THE ROLE OF PROSODY IN CONSTITUENT ORDERING

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1. Introduction

(1) Does phonology influence the ordering of meaningful elements (morphemes, words, phrases)? See e.g. Pullum and Zwicky 1989 for discussion.

(2) The double object construction.
(a) Celebrity status gave [Schwarzenegger] [options]
(b) She was recommending [me] [designs] and I gladly listened

(3) The prepositional construction:
(a) Man gave [names] [to all the animals]
(b) I am assigning [it] only [to my advanced 5th graders]

(4) The Heavy NP Shift construction:
(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]

(5) Main conclusions:
(a) Prosody plays a role in constituent linearization in English.
(b) The prosodic effects are mostly gradient and variable, yet entirely systematic.

(6) Goals of this talk:
(a) Present a phonological model that predicts, for each input, what the possible orderings are as well as the quantitative preferences among them
(b) Test the model on data from 1,580 prosodically annotated dative constructions extracted from www.blogspot.com (The Blogspot Corpus).

2. The Dative Alternation

(7) Three observations suggest that phonology plays some role in the Dative Alternation:
- Unstressed pronouns behave differently from other NPs (me vs. designs)
- The “weight” of the NP matters (the men vs. the rules of the Geneva Convention).
- The foot structure of the verb arguably matters (gīve vs. èxpláín)
2.1 Unstressed pronouns

Lexically unstressed pronouns have special ordering properties.

Generalization 1: Lexically unstressed pronoun themes are avoided in double object constructions:
(a) Pat gave [food] [to Chris] ~ Pat gave [Chris] [food].
(b) Pat gave [it] [to Chris] ~ *Pat gave [Chris] [it].

Generalization 2: 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):
(a) *I gave [her] [it]
(b) *I gave [my sister] [it]

Generalization 3: Lexically unstressed pronoun goals occur 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):
(a) *I lowered John the box.
(b) *Susan muttered Rachel the news.
(c) *John donated the charity money.
(d) *John returned the government the money.

The same pattern emerges even with verbs like give. The Blogspot Corpus:
(a) short verb + pronominal goal + non-pronominal theme: 94.3% double objects, (e.g. I gave him the book)
(b) short verb + non-pronominal goal + non-pronominal theme: 26.6% double objects (e.g. I gave Jim the book)

Constraints:
(a) Every XP forms a prosodic phrase (cf. Truckenbrodt 2007).
(b) Unary unstressed prosodic phrases are avoided. *(x)
(c) Stress clashes are avoided within a prosodic phrase. *CLASH

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(a) *Pat gave Chris (it). *(x)
(b) Pat gave it (to him). lexically unstressed, binary
(c) Pat gave Chris (food). lexically stressed, unary
(d) Pat gave Chris (some food). lexically stressed, binary
(19)  (a)  *John (returned the government) (the money).  *CLASH  
(b)  Judas (returned them) (the money).  no clash

(20)  Assumption: *CLASH is violated if both V and XP contain a lexical stress, irrespective of the amount of inter-stress material. (Alternative definitions of *CLASH are possible.)

(21)  Clash avoidance also provides a rationale for the quantitative asymmetry in (16):
(a)  I (gave Jim) (the book)  26.6% of all realizations are double objects
(b)  I (gave him) (the book)  94.3% of all realizations are double objects

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

2.2 End weight

(23)  The Principle of End Weight: “Heavy” constituents come last (see e.g. Wasow 2002).

(24)  Example: Heavy NP Shift
(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]

(a)  Sentence stress falls on the rightmost constituent (The Nuclear Stress Rule).
(b)  Word stress and sentence stress preferably coincide.


(27)  x
     x
     x
     x
     x   x   x   x
   ((volunteer firemen) (save lives))


<table>
<thead>
<tr>
<th>STRESS-TO-STRESS</th>
<th>STRESS-TO-STRESS</th>
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<tbody>
<tr>
<td></td>
<td>**!</td>
</tr>
<tr>
<td>a. Robertson gave [critical backing] [to Bush]</td>
<td></td>
</tr>
<tr>
<td>b. Robertson gave [Bush] [critical backing]</td>
<td>*</td>
</tr>
</tbody>
</table>
Stress-to-Stress has the effect of maximizing the number of lexical stresses in the constituent under sentence stress.

Prediction 1: Function words (a/an, the, of, …) should not count for weight.

This prediction is not made by
(a) syntactic hypotheses where weight is measured in (orthographic) words or syntactic nodes (see e.g. Wasow 2002)
(b) the phonological hypothesis that measures weight in syllables

Preliminary evidence from the prosodically annotated version of the Switchboard Corpus (Speriosu 2007, in progress): Lexical primary stresses are better end-weight predictors than length in words (Bresnan, p.c.).

Prediction 2: The weight effect should disappear if nuclear stress is lured away:
(a) Robertson gave [critical backing] [to Bush] last year
(b) not to give [children] [it] to avoid possible allergies (B&N 2003:19-20)
(c) never send [someone] [them] in the mail either (B&N 2003:19-20)
(d) showing [people] [him] through our life (B&N 2003:19-20)

Prediction 3: Only the relative weight of the arguments should matter:
(a) Goal < Theme: gave (my sister) (twenty dollars)
(b) Goal > Theme: gave (the money) (to my little sister)
(c) Goal = Theme: gave (my sister) (the money) ~ gave (the money) (to my sister)

Alternative hypothesis (Jäger and Rosenbach 2004): length effects are additive
(a) verb [word] Go [word word] Th Theme prefers the right edge.
(b) verb [word word] Go [word word word] Th Theme prefers the right edge even more.


2.3 Verb length

Dative Alternation is restricted to verbs dominated by a single foot (Fraser 1998, Grimshaw 2005).

(a) They (gave) the church money
(b) *They (do)(nated) the church money.
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)    (lease)  (pay)  (write)  (xerox)

The verbs in the leftmost column appear to have an initial extrametrical vowel, witness reduction. (See Downing 1998 for the prosodic misalignment of onsetless syllables.)

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

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

Some alternating two-foot verbs. Note that in all these verbs the initial foot is disyllabic.

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

Why should the number of feet matter? Grimshaw 2005 identifies the one-foot constraint, but suggests that it is an arbitrary learnability cue with no connection to English prosody.

Constraints:

(a) V + NP form a prosodic phrase (Inkelas and Zec 1995).
(b) Prosodic constituents are preferably binary.       *TERNARY
(c) The goal NP must be parsed together with its head. PARSE(Goal)

Prepositional constructions:

(a)  *((do)(nate) (my sister)) (the book)       *TERNARY
(b)  *((do)(nate)) (the money) (to my sister)   PARSE(Goal)

PARSE(Goal) is satisfied by the prosodic parsing (give my sister) where the head is the verb as well as by (to my sister) where the head is the preposition.
PARSE(Goal) may reflect a syntactic difference between the two constructions.

Prediction: Only the number of feet in the verb should matter. Thus, *donate* and *donated* are correctly predicted to show the same alternation pattern (Fraser 1998).

Data from [www.blogspot.com](http://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*

<table>
<thead>
<tr>
<th>CONSTRUCTION</th>
<th>TOKENS</th>
<th>EXAMPLE</th>
</tr>
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<tbody>
<tr>
<td>Prepositional Construction</td>
<td>1,103</td>
<td>I returned the book to my little sister.</td>
</tr>
<tr>
<td>Double Object construction</td>
<td>425</td>
<td>I gave her the book.</td>
</tr>
<tr>
<td>Heavy NP Shift</td>
<td>52</td>
<td>I returned to her the old book.</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 251, p \leq 0.001 \] (Heavy NP Shift omitted)

Heavy NP Shift only occurs with two-foot verbs. Why?
3. The phonological model

3.1 Inputs and outputs

(52) (a) **Input space:** 8 possible types of VPs  
(b) **Output space:** 4 orderings, 2 phonological phrasings

<table>
<thead>
<tr>
<th>VERB</th>
<th>GOAL</th>
<th>THEME</th>
<th>OUTPUT CANDIDATES</th>
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</thead>
<tbody>
<tr>
<td>one foot</td>
<td>stressed</td>
<td>stressed</td>
<td>(give) (the book) (to my sister)</td>
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<tr>
<td></td>
<td></td>
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<td>(give) (to my sister) (the book)</td>
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<td>(give) (the book) (my sister)</td>
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<td>(give) (my sister) (the book)</td>
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<td>(give the book) (to my sister)</td>
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<td>(give to my sister) (the book)</td>
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<td>(give the book) (my sister)</td>
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<td>(give my sister) (the book)</td>
</tr>
<tr>
<td>one foot</td>
<td>stressed</td>
<td>--</td>
<td>(give) (it) (to my sister)</td>
</tr>
<tr>
<td>one foot</td>
<td>--</td>
<td>stressed</td>
<td>(give) (the book) (to her)</td>
</tr>
<tr>
<td>two feet</td>
<td>stressed</td>
<td>stressed</td>
<td>(return)(the book) (to my sister)</td>
</tr>
<tr>
<td>two feet</td>
<td>--</td>
<td>--</td>
<td>(return)(it)(to my sister)</td>
</tr>
<tr>
<td>two feet</td>
<td>--</td>
<td>--</td>
<td>(return)(the book)(to her)</td>
</tr>
</tbody>
</table>

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

(54) **Dominated constraints:**  
*TERNARY: No ternary prosodic phrases.  
*CLASH: No stress clashes within a prosodic phrase.  
*PHRASE: No prosodic phrases (gradiently evaluated).  
FOCUS(To): Focus goal, i.e. put the goal NP under phrasal stress.  
FOCUS(Th): Focus theme, i.e. put the theme NP under phrasal stress.  
*to: No preposition.
The tableau for the input ‘give(*my sister*, the book)’. Four possible winners (a, b, e, h).

<table>
<thead>
<tr>
<th></th>
<th>PAR(Go)</th>
<th>*(x)</th>
<th>*TERN</th>
<th>*CLA</th>
<th>F(Th)</th>
<th>F(Go)</th>
<th>WS⊃PS</th>
<th>*to</th>
<th>*PHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (give)(the book)(to my sister)</td>
<td>PAR(Go)</td>
<td>*(x)</td>
<td>*TERN</td>
<td>*CLA</td>
<td>F(Th)</td>
<td>F(Go)</td>
<td>WS⊃PS</td>
<td>*to</td>
<td>*PHR</td>
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<td>b. (give)(to my sister)(the book)</td>
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<td>c. (give)(the book)(my sister)</td>
<td>*!</td>
<td>*</td>
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<td>*</td>
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<tr>
<td>d. (give)(my sister)(the book)</td>
<td>*!</td>
<td>*</td>
<td>*</td>
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<td>e. (give the book)(to my sister)</td>
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<td>f. (give to my sister)(the book)</td>
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<td>g. (give the book)(my sister)</td>
<td>*!</td>
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<td>h. (give my sister)(the book)</td>
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The tableau for the input ‘give(*my sister*, it)’. One possible winner (e).

<table>
<thead>
<tr>
<th></th>
<th>PAR(Go)</th>
<th>*(x)</th>
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<th>*CLA</th>
<th>F(Th)</th>
<th>F(Go)</th>
<th>WS⊃PS</th>
<th>*to</th>
<th>*PHR</th>
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<tbody>
<tr>
<td>a. (give)(it)(to my sister)</td>
<td>*!</td>
<td>*</td>
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<td>b. (give)(to my sister)(it)</td>
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<td>c. (give)(it)(my sister)</td>
<td>*!</td>
<td>*</td>
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<tr>
<td>d. (give)(my sister)(it)</td>
<td>*!</td>
<td>*</td>
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<td>e. (give it)(to my sister)</td>
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<td>f. (give to my sister)(it)</td>
<td>*!</td>
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<td>g. (give it)(my sister)</td>
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<td>*!</td>
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<td>*</td>
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</tbody>
</table>

A summary of predictions. The inputs in (d) add the gradient weight effect.

<table>
<thead>
<tr>
<th>INPUT</th>
<th>DOUBLE OBJECT</th>
<th>NP + PP</th>
<th>HNPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) /give(her, it)/:</td>
<td>--</td>
<td>yes</td>
<td>--</td>
</tr>
<tr>
<td>/return(her, it)/:</td>
<td>--</td>
<td>yes</td>
<td>--</td>
</tr>
<tr>
<td>/give(my sister, it)/:</td>
<td>--</td>
<td>yes</td>
<td>--</td>
</tr>
<tr>
<td>/return(my sister, it)/:</td>
<td>--</td>
<td>yes</td>
<td>--</td>
</tr>
<tr>
<td>(b) /give(her, the book)/:</td>
<td>yes</td>
<td>yes</td>
<td>--</td>
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<tr>
<td>/return(her, the book)/:</td>
<td>yes</td>
<td>yes</td>
<td>--</td>
</tr>
<tr>
<td>/give(my sister, the book)/:</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>/return(my sister, the book)/:</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>(c) /give(my sister, the old book)/:</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>/return(my sister, the old book)/:</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>/give(my little sister, the book)/:</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>/return(my little sister, the book)/:</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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</table>

How about the preferences among the three variants?

3.2 Deriving quantitative patterns

What kinds of languages do these constraints predict? Use OTSOFT (Hayes, Tesar, and Zuraw 2003) to compute the factorial typology. The result contains 30 languages.
(60) **The crucial observation:** Some <input, output> mappings entail others. Example:
If ‘<give(my sister, the old book)’, *give my sister the old book>* is possible,
so is ‘<give(her, the book), give her the book>’.

(61) Factorial typology for two inputs. D = double object construction (shaded), P = prepositional construction, H = heavy NP shift

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<tr>
<th></th>
<th>1</th>
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(62) We call the set of all entailments derived by a grammar a T-ORDER.

(63) Assumptions about variation (Kiparsky 1994, Anttila 2007):
(a) Variation arises from multiple grammars within/across individuals.
(b) The number of grammars predicting an output is proportional to its frequency of occurrence.

(64) Example: Assume an individual with four grammars #1, #3, #7, #8. In the long run, the individual’s rate of double objects for inputs A and B will approximate 1/4 and 3/4.

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<th>3</th>
<th>7</th>
<th>8</th>
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<td>A</td>
<td>P</td>
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<td>P</td>
<td>H</td>
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<td>B</td>
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<td>D</td>
<td>P</td>
<td>D</td>
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(65) Prediction: Input B should yield at least as many double objects as input A. More generally, the T-order should hold true quantitatively in the corpus data.

(66) How to work out the complete T-order? Two methods:
(a) Figure out the Elementary Ranking Conditions (ERCs) for each <input, output> mapping and the entailments among them (Prince 2002a, 2002b 2006).
(b) Figure out the entailments from the factorial typology.

**T-order-Generator (Anttila and Andrus 2006) is a free open-source Python program for computing and visualizing T-orders.**

(67) The T-order for the Dative Alternation Grammar contains 168 entailments [SLIDE]
<return(my little sister, the book), D = 0.4%>

<give(my little sister, the book), D = 8.2%>  <return(my sister, the book), D = 4.7%>

<give(my sister, the book), D = 26.6%>  <return(my sister, the old book), D = 12.5%>

<give(my sister, the old book), D = 53.0%>  <return(her, the book), D = 38.7%>

<give(her, the book), D = 94.3%>
How well does the T-order match the data?
(a) Precision = 0.988, i.e. 99% of the predicted edges are correct.
(b) Recall = 0.491, i.e. 49% of the correct edges are predicted.

If we remove the rankings, precision remains about the same, but we lose in recall:
(a) Precision = 0.993
(b) Recall = 0.117

4. Specific predictions

4.1 HNPS and verb length

Prediction: Long verbs are predicted to exhibit more Heavy NP Shift than short verbs.

Heavy NP Shift in the blogspot corpus:
(a) return [to her] [the book] N = 31
    return [to my sister][the old book] N = 17
    return [to my little sister] [the book] N = 3
    return [to my sister][the book] N = 2
(b) give [to her][the book] N = 0
    give [to my sister][the old book] N = 0
    give [to my little sister][the book] N = 0
    give [to my sister][the book] N = 0

With two-foot verbs, *TERNARITY favors Heavy NP Shift:
(a) ??(revealed him)(the truth) Dative Shift dispreferred
(b) (revealed)(to him)(the truth) Heavy NP Shift preferred

<table>
<thead>
<tr>
<th></th>
<th>*TERNARITY</th>
<th>*PHRASE</th>
<th>*to</th>
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<tbody>
<tr>
<td>→ a.</td>
<td>[(re)(veal)] [to him] [the truth]</td>
<td>***</td>
<td>*</td>
</tr>
<tr>
<td>→ b.</td>
<td>[(re)(veal)(him)] [(the truth)]</td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>

With one-foot verbs, Heavy NP Shift is unnecessarily complicated:
(a) (give her)(the book) Dative Shift preferred
(b) ??(give)(to her)(the book) Heavy NP Shift dispreferred

<table>
<thead>
<tr>
<th></th>
<th>*TERNARITY</th>
<th>*PHRASE</th>
<th>* to</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>#[(give)] [to her] [the book]</td>
<td>***</td>
<td>*</td>
</tr>
<tr>
<td>→ b.</td>
<td>[(give)(her)] [the book]</td>
<td>**</td>
<td></td>
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</tbody>
</table>

The comparative nature of well-formedness: The well-formedness of an expression depends on the well-formedness of alternative expressions for the same meaning.
4.2 Pronoun sequences

(75) DIALECT 1 | DIALECT 2 | DIALECT 3
---|---|---
I gave her it | *I gave her it | *I gave her it
*I gave my sister it | *I gave my sister it | I gave my sister it
(Hawkins 1994:312) | (Erteschik-Shir 1979:452) | no such dialect

(76) (a) In Dialect 1, *(x) ‘Avoid lexically unstressed unary constituents’ is dominated.
(b) Dialect 3 violates an implicational universal.

(77) T-order

\[
\text{<give(my sister, it), } H = 0\% > \quad \text{<give(my sister, it), } D = 0\% >
\]

\[
\text{<give(my sister, the book), } H = 0\% > \quad \text{<give(her, it), } D = 0\% > \quad \text{<give(my sister, the book), } D = 26.6\% >
\]

\[
\text{<give(her, the book), } D = 94.3\% >
\]

\[
\text{<give(her, the book), } P = 5.7\% >
\]

\[
\text{<give(my sister, the book), } P = 73.4\% > \quad \text{<give(her, it), } P = 100\% >
\]

\[
\text{<give(my sister, it), } P = 100\% >
\]

(78) The reason for the pronoun vs. NP asymmetry is *CLASH:
- I (gâve my sister) (it) *CLASH violation
- I (gâve her) (it) --

(79) The prosodic analysis predicts a parallel grammaticality contrast between *I gave her the book > I gave my sister the book*. This contrast emerges quantitatively in the blogspot data:
- I (gâve my sister) the book *CLASH violation 26.6%
- I (gâve her) the book -- 94.3%
4.3 Disfluencies

(80) **Assumption:** Fillers like *uh, you know,* etc. introduce a prosodic break.

(81) **Prediction:** A filler (= prosodic break) can never occur between V and a pronominal XP.

(82) This is confirmed by the Switchboard Corpus data (Speriosu 2007, in progress)
(a) I’ll give you, you know, two to three years.
   *I’ll give, you know, you two to three years.
(b) The Constitution gives, uh, the individual the right to own firearms.
   *The Constitution gives, uh, him the right to own firearms.

(83) The predicted orderings and phrasings for inputs containing pronouns:

<table>
<thead>
<tr>
<th>Input</th>
<th>Predicted Phrasing</th>
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<tbody>
<tr>
<td>/give(her, it)/</td>
<td>![Double Object]</td>
</tr>
<tr>
<td>/return(her, it)/</td>
<td>![Prepositional]</td>
</tr>
<tr>
<td>/give(her, the book)/</td>
<td>![Double Object] ![Prepositional]</td>
</tr>
<tr>
<td>/return(her, the book)/</td>
<td>![Prepositional] ![HNPS]</td>
</tr>
<tr>
<td>/give(my sister, it)/</td>
<td>![Prepositional]</td>
</tr>
<tr>
<td>/return(my sister, it)/</td>
<td>![Prepositional]</td>
</tr>
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</table>

5. Future work

(84) **Work in progress:** See whether including the prosodic factors improves the performance of existing quantitative models of the English Dative Alternation (Bresnan et al. 2007).

(85) The Verb-Particle construction:
(a) it slows the machine down    ~    it slows down the machine
(b) it slows me down            *it slows down me

(86) Ternarity avoidance: verbs longer than one foot do not combine with particles at all.
(a) I called him up.            *I telephoned him up.
(b) I offered it up.            *I presented it up.
(c) I gave it up.               *I donated it up.
(d) ‘fess up                    *confess up (Harley 2007, 25)

(87) The complementarity of *re-* and the verb particle (Banfield 2007):
(a) John shipped off his prizes. *John reshipped off his prizes.
(b) Let’s build up our defenses. *Let’s rebuild up our defenses.
(c) You should write down the response. *You should rewrite down the response.
(d) It’s time to count out the money. *It’s time to recount out the money.
Possessive constructions (data from Kirke 2004):
(a) Austin’s restaurants (62%) > Austin’s streets (11%)
(b) streets of Austin (89%) > restaurants of Austin (38%)

7. Conclusion

- Prosody plays an active role in constituent linearization in English.
- The prosodic effects are mostly gradient and variable, yet absolutely systematic.

Acknowledgements

- T-Order Generator: Curtis Andrus
- The Blogspot Corpus: Philipp Angermeyer, Rahul Balusu, Peter Liem
- The prosodic annotation of Switchboard: Matt Adams, Mike Speriosu
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