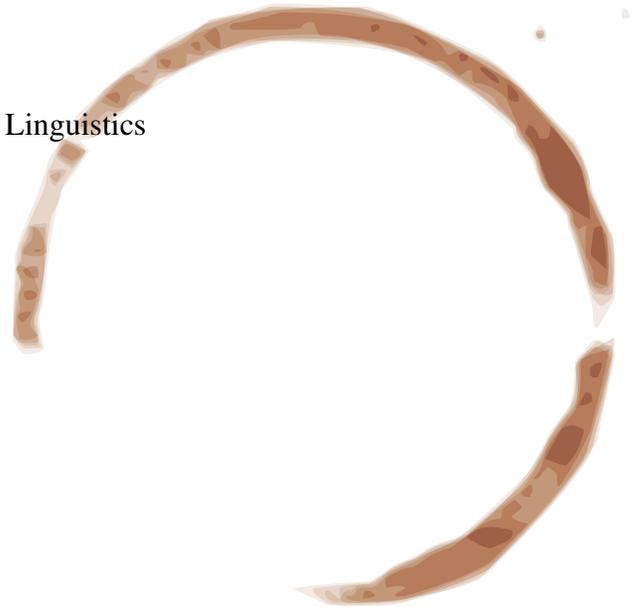


Deriving English compound stress: insights from Distributed Morphology and multiple spell-out

Scott Jackson¹ and Jeffrey Punske²

¹ University of Maryland
Center for Advanced Study of Language
7005 52nd Avenue
College Park, MD 20742
scottrj@umd.edu

² University of Oklahoma
Department of Modern Languages, Literatures, & Linguistics
121 Kaufman Hall
Norman, OK 73019
punske@ou.edu



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

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.

Acknowledgement footnote

The authors would like to thank the following people for support and assistance: Andy Barss, Heather Jackson, Cathy Doughty, Dylan Herrick, and Marcia Haag. As usual, all remaining errors are our own.

Keywords: compounds, stress, Distributed Morphology, Phase Theory, English, nominal structure

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 groundwork formalisms of Chomsky and Halle (1968) and Liberman and 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 larger constituents like sentences. The distinction between these rules is connected to the idea that there are two stages to the phonological cycle, a lexical cycle and a phrasal cycle. In contrast, Cinque (1993) proposed an alternative which would derive stress patterns in compounds from the same general principles that derive the 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 several patterns of data which appear difficult for both of these general approaches (Bauer 1998; Giegerich 2004, 2005, 2009; Liberman and Sproat 1992; Olsen 2000; Zwicky 1986). Giegerich (2009) provides a recent summary of the primary empirical problems with traditional Compound Stress Rule approaches, 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, the present analysis proposes 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 remotivates 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 offer a straightforward way to capture these insights.

The structure of the paper is as follows. Section 1.1 presents the primary data patterns which are 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 multiple spell-out, 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 and Plag 2012; Kösling and Plag 2009; Kunter 2011; Plag 2006, 2010; Plag, Kunter, and Lappe 2007; Plag, Kunter, Lappe, and Braun 2008).

1.1 Patterns in English compounding

There is a substantial literature on the nature of compounding and compound stress in English (including Bauer 1983a,b, 1998; Bloomfield 1933; Chomsky and Halle 1968; Cinque 1993; Fudge 1984; Giegerich 2004, 2005, 2009; Kunter 2011; Ladd 1984; Lees 1963; Levi 1978; Liberman and Prince 1977; Liberman and Sproat 1992; Marchand 1969; Olsen 2000; Plag 2003; Plag, Kunter, Lappe, and Braun 2008; Selkirk 1984; Zwicky 1986). An extensive review is beyond the scope of this paper, but we will draw attention to several patterns that have created challenges for a simple, unified analysis of 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 “normal” 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 “standard” 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 a single orthographic word (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 and Halle (1968) or Liberman and Prince (1977) would be at least descriptively adequate, and the remaining challenge would be to understand the difference between adjectives in A+N compounds, and more “typical” phrasal adjectives. However, there also exist examples of N+N structures which do not get initial stress (Giegerich 2009; Liberman and 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 and 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 set of affairs.

<INSERT TABLE 1 ABOUT HERE>

Table 1 displays several of these patterns, which are illustrative of the analytic challenges that the data impose. Liberman and 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 initial impressions of earlier work 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 these patterns 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?

The first two questions are concerned with providing an adequate description of the data, with the goal of establishing some independent difference between the stress categories other than stress. One logical possibility is that the stress patterns in all of these constructions are completely arbitrary, and to the extent that they are consistent, they are determined on a case-by-case basis in the lexicon. To the extent that this is not true, however, it should be possible to uncover some way to predict or correctly classify the initial-stress cases from the final-stress cases. The second question raises the possibility that the explanation for the N+N cases may differ from the

explanation of the A+N cases. But given the striking parallels between the two, this would also be a disappointing and surprising result.

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 in examples like those in (a) of table 1. 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 (d) could be seen 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 and 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 and 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*, *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 in relation to the N+N cases. 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 (1-b) is elusive.

Question (1-c) has only very rarely been discussed in the literature, perhaps because the first two descriptive questions have proven so vexing. Cinque (1993) proposed an elegant view that the relationship between syntactic structure and phonological structure may in fact be 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. 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 crux of the present analysis follows the suggestion by Cinque (1993), claiming that the difference is quite simply structural, in line with a theory in which all morphological structure is expressed as syntactic structure. When the initial element in the construction is merged and interpreted in a complement position to the head, this position is also assigned stress, following general stress-assignment principles. In contrast, all of the final-stress patterns are derived from the initial element being merged into a higher adjunct position. Thus, the distinction is that on the left side of table 1, the modifier is always in a complement relationship with the head noun, and on the right side of the table, it is always in an adjunct relationship. This categorization was suggested first by Selkirk (1984), and the present analysis simply shows that the complement-adjunct distinction follows from a Distributed Morphology analysis motivated on independent grounds. Furthermore, it is shown that the stress patterns are not arbitrarily associated with these two structures, but rather fall out naturally from general phase-based stress assignment, given the proposed structural differences. The technical details of this analysis follow.

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, 2005; 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 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 and Selkirk 2007; Legate 2003; Samuels 2009; Sato 2009).²

A full review of the theoretical innovations of Distributed Morphology and multiple spell-out 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 and Marantz 1993, 1994; Harley and Noyer 1999; Marantz 2001). Morphemes are manipulated by the syntax, and at the end of a derivation (or at spell-out, in a

multiple spell-out framework), Vocabulary Items are inserted to provide pronunciation of the resulting feature configurations. This contrasts with the lexicalist approaches (see Chomsky 1970; Di Sciullo and Williams 1987; Halle 1973; Pullum and Zwicky 1991; Selkirk 1982, for representative discussion), in which full lexical items are merged into the syntactic derivation from the beginning.

There are several variations on the theoretical notion of multiple spell-out, including the prominent Phase Theory 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 and 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, 2005; Embick 2010; Marantz 2001, 2008). Within these approaches, the assumption is 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). Harley (to appear) argues against the hypothesis that category assigning heads are phase heads, arguing that the Chomsky phase head is actually *voiceP*, distinct from *vP*.

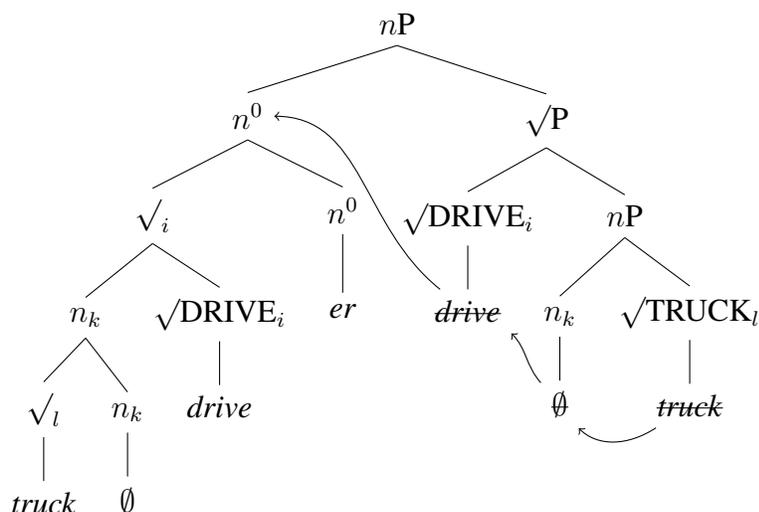
Delving too far into these issues would divert the main focus of the present paper. Whether or not all category-assigning heads are phase heads is largely irrelevant to the analysis, as long as at least some forms of *nP* are considered phases. This approach is certainly consistent with the hypothesis that category-assigning heads are phase heads, but, because all of the relevant *nPs* discussed here have complete thematic structures, this assumption may also be consistent with a more narrow view of phase heads (i.e., some *nPs* may meet the “propositional” requirement of the Chomsky 2001 approach).

A final element of multiple spell-out 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 n^0 . 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 nP .

While Harley (2011) motivates this structure without considering stress assignment, given 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 truck.

A number of proposals have been made regarding the precise formulation of sentential stress rules, and choosing between them involves arguments outside the scope of this paper, including interactions with information structure and verbal functional structure. However, a number of competing theories all provide the same prediction in this structure, which is that the internal argument to the verb in (3) receives primary stress. As an example, we will refer to the specific formulation of Kratzer and Selkirk (2007), given in (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. In example (3), the complement to the *v* phase head is the object DP *a truck*. Therefore, this DP is phrased as a major prosodic phrase and thus receives stress. The analysis of the stress in the compound structure from (2) proceeds exactly the same, once it is assumed that *n* can be a phase head. Whether the *n* head of $\sqrt{\text{DRIVE}}$ or $\sqrt{\text{TRUCK}}$ induces a phase, the complement *truck* is predicted to receive stress.⁴

The rule (4) is just one of many possible alternatives, so it is useful to be explicit about the range of possibilities that will serve the analysis here. There are three necessary conditions for a system of stress assignment to fulfill the needs of the proposed analysis. First, complements to phase heads must be in the domain for stress assignment. Whether the rule is that given in (4) or some other variant (such as those formulated by Legate 2003, Kahnemuyipour 2004, Adger 2007, or Jackson 2007), as long as it is in a complement configuration under the *nP* phase, *truck* will get assigned stress. The second condition is that at least the higher *n* must be a phase head, and the complement *truck* must merge in before that *nP* phase is complete. Otherwise, it is assumed that the lower copy of *truck* will not be available to operations like stress assignment, following the assumptions regarding phase impenetrability (Chomsky 2001). In other words, because *truck* incorporates into the compound structure, it is only “visible” to the rules that would assign it stress in the complement position until the higher *nP* phase is complete. The third and final condition on the stress rule 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*.

The first two conditions merely describe what must be assumed about the syntactic structure in order for stress to be assigned in the predicted way. Thus, as long as these conditions are satisfied, the structure could be somewhat different than the one proposed in (2) and still fit the general proposal. The third condition appears at first to be merely a convenient (and necessary) stipulation, but it turns out to be independently motivated by data from the sentential stress literature. Legate (2003), Adger (2007), and Jackson (2007) all discuss examples such as (5) originally from Bresnan (1971, ex. 5, p. 258, attributed to Newman, 1946), re-cast in the framework of an MSO analysis of sentential stress.

- (5) 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 here is that in (5-b), *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. The present analysis requires the same preservation of stress after movement.

In summary, the analysis follows naturally from analyses proposed in previous work for independent reasons. 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 nP phase reaches the point of spell-out, the same stress assignment principles that assign nuclear stress apply to assign stress to the complement (e.g., *truck*). Third, that complement undergoes incorporation with the head noun, resulting in the observed linear order of constituents. Finally, parallel to data observed at the sentential level, the stress that was assigned when the nominal modifier was in the complement position remains after incorporation. The result is the canonical initial stress pattern associated with compounds. 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 to an example 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., $\sqrt{\text{DRIVE}}$). 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 (6) and (7).

- (6) horseshoe
- a. shoes designed for horses
 - b. shoes made in the shape of horses
 - c. shoes made out of horse skin
- (7) swanboat
- a. boat made in the shape of a swan
 - b. boat made for swans
 - c. boat made from swans

In both examples, (a) is the more common, preferred reading without context, but even though these examples are highly conventionalized, other possible readings still exist. 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 again 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 constrained by some additional predicate, which may be strongly conventionalized, but which will be highly dependent on context, encyclopedic knowledge, and other considerations external to the observed constituents.

This characterizes all initial-stress N+N meaning relationships 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 and 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

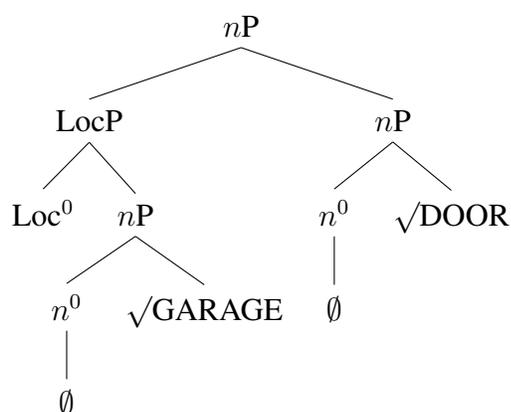
N+N combinations without initial stress are not uncommon in English. Estimates from the literature suggest that between one third and one fourth of N+N constructions have final stress (Liberman and Sproat 1992: 25%; Sproat 1994: 30%; Bell 2008: 32%; though Plag and Kunter 2010 find only 5-10% final stress 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 much more complex derivation than a simple modifier representation, so for economy reasons, it may be dispreferred.⁵ 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. Thus incorporation of *fruit* as a complement of *juice* is tolerated because there is no corresponding adjective.⁶

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 to be 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 initial noun may merge as an adjunct into a position above the *nP* 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 defined than the broad “connected-with” semantics of the initial-stress N+Ns. The analysis here thus assumes 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 (8).

(8)



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 the Locative functional structure (or any other available functional structure). It must instead merge as a complement to $\sqrt{\text{BAND}}$, 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. 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. Some of these arguments actually support the analysis proposed here.

For example, while *one*-replacement may not be applied in all cases,⁷ there are clear cases where it can apply to the head noun in final-stress N+Ns. For example:

- (9) 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* must merge into an adjunct position above *n*P, where this does not seem to be the case for the initial-stress cases here.

An additional demonstration that the initial-stress modifiers must be in a closer position than the final-stress modifiers is given in (10).⁸

- (10) 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 (8), only $\sqrt{\text{DOOR}}$ 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 (8), 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 (11).

- (11) 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 encyclopedic

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”).

2.5 A+N constructions

Having established the analysis for N+N constructions, we now turn to A+N constructions. 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 and Sproat (1992) demonstrate. Therefore, the burden of the analysis is on explaining why some A+N constructions do appear to involve incorporation.

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 modifier-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.

- (12) a. That’s a very black *bírd*.
 b. *That’s a very *bláckbird*.
 c. I like extremely sticky *búns*.
 d. *I like extremely *stícky buns*.
- (13) a. I’ve never seen a blacker *bírd* than the one over there.⁹
 b. *I’ve never seen a *bláckerbird* than the one over there.
 c. I think you have the stickiest *bún* of the batch.
 d. *I think you have the *stíckiest bun* of the batch. (referring to the type of pastry known as a *stícky bun*)

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

- (14) 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 (10), other adjectives can occur before the incorporated adjective, but not between the incorporated adjective and the head noun.

- (15) a. I'd like a white sticky bun.
b. *I'd like a sticky white bun. (with the meaning of *sticky bun*)
c. I'd like a sticky, white bün. (with the meaning of *sticky bün*)
- (16) a. He left in a swift red boat. (swift > red in normal adjective ordering)
b. *He left in a red swift boat.
c. *He left in a swift red boat. (swift boat = special type of boat)
d. He left in a red swift boat.

Example (15) demonstrates that a phrasal adjective (here, *white*) cannot intervene between an incorporated adjective and the head noun, and example (16) 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.

- (17) a. beef ribs (final-stress N+N construction, analogous to steel bridge)
b. short, beef ribs (short = regular phrasal adjective)
c. *beef short ribs
d. beef shórt ribs (type of shórt rib)

Thus a regular phrasal adjective cannot intervene between the head noun and an adjunct nominal modifier (17-c), but an incorporated adjective can (17-d), just as an incorporated nominal modifier can intervene between the head and an adjunct nominal modifier, as in (10). 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 *nP*, but may in fact be lower than typical 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.

In summary, these syntactic facts support the current proposal that initial-stress A+N constructions involve the same complement-head incorporation structure as that developed for N+N constructions shown in (2). We now turn to semantic arguments for this structure.

In short, the generalization appears to be that the semantics of the incorporated adjective appear to be non-transparent, and perhaps even specific to that A+N combination. For example, a *pink slip* is a notice of being fired from a job, but nowhere else in the lexicon does *pink* have to do with employment or unemployment. Most incorporated adjectives have the character of relating in some way to their typical “dictionary meaning,” but extended in a way to be much more specific. For example, blackboards may have been commonly black initially,¹⁰ but this is not a requirement. The White House is in fact white, but the meaning refers to a particular building, and commonly by extension, the president or even the whole executive branch of the U.S. government. Sticky buns are typically fairly sticky, but that is not the only qualification of a sticky bun (they are also sweet, usually involve cinnamon, etc.).

This quality of having semantics that are specific to the combination with that particular head noun root fits well with the proposed structure. In the analysis thus far, the phonological consequence of multiple spell-out has been critical, as providing the mechanism for cyclic stress assignment. However, the notion of spell-out relates to semantic interpretation as well. Thus, the domain of spell-out is not only the domain of stress assignment, but also for semantic interpretation. At this stage in the derivation, the adjective has incorporated with the root of the head noun, but the noun has not yet merged with its nominalizing n head. It makes sense that the semantics of the adjective would therefore be tightly linked to the context of the head.

Furthermore, the semantics of these adjectives could be seen as a generic “type-of” kind of relationship, paraphrased as “A+N is a special type of N, somehow related to A,” where the “somehow” is determined by encyclopedic knowledge and/or context. This vague, underspecified relationship is reminiscent of the “vague predicate” semantics involved with the initial-stress N+N constructions. This suggests that the semantics of the complement-head relationship in the incorporation structure really are the same across the N+N and A+N constructions. It is simply the fact that adjectives have different semantics than nouns which makes for any apparent differences, including the fact that adjectives cannot be arguments of predicates, which is why the one well-defined semantic case in the N+N constructions (the argument-predicate class) does not have a parallel in the A+N constructions.

Finally, there are some examples which provide evidence that the semantics of the A are determined in combination with the root, to the exclusion of the nominalizing head, which is exactly the prediction of the incorporation structure.

(18) *legal wórk* vs. *légal work*

- a. This work is legal. (\neq *légal work*)
- b. #This *legal wórk* is illegal.
- c. This *légal work* is illegal. (e.g., performed without a license)
- d. This worker is legal. (= not illegal)
- e. #This *legal wórker* is illegal.
- f. This *légal worker* is illegal. (e.g., an illegal immigrant)

In short, a *légal worker* is a person who does *légal work*. In both constructions, *legal* merges as complement to $\sqrt{\text{WORK}}$, before this structure merges with a nominalizing head such as *-er*. This is consistent with the claim that the semantics of the A + root combination are fixed in the initial phase, allowing the semantics of the A to be determined very specifically within the context of the root, as a complement.

To briefly summarize this section, the analysis proposed for N+N constructions applies in a parallel way to A+N constructions, with some subtle differences that fall out from the differences between adjectives and nouns. The analysis of initial-stress A+N constructions as complement-head constructions is supported by both syntactic and semantic facts.

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. 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 nP , 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 and 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 *bláckboard*, *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 *nP* 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 píe* 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 and Plag 2012; Kösling and Plag 2009; Kunter 2011; Plag 2006, 2010; Plag and Kunter 2010; Plag, Kunter, and Lappe 2007; Plag, Kunter, Lappe, and Braun 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 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. In fact, the approaches may ultimately complement each other, especially if additional variables such as information structure might elucidate some of the more difficult examples such as the contrast between initial-stress *Párk Street* and final-stress *Park Avenue*. This example is interesting in that it is so robust, such that street names with *Street* have initial stress, where street names with any other label (*Avenue, Road, Circle, Alley*, etc.) all have final stress. But it is also an unusual example, in that street-naming conventions have some unique properties. Still, the appealing intuition is that *Street* does not receive stress because it is the “default,” which may imply certain kinds of information structure. In general, the stress rules assumed in the present analysis must necessarily interact with information structure at the sentential level, and since the proposal is that there is no distinction between compound and sentential stress, it is also assumed that information structure would interact with compound stress as well.

However, the primary argument in this paper is that by assuming some previously-motivated analyses from Distributed Morphology and multiple spell-out 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. 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, this analysis may provide a new basis of comparison for exploring the relative merits and interactions of rule-based and processing-based theories.

4 Conclusions

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 and Halle (1968), Liberman and 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). The fact that it does so while still accounting for the full variety of stress patterns is notable.

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 an external 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) is a kind of elsewhere condition. 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 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 a kind of escape from the circular definitions of compounds and compound stress. The analysis proposes that the proper division is between 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 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 *nP* is a fruitful way to proceed, in order to better understand the semantic conditions that allow N+N adjunction structures, and this is also a relatively novel contribution. In the end, this analysis extends work in other 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.

References

- Adger, David (2007). “Stress and phasal syntax”. In: *Linguistic Analysis* 33, pp. 238–266.
- Arad, Maya (2003). “Locality constraints on the interpretation of roots: The case of Hebrew denominal verbs”. In: *Natural Language & Linguistic Theory* 21.4, pp. 737–778.
- (2005). *Roots and patterns: Hebrew morpho-syntax*. Vol. 63. Springer.
- Baker, Mark (1988). *Incorporation*. Oxford University Press.
- Bauer, Laurie (1983a). *English word-formation*. Cambridge University Press.
- (1983b). “Stress in compounds: a rejoinder”. In: *English Studies* 64, pp. 47–53.
- (1998). “When is a sequence of two nouns a compound in English”. In: *English Language and Linguistics* 2.1, pp. 65–86.
- Bell, Melanie J. (2008). *Noun noun constructions and the assignment of stress*. Paper presented at the *1st Conference of the International Society for the Linguistics of English*.
- Bell, Melanie J. and Ingo Plag (2012). “Informativeness is a determinant of compound stress in English”. In: *Journal of Linguistics* 48, pp. 485–520.
- Bloomfield, Leonard (1933). *Language*. Chicago: Holt.
- Boeckx, Cedric and Kleanthes K Grohmann (2007). “Remark: Putting phases in perspective”. In: *Syntax* 10.2, pp. 204–222.
- Bresnan, Joan (1971). “Sentence stress and syntactic transformations”. In: *Language* 47.2, pp. 257–281.
- Chomsky, Noam (1970). “Remarks on Nominalization”. In: *Readings in Transformational Grammar*. Ed. by R. A. Jacobs and P. S. Rosenbaum. Waltham, MA: Ginn, pp. 184–221.
- (2000). “Minimalist inquiries: the framework”. In: *Step by Step: Essays on Minimalist syntax in honor of Howard Lasnik*. Ed. by J. Uriagereka R. Martin D. Michaels. Cambridge, MA: MIT Press, pp. 89–155.
- (2001). “Derivation by phase”. In: *Ken Hale: A life in language*. Ed. by Michael Kenstowicz. Cambridge, MA: MIT Press, pp. 1–52.
- (2008). “On phases”. In: *Foundational issues in linguistic theory: essays in honor of Jean-Roger Vergnaud*. Ed. by María-Luís Zubizarreta Robert Freidin Carlos P. Otero, pp. 133–166.
- Chomsky, Noam and Morris Halle (1968). *The sound pattern of English*. New York, NY: Harper and Row.
- Cinque, Guglielmo (1993). “A null theory of phrase and compound stress”. In: *Linguistic Inquiry* 24.2, pp. 239–297.
- Di Sciullo, Anna-Maria and Edwin Williams (1987). *On the definition of word*. Springer.

- Dobashi, Yoshihiko (2003). “Phonological phrasing and syntactic derivation”. PhD thesis. Cornell University.
- Dowty, David R. (1979). *Word meaning and Montague grammar*. Springer.
- Embick, David (2010). *Localism versus globalism in morphology and phonology*. MIT Press.
- Fudge, Erik (1984). *English word stress*. London: Allen & Unwin.
- Gallego, Ángel J (2010). *Phase theory*. Vol. 152. John Benjamins Publishing Company.
- Giegerich, Heinz J. (2004). “Compound or phrase? English noun-plus-noun constructions and the stress criterion”. In: *English Language and Linguistics* 8.1, pp. 1–24.
- (2005). “Associative adjectives in English and the lexicon-syntax interface”. In: *Journal of Linguistics* 41.3, p. 571.
- (2009). “The English compound stress myth”. In: *Word Structure* 2.1, pp. 1–17.
- Halle, Morris (1973). “Prolegomena to a theory of word formation”. In: *Linguistic inquiry* 4.1, pp. 3–16.
- Halle, Morris and Alec Marantz (1993). “Distributed morphology and the pieces of inflection”. In: *The view from Building 20*, pp. 111–176.
- (1994). “Some key features of Distributed Morphology”. In: *MIT working papers in linguistics* 21.275, p. 88.
- Harley, Heidi (2011). “Compounding in Distributed Morphology”. In: *The Oxford Handbook of Compounding*. Ed. by R. Lieber and P. Stekauer. Oxford University Press, pp. 129–144.
- (to appear). “On the identity of roots.” In: *Theoretical Linguistics*.
- Harley, Heidi and Rolf Noyer (1999). “Distributed morphology”. In: *Glott International* 4.4, pp. 3–9.
- Ishihara, Shinichiro (2007). “Major phrase, focus intonation, multiple spell-out (MaP, FI, MSO)”. In: *The Linguistic Review* 24.2-3, pp. 137–167.
- Jackson, Scott R. (2007). “Information, Truth, Structure, and Sound”. PhD thesis. University of Arizona.
- Kahnemuyipour, Arsalan (2004). “The syntax of sentential stress”. PhD thesis. University of Toronto.
- Kiparsky, Paul (1982). “Lexical phonology and morphology”. In: *Linguistics in the morning calm: selected papers from SICOL-1981*. Seoul: Hanshin.
- Kösling, Kristina and Ingo Plag (2009). “Does branching direction determine prominence assignment? An empirical investigation of triconstituent compounds in English”. In: *Corpus Linguistics and Linguistic Theory* 5.2, pp. 201–239.
- Kratzer, Angelika and Elisabeth O. Selkirk (2007). “Phase theory and prosodic spellout: The case of verbs”. In: *The Linguistic Review* 24.2-3, pp. 93–135.

- Kunter, Gero (2011). *Compound stress in English: The phonetics and phonology of prosodic prominence*. De Gruyter.
- Ladd, D. Robert (1984). "English compound stress". In: *Intonation, accent and rhythm*, pp. 253–266.
- Lees, Robert B. (1963). *The grammar of English nominalizations*. Bloomington: Indiana University.
- Legate, Julie Anne (2003). "Some interface properties of the phase". In: *Linguistic Inquiry* 34.3, pp. 506–515.
- Levi, Judith N. (1978). *The syntax and semantics of complex nominals*. New York: Academic Press.
- Lieberman, Mark and Alan Prince (1977). "On stress and linguistic rhythm". In: *Linguistic Inquiry*, pp. 249–336.
- Lieberman, Mark and Richard Sproat (1992). "The stress and structure of modified noun phrases in English". In: *Lexical Matters, CSLI Lecture Notes* 24, pp. 131–181.
- Marantz, Alec (2001). *Words*. WCCFL XX Handout, USC.
- (2008). "Phases and words". In: *Phase in the theory of grammar*. Ed. by Sook-Hee Choe. Seoul: Dong In, pp. 191–222.
- Marchand, Hans (1969). *The categories and types of present-day English word formation*. München: Beck.
- Newman, Stanley (1946). "On the stress system of English". In: *Word* 2.3, pp. 171–187.
- Olsen, Susan (2000). "Compounding and stress in English: a closer look at the boundary between morphology and syntax". In: *Linguistische Berichte* 181, pp. 55–70.
- Plag, Ingo (2003). *Word-formation in English*. Cambridge University Press.
- (2006). "The variability of compound stress in English: structural, semantic and analogical factors". In: *English Language and Linguistics* 10.1, pp. 143–172.
- (2010). "Compound stress assignment by analogy: The constituent family bias". In: *Zeitschrift für Sprachwissenschaft* 29.2, pp. 243–282.
- Plag, Ingo and Gero Kunter (2010). "Constituent family size and compound stress assignment in English". In: *New Impulses in Word-Formation*. Ed. by S. Olsen. Hamburg: Buske, pp. 349–382.
- Plag, Ingo, Gero Kunter, and Sabine Lappe (2007). "Testing hypotheses about compound stress assignment in English: a corpus-based investigation". In: *Corpus Linguistics and Linguistic Theory* 3.2, pp. 199–232.
- Plag, Ingo, Gero Kunter, Sabine Lappe, and Maria Braun (2008). "The role of semantics, argument structure, and lexicalization in compound stress assignment in English". In: *Language* 84.4, pp. 760–794.

- Pullum, Geoffrey K. and Arnold M. Zwicky (1991). "A misconceived approach to morphology". In: *Proceedings of the Tenth West Coast Conference on Formal Linguistics*. Stanford: CSLI Publications, pp. 387–98.
- Samuels, Bridget D. (2009). "The structure of phonological theory". PhD thesis. Harvard University.
- Sato, Yosuke (2009). "Spelling out prosodic domains: a multiple spell-out account". In: *InterPhases: phase-theoretic investigations of linguistic interfaces*. Ed. by Kleanthes K. Grohmann. Oxford University Press, pp. 234–262.
- Scott, Gary-John (2002). "Stacked adjectival modification and the structure of nominal phrases". In: *Functional structure in DP and IP. The cartography of syntactic structures 1*, pp. 91–120.
- Selkirk, Elisabeth O. (1982). *The syntax of words*. MIT Press.
- (1984). *Phonology and syntax: The relation between sound and structure*.
- Siddiqi, Daniel (2009). *Syntax within the word: economy, allomorphy, and argument selection in Distributed Morphology*. John Benjamins Publishing Company.
- Sproat, Richard (1994). "English noun-phrase accent prediction for text-to-speech". In: *Computer Speech & Language* 8.2, pp. 79–94.
- Uriagereka, Juan (1999). "Multiple Spell-Out". In: *Working Minimalism*. Ed. by Norbert Hornstein Samuel D. Epstein. Cambridge, MA: MIT Press, pp. 251–282.
- Zwicky, Arnold M. (1986). "Forestress and afterstress". In: *Ohio State University Working Papers in Linguistics* 32, pp. 46–62.

Notes

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

²Samuels (2009, Chapter 5, p.) 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. First, the structural analysis of incorporation is different; it is critical for the present analysis that initial-stress N+N structures of both the *trúck driver* and *kítchen towel* types be derived with similar complement-head structures, whereas Samuels proposes a [root root] structure for these. Second, Samuels does not illustrate how her analysis captures the full range of facts, specifically final-stress N+N constructions, or A+N constructions, thus it is hard to compare. Third, Samuels makes different assumptions about where stress rules are assigned; she assumes that D is the relevant phase head for stress assignment, while the present analysis assumes *n*. This latter difference is taken as another example of the many current theories of phase-based stress assignment, which differ in their formulation, but account for mostly the same facts. The present analysis assumes relatively little with respect to the precise formulation of stress rules, as described in the main text. Finally, Samuels (2009) is motivated by the same set of 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 it is assumed that the primary insights of the present analysis could be expressed within that framework as well.

³Siddiqi (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.

⁴Under 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.

⁵The 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 captured in an incorporation structure.

⁶Note that *fruity* has a different kind of meaning, something like "like a fruit," not "made from fruit," which is the meaning of *fruit* in *fruit juice*.

⁷Bauer (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.

⁸Example (10-b) is only possible with a reading such that *bay steel* is a type of steel, out of which the bridge is made.

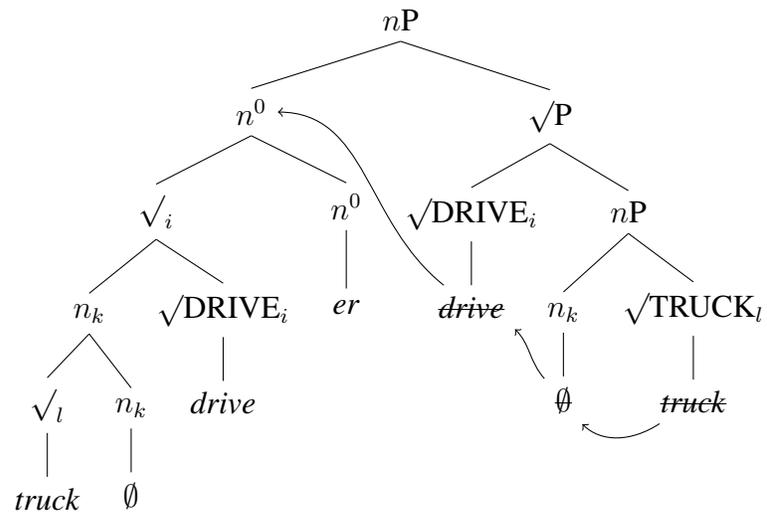
⁹Note that "neutral" stress in sentences with comparatives can often be obscured by independent effects of informational focus.

¹⁰In the personal experience of the authors, blackboards were typically green.

Table 1: Some examples of modificational structures in English

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

(2)



(8)

