Rhythm's role in genitive construction choice in spoken English

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0. Introduction[1]

English has two syntactically distinct constructions for expressing the possessor and possessum relationship: the *s*-genitive and the *of*-genitive:

(1) a. the car's wheel b. the wheel of the car

The *s*-genitive (1a) is a single noun phrase, where the possessor *car* occurs before the possessum *wheel* accompanied by the possessive clitic *–s*. The *of*-genitive (1b) consists of two noun phrases, with the possessor *car* located in a prepositional phrase headed by *of*.

The choice between the two English genitive constructions is not a free one. Rather, the choice of one genitive construction over the other is conditioned by the interaction of semantic, syntactic, phonological, and sociolinguistic factors (e.g., Rosenbach 2002, Hinrichs and Szmrecsányi 2007; Kreyer 2003; Szmrecsányi and Hinrichs 2008; Tagliamonte and Jarmasz 2008). In this study, we examine the influence of rhythm, which has been known to interact with syntax, in predicting genitive construction choice in spoken English. We do so by incorporating rhythmic factors into a single model of genitive choice alongside the previously identified predictors using logistic regressing modeling. We find that while rhythm significantly influences construction choice, its explanatory role is small relative to other known predictors. Thus, rhythm—and phonological factors at large—must not be discounted in studies of syntactic variation, but the converse is also crucially true: rhythm alone does not do or explain everything.

The paper is organized as follows. Section 1 motivates our investigation of rhythm's effect on genitive construction choice, reviewing previous work on prosody-syntax interaction and presenting our definition of rhythm for this study. Sections 2 and 3 present our spoken English genitive data and introduce each of the predictors in our model, respectively. Results of

our analysis are in §4, with discussion in §5. Section 6 concludes.

1. Rhythm and its role in syntactic construction choice

Rhythmicity is, as characterized by Abercrombie (1967), "the periodic occurrence of some sort of movement, [which produces] an expectation that the regularity of succession will continue." This definition of rhythmicity forms one of the fundamental assumptions of metrical theory: because we expect regularity, languages strive towards a perfect state of rhythmicity, where stress is equally distributed and spaced (Selkirk 1984; Hayes 1995; a.o.) One of the most desired rhythmic states in language, then, is a "fundamental contrast between stressed and unstressed syllables" (Schlüter 2005: 19), as in the word *álabàster*, where exactly one unstressed, weak syllable occurs between each stressed syllable. Language tries to avoid deviation from the equal distribution of stress. Clash—adjacent strong syllables (*thirtéen mén*)—is dispreferred, as is lapse—adjacent weak syllables (*Míllington's regret*). Selkirk (1984) terms this rhythmic drive towards equally distributed stress "the Principle of Rhythmic Alternation," describing it as "a sort of Platonic ideal to which the rhythmic structure, grounded in syllables, tones, and syntactic structure, aspires" (55).

While the interaction of rhythm and syntax has long been noted in the generative literature, the early work in this vein focused largely on the influence of syntax on metrical and prosodic structure. Some even questioned the bi-directionality of the phonology-syntax relationship (e.g., Vogel and Kenesei 1990). Recent research, however, has suggested and demonstrated the influence that rhythm, rhythmicity, and the Principle of Rhythmic Alternation can exact on syntax. From psycholinguistic studies of processing and production to studies in historical change, rhythm's effects on syntax—and in particular, syntactic word order choice—are more and more evident.

Psycholinguistic experiments have shown that the Principle of Rhythmic Alternation has a significant influence on syntactic word order. In a study on word order in English noun phrase coordination, McDonald, Bock, and Kelly (1993) found that "words are more likely to be ordered in a way that enhances rhythmic alternation between stressed and unstressed syllables" (215). More subjects ordered the constituents *surprise* and *sin* as *surprise and sin* rather than *sin and surprise*. The former order maintains a perfectly alternating stress pattern—*surPRISE and SIN*—while the latter violates the Principle of Rhythmic Alternation with two unstressed syllables between stressed ones—*SIN and surPRISE*. The effect of rhythm in

McDonald et al. (1993) proved even more significant to word order than the Heavy-last Principle of ordering short constituents before longer ones.

The Principle of Rhythmic Alternation also influences diachronic syntactic construction change and variation. Schlüter (2005) provides numerous examples from the history of English showing that there is a historical tendency to avoid rhythmic clashes and lapses. For instance, the strive for eurhythmy explains the disproportionate disuse of *a*-adjectives such as *aware* in pre-nominal positions. The majority of English nouns have initial stress, and, as such, exhibits stress clash when pre-modified by *a*-adjectives, which have final stress. The use of the phrase *aware person* is therefore rarer than a construction without pre-modification, *the person who was aware*. Outside the noun phrase, Schlüter also shows the effect of the Principle of Rhythmic Alternation on adverbial and verbal structures.

More closely related to the present study, Anttila, Adams, and Speriosu (2010) explored the role of stress clash in predicting the English dative construction, which, similar to the English genitive, varies in syntactic word order. They questioned whether rhythm helps in the choice between the double object construction (*We gave the child the dog*.) and the prepositional construction (*We gave the dog to the child*.) Anttila et al.'s data from the Switchboard Corpus and a written corpus of informal blogs suggests that prosody significantly affects the choice of dative construction. To avoid stress clash, speakers preferentially choose the more eurhythmic alternative, which is modeled by Anttila et al. in Optimality-theoretic terms.

Following the precedent set by recent literature showing the two-way interaction of syntax and prosody, the goal of the present study is to explore the influence of rhythm—specifically, the Principle of Rhythmic Alternation, following Schlüter 2005)—on genitive construction choice. We proceed with the hypothesis that the Principle of Rhythmic Alternation plays a role in predicting and determining which genitive construction speakers use. If speakers indeed optimize for rhythmicity, they should choose the more rhythmic construction over the less rhythmic. For example, compare the *s*- and *of*-genitive pair in (2):

(2) a. the chíldren's vóices
W S W S W

b. the vóices of the chíldren
W S W W W S W

The *s*-genitive, (2a), exhibits perfect alternating rhythm, with lexical stresses distributed evenly throughout the construction, as shown by the alternating S(trong)s and W(eak)s marked below the words. On the other hand, the alternative *of*-genitive in (2b) does not have perfectly alternating

rhythm: three unstressed W syllables occur between the two stressed S syllables, forming a lapse in rhythm. Our prediction, dictated by the Principle of Rhythmic Alternation, is that speakers will choose the more optimally rhythmic variant of the genitive—in (2), for example, the *s*-genitive.

Our study differs from Anttila et al.'s (2010) in that their analysis of prosody in the dative alternation is more nuanced than the basic definition of the Principle of Rhythmic Alternation. In addition to stress clash, Anttila et al. also include in their model constraints on the formation and well-formedness of higher level prosodic phrases. There are potential complications, however, in using higher-level prosodic phrasing such as sentence stress in predicting syntactic word choice. Utilizing higher level prosody in a model opens the door to confounds between prosody and syntax, semantics, and processing since prosodic structures are in part defined by syntactic constructions (Selkirk 1984; a.o.). For this study, therefore, we are primarily concerned with the simple strive for the alternation of stressed and unstressed syllables, as formulated in the Principle of Rhythmic Alternation, and its influence on genitive construction choice, leaving the question of higher-level prosodic effects open for future investigation.

In studying the effects of rhythm on syntax, we find it of the utmost importance to also consider the relative effect of rhythm with respect to other known predictors that influence genitive construction choice. In their study on English datives, Anttila et al. (2010) focus primarily on prosody, mentioning only in passing that other constraints—syntactic, semantic, informational—may also take part in determining syntactic word order. But, it is truly impossible to judge the actual effect of rhythm on syntax if it is examined in isolation without controlling for the effects of other non-rhythmic conditioning factors. In their series of experiments, McDonald et al. (1993) note that prosody influences word order "only in the absence of an animacy contrast" (188). Judging from McDonald et al.'s results, discounting syntactic, semantic, informational, and sociolinguistic factors in a study of syntactic construction choice is dangerous—as is discounting phonological and rhythmic factors. Thus, in addition to asking the question of how good a predictor of genitive choice rhythm is, we also ask: when combined with the previously identified factors listed in (2), both phonological and non-phonological, how important are rhythmic influences?

2. The data

Our study utilized spoken data from the manually parsed Penn Treebank

portion (Marcus et al. 1993) of the Switchboard corpus of American English (Godfrey and McDaniel 1992) under the hypothesis that rhythmic and phonological effects will be most apparent in spoken contexts. Exploration of rhythm in written data is saved for future research (see Grafmiller 2010). The Switchboard corpus consists of telephone conversations between native American English speakers who did not know each other and were assigned random, predetermined conversation topics.

The key criterion for identifying the data in this study was the reversibility and interchangeability of the *s*-and *of*- genitive constructions. Following the previous work on genitive construction choice (Rosenbach 2002; Kreyer 2003; Hinrichs and Szmrecsányi 2007; Szmrecsányi and Hinrichs 2008; a.o.), we only included constructions whose alternatives were equivalent and possible paraphrases: e.g., *the doctor's patients ≅ the patients of the doctor*/. Excluded, then, were constructions where the *s*- and *of*- alternatives were not interchangeable, all of which have been previously identified and include the following (Quirk et al. 1985; Biber et al. 1999; Rosenbach 2002, 2006; Kreyer 2003):

- Post-genitives: *We meet at Bill's ≠ *We meet at of Bill.*
- Genitives without noun heads: *the cost of providing the startup ≠ *providing the startup's cost*
- Quantitative constructions: *a cup of soup ≠ a soup's cup*
- Qualitative constructions: *this kind of work ≠ *this work's kind*
- Material constructions: *a crown of gold ≠ *gold's crown*
- *Of*-constructions with premodifying quantifiers: *most of the people ≠ *the people's most*
- Descriptive genitives: *women's magazines ≠ the magazines of the women*
- Indefinite possessums: *a book of a teacher ≠ a teacher's book*
- Fixed expressions: *arm's reach ≠ the reach of the arm*

For purposes of this study, we also did not consider genitives with pronominal possessor or possessum NPs, following previous work by Rosenbach (2002) and Hinrichs and Szmrecsányi (2007). Pronominal genitives greatly disfavor the periphrastic *of*-genitive and vary nearly categorically on animacy (see Grafmiller 2010 for recent discussion).

Genitives were chosen from the Treebank Switchboard corpus using a combination of automatic Tgrep2 filtering and manual coding. The four researchers collaborating on this study each coded a portion of the corpus, excluding constructions listed above and cross-checked their results with the others. Our data was then checked once more for consistency by the

second author. We concluded with 1124 genitives, of which we had to exclude nine more due to missing or incomplete contextual information from Switchboard. In sum, the corpus has 1115 genitives, with 659 instances of *of*-genitives (59.1%) and 456 instances of *s*-genitives (40.9%).

3. Predictors

This section presents the conditioning factors coded in our data.

3.1 Rhythm

Before being able to examine rhythm in the genitive alternation, we first annotated our dataset with lexical stress information using automatic annotation of both primary and secondary stress based on the Carnegie Mellon University Pronouncing Dictionary (CMU). Since we are interested in the simple alternation between stressed and unstressed syllables, we chose to collapse the distinction between primary and secondary stress; thus, both primary and secondary stressed syllables are, for our purposes, considered stressed syllables, forming a binary distinction between syllables that are stressed and those that are not. Words that were not found in CMU were manually coded by the first author for lexical stress and syllabification, following CMU annotations as closely as possible. Using CMU as the source of our lexical stress annotations provides us with a way to approximate speakers' stored lexical information about a word's phonological properties—in particular, stress—independent of other phonetic and syntactic pressures and effects during the speech act. A study of actual stress patterns utilized in the Switchboard conversations is left to future research. The stressed annotations from CMU were randomly hand-checked for accuracy.

As laid out in §1, we hypothesize that the Principle of Rhythmic Alternation influences the choice of genitive constructions in English. All else being equal, given a pair of possessor and possessum NPs, speakers should, under our hypothesis, choose the more eurhythmic construction, be it the *s*-genitive or the *of*-genitive. Take, for example, the possessor-possessum pair in (3): *the children* and *the voices*.

(3) a. the chíldren's vóices
W S W S W

b. the vóices of the chíldren
W S W W W S W

In (3), we would expect speakers to avoid lapse in the *of*-genitive construction of (3b) and instead prefer the eurhythmic *s*-genitive construction. Conversely, the *of*-genitive construction of the possessor and possessum pair *government* and *response* in (4b) is more eurhythmic:

(4) a. the góvernment's respónse
W S W W W S

b. the respónse of the góvernment
W W S W W S W W

In *the government's response* (4a), there is a lapse of three unstressed W syllables between the S syllables whereas in *the response of the government* (4b), there is only a lapse of two unstressed W syllables. Thus, we would expect that the latter construction is preferred.

Speakers, when deciding between two alternative genitive constructions, should take into account both the *s*- and *of*- genitive forms for any given possessor-possessum pair. To model this intuition, we developed a measure of *eurhythmy distance* that quantifies how rhythmic each genitive construction is across the local possessor-possessum boundary. Take again the possessor and possessum pair *children* and *voices*. In the *s*-genitive construction (5a), there is one unstressed syllable between the two stressed syllables at the right and left edges of the possessor-possessum boundary:

(5) a. the chíldren's vóices
W S W S W
1

b. the vóices of the chíldren
W S W W W S W
3

In the *of*-genitive construction for the same possessor-possessum pair (5b), there are three unstressed syllables spanning the possessor-possessum border; that is, there are three weak syllables between the leftmost stress of the possessor and the rightmost stress of the possessum.

Eurhythmy distance takes the number of intervening syllables between stress peaks in the genitive constructions as shown in (5) above and measures how far away from perfectly alternating rhythm a given construction is. We will refer to eurhythmy distance when the possessor and possessum are in the *s*-genitive form as *s*-Eurhythmy Distance (*s*-ED) and when the possessor and possessum are in the *of*-genitive form as *of*-Eurhythmy Distance (*of*-ED). Eurhythmy distance is calculated by taking the absolute value of the number of unstressed syllables between stress peaks across the genitive border, as formulated in (6).

(6) *s*- ED = | # of unstressed syllables between possessor and possessum – 1 |
of-ED = | # of unstressed syllables between possessum and possessor – 1 |

For the possessor-possessum pair of *children* and *voices*, then, the *s*-ED is 0, and the *of*-ED is 2.

In the eurhythmy distance measure, a count of 0 means that the construction exhibits the ideal eurhythmic alternation of S and W syllables, with exactly one W syllable intervening between two S syllables. Thus, any eurhythmy distance that does not equal 0 means that perfectly alternating rhythm is not achieved by the construction, and under our hypothesis, the speaker will not prefer these more arrhythmic constructions (*s*/*of*-ED > 0). Additionally, the eurhythmy distance measure makes no distinction between clashes and lapses. Compare, for example, the constructions in (7).

(7) a. the kíd's vóice
W S S
0
s-ED = | 0 – 1 | = 1

b. the géneral's vóice
W S WW S
2
of-ED = | 2 – 1 | = 1

The examples in (7) have different numbers of unstressed syllables between their possessors and possessums. Despite this difference, both constructions in (7) are the same distance away from perfect rhythmic alternation (*s*-ED = 1), which the eurhythmy distance measure captures. Further discussion of rhythmic clashes and lapses occurs in §5.

3.2 Other predictors

FINAL SIBILANCY. Speakers tend to avoid immediately adjacent sibilants, including [s], [z], [ʃ], [tʃ], [ʒ], and [dʒ], in an OCP-type ban on neighboring sibilant sounds (Menn and MacWhinney 1984; Zwicky 1987; a.o.). In the *s*-genitive construction, the *–s* possessive morpheme will sometimes occur next to a final sibilant in the possessor: *the veterans* + *-'s* + *descendents*. Even though repairs such as haplology of the possessive morpheme or [ə] epenthesis exist, speakers tend to avoid the occurrence of sibilants altogether by using the *of*-genitive construction. Hinrichs and Szmrecsányi (2007) find that the presence of a final sibilant on the possessor NP significantly reduces the likelihood of the *s*-genitive in both speech and writing. After manually and automatically[2] coding for the presence of a

final sibilant in the possessor NP, we found that there are significantly fewer *s*-genitives with final sibilants in their possessors (34/460) than there are *of*-genitives with final sibilants (133/663)($\chi^2 = 34.432$, $p < 0.0001$).

ANIMACY. The animacy of the possessor is perhaps the largest predictor of genitive construction choice, as identified in the previous literature. *S*-genitives overwhelmingly have animate possessors while *of*-genitives have inanimate ones, which has been found to be true across all studies on genitive construction choice (see especially Hinrichs and Szmrecsányi 2007; Szmrecsányi and Hinrichs 2008; Tagliamonte and Jarmasz 2008; a.o.). In this study, we simplify animacy to a binary distinction between animate possessors—animals and people—and inanimate possessors—all others. There are significantly more animate *s*-genitive possessors (389/460) than there are *of*-genitive ones (78/663)($\chi^2 = 592.515$, $p < 0.0001$). *Of*-genitive possessors are more often inanimate than their *s*-genitive counterparts. The effect of animacy is so strong that it is nearly categorical in our data; hence, the model presented in §4 includes interactions between animacy and other conditioning factors—most notably, rhythm.

THEMATICITY. Osselton (1988) examined the tendency of topical or "thematic" possessors to favor the *s*-genitive even when they are otherwise disfavored. For example, in a textbook on phonology, *sound*, which, as an inanimate possessor, would likely occur in an *of*-genitive elsewhere, would be more likely to occur in the *s*-genitive: e.g., *the sound's feature structure.* Hinrichs and Szmrecsányi (2007) found that Osselton's hypothesis holds true in written English genitives, with thematic possessors occurring more often in the *s*-genitive alternative. Following Hinrichs and Szmrecsányi (2007), we took the log text frequency of the head noun in each possessor, extracted and calculated automatically via a Python script, as a count of thematicity. We do not find a significant effect of thematicity in predicting genitive construction choice ($\chi^2 = 0.048$, $p < 1.0$); therefore, thematicity has been excluded from our final modeling.

GIVENNESS. It has been hypothesized that the information status of the possessor influences genitive construction choice (Biber et al. 1999; Quirk et al. 1985). Namely, if a possessor denotes a discourse-old item, it is more likely to occur in an *s*-genitive construction so as to place given information before new information. We manually coded givenness by looking for reference of any kind to the possessor in the preceding ten line context of the genitive. We find that givenness does not necessarily follow our expectations: there is in fact a significantly greater proportion of given possessors in *of*-genitives (23%) than in *s*-genitives (12%)($\chi^2 = 12$, $p < 0.001$).

END WEIGHT. End weight is another strong effect that has long been

noted and studied: speakers prefer to place longer, more complex constituents after shorter, less complex ones, thereby facilitating parsing (Behagel 1909; Quirk et al. 1985; Hawkins 1994; Wasow 2002; Bresnan et al. 2007; Rosenbach 2005). The weight and complexity of a constituent is effectively measured by the number of words, following Hinrichs and Szmrecsányi (2007) and work in other construction choice studies (e.g., Bresnan et al. 2007; cf. Anttila et al. 2010). The number of words in each possessor and possessum were automatically counted by a Python script. We predict that the heavier the possessor NP is, the more likely it will follow the possessum and occur in the *of*-genitive, as in the extreme example given in (8).

(8) a. ✓[the attitude]$_{possessum}$ of [people who are really into classical music and feel that if it's not seventy five years old, it hasn't stood the test of time]$_{possessor}$
b. ???[people who are really into classical music and feel that if it's not seventy five years old, it hasn't stood the test of time]$_{possessor}$'s [attitude]$_{possessum}$

The *of*-genitive in (8a)—a genitive from our data—exemplifies the end weight effect, with the super-long possessor following the much shorter possessum. In (8b), which is a construct, the longer possessor precedes the single word possessum, making this alternative dispreferred.

It is important to note here that our measure of end weight is one of *syntactic* complexity and not a phonological measure. Some other works frame end weight as a phonological property, using, instead of word count, the number of syllables for constituent weight (e.g., McDonald et al. 1993) or the number of lexical stresses to calculate phonological complexity (Anttila et al. 2010). Crucially, however, McDonald et al. (1993) found phonological end weight measured in syllables to be insignificant in their tests on word order. Recent research has also suggested that word count is a sufficient proxy for phonological complexity and lexical stresses (Grafmiller and Shih, in prep); thus, we follow the precedence in construction choice studies by using word count rather than syllable or lexical stress count.

PERSISTENCE. Persistence describes a possible priming effect of one structure on subsequent construction choices. For example, in genitive construction choice, the presence of an *s*-genitive may prime the choice of another *s*-genitive the next time the speaker has to choose between constructions. Previous genitive research (Szmrecsányi 2006; Hinrichs and Szmrecsányi 2007) has found persistence to be a significant—if small—effect in both spoken and written English. In our data, however, we had excluded pronominal genitives (see §2), which meant that we could only easily calculate persistence based on genitives without pronouns. Most

likely due to our exclusion of the pronominal data, our measure of persistence, contrary to Hinrichs and Szmrecsányi (2007), is an insignificant factor in predicting genitive choice; however, the result should be verified in a study that includes all genitive data, including constructions with pronouns.

SPEAKER AGE AND GENDER. The competition between the Germanic *s*- and French *of*-genitive forms began during the period of heightened contact with French following the Norman Conquest. The *of*-genitive took over as the predominant construction until around the 16th century, after which the *s*-genitive began to increase (Rosenbach 2007: 154). The trend of increasing *s*-genitive usage has continued through modern English: Hinrichs and Szmrecsányi (2007) find an increase in *s*-genitive frequency present between 1960 and 1990. Because of its French origins and predominance prior to the 16th century, the *of*-genitive form is often regarded as having formal connotations (Rosenbach 2002; Tagliamonte and Jarmasz 2008). The association of formality and the *of*-genitive leads to the hypotheses that women, who have been found in sociolinguistic studies to utilize formal structures more frequently than men, are more likely to use the *of*-genitive construction and that people with higher education use more *of*-genitive constructions. In their study on spoken genitives in Toronto English, Tagliamonte and Jarmasz (2008) show a correlation between older age and the use of more *of*-genitives but do not find significant effects of speaker gender or education. We utilize the speaker gender and age information available with the Switchboard data; speaker education was excluded due to missing educational information for some of the subjects.

4. Modeling and analysis

In this section, we present a model of genitive construction choice in spoken English using a logistic regression analysis and the conditioning factors presented above[3]. Factors in the final model were selected via stepwise backward elimination in which insignificant factors were removed sequentially. Insignificant and unreliable predictors were eliminated when the absolute value of their estimated coefficients were smaller than twice their standard error. The models were also verified using a step-up method where each predictor, beginning with those previously identified as significant in the literature, was added one at a time until no further improvement of the models occurred. We then tested the model for over-fitting using bootstrap resampling (N runs = 1000) in which the model was fit to random resamples of the dataset. Table 1 below provides the results of the model.

Table 1. Logistic regression estimates: Ratios represent the relative chances of *s*-genitive over *of*-genitive

Factor	**Odds Ratio**	**Estimate**	**Std. Error**	**Z value**	**Pr (>|z|)**	
Intercept	23.01	3.141	0.544	5.77	0.0000	***
Possessor animacy = inanimate	0.004	-5.573	0.400	-13.93	0.0000	***
Possessor word count	0.475	-0.738	0.119	-6.20	0.0000	***
Final sibilant	0.314	-1.151	0.315	-3.65	0.0003	**
s-Eurhythmy distance	0.550	-0.660	0.258	-2.56	0.0104	.
of-Eurhythmy distance	0.575	-0.549	0.159	-3.46	0.0005	**
Speaker birthdate	1.393	0.337	0.157	2.15	0.0317	.
Possessor givenness = not given	1.635	0.487	0.251	1.94	0.0523	
Interactions						
s-RD * animacy =inanim	2.517	0.985	0.362	2.72	0.0065	*
of-RD * animacy =inanim	2.696	0.988	0.212	4.66	0.0000	***

N	1111	adjusted Nagelkerke R^2	0.667
model χ^2	375.00 (df = 9)***	% correct (%baseline)	92.3 (69,6)
adjusted *Dxy*	0.837	κ	15.686

. significant at $p < 0.05$, * significant at $p < 0.01$,
** significant at $p < 0.001$, *** significant at $p < 0.0001$

Our model accurately predicts 92.3% of the data and accounts for more than two-thirds of the variance in the dependent variable ($R^2 = 0.667$). The model exhibits moderate and potentially harmful collinearity ($\kappa = 15.686$). Collinearity occurs when there is overlap amongst multiple predictors with respect to the variance that each explains, and it is especially prevalent with this kind of data where many of the factors are slightly to moderately correlated. We should note that the presence of certain factors in the model particularly increase collinearity, most notably speaker age and the interaction factors. Removal of speaker age, for example, κ by 4.15. In general, κ values below 6 indicate little collinearity while those between 6 and 15 indicate moderate collinearity (Baayen 2008: 182).

Table 1 above only reports the significance and effects of the predictors in the model. Figure 1 shows the explanatory power that each predictor has in the model, measured by the increase in -2 log likelihoods. To calculate each predictor's explanatory power, we removed each predictor from the

full model. The decrease in the model's goodness-of-fit (increase in -2 log likelihood) was recorded with each predictor removed in turn. As is evident from Figure 1, animacy holds the most explanatory power for our data. Even the explanatory power of the next significant predictor—possessor weight—follows far behind the power of animacy in predicting genitive construction choice. Possessor givenness and speaker age come in last in explanatory power for the model, superseded by eurhythmy distance in the *of*- and *s*-genitive forms and final sibilants in the possessor.

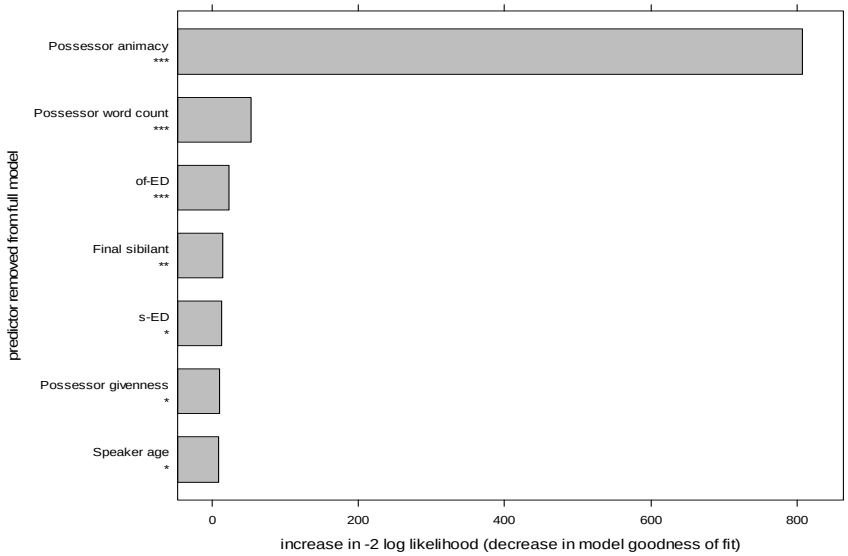

Figure 1. Increase in -2 log likelihood (decrease in model goodness-of-fit) if factor removed

The most significant and reliable predictors in our model are possessor animacy, possessor word count, and the presence of a final sibilant in the possessor, a finding that parallels the results of other recent work in genitive construction choice (Hinrichs and Szmrecsányi 2007). The least reliable effects in the model are the age of the speaker (speaker birthdate) and possessor givenness). Figure 2 shows the partial effects plots of these model predictors, except rhythm, where a great log odds value indicates an increased probability of an *s*-genitive construction for the given value of that predictor when all other predictors in the model are held constant.

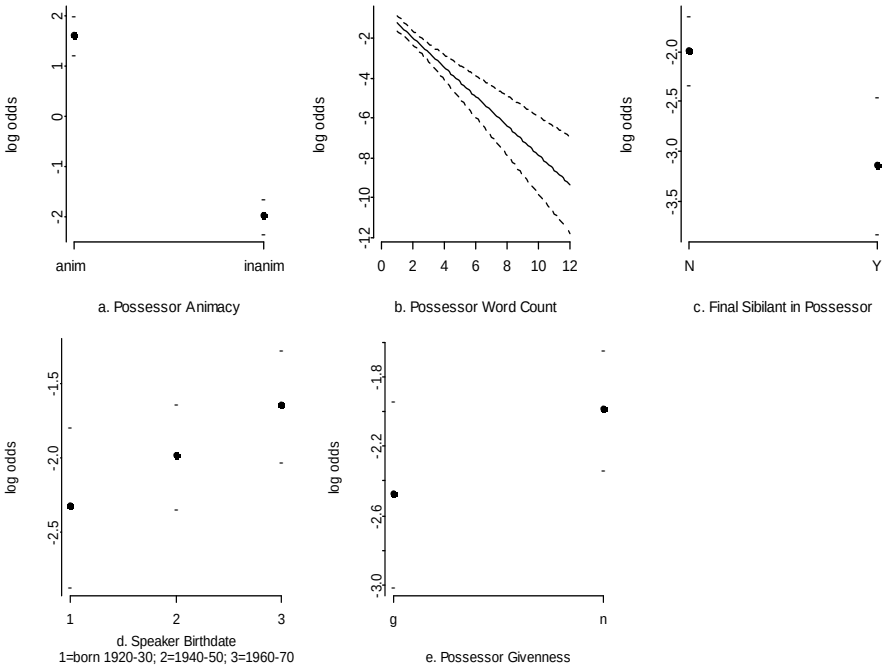

Figure 2. Partial effects of model predictors

In Figure 2a, we see that genitives with inanimate possessors are more likely to occur in the *of*-genitive form whereas animate possessors are more likely to occur in the *s*-genitive form, conforming to our expectations of the effect of animacy as discussed in §3.2. Figure 2b shows the effect of possessor weight in words: the more words—a proxy for syntactic complexity—that there are in the possessor, the more likely the possessor will come second, resulting in an *of*-genitive construction. Shorter possessors are more likely to form an *s*-genitive, which is completely consistent with previous findings. Figure 2c demonstrates that the OCP avoidance of adjacent sibilants in the possessor significantly affects syntactic word order. The presence of a final sibilant predisposes the speaker to using the *of*-genitive construction to avoid a sequence of two sibilant sounds. Speaker age (Figure 2d) behaves as we hypothesized: younger subjects tend to use the *s*-genitive form more than older subjects, as is evident from the positive slope. As mentioned earlier, the effect of possessor givenness conflicts with our expectations. Rather than given possessors occurring in the *s*-genitive, we find that there is a trending tendency for given possessors to occur in

the *of*-genitive construction (Figure 2e). The reason for this reversal of expectations is unclear and was not further pursued in this study.

Finally, we come to the effects of eurhythmy distance. Both measures of eurhythmy distance—*s*-ED and *of*-ED—exhibit significant interactions with the animacy of the possessor. The interactions mean that animacy affects rhythmicity's influence on determining genitive construction choice. Figure 3 provides the partial effects plot of *of*- and *s*-ED, separated by animate and inanimate possessors, with all other predictors in the model held constant. The main effect of *of*-ED has a negative estimate slope (-0.55) though we expected a positive slope because our hypothesis stated that as *of*-ED increases—that is, the further away from eurhythmy the *of*-genitive gets—the more likely an *s*-genitive should occur to avoid rhythmic violations. The cumulative effect of *of*-ED and its interaction with animacy, however, indeed has a positive slope in genitives with inanimate possessors (-0.55 + 0.99 = 0.44), as seen in Figure 3a. We can also see that the confidence intervals of predicted odds in *of*-ED with animate possessors crosses 0, indicating that, in genitives with animate possessors, *of*-ED does not have a reliable predictive value. *Of*-ED, therefore, is a reliable predictor of genitive construction choice only when the possessor is inanimate.

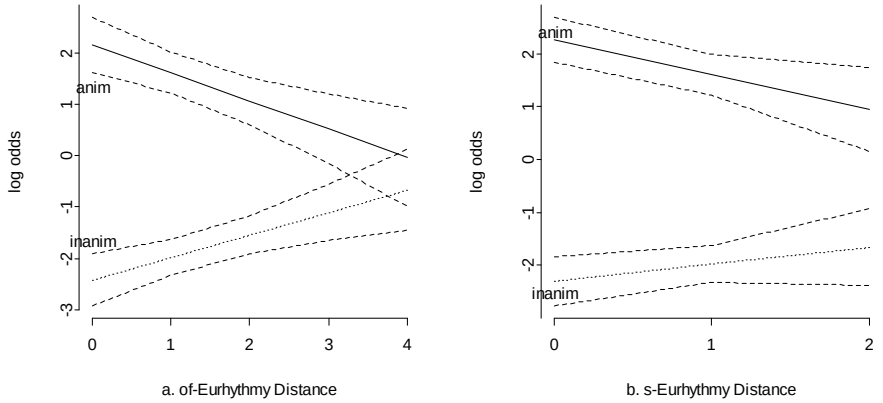

Figure 3. Log odds of ED measures by Possessor Animacy

Figure 3b demonstrates that *s*-ED behaves similarly to *of*-ED, with a negative slope in genitives with animate possessors and a positive slope in genitives with inanimate possessors. Amongst animate possessors, *s*-ED behaves predictably: as distance from perfectly alternating rhythm grows in the *s*-genitive construction, the model predicts that speakers are more likely

to choose the *of*-genitive alternative. The avoidance of lapse especially causes speakers to seek a more rhythmically optimal construction. On the other hand, amongst inanimate possessors, we see a slight upwards sloping of *s*-ED, though the overlapping and wide confidence intervals, given the very small magnitude of the change, indicate that *s*-ED is not a reliable predictor in predicting construction choice for genitives with inanimate possessors. Animacy is clearly such a strong predictor of the genitive alternation that it dampens the effect of rhythmicity on construction choice; although, we should note that, given more data that includes *of*-genitives with animate possessors and *s*-genitives with inanimate possessors, we might and expect to see stronger and animacy-independent effects of rhythm emerge. The interaction between animacy and the eurhythmy distance measures will be further discussed in the next section.

5. Discussion

In §4, we presented our model of genitive construction choice in English using *s*- and *of*-eurhythmy distance to quantify rhythm. In this section, we discuss the efficacy of our eurhythmy distance measure in comparison to more standard and separate rhythmicity measures of clash and lapse (§5.1). Then we consider the differences between *s*-ED and *of*-ED and argue for the necessity of both eurhythmy distance measures (§5.2).

5.1 Eurhythmy Distance vs. Clash and Lapse

One departure of the eurhythmy distance measure presented here from previous treatments of rhythmicity (e.g., Anttila et al. 2010) is the collapsing of the clash versus lapse distinction in the ED count. ED fails to preserve the difference between clash and lapse: both are considered one step away from perfectly alternating rhythm (*s*/*of*-ED = 1). In the previous literature, however, it is a common hypothesis that stress clash is more grave a violation of the Principle of Rhythmic Alternation than stress lapse. Nespor and Vogel (1989) state: "while there is a strong tendency to eliminate lapses, they are not felt to be quite as disturbing as clashes" (87). This suggests that the loss of distinguishing clash and lapse should be a costly one.

We can examine the actual effect of clash and lapse by substituting these measures for ED in an otherwise identical model of genitive construction choice (henceforth Model II). Model II includes clash in the *s*-genitive

form (no unstressed syllables intervening between stressed syllables at the possessor-possessum border); *s*-genitive lapse (the distance away from perfectly alternating rhythm if there are two or more unstressed syllables between stress peaks at the possessor-possessum border); and *of*-genitive lapse (the distance away from perfectly alternating rhythm if there are two or more unstressed syllables between stress peaks at the possessum-possessor border). Clash in the *of*-genitive is unnecessary because *of* is treated as unstressed and as such, *of*-genitives will never have stress clash.

Holding non-rhythmic predictors constant, we find that both *s*-genitive lapse ($\beta = -1.07$; $z = -3.63$; $p < 0.001$) and *of*-genitive lapse ($\beta = -0.468$; $z = -2.89$; $p < 0.01$) are good predictors of genitive construction choice. *S*-genitive clash, however, is not ($\beta = 0.166$; $z = 0.73$; $p < 0.5$). This result runs counter to the hypothesis that stress clashes are more disfavored than lapses, and that, in the event of stress clash, the alternative construction will be chosen. A possible explanation for the unreliability of stress clash as a predictor is that speakers have other repairs available to avoid clash: the Rhythm Rule, for example, in environments where stress shift or retraction may occur. Since our rhythm counts only include dictionary-based lexical stress, there is no way to know for sure without consulting the actual Switchboard sound recordings, which is left for future study. What speakers may be doing in the presence of clash is repairing the clash via stress shift, retraction, or promotion. Lapse, unlike clash, is more difficult to correct since stress insertion on unstressed syllables is an impossible repair. Hence, we see from Model II a clear influence of stress lapse, where longer lapses in stress will result in speakers choosing the alternative construction.

Given the unreliability of stress clash in predicting genitive construction choice in our data, we would not gain anything from the separation of clash and lapse as different predictors. In fact, the combined ED measure allows us to capture the influence of rhythmicity with fewer degrees of freedom than clash and lapse, thereby preventing over-fitting of the model from too many predictors and potentially high collinearity amongst factors.

5.2 *s*-ED vs. *of*-ED: prosodic phrasing

The approach to quantifying simple alternating stressed and unstressed syllables utilized in this paper departs from much of the previous literature on rhythm and syntax interaction, which focuses on phrasal and prosodic stress and phonology. Given that the *s*- and *of*-genitives have different prosodic and syntactic structures, we might expect to see these differences re-

flected in rhythmicity's influence on genitive construction choice—particularly in how strictly the Principle of Rhythmic Alternation applies within different prosodic domains (see esp. Nespor and Vogel 1986; Selkirk 1984; a.o.). Within a single prosodic phrase, language users have been noted to desire greater eurhythmy than across prosodic phrase boundaries. For example, certain stress shifting repairs such as the Rhythm Rule in English operate only within noun phrases and not without. To illustrate, consider the sequence of *thirteen* and *men* in (9).

(9) a. In the room, there were *thirteen men*.
b. When he was *thirteen*, *men* seemed much smarter to him.

In (9a), *thirteen men* is one prosodic phrase; therefore, the Rhythm Rule applies to avoid the stress clash of *thirTEEN* and *MEN*, and the main stress of *thirteen* shifts to the first syllable, forming perfectly alternating stress: *THIRteen MEN*. In (9b), the sequence *thirteen men* does not form a single prosodic phrase, and the stress clash is not repaired via the Rhythm Rule.

The genitive constructions exhibit a difference in prosodic domains (10). The *s*-genitive construction forms a single NP and prosodic phrase.

(10) a. [the car's wheel]$_{\text{P-Phrase}}$ b. [the wheel]$_{\text{P-Phrase}}$ [of the car]$_{\text{P-Phrase}}$

On the other hand, two prosodic phrases form the *of*-genitive (10b). The prosodic phrasing in (10) is independently corroborated by the presence of speaker disfluencies in the Switchboard genitive dataset. We hand-coded for disfluencies, as in (11), intervening between the possessor and possessum of genitive constructions in our spoken data.

(11) a. the norms of, *um*, public behavior
b. the school district's, *you know*, goals

Our data indicates that speakers insert significantly more disfluencies in *of*-genitive constructions (n=79) than in *s*-genitive constructions (n=24)(χ^2 = 12.316, $p < 0.001$). The greater number of disfluencies in the *of*-genitive can be taken as evidence for a looser prosodic and phrasal constituency existent in the *of*-genitive constructions whereas speakers insert fewer disfluencies in *s*-genitives because they have tighter prosodic constituencies.

Because of the difference in prosodic phrasing between the *s*- and *of*-genitives, a phrase-oriented approach would predict that the Principle of Rhythmic Alternation applies more strictly within *s*-genitives, which are

singular prosodic units, and for eurhythmy distance in *s*-genitives (*s*-ED) to be the most—and perhaps only—important factor when speakers consider alternative constructions. Our model, however, demonstrates the opposite result: both *of*- and *s*-ED are reliable predictors of construction choice, suggesting that, despite a difference in the prosodic phrasing of the genitives, the difference is not reflected in the effect of rhythmicity on construction choice. Irrespective of higher level stress domains, our results show that even the low-level and simple binary alternation of stressed and unstressed syllables influences speaker choice of syntactic ordering.

The distinction between *s*- and *of*-ED's predictive value amongst animate and inanimate possessors, respectively, is also important because it demonstrates that, in spoken English genitive construction choice at least, low-level rhythmic effects are subservient to stronger semantic predictors like animacy. One might imagine that speakers are predisposed to either the *s*- or *of*-genitive form based on the animacy of the possessor: animate possessors strongly prefer the *s*-genitive construction while inanimate possessors prefer the *of*- construction. Speakers then consider the rhythmic costs. Within genitives with animate possessors, they consider whether the *s*-genitive is rhythmically optimal because animate possessors favor the *s*-genitive—if it is not, they choose the alternative construction, the *of*- genitive. Within genitives with inanimate possessors, speakers consider whether the *of*-genitive is eurhythmic because inanimate possessors are biased towards *of* constructions. The alternative form is used if the *of*-genitive's distance from perfectly alternating stress is too great. Animacy's interactions with eurhythmy distance suggest that the consideration of high-level (semantic) predictors like animacy feeds and constrains the consideration of lower-level factors like the Principle of Rhythmic Alternation.

6. Conclusion

We began this study with two major questions about the role of rhythm in genitive construction choice in spoken English: (1) How good is rhythm as a predictor of genitive construction choice?, and (2) How important are rhythmic influences when combined with other phonological and non-phonological predictors? To answer these questions, we developed a method of quantifying rhythm: eurhythmy distance. Eurhythmy distance tells us that rhythm plays a significant role in genitive construction choice, but the role that it plays is small in relation to other factors and is conditioned and constrained by the effect of animacy. As Hinrichs and Szmrecsányi

(2007) find in their study of written genitive data, animacy, weight, and the presence of a final sibilant in the possessor are the most significant predictors of genitive choice in spoken English. In addition to the possessor's givenness and sociolinguistic factors, rhythm has a much smaller—though still crucial—part in the choice between *s*- and *of*-genitive constructions.

The exploration of rhythm in spoken construction choice and the development of the measure of eurhythmy distance in this paper are amongst the first of their kind; therefore, there is great necessity for further work and refinement. In this study, we only consider a local measure of rhythm, looking with limited scope at the boundary between possessors and possessums. This narrow and short-sighted vision of rhythm may be largely inaccurate. Rhythm, from Abercrombie (1967), is the expectation of regularity in evenly spaced stresses, so a more accurate measure of rhythm might be a more global one with wider scope, testing whether the rhythmic regularity expected by the language user is maintained throughout the genitive construction by using one genitive over its alternative form.

We have also utilized idealized, dictionary-based stress annotations for the purposes of this study, which were hypothesized to reflect speakers' stored lexical representations. The actual phonetic pronunciation, however, may or may not follow dictionary approximations. In the actual spoken stream, we might find greater or lesser effects of rhythmicity, especially taking into consideration repairs of stress violations such as the Rhythm Rule. The spoken Switchboard data used in this study provides an opportunity for future phonetic verification and investigation of our current results.

There are many further avenues of research that are necessary to better understand the rhythm's role in genitive construction choice. For instance, the role of rhythm in spoken and written construction choice may differ due to the natures of spontaneous speech and calculated writing. In writing, speakers have potentially more time to consider the alternatives between *s*- and *of*-genitives resulting in a greater effect of rhythm on construction choice; at the same time, writers may not be as concerned with phonological properties in written work, and rhythm's effect may diminish in comparison to spoken use (Grafmiller 2010). Whether the role of rhythm in genitive construction choice has changed throughout the development of English also may provide further understanding of what influences speakers to make the choice of one genitive construction over another.

The results of this study clearly demonstrate that rhythm—and more specifically, the Principle of Rhythmic Alternation—should be considered a potential influencer of construction choice in English. Its role is small, especially when compared to some semantic, pragmatic, processing, and

other phonological factors, and rhythm, as a dependent on other predictors, definitely does not have complete explanatory power of construction choices. But, though its role may be small, rhythmicity is still significant and important in the decision of how to say what we choose to say.

Notes

1. We thank Arto Anttila, Beth Levin, Paul Kiparsky, Marie-Catherine de Marneffe, Florian Jaeger, Gabe Recchia, Jen Hay, Sali Tagliamonte, and the Stanford Spoken Syntax Lab for their valuable discussion. Acknowledgements to the Stanford Phono-Workshop; Empirical Syntax Research Seminar; DGfS: *Rhythm Beyond the Word* Workshop; and Berkeley Phonology Phorum participants for their helpful feedback. Special thanks lastly to Ralf Vogel and Ruben van de Vijver for their organization of the DGfS workshop and this volume. This material is based in part upon work supported by the National Science Foundation under Grant Number IIS-0624345 to Stanford University for the research project "The Dynamics of Probabilistic Grammar" (PI Joan Bresnan). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.
2. Automated coding was done using Python scripts and the phonological segment annotations in CMU.
3. Graphics and statistics were prepared using the R statistical computing platform (R Development Core Team 2010) and the Design library (Harrell 2009).

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