# Phonological Constraints on Constituent Ordering

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## 1. Introduction

Does phonology influence the ordering of meaningful elements (morphemes, words, phrases)? The answer is usually taken to be no (see e.g. Pullum and Zwicky 1989), but an investigation into the quantitative distribution of constituents tells a different story. This paper reports the results of a preliminary study of the English dative alternation in a corpus of 1,580 prosodically annotated dative constructions extracted from www.blogspot.com (The Blogspot Corpus). Some attested examples are shown in (1)-(3). We call (1) the double object construction, (2) the prepositional construction, and (3) the Heavy NP Shift construction. Syntactic constituents are indicated by square brackets ([ ]).

(1)　　(a)　　Celebrity status gave [Schwarzenegger] [options].
　　　　(b)　　She was recommending [me] [designs] and I gladly listened.

(2)　　(a)　　Man gave [names] [to all the animals].
　　　　(b)　　I am assigning [it] only [to my advanced 5th graders].

(3)　　(a)　　A staff sergeant is explaining [to the men] [the rules of the Geneva Convention].
　　　　(b)　　I'm going to reveal [to you] [the terms of the wager].

Our main conclusion is that prosody plays a role in constituent linearization in English. The prosodic effects are mostly gradient and variable, yet entirely systematic. We present a phonological model that predicts, for each input, the possible linearizations as well as the quantitative preferences among them.

This study should be considered an interim report on work in progress. In particular, we will not undertake the important task of arguing against alternative hypotheses here. Our goal in this preliminary study is to show that a prosodic analysis of the dative alternation is feasible and that the predictions are consistent with the facts. We conclude that the prosodic hypothesis is a serious contender that must be taken into account in any attempt to explain the dative alternation in English.

## 2. Empirical generalizations

Several well-known observations suggest that prosody plays a role in the dative alternation. We start by summarizing three major generalizations based on earlier work and our corpus study.

### 2.1. The unstressed pronoun generalization

Lexically unstressed pronouns (e.g. *me, you, him, her, it, us, them*) differ from other NPs in several ways. First, lexically unstressed pronoun themes usually do not occur in double object constructions:

(4)　　(a)　　Pat gave [food] [to Chris] ~ Pat gave [Chris] [food].
　　　　(b)　　Pat gave [it] [to Chris] ~ *Pat gave [Chris] [it].

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In dialects where lexically unstressed pronoun themes are allowed in double object constructions they preferably occur after lexically unstressed pronoun goals (Erteschik-Shir 1979, Hawkins 1994):

(5)     (a)     ?I gave [her] [it].
        (b)     *I gave [my sister] [it].

Second, lexically unstressed pronoun goals are commonly found in double object constructions with verbs like *lower, mutter*, *donate,* and *return* where other NPs are usually banned (Bresnan and Nikitina 2003, henceforth B&N 2003; Grimshaw 2005):

(6)     (a)     *I lowered John the box.
        (b)     Buddha lowered him the silver thread of a spider.          (B&N 2003)

(7)     (a)     *Susan muttered Rachel the news.
        (b)     She muttered him a hurried apology.          (B&N 2003)

(8)     (a)     *John donated the charity money.
        (b)     They can get the gullible ones to donate them money.          (Google)

(9)     (a)     *John returned the government the money.
        (b)     Judas returned them the money.          (Google)

Even with verbs like *give*, lexically unstressed pronoun goals are favored in the double object construction. The examples in (10) illustrate this quantitative asymmetry in the Blogspot Corpus. Of all VPs with a one-foot verb (e.g. *give*), a pronominal goal, and a non-pronominal theme, 94.3% choose the double object construction. In contrast, of all VPs with a one-foot verb, a non-pronominal goal, and a non-pronominal theme, only 26.6% choose the double object construction.

(10)    (a)     I gave [her] [the book].          94.3% of all realizations are double objects
        (b)     I gave [my sister] [the book].          26.6% of all realizations are double objects

In this paper, we will pursue a prosodic explanation of these facts. First, we propose that the ill-formedness of **Pat gave* [*Chris*] [*it*] ((4b), (5b)) arises because this sentence contains a prosodic phrase that consists of an unstressed pronoun. More specifically, we assume that every syntactic XP forms a prosodic phrase (see e.g. Truckenbrodt 2007) and that a unary prosodic phrase must contain at least one lexical stress. Prosodic constituents are indicated by parentheses (( )).

(11)    Unary unstressed prosodic phrases are avoided
        (a)     *Pat gave Chris ([it]).          lexically unstressed, unary
        (b)     Pat gave it ([to him]).          lexically unstressed, binary
        (c)     Pat gave Chris ([fóod]).          lexically stressed, unary
        (d)     Pat gave Chris ([some fóod]).          lexically stressed, binary

Second, we suggest that the unexpected well-formedness of *Judas returned them the money* ((6b), (7b), (8b), (9b)) arises because an unstressed pronoun avoids stress clash with the preceding verb. In the attested example (13), the writer's choice between the prepositional construction and the double object construction reflects the phonology of the goal phrase (*every good child, them*).

(12)    Stress clashes are avoided
        (a)     *John [retúrned the góvernment] [the money].          stress clash
        (b)     Judas [retúrned them] [the money].          no stress clash

(13)    With war still looming in Iraq and Santa having to <u>deliver presents to every good child in the world</u> by 24 hrs, I wonder if this year his sleigh will get shot down by a SAM (Surface-to-Air Missile) when he's <u>delivering them presents</u> over Iraq. (Google)

In the same way, clash avoidance provides a rationale for the quantitative asymmetry in (10): the double object construction is better with a lexically unstressed goal than with a lexically stressed goal.

## 2.2. The end weight generalization

The second generalization is that "heavy" constituents come last. This is sometimes called the Principle of End Weight (see e.g. Wasow 2002). A well-known example is Heavy NP Shift:

(14)    (a)        A staff sergeant is explaining [to the men] [the rules of the Geneva Convention].
        (b)        I'm going to reveal [to you] [the terms of the wager].

We propose to derive end weight effects from two prosodic constraints. The first constraint states that in English, phrasal stress falls by default on the rightmost constituent. This is known as the Nuclear Stress Rule (Selkirk 1995:562, paraphrasing Chomsky and Halle 1968:15-24):

(15)    <u>The Nuclear Stress Rule</u>: The most prominent syllable of the rightmost constituent in a phrase P is the most prominent syllable of P.

A simple example of phrasal stress assignment is shown in (16) in terms of the metrical grid notation. All four words, *volunteer, firemen, save,* and *lives*, are lexically stressed. At the first cycle, phrasal stress falls on *firemen* and *lives*. At the second cycle, phrasal stress falls on *lives*.

(16)
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                              x
                x             x
          x     x       x     x
      ((volunteer firemen) (save lives))
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The second constraint states that word stress prefers to coincide with phrasal stress. More specifically, every word stress strives to be placed in a constituent that receives phrasal stress. We call this the Stress-to-Stress Principle:

(17)    <u>The Stress-to-Stress Principle</u>: Word stress implies phrasal stress (WS ⊃ PS) (gradient).

The Stress-to-Stress Principle is illustrated in (18) in terms of an OT tableau. In candidate (18a), there are two word stresses (*crítical, bácking*) that fall outside the phrasally stressed constituent. Candidate (18b) only has one such stress (*Búsh*). Thus, the latter candidate is better in terms of the Stress-to-Stress Principle. The fact that both variants are possible suggests that the Stress-to-Stress Principle is not the only constraint that decides the matter.

(18)    Satisfying the Stress-to-Stress Principle

|  | WS ⊃ PS |
|---|---|
| <br>                              x<br>          x       x       x<br> (a)    Robertson gave [critical backing] [to <u>Bush</u>] | **! |
| <br>                              x<br>          x       x       x<br> (b) →Robertson gave [Bush] [critical <u>backing</u>] | * |

The net effect of the gradiently evaluated Stress-to-Stress Principle is to maximize the number of lexical stresses in the constituent under phrasal stress. A number of predictions follow. First, the absolute number of word stresses should be irrelevant for end weight. Only the relative weight of the argument phrases should matter (as argued in Wasow 2002, but cf. Jäger and Rosenbach 2004). Thus, for example, substituting *my déar líttle síster* for *my líttle síster* in (19b) should not increase the probability of Heavy NP Shift since the goal is heavier than the theme in both cases.

(19)     Only relative weight should matter
  (a)      Goal < Theme: *gave* (*my síster*) (*twénty dóllars*)
  (b)      Goal > Theme: *gave* (*the móney*) (*to my líttle síster*)
  (c)      Goal = Theme: *gave* (*my síster*) (*the móney*) ~ *gave* (*the móney*) (*to my síster*)

Second, the Stress-to-Stress Principle predicts that the weight effect should weaken or disappear if nuclear stress is lured away. Whether and to what extent this happens depends on the precise formulation of the phrasal stress rule. Potential cases include the examples in (20) where the VP is followed by an adverbial phrase which is eligible for sentence stress:

(20)     The weight effect should weaken or disappear if nuclear stress is lured away
  (a)      Robertson gave [critical backing] [to Bush] <u>last year.</u>
  (b)      never send [someone] [them] <u>in the mail either</u>           (B&N 2003:19-20)
  (c)      showing [people] [him] <u>through our life</u>                      (B&N 2003:19-20)
  (d)      not to give [children] [it] <u>to avoid possible allergies</u>     (B&N 2003:19-20)

Third, the Stress-to-Stress Principle predicts that lexically unstressed function words (e.g. *a/an*, *the*, *of*, etc.) should not count for weight. This prediction is not made by the various syntactic hypotheses where weight is calculated in terms of (orthographic) words or syntactic nodes (for various options, see Wasow 2002). Neither is this prediction made by the alternative phonological hypothesis that calculates weight in terms of the number of syllables.

Fourth, the Stress-to-Stress Principle predicts that languages where nuclear stress falls on the left should exhibit leftward Heavy NP Shift. One potential example is Japanese; see McCawley (1977:273), cited in Cinque (1993:271), and Yamashita and Chang (2001) for relevant discussion.

All these predictions are in principle straightforward to test by means of grammaticality judgments, prosodically annotated corpora, and psycholinguistic experiments. Since the data are mostly variable, such tests will necessarily involve detailed quantitative work. Exploring these predictions will be an important task for the future.

## 2.3. The verb length generalization

The dative alternation is clearly sensitive to the nature of the verb. Many different proposals are on record (see e.g. Green 1974, Gropen et al. 1989, Krifka 1999, Harley 2007, to mention just a few). Here we will explore the prosodic hypothesis formulated by Grimshaw (2005) (for a precedent, see Fraser 1998). Grimshaw notes that the core class of alternating verbs have exactly one foot, e.g. (*give*), *a*(*ssign*); the non-alternating verbs have two or more feet, e.g. (*ex*)(*plain*) and (*do*)(*nate*). This captures the well-known contrast in (21).

(21)     (a)      They (gave) the church money.
         (b)      *They (do)(nated) the church money.

The one-foot constraint correctly predicts that only the number of feet should matter. Thus, the disyllabic *donate* and the trisyllabic *donated* are correctly predicted to show the same alternation pattern: both contain exactly two feet (see Fraser 1998).

Some alternating verbs are listed in (22). The verbs in the leftmost column have an initial extrametrical vowel, witness reduction. Some non-alternating verbs are listed in (23).

(22)     Some alternating one-foot verbs

|          |          |          |          |           |
|----------|----------|----------|----------|-----------|
| a(ccord) | (bring)  | (lend)   | (phone)  | (cable)   |
| ad(vance)| (give)   | (loan)   | (send)   | (forward) |
| a(llot)  | (grant)  | (mail)   | (show)   | (offer)   |
| a(llow)  | (hand)   | (owe)    | (teach)  | (promise) |
| a(ssign) | (lease)  | (pass)   | (tell)   | (signal)  |
| a(ward)  | (leave)  | (pay)    | (write)  | (xerox)   |

(23)     Some non-alternating two-foot verbs (Levin 1993)

|             |             |
|-------------|-------------|
| (con)(vey)  | (ex)(plain) |
| (de)(liver) | (pre)(sent) |
| (dic)(tate) | (re)(mit)   |
| (do)(nate)  | (re)(turn)  |
| (en)(trust) | (trans)(fer) |

Just like the other prosodic constraints, the one-foot constraint is violable. In particular, some two-foot verbs appear to undergo the dative alternation, at least to some extent. Note that in all these verbs the initial foot is disyllabic.

(24)     Some alternating two-foot verbs

|               |                |
|---------------|----------------|
| (allo)(cate)  | (reco)(mmend)  |
| (cata)(pult)  | (sate)(llite)  |
| (conse)(crate) | (sema)(phore) |
| (guaran)(tee) | (tele)(cast)   |
| (nomi)(nate)  | (tele)(graph)  |
| (radi)(o)     | (tele)(phone)  |

What is the rationale behind this prosodic classification of verbs? Grimshaw (2005) explicitly identifies the one-foot constraint, but suggests that it is only an arbitrary learnability cue with no real connection to the prosodic system of English. However, it seems possible to go further. Suppose that a verb forms a prosodic phrase with the argument immediately on its right (Inkelas and Zec 1995). Suppose further that prosodic constituents are preferably binary. It follows that ((*give*) (NP)) NP should be prosodically superior to *((*do*)(*nate*) (NP)) NP because the latter contains a ternary prosodic phrase:

(25)     (a)      ((give) ([my sister])) ([the book])          binary phrase
         (b)      *((do)(nate) ([my sister])) ([the book])     ternary phrase

In order for this explanation to work, one further assumption is necessary. The analysis crucially assumes that the double object construction and the prepositional construction have different phonological phrasings:

(26)     (a)      *((do)(nate)  (my sister))  (the money)          a ternary constituent
         (b)       ((do)(nate))  (the money)  (to my sister)       no ternary constituents

These facts suggest that the verb and the immediately adjacent argument are phrased together in (26a), hence the ternarity violation, but separately in (26b), hence no ternarity violation. This may reflect a syntactic difference between the two constructions. For the present purposes, we simply posit the following constraint:

(27)     PARSE(Goal): The goal NP must be prosodically parsed together with its syntactic head.

This constraint is satisfied by the prosodic parsing (*gave my sister*) where the head is the verb as well as by (*to my sister*) where the head is the preposition.

   We conclude by showing the quantitative distribution of the data by verb type. With one-foot verbs (e.g. *give*), the double object construction and the prepositional construction are about equally common. As one might expect, with two-foot verbs the prepositional construction is strongly favored, but double objects are also possible (> 100 tokens).

(28)     Data from www.blogspot.com (16 verbs, 1,580 sentences):
   - One foot verbs: *assign, award, bring, give, offer, promise*
   - Two foot verbs: *administer, bequeath, concede, convey, deliver, donate, explain, guarantee, recommend, reveal*
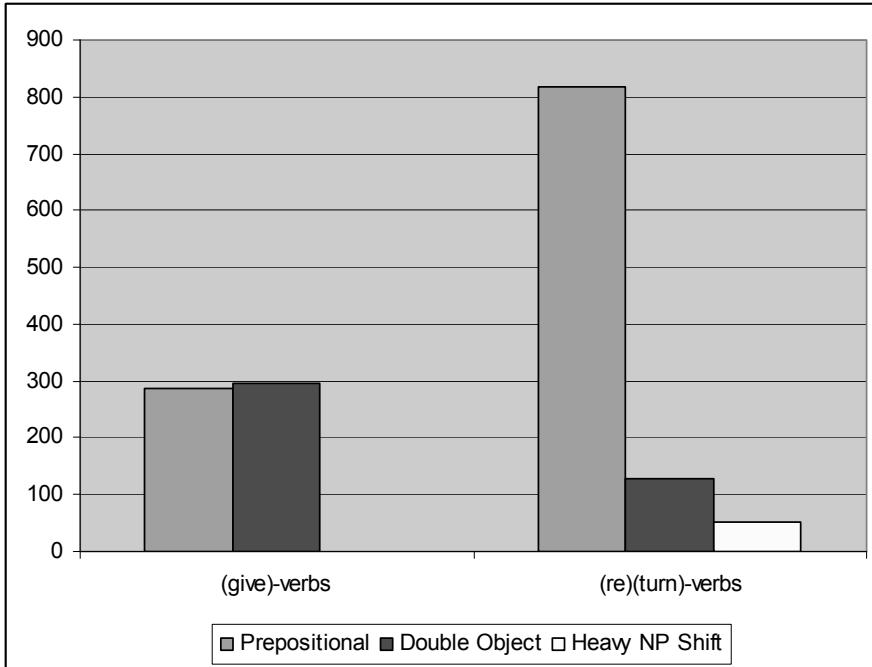


$df = 1$, $X^2 = 251$, $p \leq 0.001$ (Heavy NP Shift omitted)

Interestingly, Heavy NP Shift only occurs with two-foot verbs. Is this a coincidence or something we should have expected? As will become clear in a moment, this fact follows from the prosodic analysis outlined above. However, in order to see this, we must understand how the constraints interact. This topic will be addressed in the next section.

# 3. The phonological model

In this section, we outline a prosodic Optimality-Theoretic model of the English dative alternation. The analysis builds on the assumption that every VP can be associated with multiple prosodic parses. The prosodic constraints introduced in the preceding section interact in parallel and select the optimal prosodic parse, which entails selecting a particular linearization of syntactic constituents.

## 3.1. Inputs and outputs

We start by laying the representational groundwork: the possible inputs and the possible outputs. First, let us consider the space of possible inputs. We consider three independent factors: the phonology of the verb, the phonology of the goal, and the phonology of the theme. The verb can have either one foot or two feet; the goal may be either lexically stressed or unstressed; and the theme may be either lexically stressed or unstressed. This taxonomy yields 8 possible types of input VPs.

Second, we consider the space of possible outputs. These consist of the different linearizations of the argument phrases and the different prosodic parses associated with them. First, there are two possible postverbal orderings: theme + goal and goal + theme. Second, the goal may or may not be preceded by *to*. Third, we assume that there are two possible prosodic parses: one where each argument is phrased separately and another where the verb is phrased together with the argument immediately on its right. All told, this results in 8 possible realizations for each input VP. The combinatorial possibilities are spelled out in (29).

(29)    (a)      <u>Input space</u>: 8 possible types of VPs
        (b)      <u>Output space</u>: 4 linearizations, 2 phonological phrasings

| VERB | GOAL | THEME | OUTPUT CANDIDATES | | |
|------|------|-------|-------------------|--|--|
| 1 foot | stressed | stressed | (*give*) (*the book*) (*to my sister*) | 3 phrases | prepositional |
| | | | (*give*) (*to my sister*) (*the book*) | 3 phrases | Heavy NP Shift |
| | | | (*give*) (*the book*) (*my sister*) | 3 phrases | |
| | | | (*give*) (*my sister*) (*the book*) | 3 phrases | double object |
| | | | (*give the book*) (*to my sister*) | 2 phrases | prepositional |
| | | | (*give to my sister*) (*the book*) | 2 phrases | Heavy NP Shift |
| | | | (*give the book*) (*my sister*) | 2 phrases | |
| | | | (*give my sister*) (*the book*) | 2 phrases | double object |
| 1 foot | stressed | -- | (*give*) (*it*) (*to my sister*) | etc. | |
| 1 foot | -- | stressed | (*give*) (*the book*) (*to her*) | | |
| 1 foot | -- | -- | (*give*) (*it*) (*to her*) | | |
| 2 feet | stressed | stressed | (*return*) (*the book*) (*to my sister*) | | |
| 2 feet | stressed | -- | (*return*) (*it*) (*to my sister*) | | |
| 2 feet | -- | stressed | (*return*) (*the book*) (*to her*) | | |
| 2 feet | -- | -- | (*return*) (*it*) (*to her*) | | |

The constraints are listed in (30)-(31). The constraints in (30) are undominated; the constraints in (31) are dominated. No rankings are assumed among the latter set. A sample violation pattern is shown in (32). In this case, there are four possible winning candidates. Which one actually wins depends on the ranking of the constraints in (31). All other candidates are either ruled out by an undominated constraint or harmonically bounded.

(30)    <u>Undominated constraints</u> (for most dialects of English):
        (a)      PARSE(Goal)         Goal NP must be parsed together with its head.
        (b)      *(x)                Avoid lexically unstressed unary constituents.

(31)    <u>Dominated constraints</u>:
        (a)      *TERNARY            No ternary prosodic phrases.
        (b)      *CLASH              No stress clashes within a prosodic phrase.
        (c)      WS ⊃ PS             Word stress implies phrasal stress.
        (d)      *PHRASE             No prosodic phrases (gradiently evaluated).
        (e)      FOCUS(Go)           Focus goal, i.e. put the goal NP under phrasal stress.
        (f)      FOCUS(Th)           Focus theme, i.e. put the theme NP under phrasal stress.
        (g)      *to                 No preposition.

(32)    The tableau for the input 'give(my sister, the book)'. Four possible winners (a, b, e, h).

| 'give(my sister, the book)' | PAR(Go) | *(x) | *TERN | *CLA | F(Th) | F(Go) | WS⊃PS | *to | *PHR |
|-----------------------------|---------|------|-------|------|-------|-------|-------|-----|------|
| a. **(give)(the book)(to my sister)** | | | | | * | | * | * | *** |
| b. **(give)(to my sister)(the book)** | | | | | | * | * | * | *** |
| c. (give)(the book)(my sister) | *! | | | | * | | * | | *** |
| d. (give)(my sister)(the book) | *! | | | | | * | * | | *** |
| e. **(give the book)(to my sister)** | | | | * | * | | * | * | ** |
| f. (give to my sister)(the book) | | | | * | | * | * | * | ** |
| g. (give the book)(my sister) | *! | | | * | * | | * | | ** |
| h. **(give my sister)(the book)** | | | | * | | * | * | | ** |

## 3.2. Deriving the quantitative patterns

Since the data are thoroughly variable, we need a theory of variation. We will assume the MULTIPLE GRAMMARS THEORY (see e.g. Kroch 1989, Kiparsky 1994): variation arises from multiple grammars within and/or across individuals. We further assume a specific quantitative interpretation of the multiple grammars theory: the number of grammars predicting an output is proportional to the frequency of occurrence of this output (see e.g. Anttila 2007 and references there).

What does the multiple grammars theory predict in this particular case? In order to find out, we first need to figure out the set of possible grammars. We do this by computing the factorial typology of the dominated constraints in (31) using OTSoft (Hayes, Tesar & Zuraw 2003). The resulting typology contains 30 languages with distinct dative alternation patterns. Most importantly, the typology reveals a set of IMPLICATIONAL UNIVERSALS. Here is an example: in every language, if the input 'give(my sister, the old book)' is realized as the double object construction, i.e. *give my sister the old book*, so will the input 'give(her, the book)', i.e. *give her the book*. This implicational universal follows from the interaction of the prosodic constraints, no matter how they are ranked. An important quantitative consequence now follows: since a grammar is a collection of rankings and every ranking preserves the implicational universal qualitatively, it follows that every collection of rankings preserves the implicational universal quantitatively. For example, the cited implicational universal guarantees that any collection of grammars drawn from the factorial typology will yield the double object construction for the input 'give(her, the book)' at the same or a higher rate than for the input 'give(my sister, the old book)'. This is a QUANTITATIVE IMPLICATIONAL UNIVERSAL predicted by the multiple grammars theory given the set of prosodic constraints in (30)-(31). We call the set of all implicational universals in a factorial typology a T-ORDER.

The T-order can be easily computed using T-Order Generator (Anttila and Andrus 2006), a Windows program that reads a factorial typology and returns the T-order as a directed graph. Since the graph is rather large, we only reproduce a small part of it in (33). For each input, the graph shows the attested percentage of double objects out of all the attested realizations (double object construction, prepositional construction, Heavy NP Shift). The proportion of double objects is correctly predicted to grow from top to bottom in the T-order.

(33)    T-order (partial graph)
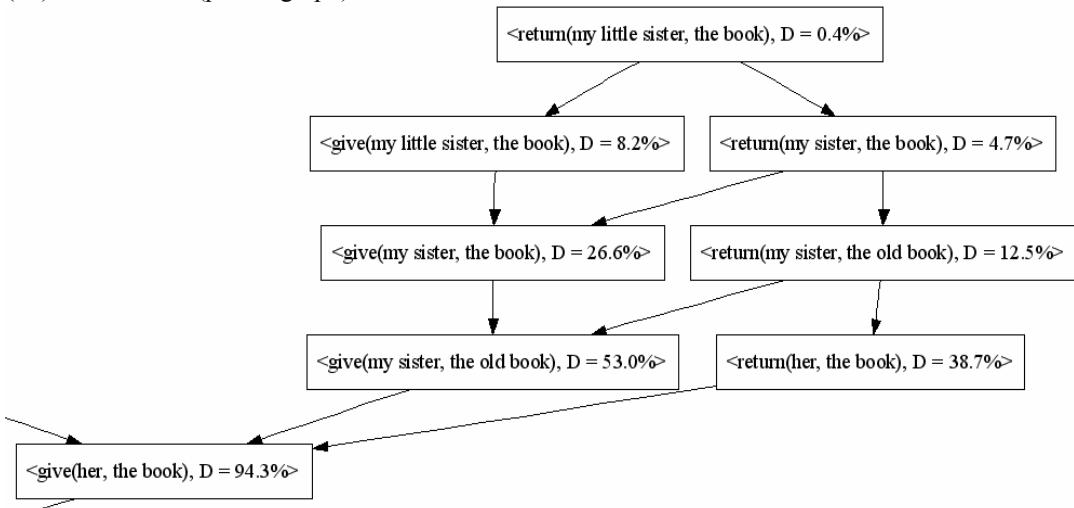


The model performs in the Blogspot data with a precision of 0.988 (i.e. 98.8% of all the predicted edges are correct) and a recall of 0.491 (i.e. 49.1% of all the correct edges are predicted). Two predictions are worth a special mention. First, two-foot verbs are correctly predicted to exhibit more Heavy NP Shift than one-foot verbs. This is because *TERNARITY favors Heavy NP Shift with two-foot verbs, but not with one-foot verbs. Second, the model predicts a dialect that allows *I gave her it*, but not *\*I gave my sister it* (Hawkins 1994:312), ruling out the reverse dialect that allows *I gave my sister it*, but not *\*I gave her it*. The reason is *CLASH: I (*gáve my síster*) (*it*) violates *CLASH, whereas

*I* (*gáve her*) (*it*) does not. This parallels the quantitative contrast between the type *I gave her the book* which is more common than the type *I gave my sister the book*. Clash avoidance thus emerges typologically across dialects as well as quantitatively within a dialect.

## 4. Conclusion

The evidence suggests that prosody matters to constituent linearization. The prosodic effects are mostly gradient and variable, yet entirely systematic. The prosodic hypothesis is thus a serious alternative that must be taken into account in any attempt to explain the dative alternation in English.

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## edited by Charles B. Chang and Hannah J. Haynie

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