

Morphosyntactic Structure of Phonological Words*

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1 Introduction

Many theories of phonology use some notion of “word” as a unit of representation or as a domain for application of phonological processes. For example, theories of the morphology-phonology interface, like Lexical Phonology (Kiparsky 1982; Mohanan 1986) or Stratal Optimality Theory (Kiparsky 2000; Bermúdez-Otero in prep.), have a part of the architecture of grammar defined as “word” level. In these theories the “word” is the point in the derivation where word-level phonology and word-level affixation happen. Similarly, theories of the Prosodic Hierarchy (Selkirk 1978, 1984; Nespor & Vogel 1986; Inkelas 1989), have a notion of word (called Prosodic Word), that is the unit of prosody smaller than a phrase. In both these types of theories, however, the determination of when a phonological unit counts as a word is not tied to any outside structure or definition, it is simply assumed as a primitive unit of the calculation. That is to say, these theories use circular logic in determining what a word is; A word is defined as the unit that undergoes the phonological processes associated with wordhood, but the phonological processes associated with wordhood are determined by examining words. Only by assuming that words are primitive units and that it is intuitive (at least, to the linguist) to determine what is and is not a word can this kind of circularity be circumvented.

The assumption that the word is a primitive unit, however, is questioned by the theory of Distributed Morphology (Halle & Marantz 1993, *et seq.*). In Distributed Morphology, the grammar is proposed to follow the Y model, meaning that the syntactic derivation is built first and then spelled out into the two branches of Phonological Form (PF) and Logical Form (LF), as shown see Figure 1:

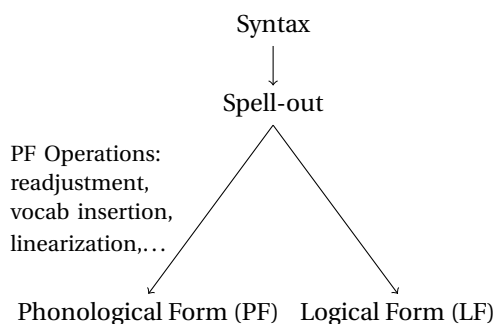


Figure 1: Architecture of Grammar in Distributed Morphology (Halle & Marantz, 1993, 1994; Pak, 2008)

Furthermore, one of the principles of Distributed Morphology is “syntax all the way down.” For the parts of the architecture that are at issue here, this means that the atomic units of the syntax are morphemes and not words. A certain amount of the argumentation in the literature is devoted to showing that words, as defined phonologically, are both too large and too small for grammatically relevant generalizations. For example, if we believe in phase-cycles on functional heads, or something remotely similar, these domains are smaller than phonological words (see Embick 2010, 2013). On the other hand, the domains for meaning storage and interpretation (for example, of idioms) are clearly larger than the phonological word (see Marantz 1997). All of this taken together, it appears that there is no need for the unit of the word on the syntactic side of the derivational model.

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If the word is not a unit on the syntactic side of the derivation, however, then there is the question of where the unit of the phonological word comes from (if, in fact, we need that unit for crucial generalizations, as I believe we do). That is, there must be some way that the phonology calculates what a word is based upon the information it receives from the syntax.

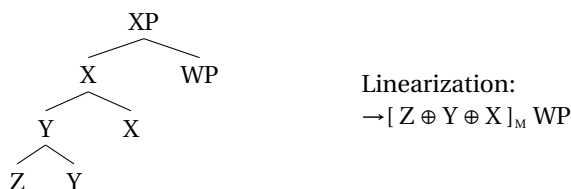
The goal of this paper is to present an overview of a theory which calculates the correspondences between the information from the morphosyntax and the phonological domain of the word. The theory presented here will be one in which the phonology has direct reference to the syntactic information, following the arguments of Pak (2008) (see also Kaisse 1985 and Odden 1995 for other direct reference theories). In principle, however, it is possible that the correspondences proposed here could be used in the syntax-phonology calculations of an indirect reference theory (e.g., those of Selkirk 1986, 1995; Nespor & Vogel 1986). This paper is not meant to be a comprehensive defense of this theory, rather a number of structure-to-phonology relations will be sketched out as an overview and introduction to this sort of research program.

2 Proposed Correspondences

In a theory without words as primitive units, the explanatory work needs to be done in terms of morphemes and objects defined by hierarchical and linear relationships between morphemes. One version of this type of theory involves structures such as the Morphosyntactic Word (M-Word), which is a particular relationship between morphemes, as shown in (1):

- (1) Morphosyntactic Word (M-Word): (Embick & Noyer, 2001)

- A (potentially complex) head not dominated by a further head-projection.



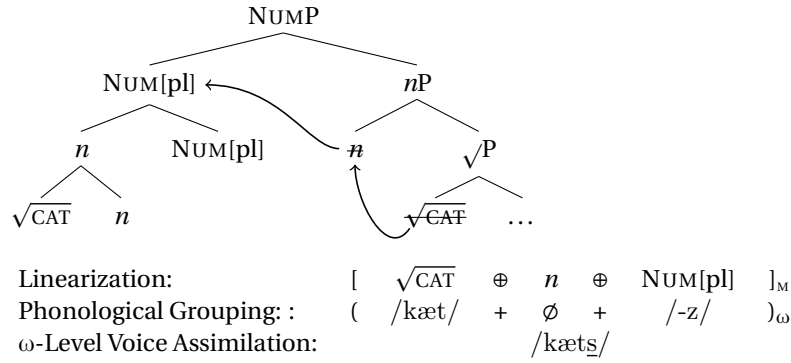
In the tree in (1) above, the complex head group containing Z, Y, and X is considered an M-Word to the exclusion of the adjacent WP. In the linearization of the syntactic structure, Z, Y, and X will be concatenated to each other at a subword level,¹ represented as \oplus . The M-Word that their complex head forms, represented with the brackets and subscript M, is concatenated to the leftmost element of the neighboring WP at an M-Word level (to be represented as \frown below; notation following Embick & Noyer 2001, Embick 2007, *et seq.*). It should be noted that the M-Word is purely a morphosyntactic structure in that it defines a particular relationship between syntactic heads and has no *a priori* relationship with the phonological shape of the exponents that these morphemes might correspond to. That said, the basic question to be explored here is what types of correspondences do exist between M-Words and phonological words (notated here as ω -Word).

While some M-Words roughly correspond to the intuitive notion of phonological word, it is not the case that all do. I propose that correspondence between M-Words and ω -Words needs to be restricted to those M-Words containing category-defining heads (*n*, *v*, *a*, etc.).² This restriction now gives us groups of syntactic heads whose spelled-out form are roughly to the intuitive notion of lexical words. That is, it picks out the syntactic configurations that correspond to, for example, “nouns”, “verbs”, and “adjectives”.

This restricted M-Word corresponds with the domain of the phonological word in many cases, but it is not the only structure that does. There are other structures, schematized in (2), that need to be considered for determining phonological wordhood:

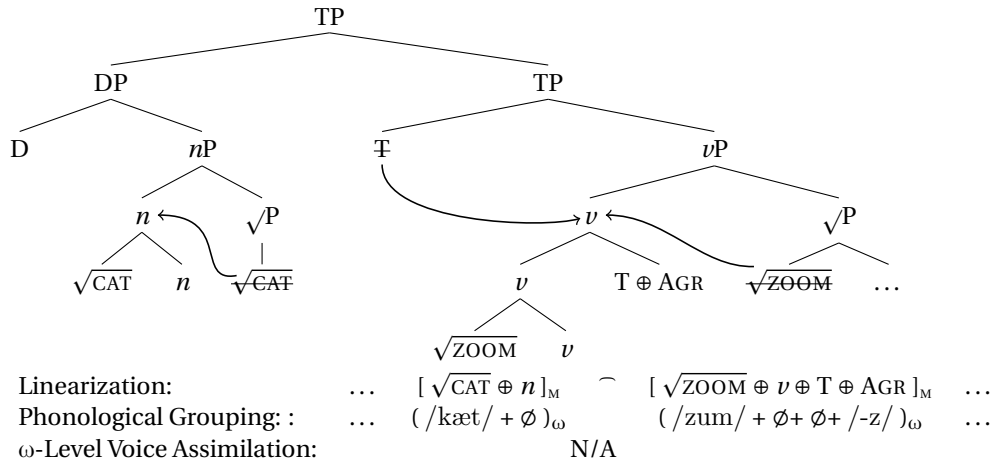
¹ A subword is simply defined as a head within a M-Word (Embick & Noyer, 2001).

² It may be the case that this restriction should not be to M-Words containing category-defining heads but rather to M-Words containing roots (or perhaps only those M-Words containing both roots and category-defining heads). This distinction does not affect the basic sketch presented here, but it remains a topic for future research.

b. Structure, Linearization and Phonological Grouping of *cats*

In (4a), syntactic movement causes the root to move up to ν and T-to- ν lowering lowers T onto ν creating the complex ν head which contains the root, the ν category-defining head, and the T and AGR nodes. This complex head contains a category-defining head and is thus subject to the M-Word \Rightarrow ω -Word correspondence. Here, critically, this means that the spell out of the AGR node /-z/ is in the same ω -Word as the root and thus will undergo the ω -Level voice assimilation. Similarly in (4b), syntactic movement raises the root to n and then to NUM[pl] creating the M-Word containing the category-defining head n . This M-Word contains the NUM[pl] node, which is spelled out as /-z/. This /-z/ is inside the same ω -Word as the root (and, critically, the final /t/ of the root) resulting in ω -Level voice assimilation between the /t/ and the /-z/.

Compare these cases with the structure of the phrase in (3c) where the relevant [t z] segments are not grouped in the same M-Word and thus do not get grouped in the same ω -Word, as shown in (5):

(5) Structure, Linearization, and Phonological Grouping of *cat zooms*

In (5), the syntactic movement creates two maximally complex heads: the M-Word containing the nominal complex *cat* and the M-Word containing the verbal complex *zooms*. These two M-Words will be linearized next to each other but are distinct complex heads in the syntax. By the M-Word \Rightarrow ω -Word correspondence, each of these M-Words will correspond to its own ω -Word. Thus, the final /t/ of *cat* will not be in the same ω -Word as the initial /z/ of *zooms*. Because they are not in the same ω -Word they do not interact at the ω -Level and no ω -Level voice assimilation applies between them.

The examples shown in (4) and (5) demonstrate that ω -Level phonology applies within the bounds of an M-Word, but not between neighboring M-Word structures.

2.2 Word Type: M-Word with additional terminal Beyond the basic M-Word \Rightarrow ω -Word correspondence, another syntactic configuration which corresponds to a ω -Word is a category-defining M-Word plus an adjacent terminal node.

With this structure, there seems to be two different phonological possibilities. In some cases the word-level phonology seems to include the adjacent terminal as well as the M-Word, schematized in (6a),

while other cases it seems that the M-Word is the phonological word and the neighboring terminal node leans onto it but never undergoes the word-level phonology, schematized in (6b).

(6) Possible M-Word + terminal correspondences

- a. $[\sqrt{\text{ROOT}} \oplus x \oplus A]_M \neg B \Rightarrow (\sqrt{\text{ROOT}} x A B)_\omega$
- b. $[\sqrt{\text{ROOT}} \oplus x \oplus A]_M \neg B \Rightarrow (\sqrt{\text{ROOT}} x A)_\omega = B$

An example each of these types is given below.

Apparent word level: One case of an adjacent terminal being included into an ω -Word is English ω -Level voice assimilation with the possessive clitic. We saw in (3) above that English has progressive voice assimilation at the ω -Level but not at the phrase level. That is, this assimilation applies within a ω -Word but not between ω -Words. However, the English possessive clitic 's is not part of the structural M-Word of its host but does participate in the ω -Level voicing assimilation, as shown in (7):

(7) Possessive clitic incorporated into ω -Word:

cat /kæt/ + 's /z/ → *cat's* [kæts]

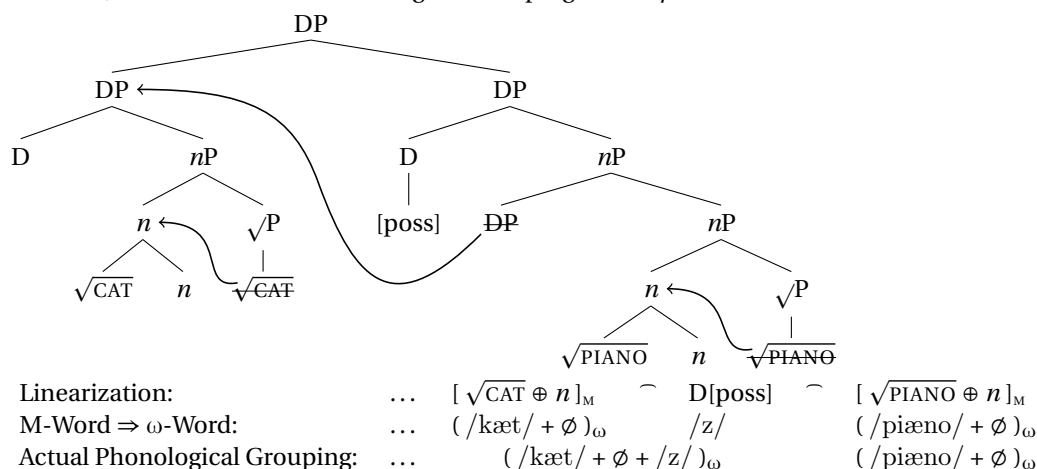
The possessive clitic has interesting behavior: syntactically it attaches to a phrase, but phonologically it attached only to the final word of that phrase regardless of the morphosyntactic category of that word (Zwicky, 1987). Examples of this clitic attaching to words of different morphosyntactic categories are give in (8):

(8) Examples of English possessive clitic 's with hosts of different categories (Zwicky, 1987:136)

- the oxen's yoke (noun)
- the person I talked to's theories (preposition)
- the person who's talking's theories (verb)

In order to account for the syntactic distribution of the possessive clitic, I must posit that the possessive clitic is generated outside the M-Word of its future host, as shown in (9). The analysis given here proposes that the possessor DP is adjoined to the possessee *nP* and the possessive clitic is the D of the possessee DP. The possessor DP is then raised to adjoin to the entire DP of the possessee. This syntactic explanation accounts for the fact that the possessive clitic appears at the right edge of the possessor phrase.

(9) Structure, Linearization and Phonological Grouping of *cat's piano*



It should be noted that the linearization of this syntactic structure places the possessive clitic outside of the M-Word containing the possessor. By a strict interpretation of the M-Word \Rightarrow ω -Word correspondence, we would expect the possessive clitic to behave as though it were outside the ω -Word of the possessor and thus voice assimilation should not apply between them. However, it is clear that

the possessive clitic does participate in the ω -Level voice assimilation, and so it must get included in the ω -Word (shown as “Actual Phonological Grouping” in 9).

The phrase-attaching hierarchical behavior of this clitic is thus explained by the syntactic movement allowing any DP to move out above the possessive D, but the linear phonological behavior of the clitic must be explained by its inclusion in the M-Word to its left after linearization has applied.

No apparent word level: It is not always the case, however, that terminals are included in a neighboring ω -Word. In some cases, the terminal instead seems to “lean” onto the ω -Word. “Leaning” here will be left theoretically vague, but it will be used to mean that the terminal in question does not participate in the ω -Word phonology (although the terminal is often not a well-formed word on its own and seems to be treated like part of the same “word” for phrasal purposes³). While the exact nature of this behavior needs to be examined further, the important information here is that the neighboring terminal does not behave like the case of “inclusion in the word level” discussed above.

One example of this situation is the Makassarese absolutive clitic, which “leans” onto the host but does not cause any changes in the phonology of the the word. The relevant data is given in (10):

(10) Makassarese Adjectives with Suffix and Clitic (Basri et al., 2000)			
	V-stem	C-stem	{r,l,s}-stem
UR Root	/lompo/	/gassiŋ/	/rantas/
Adjective stem	lompo “big”	gassiŋ “strong”	rantasa? “dirty”
Comparative suffix /-aŋ/	lompo-aŋ “bigger”	gassiŋ-aŋ “stronger”	rantas-aŋ “dirtier”
Absolutive clitic /-a?/	lompo-a? “I am big”	gassiŋ-a? “I am strong”	rantasak-a? “I am dirty”

In Makassarese, the segments /r/, /l/, or /s/ are illicit word-finally. Roots ending in these segments take an epenthetic /ak/ (which can become /a?/) at the word level in order to comply with this constraint. For ease of presentation, these epenthetic segments are underlined here. Thus, we see the root /rantas/ becomes rantasaak?, but no epenthetic material is added to the other roots whose final segments are licit word-finally. In the comparative form of adjectives, the comparative suffix /-aŋ/ blocks the epenthesis because the illicit segment is never word-final. Thus, the comparative of the root /rantas/ is rantásaŋ “dirtier” and not *rantasak-aŋ.

With the absolutive clitic /-a?/, however, epenthesis still occurs as evidenced by the form rántasak-a? “I am dirty” and not *rántas-a?. If the absolutive clitic were incorporated into the ω -Word (like the English possessive clitic), we would expect it to behave like the comparative suffix; it should block epenthesis because the illicit segment would not be word final. If this were the case, we would expect the form *rántas-a? (which, it should be noted, is perfectly licit phonologically). However, this is not the case; epenthesis still occurs resulting in the form rántasak-a?. Thus, because the absolutive clitic does not participate in the ω -Level phonology, it must not become part of the ω -Word of its host. The linearization and phonological grouping of Makassarese adjectives with the absolutive clitic is as shown in (11):

(11) Linearization and Phonological Grouping of Makassarese Adjective and Absolutive Clitic	
Linearization:	[adjective] _M ^ absolutive
Phonological Grouping:	(adjective) _ω = absolutive

The Makassarese absolutive clitic must simply “lean” onto its host. That is, the clitic does not affect the ω -Level phonology of the host, but the host and clitic seem to behave as a unit for the purposes of phrasal behavior.

Remaining Question: The examples of the English possessive clitic and the Makassarese absolutive clitic given above leave some questions about the nature of the inclusion of terminal nodes into adjacent ω -Words: Is there a principled way to determine what terminals will be included (or what ω -Words serve

³ Following the reasoning of Pak (2008) for phrasal phenomena, it could be the case that these “leaners” do not behave as part of the M-Word when the relationships between pairs of M-Words are being calculated but do behave as part of the M-Word during the part of the calculations when longer chains of M-Words are being worked on.

as hosts) or is this behavior idiosyncratic? Is this behavior a parameter of each language or are there syntactic or phonological factors which play a role?

These questions are subjects for future research.

2.3 Word Type: Terminal nodes in same spell-out cycle Some ω -Level phonological processes apply to a group of terminal nodes that are not in the same M-Word but are in the same spell-out cycle, as schematized in (12):

- (12) Phonological grouping of adjacent terminal nodes not in an M-Word:

$$A \neg B \neg C \Rightarrow (A B C)_{\omega}$$

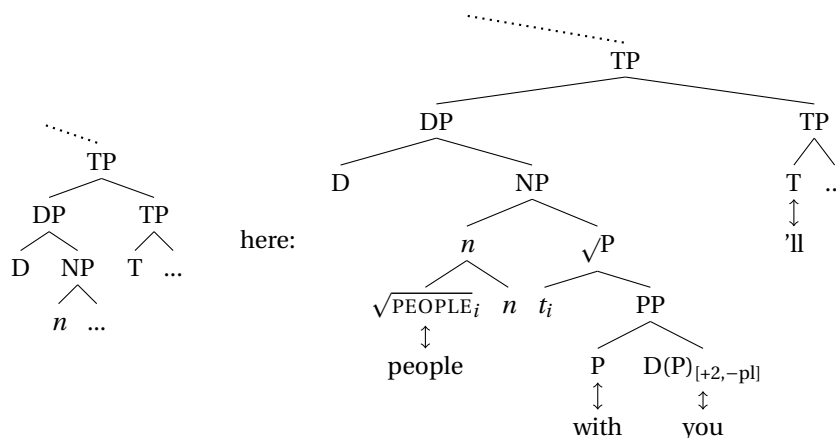
Phonology of English auxiliary contraction: One example of a ω -Word formed from adjacent terminals is auxiliary contraction in English. A pronoun and a contracted auxiliary, for example, *you* and *'ll*, have a different phonological relationship than a full NP with that auxiliary. In (13a), the pronoun and contracted auxiliary form a single syllable and there is a change to the underlying vowel (/u/ → [ʊ]), whereas this phonology can not apply in the cases of full noun phrases in (13b):

- (13) Phonology of English Contraction (Zwicky, 1970; MacKenzie, 2012; Embick, 2012)

- a. You'll have to do that. ([jʊl])
 b. i. The people with you'll have to do that. (*[jʊl], ✓[ju.əl])
 ii. Sue'll have to do that. (*[sʊl], ✓[su.əl])

For the cases in (13b), it appears that the *'ll* auxiliary is behaving like a non-included clitic, similar to the Makassarese absolutive clitic discussed above. The structure and derivation of (13b-i), where the pronoun *you* is embedded in an full NP, is shown in (14).

- (14) Derivation of Full NP + Auxiliary: the people with *you'll* /ju.əl/



Insertion of *n* causes linearization of complement of *n*

Linearization: $[\sqrt{\text{PEOPLE}} \ n]_M \neg P \neg DP$

Phonological Grouping: $(\sqrt{\text{PEOPLE}} \ n)_{\omega} \ P \ DP^4$

Spellout and ω -Level phonol.: *people with* /ju/

Spell out of remaining structure

Linearization: $\dots (NP) \neg T$

Phonological Grouping: $\dots (\text{people with} /ju/)_{\omega} \ T$

Spellout and ω -Level phonol.: *people with* /ju/ /l/

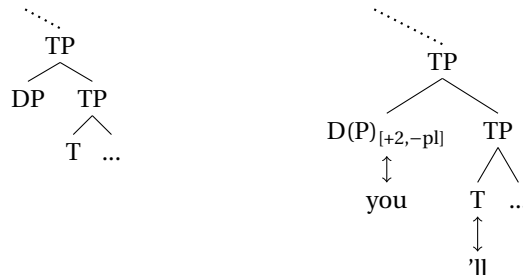
Repair: $\rightarrow /ju/ / \text{əl}/$

⁴ This P and DP will be grouped together into a ω -Word by Stray Terminal Grouping (discussed below).

Given a theory of spell-out in which cyclic heads cause the spell-out of their complements (for example, the C_1 -LIN theory from Embick 2010), the n head causes spell-out of its complement, causing *you* to be spelled-out and grouped together with the P to its left. When the T node is spelled out later, it is not part of the same M-Word nor ω -Word as *you*. Because *you* and *'ll* are not in the same ω -Word and so do not undergo the ω -Level phonology together. The contracted auxiliary *'ll* (underlying /l/) must undergo some repair mechanism to render it pronounceable, here schwa insertion, resulting in [əl].

The same analysis is applicable for the case of the proper name in (13b-ii), assuming that proper names are not just pronouns but have more structure to them. In the pronoun + auxiliary case (15), however, there is a difference in the structure.

- (15) Structures for noun and pronoun with auxiliary
here:



Linearization: DP~T

Assuming pronouns are not full noun phrases (see, e.g., Déchaine & Wiltschko 2002), this means that there is no category-defining head in the pronoun. Because of this, the pronoun will not undergo spell-out separately from the neighboring auxiliary. In addition, this means that the pronoun is not a category-defining M-Word. The result is two adjacent terminal nodes that have no category-defining M-Word boundaries between them.

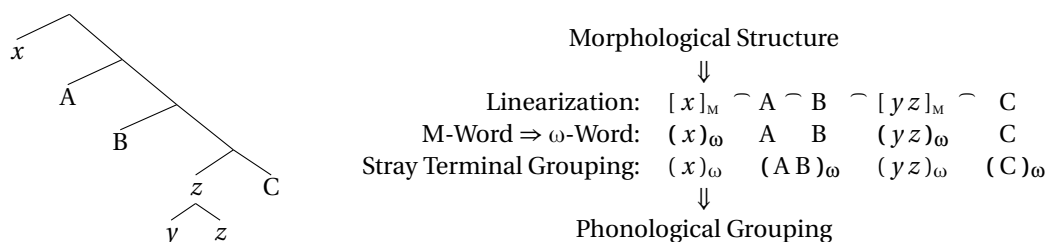
I propose that these terminal nodes are being grouped together into a ω -Word of their own despite not being part of any category defining M-Words. The proposed mechanism is “Stray Terminal Grouping”:

Stray Terminal Grouping: The structures above show that there is a difference between the cases of full NP + auxiliary and pronoun + auxiliary, but they do not answer the question of why terminal nodes (that are otherwise un-spelled-out) in the same spell-out cycle are grouped together as a phonological word.

I propose a principle of “Stray Terminal Grouping”: Terminals that are not part of a M-Word may be grouped together into a ω -Word.⁵ A schematic example is given in (16):

- (16) Stray Terminal Grouping:

- Small italics (*x*) refers to a category-defining head
- Capitals (A) refer to non-category-defining heads

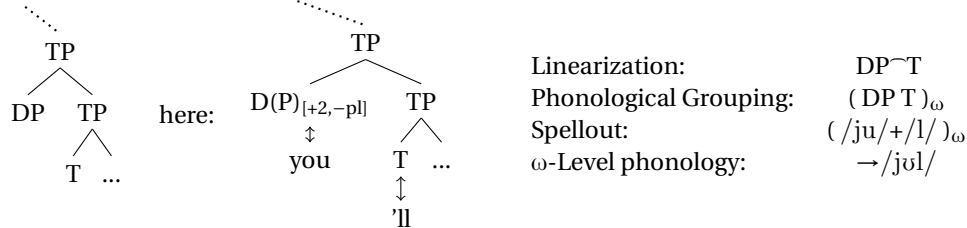


As shown in (16), Stray Terminal Grouping is a step in the PF derivation between morphological structure and phonological grouping. It takes any linearized morphological terminals that have not been grouped into ω -Words by the basic M-Word ⇒ ω -Word correspondence and combines them with any stray neighbors into ω -Words.

⁵ This principle is similar to the observation made by Selkirk (1995) that function words are aligned with nearby prosodic structures.

To return to the case of the English contracted auxiliary, Stray Terminal Grouping will take the linearization output from (15), shown again in (17), and will group together the pronoun and auxiliary into a ω -Word. Assuming that the syllabification and vowel reduction processes are ω -Level, this explains the outcome of this case:

(17) Derivation of Pronoun + Auxiliary: *you'll* \rightarrow /jʊl/



To summarize, in the case of the bare pronoun and the contracted auxiliary (17), there are no category-defining M-Words in the relevant part of the linearization, so the nodes are combined together by Stray Terminal Grouping into an ω -Word. In the cases with the full NP (14), there are M-Words in the structure which are converted into ω -Words. Because of this, the noun and the auxiliary are not able to be grouped in the same ω -Word and thus do not share the same phonological interaction as seen in the case of the bare pronoun.

A note on *you'll* as [jʊ.əl]: It should be noted that, while [jʊl] is the most natural way to pronounce the bare pronoun and auxiliary *you'll*, in the case of (13a), it is also possible to use the pronunciation [jʊ.əl]. It must be the case, then, that Stray Terminal Grouping is variable or optional in some way. As a first hypothesis, I suggest that the application of Stray Terminal Grouping is sensitive to something like focus or prosodic stress in such a way that the DP+T structure can be grouped as (DP) ω =T. The conditioning factors on this variation need to be investigated further.

3 Conclusion

The principles of Distributed Morphology eliminate the word as a primitive unit of the syntax, but it is clear that the phonological word is a domain for phonological processes. The question, then, is how the phonological word is calculated. This paper presented an overview of a theory relating morphosyntactic structure to phonological groupings in order to help answer this question. A few of the correspondences between M-Words and ω -Words were sketched out and some examples of each were given. There are, however, remaining questions about these relationships:

- What sort of restrictions need to be made on M-Words to determine which M-Words correspond with ω -Words?
I proposed here that only M-Words containing category-defining heads are relevant to the correspondence, but there are other possibilities. One possibility is that the restriction should be to M-Words containing roots. This possibility needs to be checked in future work by comparing M-Words with category-defining heads but without roots, for example, light verbs or (perhaps) heavy and light prepositions.
- When there is a terminal adjacent to a category-defining M-Word, is there a principled way to determine what terminals will be included (or what ω -Words serve as hosts) or is this behavior idiosyncratic? What is the relationship between this inclusion of adjacent terminals and Stray Terminal Grouping?
- What are the conditioning factors on when stray terminals will be grouped together and when they will form a different relationship?
- What is the relationship between cyclic domain boundaries and the sort of phonological grouping mechanisms seen in Terminal Inclusion and Stray Terminal Grouping?

In addition to the questions about the basic mechanisms above, the theory sketched here presents a complex PF derivation in which morphosyntactic operations are interleaved with phonologization of exponents and morphophonological processes. This leads to interesting areas of research of, for example, the phonological effects of morphological movement (see, for example, Shwayder 2014).

I hope further research along the lines of the theory introduced here will help to explore possible operations in the PF derivation and elucidate the path between the morphosyntax and the phonology.

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