Culturally conditioned language change? A multi-variate analysis of genitive constructions in ARCHER

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Acknowledgments

We wish to thank the Freiburg Institute for Advanced Studies (FRIAS) for funding the project "Predicting syntax in space and time". This material is also based upon work supported by the National Science Foundation under Grant No. BCS-1025602. We also acknowledge helpful comments and suggestions by an anonymous referee.

1 Introduction

The paper is concerned with the development of two competing NP constructions in Late Modern English, the *s*-genitive, as in (1), and the *of*-genitive, as in (2).

(1) *before* **[*the Seneschal*]***s* **[*Brother*]** *could arrive, he was secured by the Governor of Newport* <ARCHER 1682pro1.n2b>

(2) the *Duke of Norfolk, having lately received another Challenge from* **[*the Brother*]** *of* **[*the Seneschal*]**, *went to the place appointed* <ARCHER 1682pro1.n2b>

Historically speaking, the *of*-genitive is of course the incoming form, which appeared during the ninth century. According to Thomas (1931, 284), the inflected genitive vastly outnumbered the periphrasis with *of* up until the twelfth century. In the Middle English period, we begin to witness "a strong tendency to replace the inflectional genitive by periphrastic constructions, above all by periphrasis with the preposition of" (Mustanoja 1960, I:70). The Early Modern English period, however, sees a revival of the *s*-genitive, "against all odds" (Rosenbach 2002, 184). While we know that the *s*-genitive is comparatively – and increasingly – popular in Present-Day English, especially American English (Rosenbach 2002; Rosenbach 2003), the literature about genitive variability in the Late Modern English period is somewhat sketchy (but see Szmrecsanyi 2013; Wolk et al. 2013).

In addressing these gaps in our knowledge about genitive variability in Late Modern English, we follow recent probabilistic approaches to language (see, for example, the papers in Bod, Hay, and Jannedy 2003; Bresnan and Ford 2010) and assume that grammatical variation and change is sensitive to probabilistic (rather than categorical) constraints, because conditioning factors may influence linguistic choice-making in extremely subtle, stochastic ways (Bresnan and Hay 2008, 246). In this spirit, we are interested in subtle changes in some conditioning factors. Specifically, we provide evidence for a diachronic weakening of the animacy constraint for which we offer various explanations, paying particular attention to a rather novel source of change in the distributional pattern of variants: changes in the wider cultural context, such as industrialisation as a transformational period (we would thus like to emphasize right at the outset that the present study is not about e.g. cultural transmission and iterative learning).

On the methodological plane, the study contributes to a growing body of literature on the probabilistic nature of the genitive alternation (see, e.g., Gries 2002; Szmrecsanyi 2006; Hinrichs and Szmrecsanyi 2007; Hundt and Szmrecsanyi 2012; Shih et al. to appear; Grafmiller to appear). Specifically, we build on research reported in Wolk et al. (2013), a

paper that investigates grammatical variation in *A Representative Corpus of Historical English Registers* (ARCHER), Version 3.1. (Yáñez Bouza 2011). ARCHER covers the period between 1650 and 1999, spans about 1.8 million words of running text, samples eight different registers, and contains British as well as American English texts. The corpus design categorizes all texts into seven subperiods of 50 years, but the precise year of composition for each text is typically also available. Coverage of American English is restricted to three of the seven periods: 1750-99, 1850-99, and 1950-99.

Among other things, Wolk et al. (2013) investigate genitive variability in ARCHER's British English news and letter section, drawing on a dataset featuring a variety of explanatory variables, such as length of the possessor/possessum (the principle of 'end weight'), animacy of the possessor, definiteness of the possessor, and so on. Building on Wolk et al.'s work, we present here an extended and richly annotated genitive dataset that covers over 5,000 genitives not only in British news and letters texts, but also in American texts. On the basis of this extended dataset – which, as for culture-relevant dimensions, covers not only time (1650-1999) but also space (Britain versus America) – we calculate a logistic regression model with mixed effects which predicts over 90% of writers' genitive choices by jointly considering a wide range of explanatory variables, as well as idiolectal and lemma-specific random effects. Our goal is to explicitly address the interplay between culture change and grammar change in the Late Modern English period. We will see that as a matter of fact, genitive variability is patterned in surprisingly similar ways in British and American English. Where culture comes in is the weakening of the possessor animacy constraint in the course of the Late Modern English period.

This paper is structured as follows. In Section 2, we explain how we identified interchangeable genitives in the corpus, and canvas genitive frequencies. In Section 3, we discuss the language-internal and language-external conditioning factors that we used to annotate our dataset. Section 4 presents the regression model. Section 5 discusses the model and compares various linguistic, conceptual, and cultural explanations for the observed changes in the effect of the animacy constraint. Section 6 offers some concluding remarks.

2 Identifying interchangeable genitives

In the present study, we explore variation between the *s*-genitives and *of*-genitives as two roughly equivalent ways of saying the same thing (Labov 1972). Our definition of variable (i.e. interchangeable) genitives precisely follows the guidelines in the Wolk et al. (2013) study, which itself follows best practice in the literature on genitive variation.

Identifying interchangeable genitives is a labour-intensive task. The procedure can be summarized as follows. We used *'*s*, **s*', *of*, and **s* (the latter only in the first two periods, when spelling without an apostrophe was still common) as search strings, and screened the resulting hits manually to weed out irrelevant material such as e.g. plural nouns. To identify interchangeable genitives, attention was restricted to genitive constructions with non-pronominal possessors or possessums. We excluded (i) demonstrative possessums possessums (e.g. *her face is as ugly as that of a dog*), (ii) constructions that are clearly fixed expressions (e.g. *the Duke of Normandy*), and (iii) partitive genitive relation contexts (e.g. *3 chests of Wine*). Further, we only included *of*-genitive constructions headed by the definite article (as in *the use of the navy*), and excluded *of*-constructions with modifying function (as in *all persons of quality*), and *of*-genitives expressing a clearly appositive relation (as in *the number of 13000 men*). As for the *s*-genitive, we focused on determiner (specifying) *s*-genitive constructions. Overall, the aim was to include genitive constructions that are interchangeable in principle rather than relying on a coder's intuition. So rather than asking the question 'does

this genitive alternate?' in every individual case, we relied on the application of clear and replicable inclusion/exclusion criteria as sketched above.

	British English			American English		
	*o*f-genitive	*s*-genitive	Total	*o*f-genitive	*s*-genitive	Total
1650-99	312	139	451			
	69%	31%	100%			
1700-49	364	152	516			
	71%	29%	100%			
1750-99	418	109	527	523	77	600
	79%	21%	100%	87%	13%	100%
1800-49	558	70	628			
	89%	11%	100%			
1850-99	446	109	555	483	132	615
	80%	20%	100%	79%	21%	100%
1900-49	435	134	569			
	76%	24%	100%			
1950-99	357	221	578	327	210	537
	62%	38%	100%	61%	39%	100%

Table 1. Interchangeable genitive frequencies (raw hits in ARCHER, and variant frequencies).

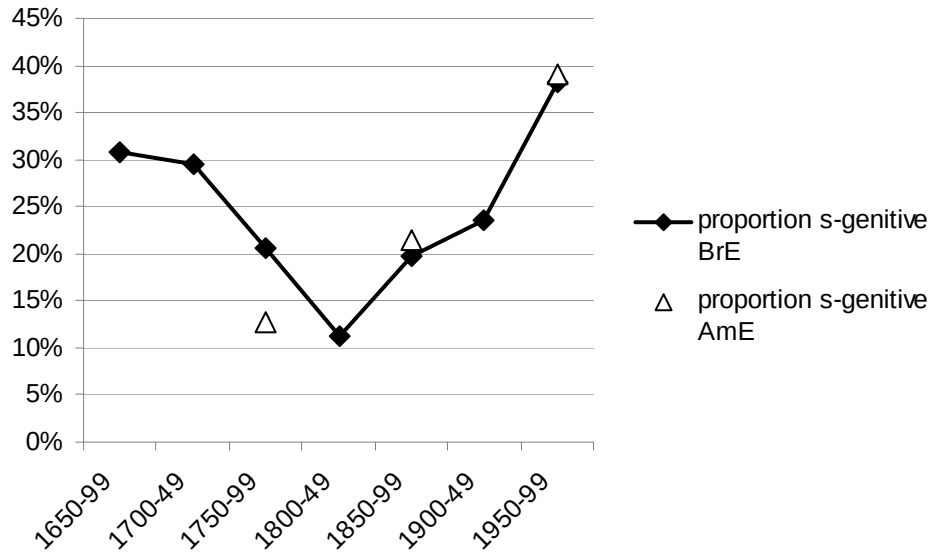

Figure 1. Proportion of *s*-genitive (*y*-axis) against real time (*x*-axis).

Our coding guidelines yielded a dataset consisting of N = 5,576 interchangeable genitives. Table 1 breaks down the numbers by genitive type, ARCHER period, and variety, Figure 1 plots *s*-genitive proportions in real time. It is amply clear that the genitive alternation exhibits robustly fluctuating variant proportions in British English (see Szmrecsanyi 2013; Wolk et al. 2013 for in-depth discussions). The frequency trajectory is such that the s-genitive

was comparatively frequent in the early and late ARCHER periods, but relatively unpopular in the middle ARCHER periods. Overall, *s*-genitive frequencies and proportions in American ARCHER texts match those in British ARCHER texts rather well. With regard to *s*-genitive proportions, there is virtually no difference in the 1850-99 and 1950-99 period. Only in the 1750-99 period are American *s*-genitive proportions significantly lower than their British counterparts ($\chi^2 = 8.96$, df = 1, $p = 0.003$). So British-American differences do not appear to be the locus of culturally conditioned genitive variation.

As an interim summary, we conclude that genitive proportions in British and American Late Modern English are quite similar. The task before us is to determine whether the same is true for how genitive choice is conditioned in the two varieties.

3 Determinants of genitive choice

Genitive variation is subject to a large number of language-internal constraints (e.g. possessor animacy, constituent weight), and to some language external factors, such as real time or variety. To probe the probabilistic grammar that conditions genitive choice, we need a dataset where each and every genitive observation is annotated for as many variables as possible. The annotation we use in the present study is exactly parallel to the genitive annotation discussed in detail in Wolk et al. (2013). In what follows, we briefly summarize the annotation guidelines.

3.1 Animacy

Previous studies have reported reliable and strong effects of possessor animacy as a locus of diachronic variability (e.g. Rosenbach 2002; Jankowski 2009; Hundt and Szmrecsanyi 2012): more animate possessors favour the *s*-genitive, less animate possessors favour the *of*-genitive Our operationalisation of animacy is based on a simplified version of the guidelines in Zaenen et al. (2004). Following Rosenbach (2008), five possessor animacy categories are distinguished:

1. Animate possessors comprise humans, higher animals and sentient human-like beings such as gods, e.g. *king*, *horse*, *god*, or *John.*
2. Collective possessors are organizations such as *administration* or *church*, as well as temporally stable groups of humans with potentially variable concord, such as *delegation*, *family*, or *enemy*.
3. Temporal nouns consist of both points in time and durations, for example *February* or *moment*.
4. Locatives are locations, including geographical states, e.g. *Russia*, *this kingdom*, *the seas*.
5. All other concrete (e.g. *rock*) or non-concrete (e.g. *idea*) noun phrases were classified as inanimate.

The hypothesis is that animate possessors are particularly often coded with the *s*-genitive, while inanimate possessors tend to occur with the *of*-genitive. The other categories should cover the middle ground.

3.2 Definiteness and nominal expression

Definiteness overlaps to some extent with discourse accessibility. Thus we assume that definite possessors tend to be discourse-old, which is why they should favour the *s*-genitive because the *s*-genitive places the possessor before the possessum, thus establishing old-before-new order (Biber et al. 1999, 305; Quirk et al. 1985, 1282). In this spirit, we straightforwardly distinguished between proper name possessors (e.g. *Mary*), definite possessors (e.g. *the king*), and indefinite possessors (e.g. *a man*). Note that we classified as proper name only noun phrases that could be considered proper names in Present-Day English and that were capitalised in the text. As definite we coded all noun phrases headed by a definite determiner, *that*, or an *s*-genitive. All other constituents were classified as indefinite.

3.3 Constituent length

In languages like English, 'heavier' (i.e. longer and/or more complex) constituents tend to follow 'lighter' ones (for example, Behaghel 1909). Therefore, long possessums should favour the *s*-genitive (which places the possessum after the possessor), while long possessors should favour the *of*-genitive (which places the possessor after the possessum). To determine the constituent lengths of individual genitive occurrences, we manually identified the constituents of each genitive construction. Genitive possessums, which may only start with a determiner in the *of*-genitive, subsequently had their first word removed from the count if that word was a determiner. Subsequently, constituent length in orthographic characters (including blanks) was established. Wolk et al. (2013) offer a detailed discussion of the accuracy of character counts vis-à-vis other measures; the upshot is that character counts, word counts, and syllable counts are very highly correlated in the type of data sampled in ARCHER. Mean possessor length in the dataset is about 18 characters (as in *the command of his royal highness*); mean possessum length is about 11 characters (as in *my wife's concernment*). In regression analysis, a logarithmic transformation was applied to the character counts to reduce skewness, and then the values were centred around 50-year period means to reduce multicollinearity and to account for possible changes in average lengths.

3.4 Semantic relation

Genitives may encode a wide range of different relations. We followed the binary distinction between prototypical and non-prototypical possessive relations in Rosenbach (2002). Prototypical relations comprise legal ownership (3-a), body part relations (3-b), kinship relations (3-c), and part-whole relations (3-d), while all remaining cases were coded as 'non-prototypical' (see the examples in (4)).

(3) Semantic relations considered prototypical

a. ownership: *RHODESIAN forces have increased security measures in and around* [***Mr Ian Smith's cattle ranch and farm at Selukwe***$_{]+\text{prototypical}}$ *after a sharp upsurge of guerrilla activity in the Midlands region of the country*. < ARCHER 1979stm1.n8b>

b. body parts: *The Irish came in to the house pul'd the man out of bed from his wife and murdered him; then tooke all the rest of the houshold, led them to the seaside, and threw them off the rocks; one of the Children hung about one of* [***the murderers legs***]$_{+\text{prototypical}}$*, yet was pull'd off and thrown after the rest*. < ARCHER 1653merc.n2b>

c. kinship: *It's said* [***the Duke of Berwick's Son***$_{]+\text{prototypical}}$ *is in one of the Ships, and Perth's two Sons in the other*. < ARCHER 1715eve1.n3b>

d. part-whole: [***The Hull of a Ship***]$_{+prototypical}$ *was seen floating between Blackness and Point and Calais and Ambeleteuse*; < ARCHER 1735rea1.n3b>

(4) Semantic relations considered non-prototypical

a. *Christian sources in Egypt say that President Sadat has gone back on a pledge he gave some years ago not to allow Islamic law to become* [***the law of the country***]$_{-prototypical}$. < ARCHER 1979stm1.n8b>

b. *THE new drama, 'John Garth,' produced at Wallack's Theatre, New York, is spoken of by the press as the best work ever written for the American stage.* [***Mr. Wallack's acting as the hero***]$_{-prototypical}$ *is greatly admired.* < ARCHER 1872gla1n6b>

c. *However, this rule is sometimes dispensed with; and particularly since the signing of the Preliminaries of Peace, our Government has permitted* [***the granting of such passports***]$_{-prototypical}$*, provisionally, for the space of a year, to ships built out of the Republic, provided that they entirely belong to natives of this country, and also fitted out here.* < ARCHER 1802joh2.n5b>

d. *The Supreme Educational Council had given instructions to the school-masters which had established religious neutrality, and a request by the Council-General of the Seine that* [***the name of God***]$_{-prototypical}$ *should never be uttered in school had been rejected.* < ARCHER 1883tim2.n6b>

According to the literature, prototypical relations should favour the *s*-genitive, while non-prototypical relations should favour the *of*-genitive.

3.5 Final sibilancy

Possessors ending in a sibilant, as in *Alice's child*, discourage the *s*-genitive (e.g. Zwicky 1987). We used an automatic annotation process, relying on the Carnegie Mellon University Pronouncing Dictionary version 0.7a[1], for identifying all possessor phrases ending in a sibilant (which includes possessors ending with a plural *s*). Tokens not included in the dictionary were coded manually.

3.6 Variety and real time

ARCHER provides the year of creation[2] of each corpus file. To ease the assessment of diachronic changes and make statistical analyses more reliable, the individual dates were centred around 1800 and converted to centuries, so that a text from 1651 would count as 1651 – 1800 / 100 = -1.49 , and a text from 1931 as 1931 – 1800 / 100 = 1.31. Additionally, of course, we consider whether a given text derives from the British or American section of ARCHER.[3]

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[1] Available online at http://www.speech.cs.cmu.edu/cgi-bin/cmudict.

[2] A small number of texts in ARCHER are not dated exactly; these were placed in the middle of a time segment, i.e. in year five of a given decade or year 25 of a 50-year period, as the case may be.

[3] In principle, text type differences are also important (Grafmiller to appear), but we note that in the dataset at hand the difference between news and letters text does not happen to make a significant difference.

3.7. Lexical effects

We used the lemma of the possessor head noun (e.g. *president* in *the president's speech*) to test for by-item effects (which were modelled as random effects in logistic regression).

4 Regression analysis

To model the joint impact of the factors discussed in the previous section on genitive choice in ARCHER, we draw on logistic regression analysis. Logistic regression is a multivariate statistical analysis technique that quantifies the effect that individual explanatory factors have on a binary dependent variable, such as genitive outcomes. We utilize a modern refinement of logistic regression analysis known as *mixed-effects logistic regression* (Pinheiro and Bates 2000).[4] In addition to so-called *fixed effects* – which are classically estimated predictors suited for assessing the reliability of the effect of repeatable characteristics, such as, e.g., possessor animacy – mixed-effects modelling addresses *random effects* to capture variation dependent on open-ended, potentially hierarchical and unbalanced groups. In this study, we model corpus file ID (a proxy for idiolectal differences) and possessor head noun lemmas (see Section 3.6) as random effects.

We followed the customary model fitting procedures. We first generated a model containing all predictors and all putatively relevant interactions. This model was then stepwise reduced by removing non-significant predictors and interactions (i.e. dependencies between predictors). Pruned models were assessed by means of the Akaike Information Criterion; random effects were evaluated by means of likelihood ratio tests. Finally, the model underwent bootstrap validation to assess the possibility of overfitting.[5] The resulting model (the so-called 'minimal adequate model') has an excellent classification accuracy (Somers' $D_{xy} = 0.92$), and correctly predicts 90.7% of all genitive tokens, a considerable increase over baseline (75.7%). Multicollinearity is not an issue ($\kappa = 8.2$).

[4] We utilized R version 2.12 (R Development Core Team 2011) and lme4 version 0.999375-33.

[5] More precisely, the individual observations were repeatedly randomly re-sampled with replacement, and the model was fit to this new data set. To ensure that each ARCHER fifty-year period has a sufficient number of observations in each run, the total number of observations per period was kept constant. All results reported as significant below are also stable under bootstrap validation; unstable predictors were removed from the model.

	odds ratio	coefficient	
(Intercept)	0.56	-0.58	**
Animacy of possessor (default: animate)			
Collective	0.10	-2.34	***
Inanimate	0.02	-4.09	***
Locative	0.03	-3.68	***
Temporal	0.14	-2.00	***
Definiteness of possessor (default: definite)			
proper name	3.73	1.32	***
Indefinite	0.63	-0.47	**
Constituent length			
possessum length	1.15	0.14	
possessum length, squared	2.24	0.81	***
possessor length	0.09	-2.39	***
possessor length, squared	0.43	-0.85	***
Semantic relation (default: non-prototypical)			
Prototypical	2.14	0.76	***
Final sibilant in possessor (default: no final sibilant)			
possessor has final sibilant	0.42	-0.88	***
Variety and real time			
American English (default: British English)	0.74	-0.31	
centuries since 1800	1.04	0.04	
Interactions			
... involving constituent length			
possessum length (I: centuries since 1800)	1.47	0.39	***
possessum length, squared (I: American English)	0.66	-0.41	*
possessum length, squared (I: centuries since 1800)	0.79	-0.24	*
possessor length (I: American English)	1.70	0.53	*
... involving animacy			
animacy of possessor: collective (I: centuries since 1800)	1.87	0.62	***
animacy of possessor: inanimate (I: centuries since 1800)	0.97	-0.03	
animacy of possessor: locative (I: centuries since 1800)	2.24	0.81	***
animacy of possessor: temporal (I: centuries since 1800)	1.67	0.51	*
... involving variety and real time			
centuries since 1800 (I: American English)	2.11	0.75	***

Table 2: Fixed effects in the minimal adequate mixed-effects logistic regression model for genitive variation in ARCHER. "I" indicates interactions. Predicted odds are for the *s*-genitive. Significance codes: * significant at $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2 reports regression coefficients (positive values indicate a favouring effect, negative value a disfavouring effects), along with rather more interpretable odds ratios (odds ratios > 1 indicate a favouring effect, odds ratios < 1 indicate a disfavouring effect), and significance levels. Predicted odds are for the *s*-genitive. We begin by discussing the main effects of the genitive predictors considered in the present study (headings 'Animacy of

possessor' through 'Variety and real time' in Table 1). Briefly put, all of the main effects behave as they should, given the literature:

- Vis-à-vis animate possessor (e.g. *Tom*), all non-animate possessor categories disfavour the *s*-genitive. For example, the odds ratio of 0.02 associated with outright inanimate possessors (e.g. *snow*) indicates that if the possessor is inanimate instead of animate, the odds for an *s*-genitive are reduced by a robust 1-0.02 = 98%.
- In comparison to definite possessors (e.g. *the man*), proper name possessors (e.g. *Tom*) favour the s-genitive (under this condition, the odds for an *s*-genitive increase by a factor of 3.73). Indefinite possessors (e.g. *a man*) disfavour the *s*-genitive.
- Long possessums favour the *s*-genitive, long possessors disfavour the *s*-genitive, fully in accordance with the principle of end weight. The complication is that both possessum and possessor length have a linear and a quadratic (squared) effect. This duality is discussed in some detail in Wolk et al. (2013); suffice it to say here that medium-length possessums and possessors are not as well-behaved as a strictly linear operationalisation of length effects would predict. We will return to this issue below.
- Against the backdrop of non-prototypical semantic relations, prototypical semantic relation (e.g. kinship relations, as in *the king's sister*) increase the odds for the *s*-genitive by a factor of 2.14.
- A final sibilant in the possessor (e.g. *President Bush's speech*) reduces the odds for the *s*-genitive by 58%.
- Finally, neither real time nor variety have significant main effects, but the two language-external variables partake in significant interaction with language-internal predictors, as we shall see shortly.

We now turn to the meat of our analysis: interaction terms between language-internal and language-external variables in the model. How does the effect of language-internal conditioning factors evolve in real time? Do British English and American English differ with regard to these effects?

To begin with, the model shows that length effects are clearly variable in space and time. Figure 2 presents a series of four univariate plots that illustrate this variability. As for real-time developments, observe that in later ARCHER periods (1876-2000), possessum length has a more linear effect than in the earlier ARCHER periods (1650-1875). This is another way of saying that in later ARCHER texts, medium-length possessums are not as unexpectedly hostile towards the *s*-genitive as in earlier ARCHER texts. (Figure 2 seems to suggest that a similar strengthening of linearity is observable with regard to possessor length, although the regression model does not identify this development as significant). Second, the regression model suggests that possessor length has a weaker effect size in American English than in British English, and indeed the bottom plots in Figure 2 indicates that the American English smoother curve is more level than the British English smoother curve, especially in the earlier period.

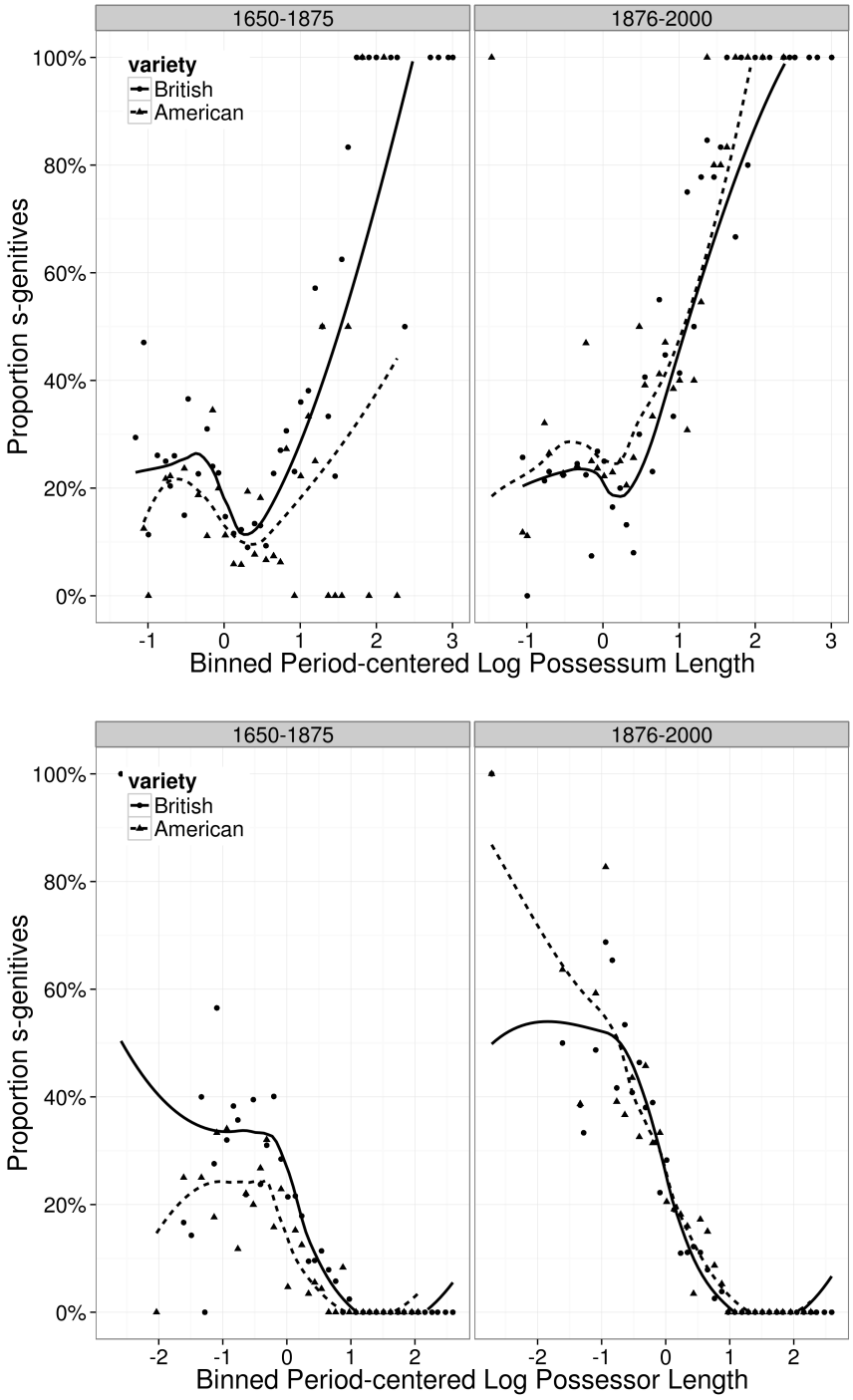

Figure 2: *S*-genitive rates (*y*-axis) as a function of possessum (top) and possessor (bottom) length (*x*-axis; binned uncentred lengths on a log scale) and variety (heavy smoother: British English; dotted smoother: American English). Left plots: 1650-1875; right plots: 1876-2000. Note: constituent lengths can be negative because observed lengths have been centred.

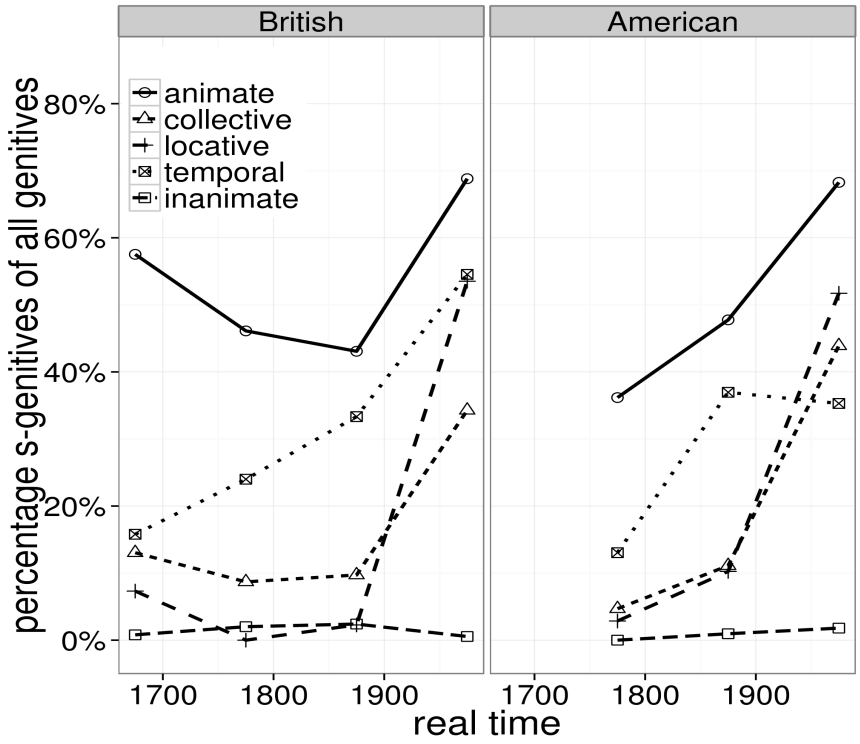

Figure 3: S-genitive rates (*y*-axis), as a function of ARCHER time slice (*x*-axis) and several animacy categories. Left: British English; right: American English. Only even-numbered ARCHER periods are shown to make the plots visually more comparable. See Wolk et al. (2013) for a graphic representation of all British English periods,

The regression model sketched in Table 2 also suggests a significant interaction between possessor animacy and real time. All non-animate possessor categories except outright inanimate possessors (e.g. *table, chair*) have become less hostile towards the *s*-genitive in the course of the Late Modern English period. In other words, there has been a tendency to increasingly use collective possessors (e.g. *government*), locative possessors (e.g. *island*), and temporal possessors (e.g. *year*) with the *s*-genitive. Figure 2 is an univariate plot that nicely illustrates this development: all the curves, except for the inanimates, are on the rise, at least since the nineteenth century. The Figure also shows that overall, British and American English behave rather similarly with regard to the development of the possessor animacy constraint – and indeed, the regression model does not find evidence for significant differences between the two varieties[6].

Finally, we note that the regression model suggests an interaction between real time and variety, such that – all other things being equal – the *s*-genitive is gaining popularity faster in American English than in British English. This interaction certainly dovetails with claims in the literature about the increasing popularity of the *s*-genitive in American English (Rosenbach 2002; Szmrecsanyi and Hinrichs 2008).

In summary, the effects that individual constraints have on genitive choice in ARCHER are largely the theoretically expected ones. What is interesting is how the

[6] A small exception pertains to the temporal possessors, where American English significantly differs from British English, presumably due to the lower number of *s*-genitives in the 1950-1999 period. This interaction was removed from the final model as it decreases model quality according to Akaike's Information Criterion.

interactions between language-internal constraints and language-external factors are playing out in the data. For one thing, we saw that the very similar frequency trajectories in British and American English identified in Section 2 are mirrored in the regression analysis to some extent: there a few significant interactions involving variety, and the only language-internal constraint that has different effects in British and American English is basically possessum length (which, interestingly, echoes similar findings in Hinrichs and Szmrecsanyi 2007, obtained on the basis of a different corpus database). However, there is robust interaction between real-time and possessor animacy. It is to the discussion of this interaction that we shall turn next.

5 Discussion: Culturally-conditioned change?

To recapitulate, we have seen in the previous section that there is a diachronic change in the effect of animacy in the genitive alternation that can be interpreted as a weakening of that predictor, in the sense that non-animate possessors (specifically collective, locative and temporal nouns) are on the rise with the *s*-genitive in real time. In this section, we sketch three more or less subtly different accounts for this change: linguistic change, conceptual change, and change in the cultural context. We will explore how these accounts can be tested, what the predictions would be, and how plausible the accounts are given the data at hand.

To set the scene, let us consider the assumption that the weakening of the animacy effect is a change in the linguistic constraints of the s-genitive. This would certainly be a plausible interpretation, but it is not the only one. When using a regression model in the way we did, we essentially determine to what degree the observed variation is conditioned on various other factors; when modelling an interaction with real time, we test whether this relationship changes over time. The accuracy of such tests, however, crucially depends on the explanatory factors themselves (1) being adequate and (2) remaining constant. We have good reason to assume that our classification strategy broadly satisfies the first condition: not only is our approach based on a body of previous research into animacy classification (e.g. Zaenen et al. 2004; Rosenbach 2005), it also leads to significant effects that behave in essence as expected. This, however, does not mean that it is perfectly adequate: if there was a small systematic difference between our classification scheme and the one that speakers use to make linguistic choices, we would in general expect that the model would still lead to similar results, albeit with less pronounced distinctions. As a hypothetical example, consider the following two ways of distinguishing between animate and collective possessors:

(a1) organizations as well as temporally stable groups of humans with potentially variable concord

(a2) organizations as well as temporally stable groups of humans with potentially variable concord containing at least 10 people (if there are less than 10 people, the entity in question is 'animate')

Our coding scheme uses (a1). What would happen to our analysis if speakers actually used (a2)? On a purely synchronic level, it would mean that some tokens that we classified as collective are actually animate, and thus that the collective group behaves more similar to the animate group in our analysis than it actually does for speakers. If the number of affected tokens is not too large, the big picture should remain largely unaffected. Diachronically, assuming everything else remains stable, we would expect the same result: a systematic, but unchanging and usually unproblematic error. In that case, a significant change through real time would be a linguistic change (in a narrow sense). The stability of the external factors, however, cannot be taken for granted: we can imagine at least two ways in which non-linguistic changes could lead to the same result.

The first is that the adequacy of type classification could have changed. Let's assume that speakers used (a1) until a certain point in time, then switched over to (a2). From then on, we would expect more genitives with 'collective' possessors to be realized as *s*-genitives than before, as more of the things we consider collective are actually members of the 'animate' group. The linguistic constraints would remain unchanged, but the conceptualisation processes that govern them change. Yet another scenario is that, while the adequacy on the type-level stays the same, the overall adequacy on the token-level changes. Here, we assume that speakers have always used (a2), and therefore that there is a small error in our estimations of the difference between the two groups from the beginning. Now imagine that the number of collective possessors (according to (a1)) that consist of at most ten people increases. We would then expect the collective possessors (again according to (a1)) to start behaving more like the animate possessors, as in absolute numbers the misclassifications increase. This would be neither a change in the underlying grammar, nor a change in conceptualization, as all types themselves behave diachronically in a stable way. The observed effect would be a change purely in the cultural context (or: in the frequency context) in which speakers use genitive constructions.

Let us now apply these ideas to derive possible explanations for the observed changes in our genitive dataset.

(e1) LINGUISTIC CHANGE. This explanation offers that genitive grammars have come to feature fewer selection restrictions. More specifically, the *s*-genitive used to have a strong constraint such that only animate possessors appear in it. This restriction persists through all periods under study, but it has considerably weakened over time. Its weakening may be related to the change of the *s*-genitive from a purely inflectional marker in Old English to a possessive determiner and referential anchor in late Middle and Early Modern English (Rosenbach 2004). Couching this in grammaticalization terms, we would say that the semantics of the constructions involved are subject to bleaching and that their host class expands.

(e2) CONCEPTUAL CHANGE. There are two distinct, but related explanations involving conceptual change.

(e2a) CHANGE IN THE CONCEPTUALIZATION OF POSSESSION. This explanation holds that the relation of possession is hypothesised to go against the preference for *animacy* more easily. The intuitive interpretation for this would be to say that possession, which has previously been largely restricted to human beings, is something that can now also be associated with other entities, for example corporations. In exactly this spirit, Nobel Prize laureate and professor of Economics and International Affairs Paul Krugman recently pointed out[7] how "transformational technologies", particularly railroad transportation, enabled the rise of abstract forms of legal ownership at the expense of concrete ownership during the nineteenth century. Once such forms of possession become common enough, it would not be surprising to see an extension of general possession to classes of possessors that are not animate. Note that from a typological perspective, such modern forms of abstract ownership are not necessary for broadening the concept of possession (see e.g. Seiler 1982; Heine 1997) but given that during Early Modern English possession in English was conceived of rather narrowly as animate possession in a rather strict sense (Rosenbach 2002), the changes in the nineteenth century may have helped to pave the way for perceiving possession more broadly.

[7] For the blog post, see http://krugman.blogs.nytimes.com/2011/01/30/transformational-technologies/ .

(e2b) CHANGE IN THE CONCEPTUALIZATION OF ANIMACY. Alternatively, instead of the conceptualization of the possession relation changing, the conceptualisation of animacy may change, leading to the same local result. To stay within the example, a corporation possessing an asset could be licensed by an extension of *possession* to entities not considered *animate*, or by extending *animacy* to corporations – a case of the adequacy of our classification scheme decreasing in relation to types. This does not necessarily mean that speakers become confused about the 'true' animacy of the entities they encounter, but that they may change their perception of how similar two classes of entities are. To give an example, vehicles such as ships are clearly inanimate, but can appear in several relations normally restricted to animate contexts (consider reference by the personal pronoun *she*, which is attested in Early Modern English already). Observe here that of the 20 *s*-genitive usages with pure inanimates in our data, at least five involve ships as possessors. It would make sense that speakers judge ships to be more like animates or collectives than they would other inanimates, such as abstract concepts – not only do ships share some of the properties of animate entities, such as movement, they are often in a metonymic relationship with the crew operating the ship.

(e3) CHANGE IN THE ENVIRONMENT / CULTURAL CONTEXT. Finally, maybe the adequacy of our classification scheme regarding types remains constant, but deteriorates overall thanks to changing token frequencies. Let us consider that some different (classes of) entities – such as ships – differ from other members of the same category; we can think of them as in-between categories, or as oscillating depending on an individual speaker's conceptualization. If the distribution of entities in the environment changes such that those that are less like the previous majority become more frequent, it will appear that any categories between which these entities oscillate become less distinct, even without any change in the linguistic system itself. As an example for how this might happen for the other categories, consider a city council. This entity would clearly be classified as a collective, yet an individual speaker may have interacted with a good number of its members, and may well construe it as more animate – and thus as a better (potential) possessor – than she would construe a large, somewhat faceless collective such as, say, an army. If discourse contained a large proportion of *city council* type recipients or possessors, collectives would show a pattern closer to clear animates, and if *army* type recipients or possessors were frequent in discourse, collectives would rather tend towards genuine inanimates. It should be noted that using a different, more detailed classification scheme would not eliminate the problem. More fine-grained distinctions increase the fit in case we chose a better scheme, but it would also increase the possibility of choosing the wrong class – we cannot directly access the representations used by speakers in the precise moment of utterance, and especially not for historical data. We would thus just move the problem.

How do these explanations fare on the empirical results presented here? We first note that a pure version of (e1) does not satisfactorily explain the cross-constructional similarity between the genitive and the dative alternation (*Tom gave Mary a present* versus *Tom gave a present to Mary*) reported in Wolk et al. (2013). This is in contrast to the other explanations: Those under (e2) can account for the cross-constructional overlap by means of the shared semantics, be they based on *possession* or *animacy*, and (e3) easily applies to both alternations if the discourse frequency of entities is assumed to be similar for recipients and possessors. However, (e1) does seem most consistent with the observed increase in temporal *s*-genitives, a change that is difficult to reconcile with simply a broadening of the concept of possession or animacy (note also that temporal nouns lead the change toward more *s*-genitive realizations among non-animate possessors).

Explanation (e3) – and to some extent also (e2) – predict that clearly inanimate cases should not change, which is supported by our data set. In addition, many of the *s*-genitives with inanimate possessors in the data (such as ships and animacy-related notions such as *life* and *soul*) are good examples for oscillation between categories. This may be a limitation of the size and composition of the current data set though – Rosenbach (2003) found a clear age-grading effect in an experimental study, such that younger speakers rated *s*-genitives with clearly inanimate possessors more acceptable than older speakers did, which would argue against explanation 3. We wish to add that, although the numbers are too small to make reliable statistical claims, according to our data inanimate possessors in the *s*-genitive are increasing in American English, and especially in the 1950-99 period take possessors such as *plan* or *system* that are neither vehicles nor animacy-related nor personalized concepts. This is again compatible with the experimental results in Rosenbach (2003), according to which American subjects lead British subjects in accepting inanimate possessors in the *s*-genitive.

Explanation (e2), and especially (e2b), would lead one to predict similar changes happening to other constructions. Beside the dative alternation (which is covered in Wolk et al. 2013), Hundt (2004) explores progressive constructions in ARCHER and finds evidence for a real-time increase of inanimate NPs in subject position, which had previously been limited to animate subjects:

(5) a. *I* was just leaving these Lodgings <1737anon.f3b> (Hundt 2004: 51)
(human subject)

b. I had never given up my opinion that *an abscess was gathering* <1868bowd.m6a> (Hundt 2004: 62)
(non-human subject)

The animacy change in progressives that Hundt (2004) diagnoses appears to have started about a century earlier than in genitives, however.

All together, there is circumstantial evidence for and against each of the three explanations we have offered; a summary is given in Table 3. While we have presented them as analytically distinct beasts, they are not by necessity mutually exclusive: the observed pattern could well have resulted from any combination of underlying changes. From the viewpoint of probabilistic, experience-based grammar it is not implausible that the underlying causes even go 'hand-in-hand', with individual changes enabling and facilitating others. For example, let us assume, as in (e3), an increase in the discourse frequency of entities that do not distinctively belong to one category. As a result, the individual categories will, for the output of existing speakers, seem less distinct even without any actual linguistic change, as per explanation (e3). Now consider new speakers entering the speech community. The input to which they are exposed contains more conflicts than that which past speakers received, and thus their hypotheses about the association between grammar, possession and animacy are likely to be less strong. This change could now be considered a genuine grammatical or semantic change. As a result, these speakers would produce even more utterances violating the original constraint, especially again in the less clear cases, feeding back into the process for the next generation.

Explanandum / Explanation	increase of *s*-genitive with collective and locative nouns	increase of *s*-genitive with temporal nouns	increase of double object datives with non-animate recipients	increasing use of progressive with inanimate subjects
change in selectional restrictions of *s*-genitive	✓	✓	✗	✗
grammaticalization of *s*-genitive as a possessive determiner (referential anchor)	✓	✓	✗	✗
change of conceptualization of possession	✓	✗	✓	✗
change of conceptualization of animacy	✓	✗	✓	✓ (for those noun classes which can be perceived of as animate)
cultural change: rise of collective entities	✓	✗	✓ (for collective nouns)	✓ (for collective nouns)

Table 3: Comparing different explanations for the decreasing effect of animacy in genitive variation, dative variation, and in progressives.

Several of the explanations considered in the previous discussion presume an underlying change in the discourse environment. Being able to observe such changes in ARCHER would strengthen our case considerably. So, for the sake of describing the population of nominal animacy categories as a function of real time, we created two *general* noun samples (which are not limited to genitive noun phrases), one each for ARCHER's British letters and news sections and each sampling approximately 5,000 random nouns spread out evenly over ARCHER's time periods. We next coded the nouns in these samples for animacy according to the guidelines in Zaenen et al. (2004), subsequently collapsing categories as necessary to match those used to code our genitive data set. The area plots in Figure 4 hence depict the distribution of animacy categories in real time. ARCHER 's letter section (right diagram) is fairly stable over time, and we will thus concentrate on the news section (left diagram) in what follows. Observe first that there is no straightforward relationship between the distribution depicted and the frequency of genitive outcomes in the

data: place nouns become less frequent, time nouns stay rather constant, and collective nouns become more frequent – yet all three categories have become more likely, as we have seen, to appear as possessors of *s*-genitives. That said, the increase in the frequency of collective nouns, which started during the 1850-1899 period, is consistent with our conjecture about environmental and cultural changes due to industrialization and the transformational technologies that have accompanied it. We finally note that in the 1800-1849 period, the frequency of animate nouns in both news and letters decreases, coinciding with – and partially accounting for – the substantial drop in *s*-genitive frequencies at that time (see Figure 1).

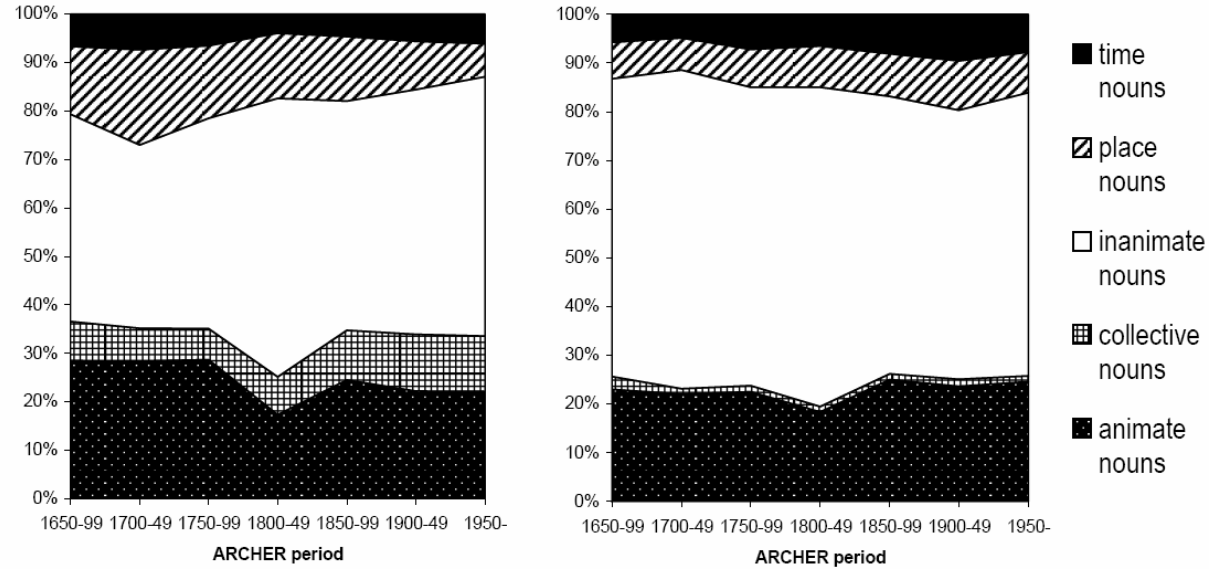

Figure 4: Animacy classification for general noun phrase sample by ARCHER period. Left: British English news. Right: British English letters.

6 Concluding remarks

In this paper, we investigated the probabilistic underpinnings of genitive choice in Late Modern English, with a particular interest in the interplay between cultural change, conceptual change, and linguistic change. We have seen that overall, genitive variability is patterned in a surprisingly similar fashion in British English and American English – so, somewhat surprisingly, regional differences are not implicated in culturally induced genitive variation. Instead, we have suggested that the diachronically variable structure and importance of the animacy constraint may very well have cultural reasons.

The idea that culture change facilitates linguistic changes is of course difficult to test empirically, as past speakers' internal knowledge is not available to us. There are, however, research avenues that would permit at least a partial investigation of such mechanics. The fourth-named author is currently exploring ways to utilize the predictive capability of regression models to generate responses for new data. Assuming that a formalization of the factors underlying the three explanations (outlined in Section 5) for the volatility of the animacy constrained can be found, we could train a model that represents the experiences of a single speaker in a linguistic community. By slightly altering the data used to train the model as compared to the data used to generate new data – for example, by increasing the number of tokens with less clear animacy distinctions – we should be able to simulate linguistic, cultural, and/or cultural changes such as those proposed in the previous section. Several such models can then be used to create the input for a new generation of models, an iterative process that simulates real-time probabilistic language change under controlled conditions. A simulation

along such lines can of course not provide hard evidence on the real history of grammar (nothing can!), but it just might provide supporting evidence and constraints on the workability and plausibility of particular explanations.

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