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1 Introduction

In recent years phonological theory has seen the rise of usage-based thinking about speech production, perception, and storage of phonological representations (for two representative collections of papers, see Barlow and Kemmer 2000, and Bybee and Hopper 2001). The term "usage-based" encompasses a rather wide range of approaches, from Exemplar Theory (Pierrehumbert 2001a, 2001b, Bybee 2000) to Cognitive Grammar (Langacker 1987), but two central insights are shared by all usage-based theorists in opposition to the traditional generative model of speech perception and production: (i) speakers' grammars are fundamentally grounded in 'usage events' (which are stored in memory along with fine—non-contrastive—phonetic detail and even with the speaker-specific information), that is built up through direct experience with speech; one consequence of such a claim is that linguistic representations are emergent, constantly updated by incoming linguistic input; (ii) stored linguistic representations are not all equal—as the system is entirely experience-driven, word frequency is its shaping force. In fact, word frequency is postulated to be a part of linguistic competence, and stored alongside other types of information in speaker's memory.

Wide support for the existence of word-specific phonetic patterns, and against the traditional modular feed-forward models of phonetic implementation in which no lexeme-specific information can affect the phonetic implementation comes from psycholinguistics: frequent words (or rather, experiences of words) have been found to have higher resting activation levels and thus to be more easily accessed in speech production (cf. Goldinger 1996, Dahan et al. 2001); being contextually predictable, they undergo various reduction processes such as durational shortening or final segment deletion at higher rates than less frequent items (Jurafsky et al. 2000).

The emphasis placed on frequency in speech production is of obvious interest to sociolinguists. If phonetic implementation is determined by the

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average of the stored exemplars for any given lexical item, then in processes of language change frequent words would be expected to be ahead of all other words, since they occur more frequently by definition, and each instance of pronunciation shifts the cloud of tokens ever more slightly in the direction of change. Indeed, some Exemplar Theorists (e.g. Pierrehumbert 2001a, 2001b, Bybee 2002) have explicitly made statements concerning the role of frequency in processes of language variation and change. However, their evidence has been questioned by Labov (2003), and Dinkin (2004, 2007), among others. The goal of this paper is twofold. First, it introduces yet another piece of sociolinguistic evidence, and examines it against Exemplar Theory's predictions. Second, it discusses a strong priming effect found upon close examination of (ing) that has not been widely recognized in sociolinguistic literature. It is argued that such production effects are given more attention by sociolinguists as they may be responsible for many effects previously considered social.

2 Exemplar Theory and Sociolinguistics

Word frequency has been shown to affect, and used to explain, various phonological reduction processes in which more frequent words undergo deletion/reduction more than less frequent words. For example, Hooper (1976) discusses a well-known process of schwa deletion before sonorants, and shows that it is conditioned by word frequency, so that in pairs like *nursery-cursory* or *memory-mammary* the more frequent word (first member of the pair) has the schwa deleted unlike the less frequent word, even though the two are phonologically similar. Further, frequency has been proposed to be one of the significant factors in processes of language change. In contrast to traditional theories of sound change—in which change is thought to be phonetically gradual, but affecting the entire lexicon—Phillips' (1984, 2001) Frequency-Actuation Hypothesis states that in segmental changes most frequent words are affected first, and consequently 'lead the change', whereas sound changes requiring analysis affect the least frequent words first. More recent work postulates frequency to be involved in *all* cases of regular sound change. According to Pierrehumbert (2001b:11) "the model is applicable to any Neogrammarian sound change". A similar position is taken by Bybee (2002).

To test Bybee's and Pierrehumbert's position, Labov (2003) examined the entire TELSUR corpus (Labov et al. 2006) for the fronting of the nuclei of the back diphthongs /uw/, /aw/, /ow/, which is a sound change in many communities in the US. However, he did not find word frequency to be a significant factor: frequent words were neither more nor less advanced in the

sound change than other words. Dinkin (2004, 2007) discovered conflicting trends when he examined the role of frequency in the short vowels from the TELSUR project involved in the Northern Cities Shift. He found that for /i/ and /e/—which become backer in the NCS—frequent words are indeed ahead of the sound change, but at the same time more frequent /ʌ/ words are fronter than low-frequency words, against the direction of the NCS. Therefore, it can not be the case that frequency plays a role in every regular sound change. Instead, Dinkin suggests frequency effects are restricted only to leniting changes. He calls this the Phillips principle: frequent words lead sound changes of lenition (broadly construed), not sound changes in general. Since changes affecting /i/ and /e/ are cases of centralization, which in turn can be referred to as reduction of articulatory effort, but neither fronting of /uw/, /ow/, /aw/ nor backing of /ʌ/ fall under this category, the presence and absence of frequency effects, respectively, is accounted for.

The Phillips principle can be also generalized to the case of *t/d*-deletion, wrongly classified by Bybee (2002) as sound change in progress. While historically stable, it is rather straightforwardly a reduction/lenition process, and thus displays frequency effects. Having said this, stable variation is a challenge to Exemplar Theory. If some of the most frequent words can be tokens of stable variables, how come their production does not shift the variable, and in effect lead to sound change? This is a difficult question for experience-driven theory like ET, and in fact for most models of language change.

The variable (ing) is the best known case of sociolinguistic stability, and thus good grounds to confront ET. If usage-based theorists are correct about the overarching role of frequency in linguistic production, we should expect to find frequency effects also in (ing), despite the fact it is a stable variable. If Dinkin is right, however, then (ing) will not display frequency effects because it is not a case of lenition.[1]

3 The variable (ing)

The variable (ing)—known also as "g-dropping" as in *walkin'* or *livin'*—involves the alternation of apical and velar variants in unstressed syllables with underlying velar coda. It is one of the best studied variables in English, and studies conducted in speech communities in the United Kingdom, Australia, New Zealand and the United States all point to the following: (i) the

[1]Adam Baker (p.c.) points out, however, that phonetic studies of tongue physiology do not make it impossible to claim that the apical nasal involves less articulatory effort than the velar nasal.

variable is a monotonic function of social class (i.e. regular social stratification is maintained for each contextual style); (ii) it is a monotonic function of contextual style (i.e. regular stylistic stratification is maintained for each social group); (iii) it is subject to little or no phonological conditioning, which led Labov (2001) to observe that the variable is more of a morphological alternation than a case of phonological reduction; (iv) it is subject to fine grammatical conditioning: the closer the token is to being a verb, the greater the chance for choosing the apical variant. Put another way, the distribution of velar and apical variants follows the so-called Nominal-Verbal continuum (Houston 1985), with progressive constructions showing the most apical use, followed by participles, adjectives, and simple nouns (cf. Labov 2001:Chapter 3); (v) it has been in stable variation for at least 50 years now; there have been no observed gains in the percentages of, say, apical variants over the years, regardless of the geographical location and the particular community studied.

The variable (ing) is subject to several lexically—and prosodically-based exclusions and idiosyncrasies. First, only unstressed syllables with (ing) show variation, therefore monomorphemic verbs forms such as *sing* or *bring* are not considered in the analysis. Second, trisyllabic forms with *–thing* such as *everything* or *anything* are excluded from coding because the last syllable receives secondary stress. Third, the words *something* and *nothing* receive a greater degree of apical pronunciation than the general nominal class to which they belong. Finally, proper nouns with final (ing) are categorically velar, and thus outside the analysis.

Because of all the above, and in addition to the reasons already outlined in section 2, (ing) is a perfect candidate for an exploratory study on frequency. Since we know such a good deal about the variable, if the results regarding social, stylistic, and grammatical conditioning are in line with the previous research, the researcher can be reasonably sure the data are not skewed or misanalyzed, which gives the study an extra measure of robustness.

4 Analysis

4.1 Data and Coding

The data used in this study come from a white lower middle class community in Roxborough, Philadelphia extensively described in Abramowicz et al. (2005). The data were collected using standard methods developed over the decades in the Linguistics Laboratory at the University of Pennsylvania, documented in Labov (1984).

573 tokens from 11 speakers have been selected for the final analysis, and coded for the following factors:

- preceding token: a rarely seen independent variable to be included in sociolinguistic analysis, it was thought of as a simple approximation of recency/priming. If all tokens of usage are stored in memory, and continuously updated, then in a variable as common in running speech as (ing) we might expect that other things being equal, the choice of a variant in any given token would affect the variant of a next token. For instance, if a speaker pronounces the coda in *ceiling* as the velar nasal, then by null hypothesis the following token—whatever is its category—is more likely to have velar pronunciation, too. Ideally, far more data would be necessary to make this factor more reliable: one may say only the next word of a specific (or the same) category should count, and perhaps only if it occurs "quickly enough", but this simple approximation of recency will suffice for current purposes.

- style: the standard stylistic categories used in the Project on Linguistic Change and Variation (Labov 1984) have been recoded into four style groups: careful, response, soapbox, and narrative. It is expected they will show an increasing rate of apical usage, in that particular order, from the most formal to the most casual style.

- grammatical status: also simplified from the original coding sheet, and from Houston's hierarchy, largely because of the inherent difficulty in deciding between some categories (e.g. gerund vs. noun), and because of the desire to keep each category well represented in the dataset. Ultimately, four factors have been coded for in this factor group: progressives, participles, adjectives, and nouns (including gerunds, and the word *during*). Again, they are listed in the order in which according to previous work they should be on the Verbal-Nominal continuum with respect to the apical-velar variation.

4.2 Measures of Frequency

Getting frequency coding right was particularly important for the study. Unfortunately, there does not appear to be a standard way of doing so. With respect to the Brown corpus (Francis and Kučera 1982), the most commonly used cut-off point in the Exemplar Theory literature is 35 per million (cf. Bybee 2002:264): anything that appears 35 or more times in the Brown cor-

pus is considered frequent, and everything under 35 infrequent. This approach has been adapted here for the sake of comparability with previous work. Dinkin (2004, 2007) experimented with other ways of coding frequency in the Brown corpus, using different kinds of frequent words counts (Top 5000 words vs. the rest, Top 500, etc.) as well as a gradient measure (each word is assigned an index based on its frequency in the Brown corpus), but his results so far do not suggest that one method is superior to others.

Within the dataset from Philadelphia, several frequency measures have been tried out, without much effect on the results. No matter whether the dataset was partitioned into two halves (frequent vs. infrequent), or ten subgroups, or arbitrary divisions (e.g. frequent words are those that appear more than 15 times in the dataset), results of multivariate analysis were consistent. Results reported below use a three-way distinction into frequent words (occurring more than 10 times in the corpus; these were *amazing, being, coming, doing, getting, going, growing (up), looking, saying, something, talking, thing, trying, walking,* and *working*; altogether they accounted for 46% of the tokens in the dataset), relatively frequent (occurring 3-10 times), and rare (less than 3 times).

Needless to say, not all factor groups are independent in the statistical sense of the word. Even cursory inspection of the most frequent words reveals that most of them are progressives, and in addition many of them have multiple grammatical categories (e.g. *doing* can be a progressive or a noun (as a gerund)). That, however, is precisely the reason for using multivariate analysis, which provides the numerical measure of the strength of each statistically significant factor (relative to other factors in the same group) by running the data against each possible combination of factors.

4.3 Results

The data were analyzed using Goldvarb, with application value “velar”, and input probability—an overall likelihood that a speaker will choose the variant selected as the application value—0.585. The analysis was conducted twice, once over only half the dataset, the other time over the entire dataset. In both runs, style, grammatical category and preceding token were chosen as significant (Log Likelihood = -302.686, $p < 0.0001$ for the whole dataset run).

The results for grammatical category and style are in line with previous work, and point to the robustness of the dataset/analysis. With respect to style, each increase in formality increases the likelihood of velar pronunciation (the exact factor values for the whole dataset are: narrative 0.388, soapbox 0.432, response 0.558, careful 0.682). Similarly, likelihood of velar pro-

nunciation increased with each step towards the Noun end of the Verbal-Nominal continuum (progressive 0.361, verb 0.403, noun 0.641, adjective 0.766). Preceding token factor group turned out to be the strongest effect in the analysis, with factor strength of 0.41 (apical 0.273, velar 0.686), compared to 0.40 for grammatical conditioning and 0.30 for style. See section 4.4 for discussion.

When only half the data are analyzed, frequency registers as significant, although Brown frequency is chosen in the best step-up run of the analysis, and the dataset frequency for the best step-down run, casting doubt over the statistical significance of the factor group. Further, any frequency effect disappears altogether when the whole dataset is taken into consideration. There are, therefore, no frequent words effects in my data.

4.4 An Excursus on Priming

One intriguing result from the preliminary analysis reported here is the strength of the previous token's significance on the choice of (ing) variant. It turns out that this rather mechanical production-related phenomenon accounts for more (ing) variation in the data than the well known social and grammatical independent variables. That in itself is an interesting finding which merits closer examination and further work in the future. Such priming considerations are not usually addressed by sociolinguists, judging from their absence in standard textbooks (e.g. Chambers 1995) or in previous work on (ing) dating back to Fisher (1958). Notable exceptions include work on morphosyntactic variation in Brazilian Portuguese (Scherre and Naro 1991, 1992), where it was found that variable concord phenomena were subject to the same kind of recency (serial) effects in the same clause or even in the preceding discourse: marking one token as X led to further marking of type X later.

Crude construction of the recency variable in the present study precludes drawing any strong conclusions, but at the very least it suggests that sociolinguists should look for production-related effects in their analyses.[2]

5 Discussion

So far the evidence from (ing) has been against frequency-based approaches. At the same time, however, the remaining observed grammatical and stylistic

[2]Some have been doing so already. Shana Poplack (p.c.) incorporates various measures of priming into standard coding sheets used at her Sociolinguistics Laboratory in Ottawa.

effects can be elegantly explained by Exemplar Theory. Section 3 included a list of exceptions to the variable: tokens of stressed (ing) and names were excluded from the analysis, and several items (e.g. *during*, *something, nothing*) were known to display behavior untypical of grammatical categories to which they belong. In traditional models of phonology (and consequently in most sociolinguistic work) these have to be stipulated as exceptions/exclusions to whatever process is responsible for the velar-apical alternation.[3] If we think of linguistic representations in terms of underlying forms with surface allophony, and imagine variation to be a probabilistic component intervening during the derivation to produce a suitable surface variant under specific social/stylistic/linguistic circumstances, then why would some items be invisible to this component (or why would the component treat them differently)?[4]

One way in which Exemplar Theory challenges standard models of phonology is by bridging the gap between phonetics and phonology (or the lexicon, where linguistic representations—underlying forms—are stored, and the phonetic implementation module). As Pierrehumbert (2001a:139) puts it: "these (the lexicon and the grammar – Ł.A.) represent two degrees of generalization over the same memories and are thus strongly related to each other". Taken to the extreme, this view is compatible with the model in which tokens are picked up from clouds of exemplars, which in turn consist of stored "speech experiences" of that item. Variation theory could be easily made compatible with this reasoning if one assumed that picking a particular "speech experience" from vast memory storage is not random, but actually obeys what has been traditionally considered variable rules probabilities. Pierrehumbert mentions the scenario (2001a:145) although she prefers to model variation in terms of exemplar strength (derivative of frequency, presumably). Crucially, though, no matter how variation is modeled in Exemplar Theory, the coding idiosyncrasies of (ing) fall out "for free"—one can simply say that stressed tokens are invariably velar because there are no apical variants stored in memory for a particular word/construction. Similarly, *something* and *nothing* register unusually high rate of apical pronunciation not because they are inherently different from other nouns, but because their clouds of tokens—built through experience—consist of stronger (or more numerable) apical variants. In fact, it may not be impossible for Exemplar Theory to dispense with the notion of grammatical category altogether, and

[3]Or one could maintain that the categoriality effects are results of the rule probability being 1 or 0 in given contexts.

[4]The same could be reformulated to stochastic OT and other approaches to model variation in OT.

something/nothing would not be considered unusual at all—their "nouniness" may have nothing to do with the degree of apical use they show. Of course, an imaginary exemplar theorist would then be forced to explain away the robust grammatical conditioning we saw replicated everywhere for (ing).

In defense of Exemplar Theory, fine grammatical conditioning in the case of (ing) is not an entirely unproblematic issue for standard phonological theory. Under most conceptions of derivation, syntactic derivation branches out into PF and LF after spell-out, where syntactic hierarchies are linearized and sent off for interpretation at phonological and semantic interfaces (Chomsky 1995). If the variation module operates at PF (and it would have to unless we would posit different underlying forms), how can it "see" past spell-out to access word-category information? This is a formidable challenge to those who assign the derivation a property called "Interface Representation Invisibility" (e.g. Uriagereka 1999). However, growing research on the syntax/phonology interface (summarized in Inkelas and Zec 1995) suggests that the output of spell-out must retain at least parts of its syntactic constituency. Processes such as French liaison or Italian *Raddoppiamento Sintattico* (*ibid*.), rely on morphosyntactic information that has to be visible at PF, and the grammatical identity of various (ing) forms would be accessible to the Variation component at PF.[5]

Having said the above, the principal finding of this paper goes against some of the bolder claims made by Pierrehumbert and Bybee concerning the role of frequency in language variation and change. On the other hand, if (ing) involves no reduction processes of any kind, as it is rather safe to conclude is the case, then the findings reported above support the Philips principle formulated by Dinkin.

6 Conclusions

We have seen that (ing) proves to be a tough nut to crack for usage-based theories. The role of word frequency is nowhere near as paramount in the case of this variable as it would seem from the Exemplar Theory literature, not surprisingly if the Philips principle is essentially correct. At the same time, the analysis presented here shows thus far unrecognized recency effect

[5]For syntactic, or morphosyntactic variables, such a variation component would have to operate at the stage of syntactic derivation. Derivational architecture of is rarely discussed explicitly in the sociolinguistic literature, but of course nothing prevents the variation module from operating in various modules of grammar, not only at PF.

that is worthy of further examination, both for (ing) in other communities, and for other sociolinguistic variables, stable or not.

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