# Deriving English compound stress: insights from Distributed Morphology and multiple spell-out

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This paper outlines an analysis of compound stress in English, which has remained a persistent puzzle at the phonological, syntactic, and morphological interfaces. The analysis is a straightforward extension of previous work in the Distributed Morphology and Phase Theory frameworks, providing insights into several problems in the analysis of English compounds. Special rules for compound stress are shown to be unnecessary, and can be unified with rules for sentential stress. Finally, a simple structural distinction between complement and adjunct structures is shown to provide the basis for the apparently complex typology of both noun-noun and adjective-noun modificational structures in English.

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# 1 Introduction

This paper outlines an analysis of compound stress in English, which has remained a persistent puzzle at the interface of phonological, syntactic, and morphological structure. The analysis is a straightforward extension of two recent lines of work in morphological and syntactic theory — Distributed Morphology and Phase Theory — and it provides insights into several longstanding problems in the analysis of English compounds. We show that special rules for stress assignment within compounds are unnecessary, and can be unified with rules for sentential stress, and that there is a simple structural basis for the apparently complex typology of both noun-noun and adjective-noun modificational structures in English.

A salient fact of English is that many compounds have initial (left-edge) stress. In the generative tradition, following the Chomsky & Halle (1968) and Liberman & Prince (1977), some version of a Compound Stress Rule is used to explain this pattern, and it differs from a Nuclear Stress Rule, which assigns stress to phrasal units, including sentences. In contrast, Cinque (1993) proposes an alternative to derive stress patterns in compounds from the same general principles that derive stress patterns in larger phrases. One appeal of this proposal is that rather than stipulate specific stress rules for compounds, the rules fall out from a more general theory of the mapping between syntactic structure and phonological structure.

However, a number of researchers have pointed out empirical problems for both of these general approaches (Bauer 1998; Giegerich 2004, 2009; Liberman & Sproat 1992; Olsen 2000; Zwicky 1986). Giegerich (2009) provides a recent summary of these problems, and the present analysis draws heavily on his insights. But where Giegerich (2009) proposes to proliferate the number of stress rules involved in order to handle the data, in this paper we offer a simpler approach, which not only unifies stress assignment of the apparently different patterns within compounds, but also unifies stress assignment in compounds with phrasal nuclear stress in English, in the spirit of Cinque (1993). The present analysis also recapitulates the insight of Selkirk (1984), that the critical distinction in the modifier-noun relation is the complement vs. adjunct distinction. The current formalisms provided by Distributed Morphology and a theory of

multiple spell-out (i.e., Phase Theory) offer a straightforward way to capture these insights. In brief, we propose that modifiers can be captured in two different structures, either as a complement to the head noun, or as an adjunct. Once these structures are assumed, the correct stress patterns can be derived following recent phase-based theories of stress assignment. We argue that various asymmetries that occur in the data result from the inherent asymmetries of how adjectives and nouns in English are able to fit into these structures.

The structure of the paper is as follows. Section 1.1 presents the primary data to be explained, setting up the challenge to any simple theory of English compounds and compound stress. Section 2.1 briefly introduces the theoretical frameworks of Distributed Morphology and Phase Theory, followed by section 2.2, which provides the core analysis of a canonical noun-noun compound structure, explicating both the syntactic and phonological structure. With this analysis in place, the other data patterns are discussed. The final section concludes with a discussion of some remaining issues, including how this analysis relates to the recent, but considerably different approach by Plag and colleagues (Bell & Plag 2012; Kunter 2011; Plag, Kunter, et al. 2008: *inter alia*).

## 1.1 Patterns in English compounding

There is a substantial literature on the nature of compounding and compound stress in English (including Bauer 1983, 1998; Bloomfield 1933; Chomsky & Halle 1968; Cinque 1993; Fudge 1984; Giegerich 2004, 2009; Kunter 2011; Ladd 1984; Lees 1963; Levi 1978; Liberman & Prince 1977; Liberman & Sproat 1992; Marchand 1969; Olsen 2000; Plag 2003; Plag, Kunter, et al. 2008; Selkirk 1984; Zwicky 1986). An extensive review is beyond the scope of this paper, but we will draw attention to data that have created challenges for a simple analysis of English compounds. Generally, nominal compounds in English can be thought of as a type of modificational structure, in which there is a head noun and some preceding element that modifies that head. There are many N+N CONSTRUCTIONS, in which the modifier itself appears to be a noun. N+N constructions are typically analyzed as compounds, allowing for an easy distinction

between typical adjectival modification, and many examples are written orthographically as a single word (e.g., *horseshoe*, *football*, *doghouse*). But there are also A+N CONSTRUCTIONS, in which the modifier is an adjective, which have been claimed to differ from phrasal adjectives in some way or another. Many A+N constructions are also traditionally analyzed as compounds, because (1) they often carry initial (left-edge) stress, parallel to the N+N compounds, (2) they are sometimes also written as single orthographic words (e.g., *blackbird*), and (3) they are typically distinguished semantically from a phrasal version of the same A+N combination (e.g., *White House* vs. *white house*).

If explaining compound stress was a matter of concluding that all and only compounds receive initial stress, the traditional Compound Stress Rule of Chomsky & Halle (1968) or Liberman & Prince (1977) would be at least descriptively adequate. However, there also exist examples of N+N structures which do not get initial stress (Giegerich 2009; Liberman & Sproat 1992; Olsen 2000; Zwicky 1986). These examples have been treated in different ways, but Giegerich (2009) makes a strong argument that they are far too common to be dismissed as "exceptions," and the fact that they group in consistent semantic classes is far too systematic for all the differences to be explained as differences in lexicalization.

A primary debate in the literature is whether these final-stress N+N constructions are in fact phrases (e.g., Bloomfield 1933; Liberman & Sproat 1992; Marchand 1969) or lexical compounds (e.g., Giegerich 2009; Olsen 2000). This particular debate is somewhat orthogonal to the present analysis, because in a Distributed Morphology analysis, even canonical compounds are treated as syntactic phrases, but it illustrates a primary difficulty with defining "compound stress." If one assumes that compound stress applies only to compounds, the definition becomes circular, applied both as a diagnostic for what counts as a compound (i.e., "compounds are constructions with compound stress"), and as a way to predict where compound stress occurs (i.e., "compound stress occurs with compounds"). But if one assumes that all N+N constructions are compounds, the difficulty is explaining why there are two systematically different stress patterns. The present analysis offers an escape route from this state of affairs.

<INSERT TABLE 1 ABOUT HERE>

The patterns in table 1 are illustrative of the analytic challenges imposed by the data. Liberman & Sproat (1992) report that in the corpus data they examined, 75% of N+N constructions had initial stress and 90% of A+N constructions had final stress. This is consistent with the intuitions that N+N constructions are canonically "compounds" with left stress, and that A+N constructions are typically "phrasal" configurations. However, the proportions of final-stress N+N constructions and initial-stress A+N constructions are not negligible, and as the examples in table 1 illustrate, they appear fairly common and productive, and thus must be accounted for.

Framed in this way, we can articulate three fundamental questions:

(1) a. If initial-stress and final-stress are two classes of constructions, does anything distinguish them, other than stress?

b. If there is a way to distinguish these classes, is it common across N+N and A+N constructions, or are the parallels between these merely coincidence?

c. How or why are any of the distinctions between these classes related to stress?

With these questions in mind, the N+N patterns illustrated in table 1 can be summarized as follows. The primary observation is that the semantic relationships between the nouns appear to relate to the stress pattern, but coming up with a neat dividing line has proven difficult. The initial-stress class is comprised of some very well-defined semantic classes, such as the argument-predicate relationship (table 1a). However, there are many other relationships that also appear in the initial-stress column. The examples in (b) could be paraphrased "$N^2$ for a $N^1$," the examples in (c) could be paraphrased "$N^2$ made out of $N^1$," and even more broadly, examples like those in (d) could be characterized as "$N^2$ having to do with a $N^1$." Other authors have discussed other distinctions and classes of relationships as well (Fudge 1984; Giegerich 2009; Levi 1978; Liberman & Sproat 1992); the point for present purposes is that narrowly categorizing the range of semantic relationships represented in left-stress N+N constructions is problematic at best.

This heterogeneity makes it difficult to pin down exactly what is different about the examples

in (e)–(i) that might explain why they do not get initial stress like the examples in (a)–(d). Some of the more common semantic categories for the final-stress cases discussed in the literature include (e) material composition, (f) temporal modification, (g) locative modification, (h) predicative ($N^2$ is a $N^1$), and (i) copulative (Zwicky 1986, Liberman & Sproat 1992, Olsen 2000, Giegerich 2004, Giegerich 2009). Drawing clear semantic lines is further complicated by the fact that there appears to be a class of "material" or "composition" in both the initial-stress and final-stress classes (c vs. e). One particularly close pair from the literature (beginning with Lees 1963) is the contrast between initial-stress *ápple cake* and final-stress *apple píe*.[1]

Moving on to the A+N constructions, the primary distinction appears to be that the semantics of the modifier are much less transparent in the initial-stress constructions (j) than they are in the more typical phrasal constructions (k). However, many idiomatic phrases have final stress, such as *red herring*, *heavy metal*, and *crazy eights*. The existence of many minimal pairs such as (j) vs. (k) makes the distinction salient, but it still suffers from the circularity problem. One might claim that stress is diagnostic of compounds, and that the difference in meaning is simply that the meanings of compounds are completely lexicalized. This would appear to be adequately descriptive of the A+N cases, but applied to the N+N cases, it would miss the generalizations that the initial-stress N+N cases are very productive and systematic. In short, a satisfying answer to question (1b) is elusive.

Question (1c) has only very rarely been discussed in the literature, perhaps because the first two descriptive questions have proved so vexing. Cinque (1993) proposed an elegant view that the relationship between syntactic structure and phonological structure is simply transparent. That is, nuclear stress falls where it does in English (and German and Italian and perhaps any other language with nuclear stress), because phonological emphasis is projected straightforwardly from the depth of syntactic embedding; in other words, the most embedded element in a syntactic tree receives the most stress. Cinque (1993) extends this same analysis to compounds, suggesting that initial stress occurs when the initial element of the compound is more deeply embedded than the head noun.

The analysis we present here follows the broad suggestion by Cinque (1993), but differs in the syntactic claims. To preview the analysis, our claim is that there is a straightforward correspondence between stress and structure, following recent phase-based developments in stress assignment. All initial-stress constructions (both N+N and A+N) are analyzed as complement-head structures and all final-stress constructions are adjunct-head structures, and the stress facts follow from this structural analysis. The complement vs. adjunct distinction was suggested first by Selkirk (1984), and the present analysis simply shows that this structural distinction follows from a Distributed Morphology analysis motivated on independent grounds.

# 2 Analysis

## 2.1 Theoretical background

The analysis developed here is more or less a direct synthesis of several preceding lines of work. We follow Harley (2011) in analyzing compounds within the framework of Distributed Morphology as a type of incorporation. We follow work by Embick (2010) and others (Arad 2003; Marantz 2001, 2008) in assuming that the category-defining $n^0$ head of nouns also defines a domain for multiple spell-out. And finally, we follow several suggestions in the literature that stress assignment is a result of cyclic application of stress rules in a multiple spell-out framework (Adger 2007; Dobashi 2003; Ishihara 2007; Jackson 2007; Kahnemuyipour 2004; Kratzer & Selkirk 2007; Legate 2003; Marvin 2002; Samuels 2009; Sato 2009).[2]

A full review of the theoretical innovations of Distributed Morphology and Phase Theory are beyond the scope of this paper, but we review the basic notions here. The core claim of Distributed Morphology is that there is no distinction between morphological structure and syntactic structure (Halle & Marantz 1993, 1994; Harley & Noyer 1999; Marantz 2001). Morphemes are manipulated by the syntax, and at the end of a derivation (or at spell-out, in a phase-theoretic framework), Vocabulary Items are inserted to provide pronunciation of the resulting feature configurations. This contrasts with lexicalist approaches (see Chomsky 1970;

Di Sciullo & Williams 1987; Halle 1973; Pullum & Zwicky 1991; Selkirk 1982: for representative discussion), in which full lexical items are merged in at the beginning of a syntactic derivation.

There are several variations on the theoretical notion of multiple spell-out, including the prominent theory of PHASES following Chomsky (2000, 2001, 2008), as well as other formulations (e.g., Uriagereka 1999). The motivations vary somewhat, but the core proposal is that the syntactic derivation proceeds in a cyclic manner, and at certain stages in the cycle, a sub-tree of the derivation is SPELLED-OUT, meaning that it is sent to the semantic and phonological interfaces for interpretation and pronunciation computations, respectively. This mechanism has many consequences, but it is generally used to explain locality phenomena, linearization of syntactic structure, cyclic movement, and other syntactic constraints (Boeckx & Grohmann 2007; Chomsky 2000, 2001, 2008; Gallego 2010; Legate 2003; Uriagereka 1999). For present purposes, the term *phase* is used to describe the domain of cyclic derivation, with the recognition that this term can have different technical interpretations under different theories of multiple spell-out.

In particular, the role of phases within the Distributed Morphology framework has largely focused on explaining the presence or absence of allomorphic variation or suppletion (Arad 2003; Embick 2010; Marantz 2001, 2008). Within these approaches, the assumption is often that all category-assigning heads ($n$, $v$, $a$, etc.) are phase heads by analogy to $v$ in the analysis of Chomsky (2000, 2001, 2008: see Marantz 2008 for further discussion of this point). However, Harley (to appear) argues against the hypothesis that category assigning heads are phase heads, arguing that the Chomsky phase head is actually *voice*P, distinct from $v$P.

Delving too far into these issues would divert the main focus of the present paper. Whether or not all category-assigning heads are phase heads is largely irrelevant to the analysis of the present data, as long as at least some forms of $n$P are considered phases (i.e., a nominal structure smaller than DP). This approach is certainly consistent with the hypothesis that category-assigning heads are phase heads, but, because all of the relevant $n$Ps discussed here have complete thematic structures, this assumption may also be consistent with a more narrow view of phase heads (i.e.,

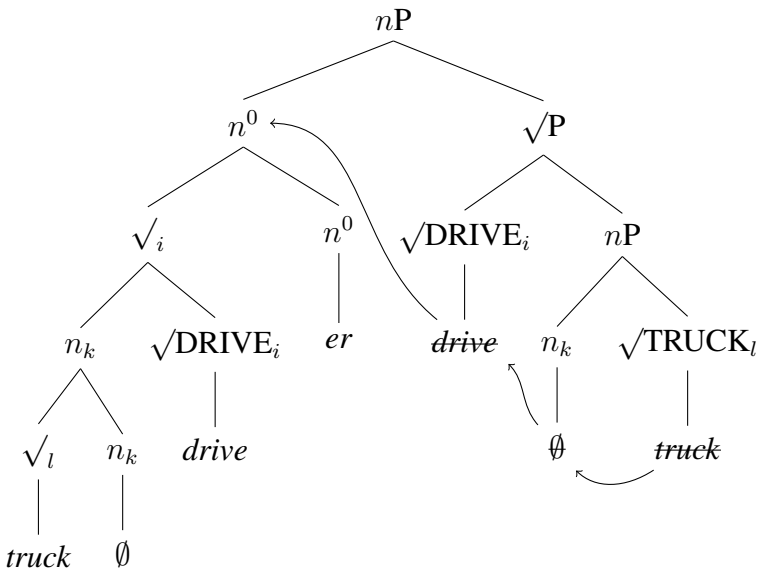
some $n$Ps may meet the "propositional" requirement of the Chomsky 2001 approach).

A final element of Phase Theory assumed here is that once a phase has undergone spell-out, the sub-parts of that phase are not available to operations in later cycles. This condition on phases is articulated by Chomsky (2001) as the Phase Impenetrability Condition.

## 2.2 N+N argument-predicate compounds

Given this background, the analysis of argument-predicate N+N compounds directly follows Harley (2011).[3] Harley argues that the theme argument is incorporated into the root before the complex element is moved into the higher $n^0$. Following Harley (2011), we assume the incorporation itself is necessary for Case reasons. This incorporation is analogous to the well-attested phenomenon of incorporation within the verbal domain (Baker 1988). The structure proposed by Harley (2011) for the compound *truck driver*, assumed here as well, is given in (2).

(2)




Harley points out that this structure also provides a natural explanation for the restrictions on the modifier in the compound, namely that it cannot inflect (* *trucks-driver*) or have a determiner (**the-truck driver*, meaning 'driver of the truck'). In short, the complement to the root cannot be a DP, only a $n$P.

Harley (2011) motivates this structure without considering stress assignment. However, once we assume this structure, predicting stress on the complement *truck* is a straightforward extension of the stress principles that derive stress on objects in transitive sentences, such as (3).

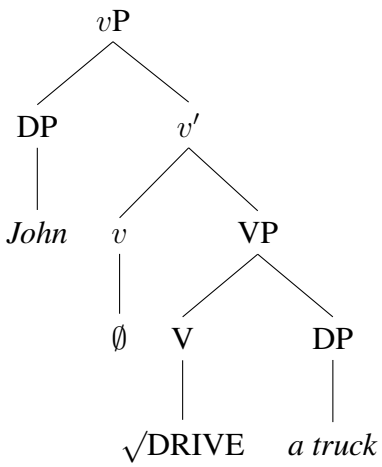
(3) John drove a trúck.

The stress pattern in (3) is correctly predicted by a number of different formulations of sentential stress rules, and choosing between these alternatives involves arguments outside the scope of this paper, including interactions with information structure and verbal functional structure. Many current proposals agree that phase-based stress rules appear to have advantages, though the precise formulations differ (Adger 2007; Dobashi 2003; Ishihara 2007; Jackson 2007; Kahnemuyipour 2004; Kratzer & Selkirk 2007; Legate 2003; Marvin 2002; Samuels 2009; Sato 2009). As an example, we refer to the specific formulation of Kratzer & Selkirk (2007), given in (4). [4]

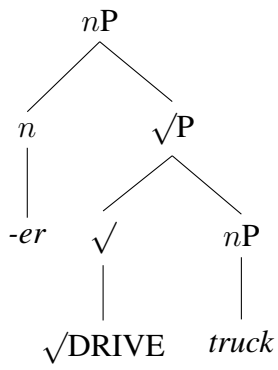
(4) **Highest Phrase Condition**: the highest phrase within the spell-out domain of a phase corresponds to a prosodic major phrase [which receives stress]. (ex. 20, p. 106)

In this formulation, the SPELL-OUT DOMAIN refers to the complement to the governing phase head.[5] In example (3), the $v$ head is assumed to be the phase head, and its complement is the VP, as shown in (5a). In the formulation of Kratzer & Selkirk (2007), the highest phrase within the VP complement is the object DP *a truck*. Therefore, this DP is phrased as a major prosodic phrase and thus receives stress. Again, while other phase-based theories of nuclear stress differ from this precise formulation (especially Adger 2007; Jackson 2007; Legate 2003), these other theories make the same empirical predictions regarding this simple transitive object example.

(5) a.




b.




The analysis of stress assignment in the compound structure from (2) proceeds in a parallel way, once it is assumed that $n$ can be a phase head. The tree in (5b) shows the relevant phase in the proposed compound structure, to highlight the parallel with the transitive verbal structure in (5a). In the compounding structure, we assume that the first relevant phase head is the nominalizer *-er*, the higher $n$ head. At this point in the derivation, the complement to the phase head is the $\sqrt{}$P, and the highest phrase within the $\sqrt{}$P is the $n$P *truck*. Thus, according to the formulation in (4), *truck* is predicted to have stress.[6] [7]

While the trees in (5) emphasize the parallelism between these structures, this is not the full story, because as (2) shows, the $n$P *truck* undergoes several movements. There is an incorporation movement to combine with $\sqrt{}$DRIVE, and the subsequent complex head undergoes head movement to combine with the higher $n^0$. If it is a lower copy of *truck* which receives stress according to the stress rule in (4), this raises the question of how stress is realized in the surface linearization *truck driver*. We claim that the stress assigned on a lower copy is "inherited" by the later copies after movement. This analysis follows independent proposals for sentential stress by Legate (2003) and Adger (2007) (and subsequently followed by Jackson 2007). The motivation for the inheritance or perpetuation of stress by these authors follows analysis of examples such as (6) originally from Bresnan (1971: ex. 5, p. 258, attributed to Newman, 1946), re-cast in the framework of a phase-based analysis of sentential stress.

(6) a. George has plans to léave. (George is planning to leave.)

b. George has pláns to leave. (George might leave some plans, say, on a table.)

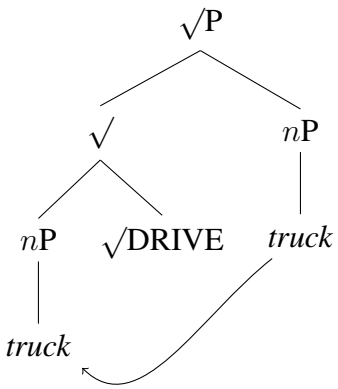
The essential insight is that in (6b), *plans* has raised from a lower position, where it was the complement of the verb *to leave*. It was in this lower position where it was assigned nuclear stress, and this stress was retained, even after raising. Legate (2003) argues that in cases where movement occurs within a phase domain, the deleted copy does not receive stress, because the copy deletion is able to proceed before (or at the same time as) the stress rule. But when a constituent moves out of the phase domain, as is the case in (6b),[8] the spell-out domain of the lower phase only includes the lower copy of *plans*. The phonological component cannot "see" both copies yet, so copy deletion does not take place, but stress assignment does. At a later phase, both copies are visible to the phonology, and so copy deletion removes the lower copy. But since they are copies of an object that has been spelled-out, the stress on the higher, remaining copy is the same as that of the lower copy. Thus, since *plans* is assigned stress in an earlier phase, the higher copy retains that stress.

We propose that this operates the same in compounding, such that the stress assigned on *truck* in the lower phase is retained as it moves higher into the surface position of *trúck driver*. In short, as long as stress is assigned to *truck* in the spell-out domain (i.e., the $\sqrt{}$P), the movement out of the spell-out domain will allow for the preservation of this stress, following the analysis of Legate (2003), Adger (2007), and Jackson (2007).

However, this is still not the entire story for the current compounding analysis. At the point of spell-out, the spell-out domain is the $\sqrt{}$P as shown in (7). As the tree illustrates, the incorporation movement itself is within the spell-out domain. Thus, the analysis of Legate (2003) would predict that stress cannot be assigned to the original position of *truck*, because it undergoes copy deletion at this same stage in the derivation, since both copies are visible to the phonological component at this point. Ultimately, this complication proves to be immaterial, because (following the stress rule) the highest phrase within the spell-out domain (i.e., under but not including the $\sqrt{}$P) is still going to be the $n$P *truck*, whether the original copy is selected, or whether the incorporated copy is selected because the original copy has been deleted. As long as *truck* is assigned stress at this

phase, that stress will perpetuate on higher copies, and the proper initial stress pattern of *trúck driver* will be realized.

(7)




At this point, we want to re-emphasize that many of the details of this analysis may be up for debate, but are largely orthogonal, since in terms of the goals of the present paper, many of the alternatives would end up with the same predictions. Therefore, it is useful to be explicit about the range of possibilities that will serve the arguments in the rest of this paper. There are three necessary conditions for a system of stress assignment to fulfill the needs of the proposed analysis. The first condition is that there is a phase-induced spell-out domain within this compounding structure. This condition is satisfied as long as at least one of the $n$ heads constitutes a phase, which is consistent with many current proposals (e.g., Arad 2003; Embick 2010; Marantz 2001, 2008). The second condition is that during spell-out of this structure, the nominal complement to the root (i.e., *truck* in 2 and 5b) must be in the domain for stress assignment at the relevant phase, and must receive primary stress. Whether the rule is framed in terms of "highest phrase," following Kahnemuyipour (2004) and Kratzer & Selkirk (2007), as formulated in (4), or whether it is framed in terms of "most embedded," following the formulations of Legate (2003), Adger (2007), or Jackson (2007) (which in turn are phased-based modifications of Cinque 1993), as long as *truck* is in a complement configuration under the $n$P phase, it is predicted to get primary stress. The third and final condition is that stress assigned to an element must remain on that element, even under movement of the element. Otherwise, the stress assigned on the lower copy of *truck* would be irrelevant to its final position in the

compound structure of *truck driver*. As discussed above, this "inheritance" of stress to later copies has been argued for on independent grounds, motivated by patterns of nuclear stress under movement such as raising, unaccusatives, and passives. The incorporation movement introduces an additional wrinkle to the technical details, but as described above, this does not seem to invalidate the empirical predictions of the analysis thus far. Whether these technical details make different predictions regarding other structures is left to future research.

In summary, the analysis follows naturally from previous work with independent motivations. First, the nominal modifier in a N+N argument-predicate construction is merged as the complement to the root of the head noun, before the root merges with its nominalizing $n$ head. Second, when the $n$P phase reaches the point of spell-out, the same stress assignment principles that assign sentential nuclear stress apply to assign stress to the complement (e.g., *truck*). Third, that complement undergoes incorporation and head movements, resulting in the observed linear order of constituents. Finally, parallel to analyses applied at the sentential level, the stress that was assigned when the nominal modifier was in a complement (or incorporated) position remains after movement. The result is the canonical initial stress pattern associated with compounds. While we have also argued that these predictions bear out even under several alternatives to some of the technical assumptions here, the crucial prediction is that primary stress will only fall on the nominal "modifier" of the head noun (e.g., will fall on *truck* in *trúck driver*) if this nominal is merged as a complement. If it is merged at a higher place in the structure, such as an adjunct position, it is not predicted to have primary stress by this analysis. We now explore how this analysis applies to the other data under consideration.

## 2.3 Other initial-stress N+N patterns

The above analysis applies where the initial element of the compound (e.g., *truck*) is clearly a theme or argument of the predicate represented by the head noun (e.g., $\sqrt{}$DRIVE). The complement configuration proposed in (2) is natural to represent this kind of relationship. However, the first element in an initial-stress N+N compound is frequently not a theme; many

other semantic relationships may be found. In fact, within a single N+N compound the relationship between $N^1$ and $N^2$ may be ambiguous, even within compounds that might be considered to have highly conventionalized meanings. Consider the following possible interpretations of the compounds in (8).

(8) horseshoe vs. swanboat

a. shoe/boat *designed for* a horse/swan

b. shoe/boat *made in the shape of* a horse/swan

c. shoe/boat *made out of* a horse/swan

In these examples, all of the meanings are available, though (a) is the more common, preferred reading for *horseshoe* and (b) is the more common reading for *swanboat*. This suggests that there is something inherently ambiguous about compounds of this type, in contrast to the more constrained meanings available in the N+N argument-predicate compounds such as *truck driver*. The resolution of this ambiguity is only determined via encyclopedic knowledge and context.

Harley (2011) discusses similar cases of *nurse shoe* and *alligator shoe* (note that these are equally ambiguous, barring plausibility/horror). Harley argues that these compounds are derived in a similar manner as *truck driver* discussed in the previous section, with $N^1$ merging as a complement to the root of the head noun ($N^2$). We also adopt this analysis, and claim that all N+N compounds with initial stress have the same general structure as that proposed for (2). The problem then becomes to understand the constraints on and interpretations of nouns merged as complements to a root.

On the one hand, there is a very wide range of semantic relationships involved with initial-stress N+N constructions (e.g. *olive oil*, *baby oil*, *garage band*), as suggested here, there may be multiple possibilities, giving rise to ambiguity. On the other hand, the class of meanings involved with the argument-predicate subclass is very constrained, and is very predictable based on the meaning of the predicate. We argue that this is a predicted result if we assume that all initial-stress constructions represent complement-head relationships. In the cases where the head

represents a predicate with an internal argument (*truck driver*, *sunrise*), the semantics are clearly delineated. But in the many cases where the head either does not contain a predicate (*baby oil*) or does not have an internal argument (*dog run*), the relationship must be determined by some additional predicate, which may be strongly conventionalized for a particular lexical item, but which will be highly dependent on context, encyclopedic knowledge, and other considerations external to the observed constituents.

We therefore characterize all semantic relationships in initial-stress N+N constructions to be either tightly constrained by the semantics of the head, or a vague "connected-with" relationship. This latter unspecified relationship has been suggested in various places (e.g., Dowty 1979; Liberman & Sproat 1992). We argue that this pattern fits cleanly into the proposal that all initial-stress N+N constructions represent a complement-head structural relationship, with the semantics derived accordingly.

## 2.4 N+N constructions with final stress

N+N combinations without initial stress are not uncommon in English (see table 1, (e) through (i) for examples). Estimates from the literature suggest that between one third and one fourth of N+N constructions have final stress (Liberman & Sproat 1992: 25%; Sproat 1994: 30%; Bell 2008: 32%; though Plag & Kunter 2010 find only 5-10% final stress in dictionaries). If the relationship represented in the initial-stress N+N constructions is virtually unconstrained, then the problem becomes explaining why some constructions do not occur with this pattern. We propose that there are two factors which explain the ability (and requirement) of some N+N constructions to carry final stress.

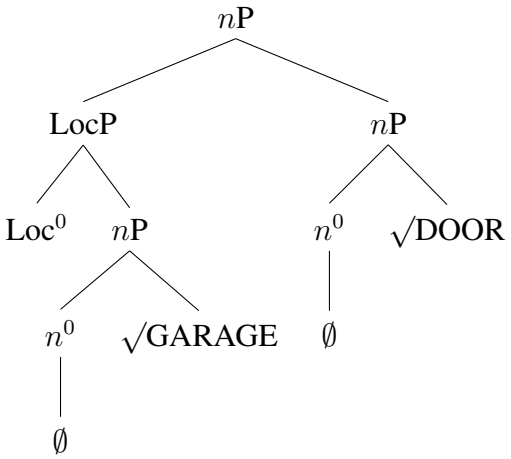
First, we assume that the incorporation process is sub-optimal in some way. It involves creating a more complex derivation than a simple adjunct merge, so for economy reasons, it may be dispreferred.[9] This agrees with the data in two respects. First, for the argument-predicate N+Ns, it may be assumed that incorporation is allowed because it is the only way to represent the complement relationship in a N+N configuration. Second, for the "argument-argument" N+Ns,

Giegerich (2004) suggests that the high occurrence of such cases is in part a result of the relative lack of productive adjective-forming morphology in English. This may in turn provide an explanation for why incorporation is tolerated in these cases. In other words, incorporation of the nominal *apple* as a complement of *juice* is tolerated because there is no corresponding adjective.

This analysis then implies that there is some additional option for the final-stress cases which allows them to avoid incorporation, and if incorporation is dispreferred, this has the effect of *requiring* that they avoid incorporation. What then is this additional option? We propose that for some semantic relationships, there is higher functional structure available, such that the modifier noun may merge as an adjunct into a position above the $n$P of the head noun.

While the semantic relationships represented in final-stress N+N constructions do not appear to be uniform (see table 1 e through i), they appear to be more constrained than the broad "connected-with" semantics of the initial-stress N+Ns. We assume that there is functional structure associated with each of these relationships, such as Material, Locative, or Temporal. Thus the structure of *garage door* is claimed to be something like that given in (9).

(9)




In contrast, the meaning of *garage* in *garage band* cannot be subsumed under "locative", because while there is a semantic connection ("the type of band that might practice in a garage"), the term *garage band* implies both more and less than location in a garage. Thus *garage* cannot merge into a Locative functional structure (or any other available functional structure). It must instead merge as a complement to $\sqrt{}$BAND, and get its meaning from the encyclopedic, conventionalized

context of the connection between these words.

Making a strong case for the functional structure required to support the relationships represented in table 1 (e)–(i) is beyond the scope of this paper (but see Scott 2002 for more general arguments), but some evidence is available in support of the general proposal that the modifier noun in final-stress N+N constructions is in a higher position than the modifier noun in initial-stress N+Ns. As mentioned previously, there have been arguments in the literature in support of the idea that final-stress N+N constructions are phrasal rather than compounds. While our claim is that the phrasal/lexical distinction is better replaced by the adjunct/complement distinction, some of the data from these arguments actually support the analysis proposed here.

For example, while *one*-replacement may not be applied in all cases,[10] there are clear cases where it can apply to the head noun in final-stress N+Ns. For example:[11]

(10) a. The crew was supposed to build a wooden bridge, but instead they built a steel one.

b. * You like to wear those alligator shoes, but I like the nurse ones.

Since *one*-replacement targets $n$Ps, this demonstrates that *steel* in (10a) must merge into an adjunct position above the $n$P, where this does not seem to be allowed for the initial-stress cases such as (10b). This is consistent with our analysis of the initial-stress structure, in which there is no $n$P that excludes the incorporated *nurse* from the head noun *shoes*.

An additional demonstration that the initial-stress modifiers must be in a closer position than the final-stress modifiers is given in (11).[12] While adjunct nominal modifiers such as *steel* allow an intervening incorporated modifier such as *bay*, the reverse is not true.

(11) a. We drove over the steel bay bridge today.

b. * We drove over the bay steel bridge today.

These examples provide some preliminary evidence that the position of the initial Ns in the final-stress N+N constructions is different, and higher, than the position of the initial Ns in the initial-stress N+N constructions.

Given this structure, the stress facts are explained straightforwardly. At the first $n$ phase in (9),

only $\sqrt{}$DOOR is in the spell-out domain (complement to the $n$ phase head), so it is assigned stress. The difference between this structure and the initial-stress structure is that in the initial-stress structure in (2), the modifier $n$P is merged low, within the domain of stress assignment, where in this adjunct structure in (9), it is merged in higher, after stress assignment has applied.

This analysis extends to a number of alternations between initial and final stress, such as those in (12).

(12) a. tóy factory (factory that makes toys) vs. toy fáctory (factory that is a toy)

b. stéel warehouse (warehouse for storing steel) vs. steel wárehouse (warehouse made of steel)

c. háir net (net worn over one's hair) vs. hair nét (net made of hair)

In each of these cases, the initial-stress example is analyzed as a complement-head relationship, in which the predicate is either supplied by the head noun or by some external encylopedic knowledge, and the final-stress example is analyzed as an adjunct-head relationship, where the modifier is merged into a functional adjunct position, from which it derives its semantics (e.g., "made-of", "is-a").

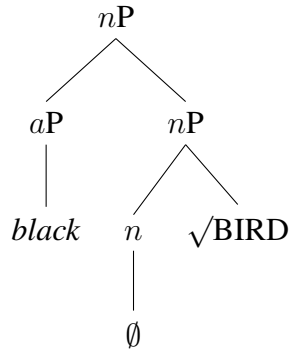
In summary, the proposal for N+N constructions is as follows. Because the syntax of English does not universally allow nominals to occur in adjunct positions (in contrast to adjectives), most nominals will not have the option of merging as an adjunct. A limited number of functional projections exist above the $n$P, such as Material, Locative, or Temporal, following Cartography-style assumptions (Scott 2002). These projections allow for nominals to merge into an adjunct structure such as (9), but only for certain semantic relationships. If a nominal is not allowed to merge into the functional adjunct position, the alternative is merging as a complement to the head noun and undergoing incorporation as in (2). This structural distinction between merge-as-complement and merge-as-adjunct maps straightforwardly to the stress distinction, such that nominals merged as complements get primary stress (resulting in initial-stress N+Ns) and nominals merged as adjuncts do not (resulting in final-stress N+Ns).

This proposal predicts not only the stress patterns, but also the less frequent occurrence of final-stress N+N structures (since there are relatively few available functional projections for adjunction sites), as well as the nature of the initial-stress N+N semantic relationships. Specifically, in constructions where the head noun represents a clear predicate, the nominal modifier (merged as complement) is obligatorily interpreted as the theme of that predicate, but where a predicate is not specified by the head noun, the semantic relationships are virtually unconstrained ("$N^2$ having to do with a $N^1$"). This is predicted because this kind of merge-as-complement structure is a type of elsewhere condition, since a more semantically-constrained adjunction site in a functional projection is not available for these nominals. In other words, merging the nominal modifier in as an adjunct (under, say, a Locative projection) will only occur if this gets the right semantics, and the N+N will surface with final stress. Only if the nominal cannot get the right semantics by merging into one of these functional projections will it merge as a complement, and thus surface in an initial stress N+N. This complement/adjunct distinction is further supported by empirical evidence that the merged-as-complement (initial-stress) nominal modifiers are structurally closer to the head noun than merged-as-adjunct (final-stress) nominal modifiers.

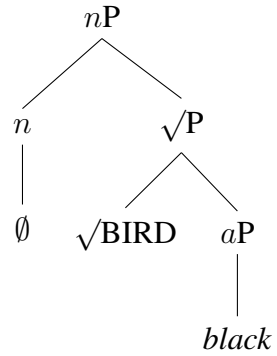
## 2.5 A+N constructions

Having established the analysis for N+N constructions, we now turn to A+N constructions. We start with the assumption that the structures are analogous to the N+N structures already proposed. One difference is that because adjunction is more universally available for adjectives, a special functional projection is not required for the adjunct structure. Thus, the contrast is between a typical adjunct structure as in (13a) and a complement/incorporation structure such as (13b).[13]

(13) a.




b.




The claim for final-stress N+Ns is that the modifier N is able to merge into a higher position, thus avoiding the incorporation structure in (2). This is predicted to be much more frequently the case with A+N constructions, simply because English syntax allows adjunction of adjectives much more freely; this is in fact the default case, as intuition suggests and the corpus data from Liberman & Sproat (1992) demonstrate. Therefore, the burden of the analysis is on explaining why some A+N constructions (specifically, the initial-stress constructions) do appear to involve incorporation (13b).

In order to explain this, we return to the notion of complement vs. adjunct. The incorporation structure involving initial stress is a structure in which the adjective is selected as a complement to the root of the head. Selkirk (1984) and Cinque (1993) have already appealed to this notion, and the analysis here follows their lead in claiming that the complement relationship adequately captures the nature of the modifer-head relationship in initial-stress A+N constructions.

Both syntactic and semantic arguments support this structure for these constructions. First, in contrast to phrasal adjectives, adjectives in initial-stress A+N constructions cannot be modified, whether or not they are spelled as separate words.

(14) a. That's a very black bírd.

b. *That's a very bláckbird.

(15) a. I've never seen a blacker bírd than the one over there.[14]

b. *I've never seen a bláckerbird than the one over there.

Similarly, in languages with overt inflectional morphology on adjectives, such as German, inflection is absent in compound forms.

(16) a. eine jung-e Frau
DET young-FEM.SING woman

b. eine Jungfrau
DET maiden

German is also more explicit regarding the orthography, which generally makes A+N constructions unambiguous, in addition to the inflectional differences.

Finally, in parallel with the N+N examples in (11), other adjectives can occur before the incorporated adjective, but not between the incorporated adjective and the head noun.

(17) a. I'd like a white stícky bun. (referring to a special type of pastry)

b. *I'd like a stícky white bun. (with the meaning of *stícky bun*)

c. I'd like a sticky, white bún. (with the meaning of *sticky bún*)

(18) a. He left in a swift red bóat. (swift > red in normal adjective ordering)

b. *He left in a red swift bóat.

c. *He left in a swíft red boat. (swíft boat = special type of boat)

d. He left in a red swíft boat.

Example (17) demonstrates that a phrasal adjective (here, *white*) cannot intervene between an incorporated adjective and the head noun, and example (18) demonstrates that this is the case even when this order would normally violate general adjective-ordering restrictions (cf. Scott 2002).

The incorporated adjective must even come between noun modifiers in final-stress N+N constructions.

(19) a. beef ríbs (final-stress N+N construction, analogous to steel brídge)

b. short, beef ríbs (short = regular phrasal adjective)

c. * beef short ríbs

d. beef shórt ribs (type of shórt rib)

Thus a regular phrasal adjective cannot intervene between the head noun and an adjunct nominal modifier (19c), but an incorporated adjective can (19d), just as an incorporated nominal modifier can intervene between the head and an adjuct nominal modifier, as in (11). Interestingly, this provides a hint of evidence that the two type of final-stress constructions are in fact not equivalent. That is, the analysis in section 2.4 argues that the nominal modifier in final-stress N+N constructions is higher than $n$P (and thus higher than any incorporated adjective), but may in fact be lower than adjunct adjective positions, which is where adjectives in final-stress A+N constructions occur. If this is true, this is a novel insight provided by this analysis, which may help reconcile some of the difficulties in classifying the final-stress N+N constructions as phrasal or compounds, since the position for nominals in final-stress N+N constructions appears to be lower than standard phrasal adjectives, but higher than the $n$ head.

For reasons of space, we will only briefly review supporting semantic evidence for these structures. In short, the semantics of adjectives in initial-stress A+N constructions are characteristically opaque and specific to that particular lexical item. For example, only in the construction *pínk slip* does the word *pink* have to do with unemployment. Similarly, the meanings of *white* in *Whíte House* (of the U.S. president) and *whíte paper* (special type of report) have nothing to do with each other, and have little or nothing to do with the general adjective *white*. The fact that the semantics of the adjective appear specific to that particular construction fits well with the proposed incorporation structure, since this means that the A+N are interpreted as a single complex head. In other words, the proposed syntactic structure fits well with the common intuition that these constructions represent more "lexicalized" semantics.

In summary, syntactic evidence supports the proposal that initial-stress A+N constructions involve the same complement-head incorporation structure (shown in 13b) as that developed for N+N constructions, by providing evidence that the adjective is in a closer syntactic configuration than phrasal (final-stress) adjectives (13a). The semantics of these initial-stress constructions is also consistent with the proposed incorporation/complement structure. Thus, the general structure analysis developed for the N+N constructions appears to also apply to the A+N constructions,

which also provides the correct stress predictions. Finally, the observed differences between the N+N and A+N constructions extend naturally from independent differences between adjectives and nouns in English (i.e., adjectives freely adjoin, but nouns can only adjoin under special circumstances, like specific functional projections). This has the advantage of accounting for some of the difficult distinctions raised in the literature, while still maintaining a simple and unified analysis of the two types of structures.

# 3 Discussion

## 3.1 Summary

This paper proposes that constructions traditionally analyzed as compounds are incorporation structures as in (2), where the modifier is a complement to the root of the head noun, merged before the head root merges with its nominalizing head $n^0$. This structure is proposed to represent all initial-stress constructions, both N+N and A+N. In contrast, the final-stress constructions are treated slightly differently between the N+N and A+N constructions. Final-stress A+N constructions are assumed to have standard phrasal adjective structures. In final-stress N+N constructions, it is proposed that the initial noun is merged as an adjunct, into a functional projection above $n$P, where the semantics of the modifier are determined by a functional head such as Material, Temporal, Locative, etc. These structures are supported by both syntactic and semantic evidence, and also make the right phonological predictions. Finally, the incorporation structure of Harley (2011) and the stress-assignment principles of Kratzer & Selkirk (2007) (among others), which provide the basis of the analysis, are all motivated on independent principles.

## 3.2 Residual problems

Naturally, there still remain some unresolved problems. One of the difficult unresolved issues is understanding the precise circumstances that license (or require) an adjective to merge as a complement in an incorporation structure instead of merging in a more typical adjunct structure. A first pass would be to require that the A+N is a subtype of N, where the semantics of A are specific to that construction. This captures many examples, such as *blackboard*, *stícky bun*, etc., but one possible counter-example appears to be *black márket*, since it appears to fit these criteria (i.e., it is a type of market, and the meaning of *black* as 'illicit' is not completely general), but it does not have initial stress. It may be possible to claim that the meaning of *black* here is "not specific enough" to require an incorporation structure (it may share a more general pattern with examples such as *black óps*), but this is drawing a very fine line, since examples such as *blácklist* appear to fall on the other side of the line. In other words, while it is not clear whether there are any true counter-examples to the above generalization, there are some borderline cases, and clarifying where the dividing line is, and how cases along that line are determined, is an area for future exploration and refinement of the preliminary analysis suggested here.

Regarding the N+N examples, as mentioned above, the ultimate success of the analysis of final-stress N+N constructions may depend on defending plausible functional projections above $n$P to account for the full range of data. Given that the more prominent categories appear to be things like Material, Locative, or Temporal, this may in fact be possible. More immediately problematic appear to be cases in which there are similar concepts in both initial-stress and final-stress semantics, such as material/composition. The classic example from Lees (1963) is the distinction between *ápple cake* and *apple píe*. It may be possible to rescue the division between these, since apple pie is arguably more composed of apples than apple cake is, but again, this may be drawing the line too finely. Note, however, that *móon pie* does have the predicted initial stress, representing a pie that is not composed of moon(s), so it may be possible to construct a proper distinction after all. This, too, is left for future research.

## 3.3 Information structure, analogy, and other factors

A relatively recent line of work in the study of compounds comes from Ingo Plag and colleagues (e.g., Bell & Plag 2012; Kunter 2011; Plag, Kunter, et al. 2008). The approach represented by these authors takes a very different tack than the one explored in the present paper. The general approach is to explore the possibility that variation in interpretation and stress in compounds and other modificational structures is not adequately accounted for by structural or rule-based semantic approaches. The argument is two-fold, emphasizing both the variability observed in large-scale empirical corpus studies (including observed cross- and within-dialect variation), and the influence of additional factors, such as information structure or lexical frequency.

While this approach differs from the more traditional approach taken here, the differences do not appear to be irreconcilable, and may in fact be complementary. The claim we make here is that by assuming some independently-motivated analyses from Distributed Morphology and multiple spell-out (phase-based) theories of stress assignment, a great deal can be explained very naturally, including some of the more historically problematic stress patterns and semantic distinctions in the complex empirical patterns of English compounds. Importantly, this analysis captures some robust, productive alternations discussed above, which are not strongly predicted by a probabilistic theory. Whether or not additional effects or apparently "exceptional" cases can be described by appealing to additional notions such as information structure, analogy, or frequency-based lexicalization, the relatively straightforward analysis proposed in this paper represents an elegant theoretical solution that captures many of the major insights of previous work, explains a wide range of complex empirical patterns, and offers a new set of insights and directions for future work in the study of compounds. Thus, even if, as Plag and colleagues assert, a complete analysis of stress and compounds must refer to information structure and processing, our analysis may provide a new basis of comparison for exploring the relative merits and interactions of rule-based and processing-based theories.

# 4 Conclusions

The analysis proposed here combines several insights from previous literature into a simple, coherent account of so-called "compound" stress in English. The distinction between initial-stress and final-stress constructions is captured as a structural difference between a complement structure and an adjunct structure, respectively, following the insight of Selkirk (1984). The complement structure proposed for initial-stress constructions like *trúck driver*, *blackboard*, or *garáge band* follows Harley (2011) in an incorporation-style analysis within the Distributed Morphology framework. The adjunct structure proposed for final-stress constructions such as *duck sóup*, *November ráin*, or *garage dóor* is derived by positing higher-level functional adjunction sites within the $n$P, following the spirit of Scott (2002) and others in the Cartography tradition. Given these structures, a phase-based theory of stress assignment, previously proposed in various forms by many researchers (including Adger 2007; Dobashi 2003; Ishihara 2007; Jackson 2007; Kahnemuyipour 2004; Kratzer & Selkirk 2007; Legate 2003; Marvin 2002; Samuels 2009; Sato 2009) provides a straightforward prediction of the correct stress patterns.

Besides accounting for the basic facts presented in 1.1, and even considering the possible limitations as discussed in section 3, this analysis has several merits. First, it improves on the parsimony of previous phonological accounts such as Chomsky & Halle (1968), Liberman & Prince (1977), and Giegerich (2009), by eliminating the need for separate compound stress rules, following insights by Cinque (1993) and in line with other recent approaches, such as Samuels (2009).

Second, the analysis predicts many of the distributional and semantic asymmetries between the different categories of constructions, which is something that no previous theoretical analysis has accomplished as naturally. These predictions run as follows. The incorporation structure is productive and readily available for N+N constructions, because where the head root represents a predicate, the initial noun functions as the internal argument of that predicate. Where the head noun does not represent a predicate, the semantic relationship between head and modifier is underspecified, and determined by a predicate supplied by convention or context. The result is

that the semantics of these "argument-argument" compounds (to borrow Liberman and Sproat's 1992 label) are a kind of elsewhere condition, with many possible meanings available. In contrast, the final-stress N+N constructions are analyzed as only being licensed when there is an adjunct functional projection which carries the required semantics. This state of affairs predicts that the final-stressed N+N constructions will be less frequent (having fewer semantic values available) and will be represented by a more constrained set of semantic relationships. Both of these predictions are borne out empirically. The converse is predicted for A+N constructions in terms of frequency, because unlike nouns, adjectives in English merge as adjuncts much more freely, so the final-stressed adjunct structure is predicted to be much more likely, and the initial-stressed incorporation structure is predicted to occur only under special semantic conditions. This prediction is also borne out in the data. The fact that N+N and A+N constructions are dealt with using the same mechanisms, but with slightly different results, is also taken to be a merit of this analysis, given the closely parallel, but not-quite-identical nature of the two constructions.

Finally, while some details still require explanation, this analysis provides a new perspective on the differences between classes of examples. It provides an avenue of escape from circular definitions of compounds and compound stress. The analysis proposes that the proper division is between complement/incorporation structures (which receive stress on the complement) and adjunct structures (which may be of different types). Thus stress is taken to be a diagnostic of complementation/incorporation. This has the same intuitive utility of claiming that compound stress is diagnostic of compounds, without the logical circularity, and it opens additional possibilities for delineating constructions beyond the traditional, vexed definitions of compounds. The analysis also suggests that exploring the functional structure above $n$P is a fruitful way to proceed, in order to better understand the semantic conditions that allow N+N adjunction structures. In the end, this analysis extends work in current theoretical paradigms, revives and re-articulates many important earlier insights, and offers new avenues of investigation towards understanding modificational structures and their stress patterns.

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# Notes

[1]Throughout, we mark primary stress with an acute accent.

[2]Samuels (2009: Chapter 5, section 5.3.2) in particular sketches an analysis of compound stress, also framed within an approach combining Distributed Morphology with multiple spell-out. However, the analysis presented here differs from Samuels' in several critical respects. Despite these differences, Samuels (2009) is motivated by many of the same insights, and develops her brief treatment of compounds as just one part of a much larger theory of the phonology-syntax interface. Thus, the analysis here agrees with the general approach of Samuels (2009), and we assume that the primary insights of the present analysis could be expressed within her framework as well.

[3]Siddiqi (2009) also provides a sketch of an analysis of compounds within Distributed Morphology. The primary issues addressed by Siddiqi are largely orthogonal to the present analysis, but the structures he posits have a similar kind of head-complement structure, and thus would fit in the general analysis proposed here.

[4]Note that Kratzer & Selkirk (2007) essentially follow the earlier proposal of Kahnemuyipour (2004), with some minor technical changes.

[5]This is called the SPELLEE by Kahnemuyipour (2004).

[6]Under a strict reading of Kratzer and Selkirk's rule, the implication is that *truck* is a "prosodic major phrase," which may be implausible under some phonological theories. We will not defend this specifically, but suggest that it is possible that other constraints may determine the exact size of the prosodic constituent. We merely assume that the spell-out domain is the domain for the application of stress rules, however that is represented in the prosodic phonology.

[7]The reader may also question why the lower $n$P is not a phase in this analysis. We do not believe that this would make a difference. In brief, even under an alternative analysis where the lowest $n$ acted as a phase head which induces spell-out, stress would still be assigned in the same place, either because (a) $\sqrt{}$TRUCK is considered a phrase and is assigned stress according to the rule in (4), or (b) $\sqrt{}$TRUCK is not considered a phrase, and thus the rule in (4) fails to apply until the next phase. This simply illustrates that as long as the general structure in (2) applies, several reasonable alternatives regarding the phase-based stress rule would make similar predictions.

[8]Legate (2003) also argues that this is the case for passives and unaccusatives, as part of an argument that these structures constitute strong phases.

[9]The elucidation of the precise economy constraints is left to further research. It is also possible that some kind of blocking effect (à la Kiparsky 1982) is playing a role. Whatever the mechanism, the assumption here is that incorporation (at least in English) is dispreferred if there are different ways to express the same meaning.

[10]Bauer (1998) has pointed out that *one*-replacement may be an unreliable test, or at least may give variable results. It is included here as a supporting argument, among others.

[11]Naturally, information structure such as contrastive focus can affect the observed stress patterns of virtually all of the examples in this paper. In the particular example in (10a), even though *steel bridge* and *wooden bridge* are normally final-stress constructions, the contrast between the two in this sentence induces a contrastive stress on *wooden* and *steel*. For reasons of space, a full analysis integrating information structure is beyond the scope of this paper, but see section 3.3 for a brief discussion. In short, we assume that the stress imposed by information structure is independent of the typical final-stress status of *wooden bridge*.

[12]Example (11b) is only possible with a reading such that *bay steel* is a type of steel, out of which the bridge is made.

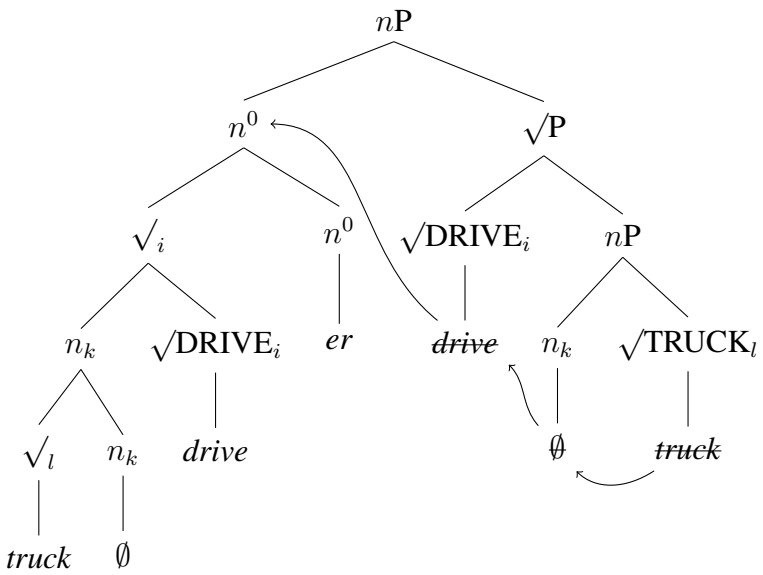
[13]For simplicity, we do not show the incorporation movement in (13b), in which *black* incorporates into the root $\sqrt{}$BIRD.

[14]Note that "neutral" stress in sentences with comparatives can often be obscured by independent effects of informational focus.

Table 1: Some examples of modificational structures in English

| Categories | | Initial (Compound) Stress | | Final (Phrasal) Stress |
|---|---|---|---|---|
| N+N | (a) | lawnmower | (e) | nylon rope |
| | | truck driver | | stone castle |
| | | | | steel beam |
| | (b) | doghouse | | duck soup |
| | | horseshoe | | |
| | | baby oil | (f) | Christmas dinner |
| | | | | spring showers |
| | (c) | olive oil | | November rain |
| | | sandcastle | | |
| | | | (g) | kitchen sink |
| | (d) | garage band | | garage door |
| | | | (h) | child actor |
| | | | (i) | singer-songwriter |
| A+N | (j) | blackboard | (k) | black board |
| | | White House (of the US president) | | white house |
| | | sticky bun (type of pastry) | | sticky bun (descriptive adj.) |
| | | pink slip (termination notice) | | pink slip (undergarment) |

(2)


nP
n0
√P
√i
n0
√DRIVEi
nP
nk
√DRIVEi
er
drive
nk
√TRUCKl
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nk
drive
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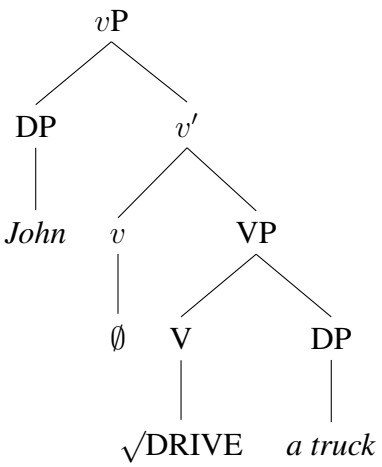
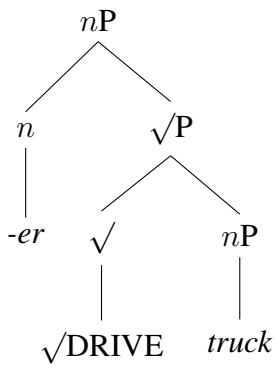
truck
truck
∅

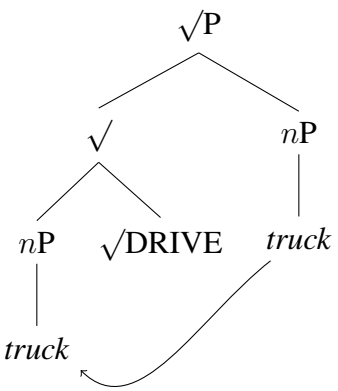
(5) a.



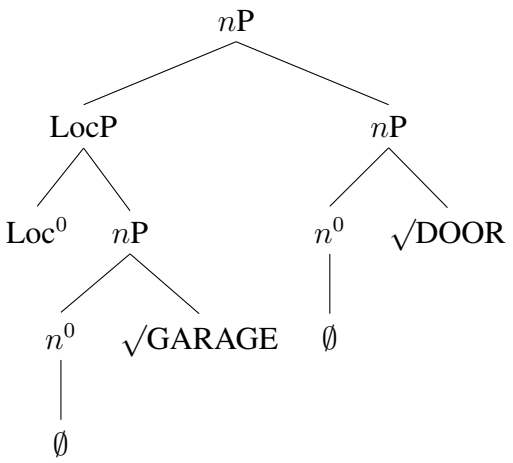

b.



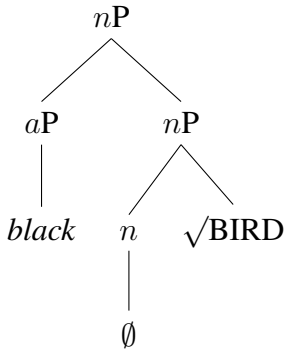
(7)



(9)


$n$P
LocP
$n$P
Loc$^0$
$n$P
$n^0$
$\sqrt$DOOR
$n^0$
$\sqrt$GARAGE
$\emptyset$
$\emptyset$

(13) a.




b.