregular, they need to be memorized. Masdars of class III are actually not masdars but feminine passive participles. In Classical Arabic, this was an optional way of forming masdars for verb forms generally. In Modern Arabic, only class III uses this masdar formation.[22]

8.1 Class II

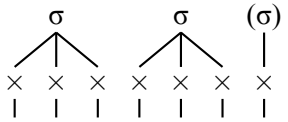
Let us first look at class II. In this class formation, the verbal stem and the masdar appear to have very little in common: the verbal stem for class II of the root KTB is *kattaba*, that is, the second consonant is doubled. The masdar form is *taktīb*, which has a /t/ prefix and does not show the doubling of the second root consonant, which is otherwise typical for class II.

Nevertheless, as I discuss in Kremers (2007), we do not need to assume different class II markers for the verbal and the nominal stem. McCarthy and Prince (1990) argue that the class II marker is a long syllable: $\sigma_{\mu\mu}$. We can use this class marker for both forms. The nominalizer of class II is obviously not /i.ā/ but /ta.ī/. It includes the /t/ prefix, which only appears in the masdar of class ii, and an alternative vowel pattern. shows the syllabic templates for both the perfective and the masdar:

(18) a.



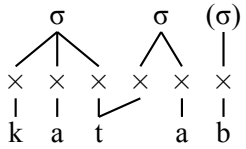
b.



[22] Some class III verbs actually have a regular masdar; e.g., *jāhada* ‘to exert oneself’, ‘to strive’. The masdar of this verb is *jihād*, which shows the regular /i.ā/ pattern.

The perfective stem, being a finite verb form, contains the finiteness marker σ_{μ}. Additionally, it consists of the root and the perfective marker, which is /a/. Adding these morphemes to the template gives us the following structure:

(19)



The /t/ of the root occupies the coda of the first syllable. Note that the /b/ of the root cannot occupy the onset of the second syllable, for the reason that we have already seen in the masdar form *intiqād*: the third root consonant must be associated with the final extrametrical syllable. In order to fill the onset of the second syllable, the /t/ spreads, creating the characteristic geminate consonant of class II verbs.

When we insert the nominalizer into the masdar template, Left-to-Right Association ensures that the element /ta/ is associated with the first syllable. The /i/ cannot be associated with the third slot position in the first syllable, because a syllable in Arabic cannot contain two vowels.[23] It must therefore be associated with the nucleus of the second syllable. The third slot position of the first syllable is then taken by the first root consonant, the second root consonant is associated with the onset of the second syllable and the third root consonant with the extrametrical syllable, as usual. In order to fill the third slot of the second syllable, the vowel /i/ spreads. The resulting word form is *taktīb*.

Note that it is not possible to associate the first root consonant with the onset of the first syllable: if that were to happen, it would not be possible to insert the nominalizer /ta.ī/ into the template. Because the first part of this morpheme consists of the segments /t/ and /a/, which must additionally appear in the same syllable (in effect, /t/ must be in the onset), the only way to accommodate the nominalizer and the root is to have /ta/ associate with the first syllable.

We see, then, that even though the verb stem and the masdar form seem very different, they are actually based on the same class II template. The gemination that occurs in the verb stem is not as such a characteristic of class II. Rather, it results from the fact that class II is characterized by a prosodic morpheme $\sigma_{\mu\mu}$. Because of this, the second root consonant occupies the coda of the first syllable, forcing it to spread to the onset of the second syllable. In the masdar form, the onset of the second syllable is filled, so that no gemination can occur.

One remark should be made here: the class III perfective form is *kātaba*, and McCarthy and Prince (1990) argue that the class III marker is $\sigma_{\mu\mu}$ as well. class II and class III are differentiated, McCarthy and Prince (1990) claim, by a lexical rule that associates the second root consonant (/t/ in the case of KTB) with the third slot position in the class marker for class II but not for class III. That is, unlike me, they claim that the second root consonant is associated with the onset of the second syllable. I assume, on the other hand, that in the class III marker, the third slot is lexically marked as a vowel position, so that the root consonant cannot be associated with it. I believe this assumption is supported by the fact that in the class II masdar, the coda of the first and the onset of the second syllable are not linked. McCarthy and Prince (1990) need to argue that their lexical rule does not apply in the masdar. This seems rather stipulative, since it does apply in all other forms of class II, including participles, which, like the masdar, are non-finite. If, on the other hand, we assume that the class III marker is lexically specified as a having a long vowel, we avoid this stipulation.

[23] Arabic does have long vowels (/a:/, /i:/, and /u:/) and diphthongs (/aɪ/, /aʊ/), but these are the result of spreading or of the combination of a vowel plus a glide, never of two vowels.

8.2 Classes V and VI

Let us cast a quick glance at the masdar forms of classes V and VI. The verbal forms of these classes are identical to classes II and III, with an additional prefix /t/.[24] The masdar forms are different, however: they do not contain the characteristic long vowel, and they do not have the vowel pattern /i.a/. Instead, they are characterized by a vowel pattern /a.u/. Importantly, the /u/ appears in the final position of the word form, while all other syllables have /a/. We may assume that the nominalizer of classes V and VI consists of a short syllable and the vowel pattern /a.u/, of which the second vowel is linked to the short syllable. The first vowel is not linked to any slot position. Additionally, the syllable has an alignment requirement, fixing it to the right edge of the p-word. The /a/ is exempt from this requirement, so that it occupies the first syllable and then spreads.[25]

9. Lexically specified morpheme forms

As we have seen, the regular masdar morpheme is /i.ā/. There are, however, a few masdar forms that have an idiosyncratic masdar morpheme: /ta.ī/ for class ii and /u.a/ for classes v and vi. How does the grammar "know" when to use which form?

In order to encode this information into the grammar, we obviously need different lexical entries for each masdar morpheme. The default morpheme can be represented as in (20):

(20) MASDAR ↔ [N,–cnt, *u*V] ↔ /i . a/ (σμμ)

This masdar morpheme selects a projection of category V in syntax. This means that it applies to any verb stem, regardless of its class. For the class II and class V/VI masdars, we need idiosyncratic masdar morphemes, which can be represented with the following lexical entries:

(21) a. MASDAR ↔ [N,–cnt, *u*V$_{[II]}$] ↔ /ta . i/ (σμμ)

b. MASDAR ↔ [N,–cnt, *u*V$_{[V/VI]}$] ↔ /u . a/ (σμ)

These masdar morphemes also select elements of category V, but crucially, they select only elements that have the additional class II or class V/VI feature. Obviously, a variant of the *Elsewhere*-Principle applies: the more specific morpheme is chosen in any given context.

Idiosyncratic morphemes are morphemes that are realized in a specific context. In the current example, the idiosyncratic morphemes are realized in the context of specific verb class features: class II and class V/VI. The way in which this is implemented here puts a clear restriction on the structural environment on which idiosyncratic morphemes may depend.

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[24] Note that the vowel /a/ is not part of the prefix: in the passive of the perfective, which is characterized by a vowel pattern /u.i/, the prefix has the vowel /u/: active *takattaba*, passive *tukuttiba*.

[25] Alternatively, one could assume that the alignment requirement applies to the entire morpheme and that the /a/ is able to spread leftward. I prefer the analysis in the text because it puts the "odd" behavior of the morpheme in the lexical entry of the morpheme itself, rather than having to extend a general principle such as spreading.

Specifically, an idiosyncratic morpheme can only depend on the category of the element it selects. That is, we cannot posit an idiosyncratic form for a syntactic head X if the context on which X depends is higher in the structure than X itself.

This is an additional reason why I have abandoned the non-finiteness marker: non-finiteness is not only marked in masdars, but also in participles. Arabic has two participles for each verb class: an active and a passive participle. As already mentioned in section 4, only the passive participle of class I has a long vowel, all other participle forms have a short vowel.

That is, we would have to assume an idiosyncratic non-finiteness marker for all participles except one. This marker would be independent of verb class but would instead depend on the conversion morpheme: nominalizer vs. adjectivizer.[26] However, as argued above, both these morphemes would be merged *higher* than the non-finiteness marker, because marking non-finiteness is only compatible with a verbal structure. Once the category of the projection has been changed to nominal or adjectival, it does not make any sense to mark (non-)finiteness in the structure.

However, if the non-finiteness marker is structurally lower than the nominalizer or adjectivizer, the current model does not provide for a way to have its realization be dependent on these heads. Merging the non-finiteness marker also means its phonological realization is added to the phonological structure being built up and since at this point the nominalizer or adjectivizer is not part of the structure yet, it is not possible to base the choice for an idiosyncratic morpheme on them.

In short, then, part of the idiosyncrasy we see in the realization of the non-finiteness marker would be impossible to account for. The idiosyncrasy is lexically determined, therefore it must depend on information that is already part of the structure when the non-finiteness marker is merged. Since this is not the case for all relevant information, positing a non-finiteness marker is not possible. Instead, the idiosyncrasies have to be included in the nominalizer and adjectivizer morphemes directly.

10. Summary and conclusions

In this paper, I have developed an analysis of Arabic verbal nouns that accounts for both their syntactic and their morphological / phonological structure. The phonological structure largely follows the proposal by McCarthy and Prince (1990), except for the fact that I do not assume the existence of a non-finiteness marker, partly because the empirical evidence for it is weak (the only other non-finite verb forms in Arabic, participles, do not have it), and partly because it is not clear where in the morphosyntactic structure it is located.

Crucial to the current analysis is that the formation of the actual word form is a phonological process. Once it is "known" to the phonology that the relevant morphemes — specifically, the nominalizer, the verb class marker (a.k.a. verbalizer) and the root— have to be combined into a single word form, the phonology can construe this form without requiring further access to morphosyntactic principles.

In the morphosyntactic structure, the three heads that make up the masdar do not form a distinct subtree. In order to let the phonology "know" that they have to be combined into a single word form, however, it is not necessary to assume head movement in syntax. It suffices to assume the principle of Input Correspondence (Ackema and Neeleman 2004), which states that an affix that attaches to a category X in syntax, must attach to the phonological form associated with the head of X in phonology. Because the verb class marker selects the root

[26] On the assumption that all participles are adjectival in Arabic, which seems a fair assumption, given that they are morphologically so and given the fact that there are no analytic verb forms that include participles (unlike Germanic and Romance languages).

and the nominalizer selects the verb class marker, the phonology combines these three morphemes into a single form.

This does not mean that *all* head movement is phonological. A verbal noun is a nominal form and as such can (and in Arabic in fact *must*) be embedded in a D projection. The relevant D head may lack an index feature, for example in the case of a construct state, which will trigger syntactic head movement of NOML to D. This head movement may obviously have an effect on the phonological form, made possible by the fact that syntactic structure is linked to phonological structure until the derivation (or at least a phase) is completed.

The idiosyncratic properties of the masdars of verb classes II and V/VI, which have masdar forms that do not follow the general pattern but which are regular for each verb class, can easily be accounted for by assuming idiosyncratic masdar morphemes that select not just an element of category V, but additionally also a class feature. Because of the way the model is set up, such idiosyncratic morphemes can only be sensitive to the feature content of the category that they select, not to the feature content of categories that are not merged yet.

As a whole, the model provides an integral analysis of Arabic verbal nouns, accounting for their syntactic and phonological effects by assuming that word formation is a phonological process and that head movement operations that serve word formation are phonological in nature.

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